EXPERIENTIAL SIMULATIONS FOR PUBLIC PARTICIPATION



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POLITECNICO
MILANO 1863

Abstract

ITA

La crescente consapevolezza da parte del pubblico di questioni in materia di ambiente dopo gli anni '50 hanno portato alla definizione di politiche per la sua salvaguardia. In concomitanza, come prova di democrazia e trasparenza, il tema della partecipazione pubblica ha acquisito importanza per quanto rigarda processi decisionali potenzialmente impattanti per i cittadini. Insieme ad alcuni strumenti per la valutazione di impatto ambientale, alcune procedure di valutazione di impatto visivo ed estetico sono state create per chiarire le implicazioni dell'adozione di piani e/o progetti. Questa è la nascita delle simulazioni urbane, tra queste, quelle esperienziali possono replicare l'esperienza che un individuo può avere interagendo con uno spazio reale ma anche progettato. Lo studio della disciplina ha portato alla definizione dello stato di fatto per quanto riguarda la sua adozione nei processi di partecipazione pubblica, ma anche delle potenzialità date dall'avanzamento tecnologico.

ENG

After WWII in western countries public concern and awareness for environmental matter led to the generation of policies and guidelines for its safeguard, among them, as a proof of democracy and transparency, the theme of public participation has been recognized as fundamental for almost every decision-making process affecting lives of citizens. Along with forecasting methods for environmental impact assessment, some visual assessment procedures born with the task of clarify the possible visual and aesthetic outcome of a proposed plan or project, being valuable tools in the hands of evaluators. Experiential simulations have the potential in the representation of the real world features and thus, simulate the experience of the users interacting with a designed space. The study of this discipline led to a definition of the state of the art for what regards its implementation in public participation processes and possiblities given by the technology advancements.

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1 Introduction

Complexity and the human/environment relationship

Cityscapes have been object of several studies, it is broadly accepted to consider cities as complex systems, composed by a series of overlapping and interconnected layers working in a symbiotic way. Hence, it is possible to find that different domains (like economy, ecology or socio-cultural aspects) form a plot that influence the built environment.

Aldo Rossi investigated the long-lasting relationship between construction settlements and the form and shape of urban areas. In the book "The architecture of the city" (1966) it is highlighted how cities are a continuously growing man-made objects with variable shapes, geometries, forms and scales. How is it possible to deal with such a dynamic object?

Urban representation discipline considers several and potentially different approaches to such an unpredictable object. In fact, the introduction of "Representation of places" by Peter Bosselmann states: "Because the richness and complexity of the real world cannot completely represented, they must [...] showing conditions as they are perceived by the human senses, chiefly vision."

This is a possible but limited outcome, firstly because of the limited cognition that humans have of the complex world, secondly because of all the dynamic elements shaping it.

Architects, urban planners and designers should always remember this context before going in deep with urban representations, often creating pretentious design schemes or "visions". In fact, it is clear that consequentialism, intended as a mere cause/effect relation, can't be the answer to an increasing need for a realistic and trustable anticipation of design outcomes. This is

one of the major tasks in urban design and other disciplines as well, legitimated by the intention of improving the real world itself. Having not as a main goal to depict with 100% accuracy the complexity of the overall system, simulations in this field are gaining relevance but still "Architectural and urban design do not systematically make use of realistic prototypes as industrial design does in order to test outcomes". (Morello and Piga, 2015)

A urban simulation should consider the built environment and its relationship to man (Physical environment, social behaviour and cognitive process involving perception through senses), essentially exploring how space affects the wellbeing of people, which is final goal of designing spaces.

Simulations

Conscious of the vagueness of the term, "simulation" might be linked to several tasks. What is simulated? for which reason? in which way?

Simulations could be useful in many contexts: performance optimization in technology-oriented researches, testing safety (vehicles i.e.), training people (from military to rescuing purposes), education, video games, economic trends, natural systems and among many others, urban planning. The latter can be involved by analysing possible effects of alternative conditions or actions, in order to anticipate possible adverse effects of bad choices.

Recent developments involve project analysis and environmental impact assessment, two very important study-fields with growing interests in both social/political aspects and technical experimentations. Hence, simulations can assist in two ways:

1. as pure data analyzable by professionals primarily (but not exclusively) for aesthetic evaluation and visual impact assessment;
2. as a presentation device or controlled stimulus to which samples of people can react in surveys to measure attitudes and public responses to the project.

(Sheppard, 1989, p 17)

The second aspect is probably the most interesting if simulations are considered as communication tools: they must, like any other form of communication, deliver a believable message to

whomever is supposed to receive it.

A simulation in this case represents a possible future environmental condition which help viewers to visualize what they actually would see in that environment: it should duplicate, as far as possible, the feelings that people would have at the real scene.

Both Appleyard and Sheppard recognized the presence of two main typologies of visual simulations: Conceptual simulation "attempt to reproduce abstractions of underlying systems or structures" (Appleyard, 1977, page 44). Experiential simulation "reproduce a concrete representation of what a place will be like when experienced" (ibidem). It has been called experiential because as a main objective there's mimicking the atmosphere of a place. In this thesis it will be stressed the possible role of the latter in the assessment and communication of a project in public participation processes.

EIA and public awareness

An Environmental Impact Assessment, request to understand the effects of a physical modification on a landscape resource (intended as any valuable feature deriving from the environment, including aesthetic quality) and for doing so it is necessary to consider different aspects of the landscape:

- elements: the individual elements that make up the landscape
- characteristics: elements or combinations of elements that make a particular contribution to the character of an area, including experiential characteristics such as tranquillity and wildness.
- Character: the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people.

(GLVIA, 2002, page 12).

Each aspect is therefore taken into account by experiential simulations, it is quite clear that spend efforts in this field could be very useful to reach sustainable developments by conserving and enhancing our environment for the benefit of present and

future generations. This principle, as a main objective, doesn't mean that landscape should not change at all, it could mean a deeper knowledge of the implications entailed by our decisions upon land use and consequent exploitation of environmental resources.

Landscape and visual impact assessment are two important component of an EIA, the latter is an evolving practice that is continuously developing for a more inclusive approach to new issues and techniques. These include, among others, the landscape character assessment and the greater emphasis on process and public participation. Moreover, "planning authorities have also become more confident about exercising their power under the EIA regulations and there is greater public awareness of the effect of development on the landscape and higher public aspirations for its use and protection." (Ivi, page 4)

However, a frequent involvement of public for project assessment raises several problems related to bad communication and consequent loss of credibility: "The spreading interest in citizen participation has now brought the issue of public communication into the foreground of planning and design concerns." (Appleyard, 1977, page 46)

Moreover, visual simulation used for this purpose have become a new field for the demonstration of professional expertise rather than an improved communications medium: models often show only new buildings, ignoring the old, with the surroundings painted in a subdued color, as if the sun shone only on the proposed design. This behaviour led to an increasing demand of public for more complete informations about impacts of projects, in recent years the explosive development of computer technology allowed the use of new media and systems to deal with this. Virtual reality applications are based on a range of technologies evolved for very different purposes and tasks but can be easily adapted and used for urban studies. Actually, it is most widely used at the later stages of design, but there is not one single approach to its use, instead there is a set of related strategies and main drivers. Could it be enough for a systematic use of a virtual reality application during public participation processes?

2 Environmental impact assessment

Legislative Background

This chapter will pass through the origins of environmental impact assessment for projects and plans, the introduction of NEPA in the USA and the european community answer to it some years later. It will be underlined how the visual impacts are considered regarding a project evaluation.

2.1 EIA origins in USA and EU

After World War II, the explosive growth of population, technology and economic development brought second and third order consequences which in the 60s began to arouse public apprehension and concern. This concern had long been present in Western society but was greatly increased by environmental controversies in the 1950s and early 1960s regarding pesticides, oil spills, and nuclear fallout.

A direct consequence of this concern was a search for operational guide planning and decision-making having an impact upon the quality of environments and the health and safety of people. EIA (Environmental impact assessment) is a technical evaluation intended to foster objective decision making: Its main objective is to foresee both positive and negative environmental impacts and consequences of a plan, policy, program and actual projects prior to the decision to move forward with the proposed action (Caldwell, 1988). In particular the term "environmental impact assessment" (EIA) is usually used when applied to actual projects and the term "strategic environmental assessment" (SEA) applies to policies, plans and programmes most often proposed by organs of state (MacKinnon et al., 2018) (Eccleston et al., 2011).

Although the standard and content of these studies has been raised through growing experience, there is also continuing concern that many could be improved. A fixed point is the description and analysis of effects on a landscape resources: it relies on the adoption of certain basic principles about the positive (or beneficìal) and negative (or adverse) effects of change in the landscape. Due to the inherently dynamic nature of the landscape, change arising from a development may not necessarily be significant. On the other hand, it could have a direct and immediately apparent effect upon people's surroundings.

It is therefore necessary to identify the landscape components that are valued by the community or society as a whole, why and how they are valued and, where possible, the people to whom they are valuable that is 'what matters and why'. Thus, EIA must be prepared by a multidisciplinary team assessing changes in the physical landscape which may give rise to changes in the character of the landscape and the way it is experienced. This could also affect the perceived value ascribed in the landscape based on particular characteristics that contribute to a 'sense of place' or influence the way in which a landscape is experienced, and on special interests such as cultural and literary associations, nature conservation or heritage interests (GLVIA, 2002). In the United States, environmental impact assessments obtained formal status in 1969, with enactment of the National Environmental Policy Act. The reason why this kind of law has been approved in US was "to protect the public and the environment from the consequences of reckless or inadequately informed policies and decisions" (Caldwell, 1988).

EIA development followed several "influences" such as rational planning theory, technology assessment, risk assessment and environmental movement. Moreover there was a popular and legislative desire to reinforce administrative responsibility through public decisions of government agencies, which in US supplement the Administrative Procedures and Freedom of Information Acts (Title 5, U.S. Code, Sec. 551 et. seq.).

There was the assumption that a systematic and interdisciplinary use of science could improve the quality of planning and decision-making. The problem arose when, between management tools (more principles than direct coercion) and good intentions, politics came into play. In fact, EIA has not been created as a "technological fix" or a panacea for environmentally "bad" decisions but as a reform in priorities affecting the administrative procedures of decision making. The effectiveness depends though upon political will of protection of the environment (ibidem): It is a process by which negative (and positive) effects of a development are undertaken, the information gathered is used to reduce likely negative effects during the design phase and then to inform the decisìon-making process by being an integral part of it (GLVIA, 2002).

2.2 NEPA in USA

NEPA, federal agencies and requirements

The National Environmental Policy Act (NEPA) is a United States law that promotes the enhancement of the environment. It was signed on January 1, 1970 establishing the President's Council on Environmental Quality (CEQ). The latter ensure that federal agencies meet their obligations under NEPA, overseeing the implementation of the environmental impact assessment process. The preamble to NEPA reads:

> "To declare national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality."

Main requirement of NEPA is to assess possible environmental effects of a proposed action prior to making decisions. It is important to specify that NEPA did not directly establish specific guidance for conducting environmental analyses. It set forth national environmental policy and goals for the protection, maintenance, and enhancement of the environment, and provided a process for implementing these goals within federal agencies. In 1978, CEQ proposed binding regulations on all federal agencies to implement NEPA. These regulations address:

- the procedural provisions of NEPA
- the administration of the NEPA process
- the preparation of environmental impact statements.

In addition, CEQ provided a variety of guidance documents on the implementation of NEPA (www.epa.gov/nepa/what-national-environmental-policy-act).

Many federal agencies have developed their own NEPA procedures as a supplement to CEQ regulations, these NEPA procedures vary from agency to agency according to their specific mission and activities. The US Forest Service, USDI Bureau of Land Management and the Soil Conservation Service, which became the Natural Resources Conservation Service (NRCS), were the early leaders among US Federal Agencies in implementing this kind of procedures. NEPA requirements for those agencies are the evaluation of the environmental and related social and economic effects of their proposed actions; and providing opportunities for public review and comments.

It must be specified that public and private procedures are different:

For public sector, Federal agencies have to prepare detailed statements commonly referred to as Environmental Impact Statements (EIS) and Environmental Assessments (EA). CEQ regulations take into account different hierarchical levels of assessment, according to the likely impact of the proposed action:

- Categorical exclusion is the class with no potential significant impacts for the environment either individually or cumulatively.
- EA (environmental assessment) is a class useful to decide if further studies are required or not, at the end, it must be clarified the necessity of an EIS, otherwise no significant impact have been found.
- EIS (environmental impact statement) is the most precise assessment documentation, required if the proposed action is posing potential significant impacts on the environment. Only a small part of federal actions actually required an EIS, in 2012 they were just 5-6000 cases on 50.000 required EAs.

Nepa affects private sector only when there is a federal "handle" on a proposed private action for example permits, licenses, grants, loans, use of federal land or resources. The proponents in private sector must submit environmental documentation along with applications and may enter into third party agreement with federal agency to hire a contractor to prepare an EIS with federal agency technical direction. To conclude, privates do not prepare

decision documents, EIS or write/permit other conditions. Each federal agency is responsible of the final decision, on the other hand, CEQ has the duty to solve both formal and informal conflicts in the process.

To sum up: A proposed agency action (or private actions as just described) to be assessed must overcome the preliminary phase of categorical exclusion. As a second step, an EA clarify if there are significant impacts, if nothing relevant is found, the action is implemented.

Third step is the creation of an EIS, such document is usually composed by 4 parts:

An Introduction including a statement of the Purpose and Need of the Proposed Action.

- A description of the Affected Environment.
- A Range of Alternatives to the proposed action. Alternatives are considered the "heart" of the EIS.
- An analysis of the environmental impacts of each of the possible alternatives.

Final step is the public review and final decision. (www.epa.gov/nepa/what-national-environmental-policy-act)(Smardon, 2016)

Visual impact assessment (VIA) origins and importance

Visual impact assessment and visual resource management systems were spurred by NEPA in the late 1970's through the 1980's. Visual assessment methods have been developed starting from the '70 by several landscape architects, technicians and US federal agencies. An early Visual Management System (VMS) was developed by Bacon, Orr and other landscape architects with ideas from several US Forest Service regions. In 1972 the US Forest Service in Washington DC developed and applied the same system. R. Burton Litton Jr. produced one of the first Forest Service method papers on visual control points in 1973. VMS was gradually implemented starting from 1976 throughout many federal forests as part of timber management and land use management planning. Lee Anderson developed a Scenic Management System, for this reason in 1995 the US Forest Service updated previous methods. The system include landscape classification, visibility of activities to sensitive users, and ability of the landscape to absorb visual impact.

In the mid 1970's the USDI Bureau of Land Management (BLM), developed its own VMS. It was mainly created by Robert Leopold, the head landscape architect of BLM. This method included a landscape classification of scenic attributes, visibility distance zones and a visual impact assessment (VIA) methodology. The latter was called a visual contrast rating system (between new project and existing environment). In 1980, the official VMS was published with simulation methods as well. The main problem was how to test reliability, validity and generalizability of the contrast rating system: a multidisciplinary team in the University of California tried to solve them from 1977 to 1979, finding out the importance of a detailed guidance.

Other agencies that have developed a landscape assessment methods are:

- the Soil Conservation Service (SCS), which is now the Natural Resource Conservation Service (NRCS) in 1972 with the hiring of Sally Schauman (their first landscape architect);
- The Federal Highway Administration (FHWA) in 1988 by publishing their visual resource guidance document for highway projects, a visual impact methodology which can be used to compare transportation alternatives based on the attributes of landscape unity, vividness and integrity. This agency manages no land and, therefore, is not concerned with visual management objectives. Instead, it focuses on guiding the design of highway projects occurring on lands subject to various jurisdictions by identifying and mitigating adverse visual effects.
- The US National Park Service (NPS) that recently provided a national guidance for visual or landscape management, creating a landscape classification and color photographic simulations of different management alternatives. Further surveys are to test parkway user reactions to the simulated management alternatives. The NPS is also developing a multi-jurisdictional policy guidance for evaluating visual impacts of projects that may impact the scenic integrity of national parks.
- US Army Corps of Engineers (USACOE) published a report entitled Visual Resources Assessment Procedure (VRAP) for the US Army Corps of Engineers in 1988. This guidance was embraced after having developed procedures to ensure

reliability and validity but, on the other hand, is fairly time consuming and costly.

(Smardon, 2016)(Aesthetics/Visual Resources Impact Assessment: APPENDIX B Aesthetics Visual Resource Methodology, Southern California International Gateway Draft EIR, 2011)

For an Environmental Impact Statement (EIS), a Visual Impact Assessment (VIA) must be completed where the project changes big portions of land and should follow the methodology of federal agencies, descripted by inner regulations.

Technically, a VIA should include visual simulation of the proposed action, taking into account different views in which the alternatives are compared. The number of views needed depends upon several aspects:

- the geographic extent of the project;
- setting in the landscape;
- impact to resources expected particular location;
- the effects on the identified viewer groups;
- the viewers' sensitivity to changes in the view.

A sufficient development of the project alternatives is needed in order to complete these analysis. The document must describe in detail any noteworthy change in the environment such as cuts/fills, walls, bridges, vegetation and structures addition or removal and alignments that influence views toward or from the project. It should include a discussion of the flexibility in outcomes as well. To conclude, it must provide mitigation measures and opportunities to avoid or minimize visual impacts.

Visual perception is an important topic when analyzing environmental quality, public concern over adverse visual impacts could be a major source of project opposition, so evaluating and openly communicating changes with the affected population is very important to a project's success. A VIA is intended to provide decision makers with information on both the positive and negative visual quality impacts that may result from a project. The assessment, along with mitigation recommendations, provides designers with information on minimizing negative impacts on visual quality, and concepts to enhance existing visual quality and community aesthetics within the scope of the project. \

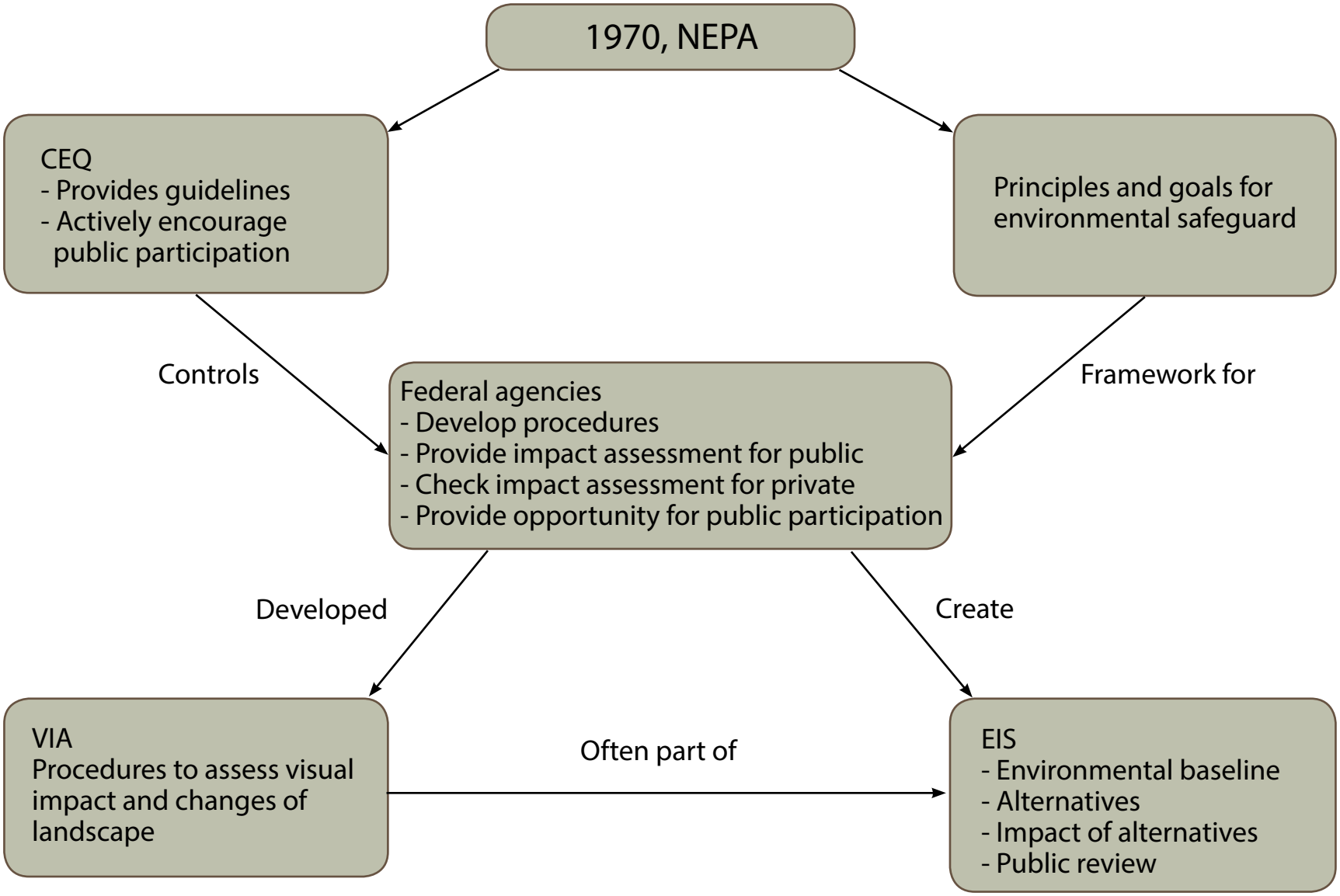


Fig. 1 Scheme of NEPA functioning (simplified)
Source: the author

2.3 European case

Environmental impact assessment: directive, standards and composition

EIA became a statutory part of the planning process within the European Union through Council Directive 85/337/EEC. In 1997, Directive 97/11/EC, which amends the 1985 Directive, extended the range of qualifying development to whìch the Directive applies and makes a number of changes to the way that EIA should be carried out.

It is important to note that a complete list of "actions" and projects requiring a study on environmental impact is included in attachment I and II into the previously mentioned Directive. Moreover, a more recent version of EU directive for environmental impacts has been done with EU/92/2011 and further implementation with EU/52/2014.

Part of the article 288 of the treaty on the functioning of the European Union states that "A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods." In other words, similarly to US federal agencies with NEPA, each Member State has the duty to independently achieve a result under a common objective. The directive also sets out the basic requirements: in their application of the Directive or in supplementary guidance, member states may, and generally do, go beyond the requirements of the Directive (GLVIA, 2002).

United Kingdom was the first country which, through "Landscape Institute" and "Institute of Environmental Management and Assessment" standardized in guidelines the entire process of landscape and visual impact assessment. The final result is a book

called Guidelines for Landscape and Visual Impact Assessment. (Smardon, 2016)

The assessment of landscape and visual effects arises within the EIA process essentially through article 3 of 1997 directive, which states:

The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with articles 4 to 11, the direct and indirect effects of a project on the following factors:

- human beings, fauna and flora;
- soil, water, air, climate and the landscape;
- material assets and the cultural heritage;
- the interaction between the factors mentioned in the first, second and third indents.

Regarding project's nature, in the whole European Union the EIA methodology should be appropriate according to location and scale of the action as well as the potential sensitivity of the site. For simple schemes, a relatively brief overall assessment of the effects on the landscape and visual amenity may be sufficient; while large complex schemes may require separate detailed assessments of each component of the project in addition to an assessment of the overall effects of the development.

EIA considers information concerning:

- the attributes of the receiving environment;
- the nature of the development;
- the likely significant effects arising;
- mitigation measures
- the main alternatives (if any) studied and the reasons for the scheme selected;
- the presentation of the above in an Environmental Statement (ES) and, in a simplified form, in a non-technical summary (NTS)

European EIA is composed by several parts:

- Screening: It is a key procedure since the result arbitrarily states to either conduct the assessment of an action (based on the likely significant impacts) or not conduct it (in the anticipated absence or triviality of such impacts);
- Scoping: it is the process of determining which are the most critical issues to study, it could involve community participation to some degree. They are early stages in EIA

with a potential strong influence in the outline proposal. Once the scoping is complete and the major impacts to be studied have been identified, prediction work can start.

- Prediction and mitigation: This stage forms the central part of an EIA, realistic and affordable mitigating measures are proposed in this phase. This phase will require good management of a wide range of technical specialists with particular emphasis on prediction methods, interpretation of predictions, with and without mitigating measures and assessment of comparisons. The main quantifiable methods of comparing options are by applying weightings to environmental impacts, using economic cost-benefit analysis or a combination of the two.
- Monitoring and management: This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation.
- Auditing: the last stage of an EIA is to carry out an Environmental Audit some time after completion of the project or implementation of a programme. It's usually done by a separate team of specialists to that working on the bulk of the EIA. The audit should include an analysis of the technical, procedural and decision-making aspects of the EIA.
- Public participation: Since projects and programmes have significant impact on the local population, a lack of understanding of the people and their society may lead to considerable negative consequences. More significantly, there may be divergence between national economic interests and those of the local population. For this reason, public participation in the planning process is essential: EIA provides an ideal forum for checking that the affected public have been adequately consulted and their views taken into account in project preparation. The level of consultation will vary depending on the type of plan or project, usually an active involvement is asked for environmental matters.

(www.fao.org/docrep/V8350E/v8350e06.htm)

European Landscape Convention

Similarly to NEPA environmental protection principles, European Union introduced the European Landscape Convention. It is a Europe-wide concept promoting the protection, management and planning of European landscapes and organises European co-operation on landscape issues. Through its ground-breaking approach and its broader scope, it complements the Council of Europe's and UNESCO's heritage conventions.

The ELC is also known as the Florence Convention since it was adopted on 20 October 2000 in Florence (Italy) and came into force on 1 March 2004 (Council of Europe Treaty Series no. 176). It is open for member states, European Community and European non-member states: It is the first international treaty to be exclusively concerned with all dimensions of European landscape. The latter term is intended as part of the land perceived by people, which evolves through time as a result of human action and natural forces. A public authority should be aware of the need to frame and implement a policy on landscape and public should be encouraged to take an active part in the process.

The first step is a phase of identification and objectives setting: the convention take into account the assessment of the landscape through field research by professionals and local inhabitants. Each landscape is composed by components and structures such as types of territories, social perceptions and ever-changing natural, social and economic forces.

The second step is a list of actions including:

- conservation and maintenance of the heritage value (protection),
- helping to steer changes according to social, economic and environmental necessity (management)
- foresee solutions for problematic areas such as peri-urban, industrial and coastal areas (planning)

One important aspect of this convention is the definition of the "landscape quality objectives": for a specific landscape there should be the formulation by the competent authorities of the aspirations of the public with regard to the landscape features of their surroundings. Moreover, management calls for:

- specialist training,

- elected representatives,
- technical staff of local, regional and national authorities,
- school and university courses dealing with values of protection, management and planning,

To conclude, ELC focuses on the landscape as a common resource, being not matter for individual states only. This implies cooperation between Parties which is encouraged at a local and regional level. The final goal is to enhance the effectiveness of the measures taken in each state, providing mutual technical and scientific assistance and facilitating exchanges of landscape specialists and the sharing of information on all matters relating to the Convention (Council of Europe online portal).

Visual impact assessment within EIA

As previously underlined, Visual Impact Assessment (VIA) born in USA during the '70s as a common procedure evaluating visual critical issues of a project.

NEPA introduced environmental requirements and federal agencies answered with particular assessment methodologies according to project's nature and characteristics. It is clear that a federal agency constantly working on specific topics can reach high standards of documents' precision and quality of techniques used, the same precision and quality standards are required for private proponents as well in the limits explained before.

In Europe the situation is quite different: each member state could impose a VIA inclusion in the EIA documentation. Unfortunately it could be a marginal aspect of the whole decisional process because often is prepared by project proponents and rarely by third party teams of environmental assessment. Nevertheless, EIA and VIA are required for most developments and more local agencies as well as project proponents are willing to produce good documentation in order to have a strong reliability and thus

being trusted during decisional process.

Indeed, VIA has certain defining features that distinguish it from methodologies used in EIA, for example it is often done by professionals involved in the design and in the preparation of management proposals, allowing the assessment to proceed as an integral part of the scheme design. Moreover, EIA procedures for some topics such as water or air quality it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. On the other hand, the assessment of visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations.

EIA and VIA have in common a combination of objective and subjective judgements, making important the use of a structured and consistent approach to differentiate among quantifiable and qualitative statements. Environmental and visual assessments are separate, although linked, procedures. The landscape baseline, its analysis and the assessment of landscape effects all contribute to the baseline for visual assessment studies. EIA is carried out as an effect on an environmental resource; Visual effects are assessed as one of the ìnterrelated effects on population.

In United Kingdom, agencies for environmental protection standardized Landscape and Visual Impact Assessment as well as other tool, identifying main issues and goals through "Guidelines for Landscape and Visual Assessment". Some best practice has been quoted as well, proposing the following workflow.

A well made document of landscape and visual impact assessment presents an opening section about objectives, responsibilities and methodology. It must contain both planning and legal context including policies and guidance on landscape designation; qualification and experience of the responsible of the assessment; the methodology used and the process followed with a scheme; the scope of the assessment, key issues and constraints or data deficiencies.

The initial step in any landscape or visual impact assessment is to review the existing landscape and visual resources that is, the baseline landscape and visual conditions.

Context data collection is thus fundamental in the research: it forms basis for the magnitude estimation of development visual effects to be identified and assessed. The study area could be

not only the project site but also the whole area from which the development is visible, also called visual envelope. Nevertheless, the extent of the area may be limited by agreements with regulatory authority within a distance expected to be suitable.

Another issue could be finding the possible visual receptors involved in the change of landscape: residents, visitors and other groups of viewers (the whole community) as well as the visual amenity of people affected.

Second step is the assessment of visual effects, it describes two main aspects:

1. the changes in the character of the available views resulting from the development: identification of potential sources of effects with respect to the potential visual receptors, checklists and matrices can often assist in this process. The document must contain a clear descrìptìon of the relevant basic elements of the development, an understanding of landscape constraìnts and opportunities and a systematic identification of potential effects. The description of the effects should include cross references, if appropriate, to plans and other graphic material.
2. the changes in the visual amenity of the visual receptors: They may arise from both built or engineered forms and soft landscape elements of the development. Consideration may also be given to the seasonal differences in effects arising from the degree of vegetative screening and/or filtering of views that will apply in summer and winter. Thus assessments may be provided for average and worst case situations (the latter being the season with leaf cover and therefore minimal vegetative screening).

It must be specified that the first and the second aspect are closely linked but the second one is therefore more problematic. People generally have differing responses to views and visual amenity depending on the context and purpose for being in a particular place. Thus, sensitivity may depends on: location, expectations, activities and importance of the view from a landmarking perspective.

After this premises, the magnitude or scale of visual change is described taking into account:

- the scale of change (loss, addition, composition and proportion of the features);

- the degree of contrast or integration of any new features in the landscape (form, scale and mass, line, height, colour and texture);
- The duration and nature of the effect, whether temporary or permanent, etc;
- Angle of view in relation to the main activity of the receptor;
- the distance of the viewpoint from the proposed development
- Extent of the area over which the changes would be visible.

A landscape and visual impact assessment should contain also a sound prediction of the magnitude of effects, reasoned criteria and judgements for evaluating significance of effects and mitigation measures. The latter are considered if the impact assessment indicates adverse effects resulting from the project. Hence, main goal is to find a solution to avoid, reduce or offset such problems making a mitigation plan. Techniques for mitigating impacts are often deriving from the impact assessment itself and usually a list of possible project treatments to address particular problems are made. For example, high visual impacts due to cut-and-fill slopes of a proposed road along a steep hillside may be mitigated by realigning the road along the flatter valley bottom, or by re establishing vegetation on the exposed cut-and-fill slopes. Those visual mitigations, if feasible, are then reanalyzed for their effectiveness and final residual impacts are determined for the mitigated project.

Once impact assessment and mitigation planning have taken place, the results of the analysis have to be communicated to the decision-makers in order that they can pass judgment on the project. Unfortunately, no standard procedures for monitoring visual impacts over time have been established although it is usually required an evaluation of actual visual impact and predicted one. It is preferable to use same criteria described precedently.

To conclude, the report resulting from the assessment can be presented also as a stand alone document, the information can be integrated into an EIA or be used as a supplementary report to accompany a planning application if EIA is not required. Anyway, the preparation of a non technical summary (NTS) is a formal requirement, and is expressly intended to help the general public and interested parties to participate in the decision making process from an informed position.

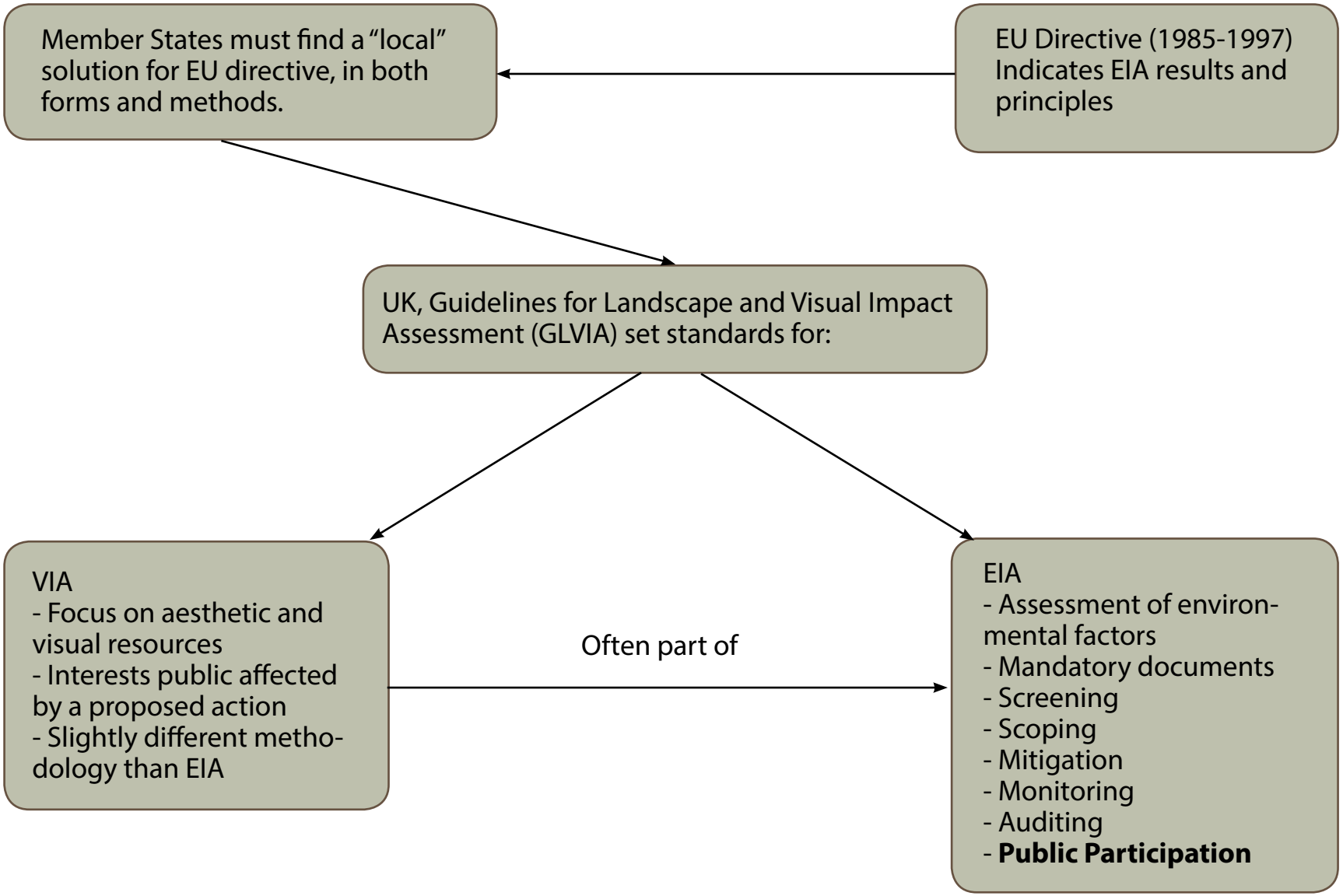


Fig. 2 Scheme of EIA (EU) functioning (simplified)
Source: the author

Italian application: VIA and VAS

With the european directive of 1985 (and 1997) Italy, as a Member state, had to create a suitable legal interpretation for the environmental impact assessment tools.

This process has been phased and delayed, compared to timing of other Countries. EIA has been introduced with the law 349/86 as a partial translation of the EEC Directive 337/85. Further laws has integrated this procedure, like DPCM 377 of August 10, 1988 and DPCM of December 27, 1988. This long period of time is due to the necessity to find suitable criteria for the exclusions and simplified procedures for simple projects and handcraft modifications. With DPR of April 12, 1996, this problem was successfully overcame, introducing specific criteria for projects characteristics. After some years of integrative laws, an homogenization of the legislative framework has been created with D.lgsl 152 of April 3, 2006 (Testo Unico in Materia Ambientale). (La procedura di Valutazione di Impatto Ambientale (V.I.A.): evoluzione normativa e procedurale, Elena Romagnoli, 2007)

Two kind of assessment have been created, VIA (Valutazione Impatto Ambientale, literally Environmental Impact Assessment) and VAS (Valutazione Ambientale Strategica, literally Strategic Environmental Assessment), in other words, italian versions of EIA and SEA explained at the beginning of this chapter.

Valutazione ambientale strategica (VAS/SEA) has a goal in the integration of environmental consideration in plans and development programs to enhance the quality of decisional process. This tool can be used before, in the meantime or after the approval in order to fill lack of bureaucracy in former plans.

“Valutazione di impatto ambientale” (EIA/VIA) is an italian administrative procedure supporting authorities like the environment ministry or the regional government. Its main objectives are to identify, describe and assess environmental impact of a project that is subject to approval or authorization process. (Decreto Legislativo 152/2006 - art. 5, lettera b). It shouldn’t be therefore misinterpret the acronym VIA (Valutazione Impatto Ambientale) with Visual Impact Assessment, in this thesis more frequently mentioned: hence, it will be used just english name. In Italy, It is considered as a control tool for main

public services and entails the study of several environmental variables and an integrated design process, with the main goal of reducing adverse effects in the building construction and foster a better integration of human activities in the environment.

The definition of "impact" is stated in two laws (L. 349/86) and (DPCM 377/88) as the "alteration of environmental factors, environmental systems, natural resources and human settlements". As previously said, the environmental impact could be both positive and negative: here, environment is intended as a complex system of physical, social, cultural and aesthetic factors determining shape, character, relation and development of a place.

An italian EIA should have, among other contents, impacts forecasting, alternative options and mitigation plan. In a decisional process, it is considered as one binding element determining the feasibility of a project using cost-benefits analysis or multi-criteria analysis for a best result.

The process that leads to a full environmental impact assessment is quite complicated and involves the regulatory authorities, Environment ministry and regional government. It starts with the preparation of the EIA documentation about environmental impacts study and is organized in logical and temporal phases, allowing a clear definition for all the involved parties. Moreover, this process entails publication of results, gathered opinions/ comments and public consultations but final decision is always due to Environment Ministry.

(La Valutazione di Impatto Ambientale applicata alle infrastrutture lineari di trasporto. Il caso della tratta A. V. Bologna-Firenze. Antonella R. Ferraro,Tutor: Maria Belvisi, ANPA Agenzia Nazionale per la Protezione dell'Ambiente,Roma, aprile 1999)

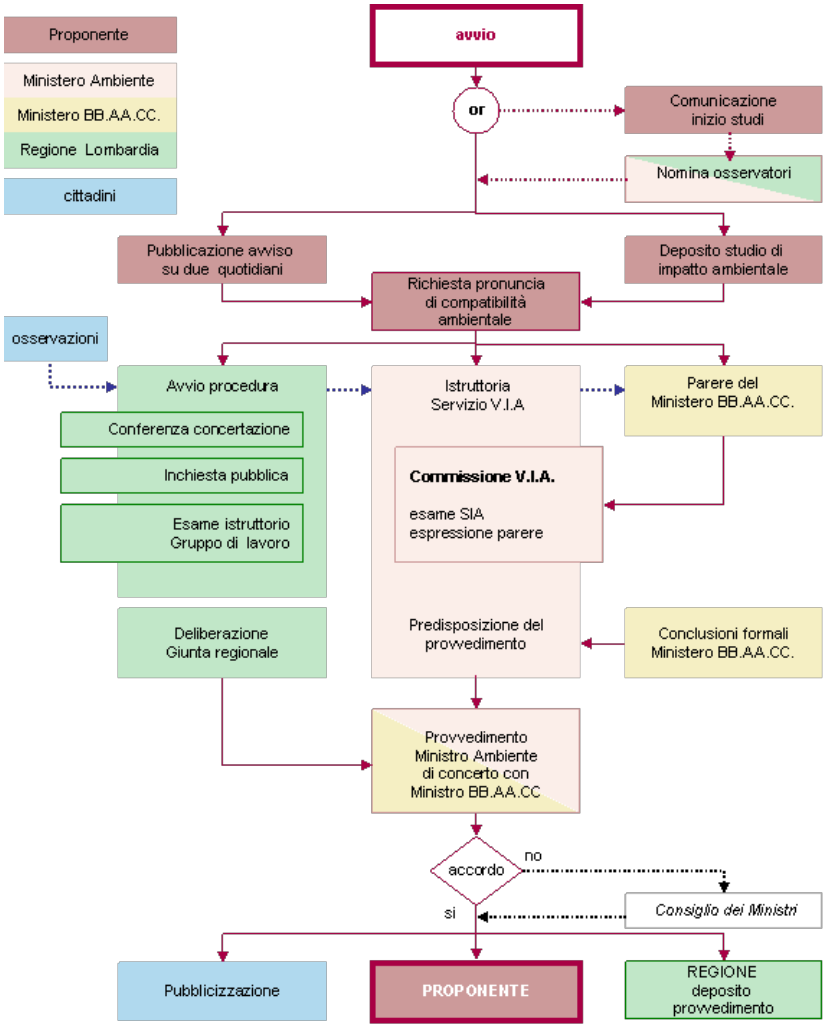


Fig. 3 Scheme of VIA (EIA) process in Italy for Lombardia region
Source: www.cartografia.regionelombardia.it

3 Experiential simulations

Mimesis, the urban environment and literature review

In this chapter it will be briefly explored the background of urban representation techniques, the role of urban simulations and more precisely the experiential one. After an introduction of “perception” and “experience”, common characteristics and probems of this “reproduction of reality” will be explained as well as media commonly used by professionals.

3.1 Representing reality

Early urban representations

Cave paintings could be recognized as the most ancient representation of reality, they are in fact dated back 40.000 years ago (upper paleolithic) being one of the most important testimony of the far human past. With parietal art it is normally intended a series of drawings on cave walls usually depicting large wild animals and scenes reminding hunts. It is still premature to talk about urban representation (main topic of this chapter) since it is mandatory to wait some thousands of years for early developed civilizations. Hence, origins of urban representation must be searched in cartography history: There are some examples of ancient maps from civilizations in the middle east, Asia and Greece.

Without going in deep in explaining the fundamental role played

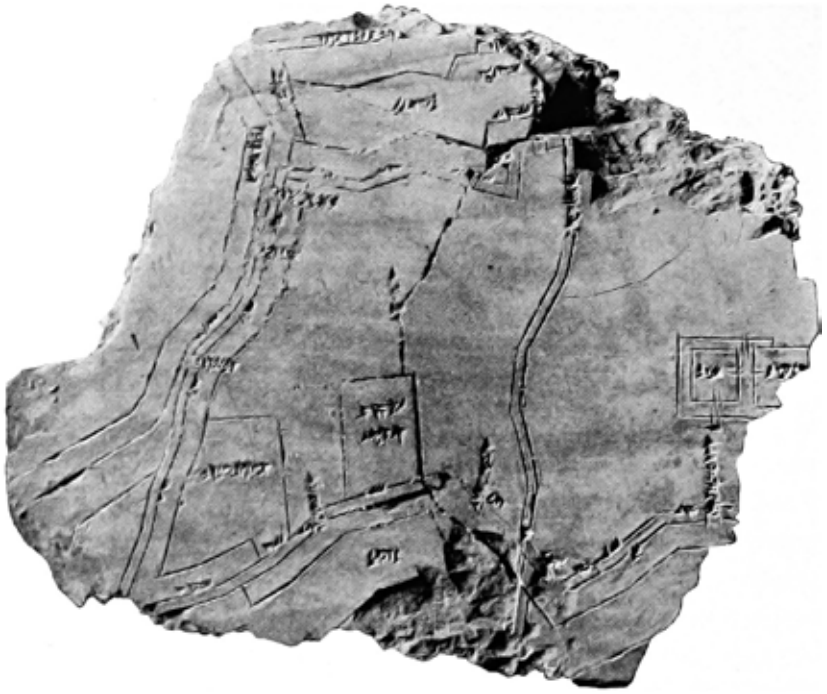


Fig. 4 Archeological clay tablet, sumerian city of Nippur

by this kind of artifacts, some particular case must be identified. The first city map ever found has been recognized to be a carved clay tablet in the ancient Babylonia dating back approximately 1500 BC (sumerian city of Nippur). (Harley J.B., The history of Cartography, volume 1, 1987 Chicago Press) It is interesting that the first urban representation ever found in human history is basically something not immediate as a view, but with an high degree of abstraction like a plan: it requires in fact a certain kind of awareness of areas, volumes and spatial organization.

In middle age this remark is confirmed by the high number of representation of city in profile view, or viewed from an elevated standpoint. This is the case of several famous paintings by Giotto, hence the focus is not upon the city itself but on the scene in which saints and normal people interact with a urban backcloth. In the same period, medieval maps of the world in Europe were mainly symbolic in form along the lines of the much earlier Babylonian world map. Known as Mappa Mundi (clothes of the world) these maps were circular or symmetrical cosmological diagrams representing the Earth's single land mass as disk-shaped and surrounded by ocean. (renz, Thomas. "Tutorials in

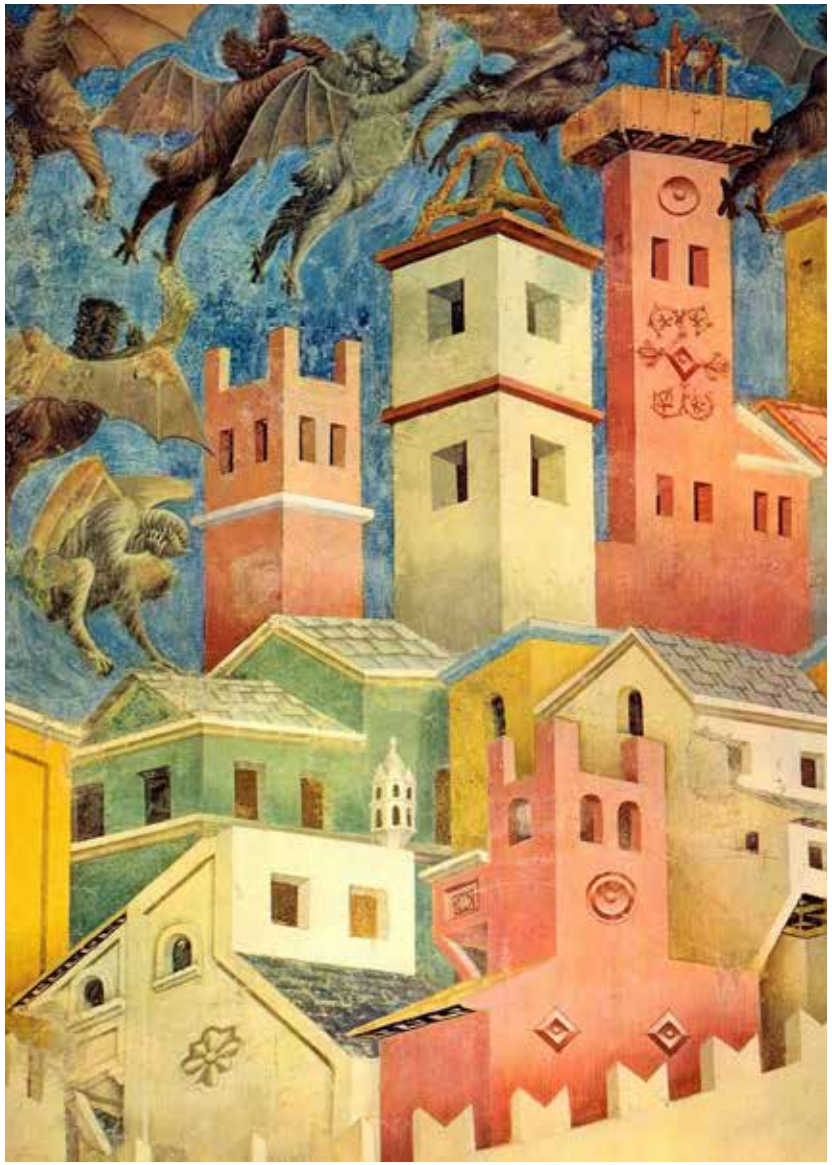


Fig. 5 Detail of Giotto's "Cacciata dei diavoli da Arezzo"



Fig. 6 Island of Chio in the book “liber insularum archipelagi”

the History of Cartography – Overview”. 2006) Other types of maps from this period are called “portolan charts” (from the italian term “porto”, harbour), they are nautical maps with useful informations for navigation routes and harbours on costs.

Some nautical charts depict patly stylized cityscapes drawn in pictogram form, for example in Cristoforo Buondelmonti’s “liber insularum archipelagi” (book of islands) from 1422.

In 1493, the Nuremberg Chronicle represent one of the most important collections of city views of the late middle ages, with over 100 illustrations. In such panoramas some relevant characteristics were highlighted such as ports, buildings, walls etc. as a background for the description of economic benefits of the city, having less emphasis for accuracy. In the 16th century, especially in Italy, the raising knowledge about mathematical projections led to production of more accurate maps and cityscapes: the city was no longer portrayed simply from an imaginary or real perspective, but drawn initially as a 2D map and then transformed into a 3D view.

The concept of Mimesis

The concept of "mimesis" is probably the most important inside representation theories, it is the root for words such as mimetism or mimetic and the meaning is "imitation", for whatever purpose. In the classical Greece, Plato made a distinction between what he called "mimesis eikastiké" and "mimesis Phantastiké". The first one has been described as the trustworthy copy of reality, the latter as the misleading copy of reality, a "fantasy" representation. Aristotle's idea was based on the concept of "imitatio naturae", in other words, the most trustable representation possible of the effective or future reality.

This can be done using techniques of aesthetic illusions or more precisely, with re-production and pre-figuration. In the renaissance Florence, thanks to the rediscovery of ancient texts, the Aristotle's theory was broadly accepted.

Indeed, Giorgio Vasari considered the "imitatio naturae" as the most challenging task for artists: a constant and focused exercise in the drawing leads to more and more lifelike representations. The crucial requirement for a precise representation was the invention of the central linear perspective.

The latter is a linear and geometric method invented by Brunelleschi after years of several experiments by other artists: this technique is essentially the determination of a viewpoint, a division of the field of view in a linear grid and a projection on the painting of vertical lines.

Brunelleschi during his formation surely had some optic notions, often working with lens for distances calculation. Moreover, he could expand his knowledge thanks to his friend Paolo dal Pozzo Toscanelli, theorizing perspective technique for the representation of an illusionary representation of the real world. In 1416 he painted on a wooden panel the urban view of the Florence baptistery but unfortunately it has been lost, we just have records of the method used.

In 1435, Leon Battista Alberti finished his "De Pictura" (on painting in english), a treatise about painting dedicated to Filippo Brunelleschi. This work is divided in 3 books and the first one is about the bidimensional "reduction" of the tridimensional reality, being the first written work on perspective. Recognizing the importance of Brunelleschi's theory, Alberti made the

process more flexible by considering the painting as the section of the optical cone, linking the viewpoint with vanishing point on the horizon line and making all the perpendicular lines of the painting converging in it. This is commonly recognized as “costruzione legittima”, a method allowing the representation of whatever space, existing or imaginary.

To quote some example of this kind: “Città ideale” or ideal city, is a common name given to a set of three paintings from the end of the 15th century, representing an imaginative scene of a city in renaissance style. They are twofold important: first of all, they are recognized as the maturation of this artistic period, while from a technical point of view their production entails a former design phase of the urban and architectural space.

Hence Urbino, Baltimora and Berlin could be seen as an ancient version of today’s renders and photomontages. After Renaissance period, urban representation has become a known technique allowing artists and architects to reach diverse goals. For example at the beginning of the 16th century Leonardo Da Vinci made a map of Cesare Borgia’s stronghold, a town plan of Imola in order to win his patronage. Precise maps were extremely rare at

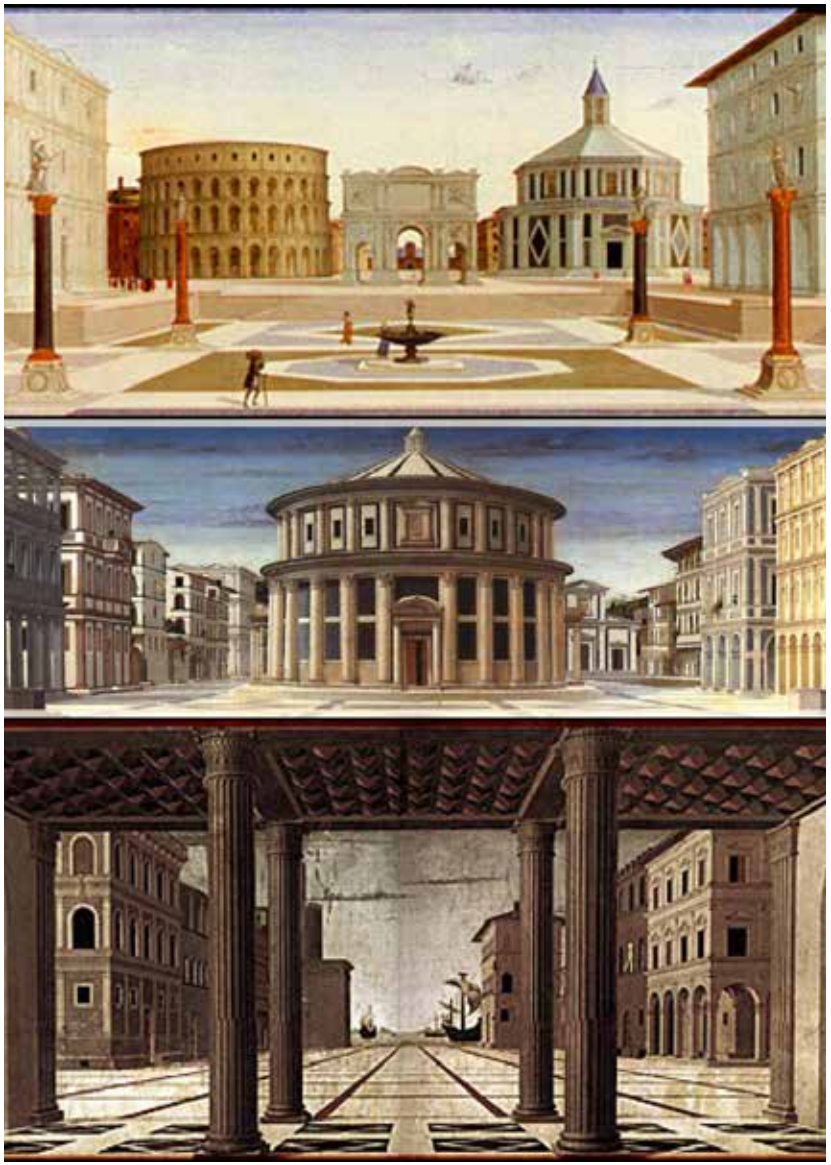


Fig. 7 Città ideale: Urbino, Baltimora, Berlino



Fig. 8 Leonardo's map of Imola

the time and it would have seemed like a new concept. Upon seeing it, Cesare hired Leonardo as his chief military engineer and architect.

Some interesting results are by painters and architects from the 18th century. Giovanni Battista Piranesi made particular representation of Rome full of heavy dramatic tone, highlighting dignity and majesty of the past by depicting ruins of architectonic elements. In the same period, Giovanni Battista Nolli made a in-depth survey of the city, entering in all the public areas and, later, in some private property. The result was a map called "nuova topografia di Roma" representing in white all the voids and in black all the volumes. The most interesting feature of this map is that it could highlight the public realm (reachable), compared to the private one (considered as a black unaccessible volume).

In the 19th century the most common way to show the future outcome of an architecture project was to paint it. Several architect of that time use this techniques with more or less valuable results. From an artistic point of view, Thomas Cole's "The Architect's Dream" which has been made in 1840 shows several architectonic elements in a completely invented environment. His romantic

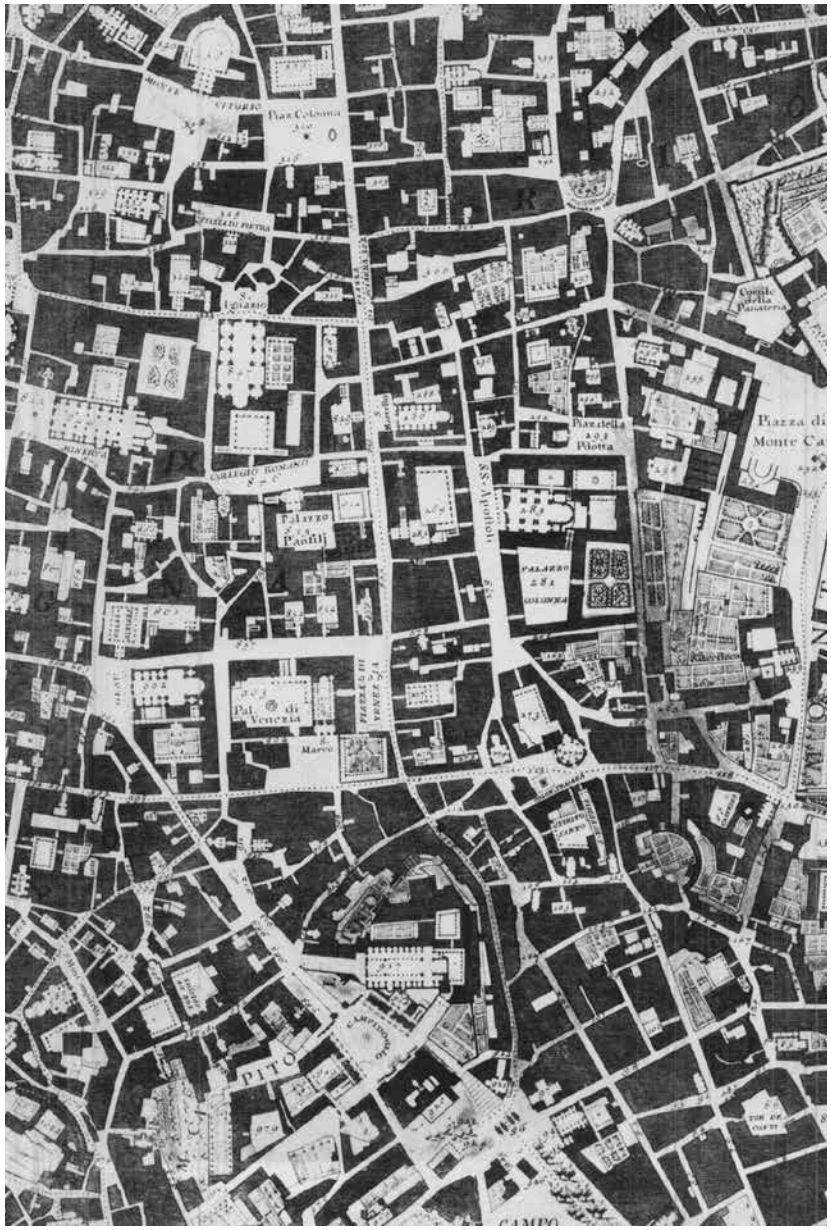


Fig. 9 Nolli's map "Nuova Topografia di Roma"



Fig. 10 Detail of Piranesi's Fontana di Trevi

idea of recovering a lost soul by paying tribute to different styles all together has been considered merely architectonic at that time, but it is now considered as the representation of artistic expression of all the passed ages.

In the last 100 years the urban representation has reached its maturity by taking multiple forms and approaches. The latter are so many that further studies has been made by numerous scholars in order to grasp as many nuances as possible. Leaving aside the artistic viewpoint, this thesis will focus on the technical one by considering a very specific branch of representation: simulations. In the next part this topic will be defined, developed and the common tools for achieving a well made simulation will be specified.



Fig. 11 Thomas Cole, "The Architect's Dream"

3.2 Simulating the urban environment

Among representation techniques for the urban environment, simulations have a specific importance in forecasting possible effects of a proposed action. Since the term "simulation" is very broad and may concern multiple sectors and different uses, from now on it will be used taking into account the specific realm of urban simulation and, later on, experiential simulation.

As previously mentioned with the concept of mimesis, simulations could be considered as a trustworthy representation of reality as well. According to Appleyard's "Understanding professional media" (1977) simulations cannot reproduce reality in toto, it selects critical aspects of that reality for particular purposes. They are composed by 3 physical elements: An information storage system, a simulation medium, a presentation format.

The first one is the physical location of the stored data, information may be stored on plans and sections of a building, in a physical model, a computer or statistical tables. As previously said, data must be accurate as much as the cost allows it, flexible to make the processes of additions, corrections and changes easy to accomplish and in conclusion data must be accessible and transparent. "If the sources of the information displayed are obscure and inaccessible to the layman, they are easily susceptible to professional "mystification," one of the most serious problems in the use of computers." (ivi, page 56) Into the information storage system is located data regarding the model used for the simulation, it represents key characteristics, behaviours and functions of the selected physical or abstract system (or process). The simulation media include "verbal descriptions, drawings (plans, sections, projections, or perspectives), photographic prints, slides, movies, and television, usually used in combinations." (ibidem) A great amount of other media has been experimented in last years,

among them, virtual reality in all its forms and purposes is a very promising one.

The presentation format could influence the effectiveness of the simulation by having a certain style, length and materials presentation sequence. It is crucial to make a right duration of contents since short presentations give few information and long ones create an overload and produce boredom.

Another component is the testing human: often, a simulation is used to test human responses to certain stimuli or to particular situations; The relationship between human and the model could be considered as the core of the simulation. In a very simplified way, such a relationship is similar to the one between the human and the real world process but several objections can be raised. Firstly, there is a concrete problem related to the temporary psychophysical condition of the tester, secondly the overall simulation could be biased by previous misleading experiences. Another important factor is the bias due to the medium chosen to represent the before-mentioned real world process. All these problems will be faced later on, once specific context will be fully explained.

The before-said features and characteristics are in a way common to all urban simulation typologies, in order to be clear about main topic of this research it must be underlined that among them just experiential simulations will be fully analysed. Hence, a step by step approach is recommended, starting from the research background led by Berkeley Environmental Simulation Laboratory.

In the late sixties, Donald Appleyard and Kenneth Craik explored issues regarding how people comprehend the everyday physical environment. This psychological research tried to explain the utility of assessment concept and methods for environmental perception, cognition and impression formation. In particular, the way in which persons encounter places and the means by which places are presented to observers (for example using simulation techniques) were among the principal objects of their studies.

It was the 1972, Appleyard and Craik received funding from the National Science Foundation to update what had been a rather simple environmental simulator purchased from Yale. The creation of very detailed maquettes was followed by the design

of the environmental simulation equipment: Karl Mellander, a mechanical and optical engineer, created a modelscope with a tiny set of movable prisms and lenses that can be walked, driven, or flown through a very small scale physical model with attached cameras. The movie of a walkthrough was used as a validation of the simulator as a research tool. (Bosselmann, 1984)

The creation of urban stage in physical maquettes started by taking photos of existing buildings. These facades were pasted on the vertical surfaces of a physical maquette, more recently it is done in a computer by creating a texture and mapping it on 3D models.

Even if that approach was totally innovative "the new simulation technique was not immediately put to use by the design and planning profession. […] the reason for the delay was cost: most planning agencies could not afford to pay the engineer, filmmaker, computer programmer, model-builders, and urban designer required to prepare a simulation at Berkeley. The cost of simulation could be justified only for very large engineering or planning projects." (Bosselmann,1998, page 94)

Main goal of a simulation laboratory should be the creation of

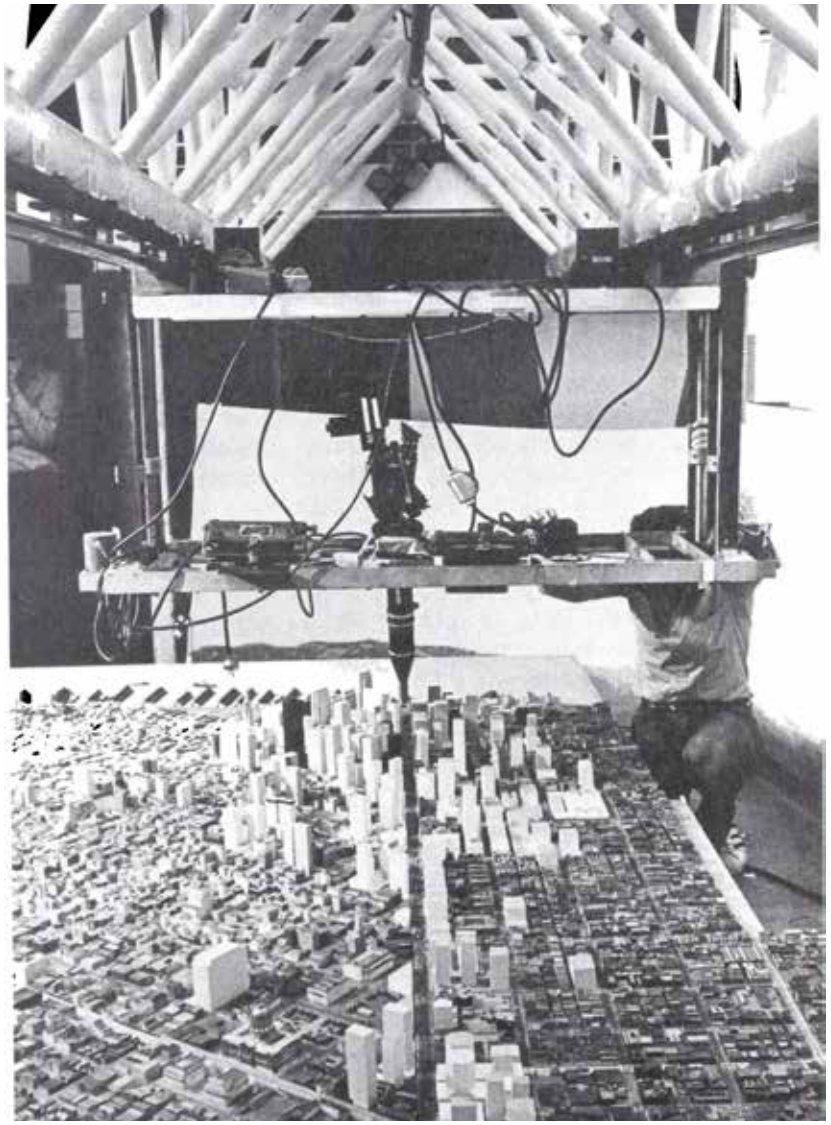


Fig. 12 The environmental simulation equipment
Source: Bosselman, 1984

trustable and unbiased representation. Initially, the work in the laboratory of Berkeley was carried out in a small scale but, over the years, the amount of work done "has expanded to match the original scope and range of activities envisioned at its inception." (Bosselmann, 1984, page 152) In fact from 1976 and 1982 the lab explored simulation as a medium in participatory planning, creating materials in order to test community responses to alternative projects. This main focus is the same as this thesis, making past experience of Berkeley lab one of the most precious resources in both knowledge gathered and aims.

Urban simulations created by this laboratory were particular typologies of simulation regarding the relation between human domain and environment. The exploration of such a relationship, changing focus according to the situational objectives, has been done from the human viewpoint having the goal of representing the environment. The simulated contents must, out of necessity, select from the richness and complexity of the real world an abstraction of actual conditions. (Bosselmann, 1998) The degree of abstraction in an urban simulation defines two sub-typologies: experiential simulation, which is the main topic of this thesis, that "tries to reproduce a concrete representation of what a place will be like when experienced. Conceptual simulations attempt to reproduce abstractions of underlying systems or structures." (Appleyard,1977, page 44) (McKechnie, 1977)

Experiential simulations have indeed a low degree of abstraction, in other words they look like a close representation of reality. Some scholars studied the use of such simulations by professionals regarding architecture and urban planning, giving the name of visual simulation because of their fundamental visual character. As the names suggest, the main topic of the first is to simulate the possible experience of a place while the second one is more focused on the simulation of the visual features of a place. Substantially they could take multiple forms, some example could be a realistic painting, photomontages, 3D visualization with computer and many other. This topic will be investigated later on.

If the abstraction degree is very high, simulations could look like diagrams or cartoons being sometimes called "conceptual simulation". In fact, they only show the basic underlying concepts of an idea or design such as structural elements, basic form, scale,

shape without representing surface elements. (Sheppard, 1989)

The possible "conceptual" information that this kind of simulations can provide are:

- "Functional aspects" like spatial accommodation of territorial activities, traffic circulation flows and channels, utility needs, water supply, waste disposal and energy consumption
- "Economic aspects" like project costs, house prices, effects on land values and demands on public services.
- "Social impacts" like income of the project users; impacts on the neighbors, the surrounding community, privacy, and community cohesion; community control; social services and safety.
- "Environmental impacts" like natural and traffic hazards; visual, air, water, and noise pollution; visual quality; ecological impacts, environmental maintenance and management effects.

(Appleyard, 1977, page 55)

Each of them are useful in different context mostly in urban planning, in particular environmental impacts can be very useful in urban design in order to test people well being regarding climate, which is one fundamental aspect of experiential simulations. In fact, the relationship between a city's form and its climate has been find out but the prediction of future buildings affecting climatic condition cannot be intuitively understood. There are no comprehensive mathematical models relating environment and comfort of pedestrians on sidewalk or in public open spaces, that is the thermal condition affecting their psychological well-being. Six variables have been discovered to affect outdoor climatic comfort: sunlight, wind, humidity, ambient air temperature, activity level and clothing. Hence, in order to produce computer calculations data can be gathered from weather records, by calculating shade produced by building at specific times and from wind tunnel measurements. In a further step, those data must be related to people's activity level, their clothing and the time they are likely to spend outdoor. (Bosselmann 1998)

From a practical perspective, in urban planning examples of conceptual simulations are mainly maps of cities that, by simplifying reality, do not contain all available information but the least possible (arranged as unambiguously as possible) to permit a skilled map reader to extract an adequate image of

reality. (Ivi, page 21)

Conventional color codes and symbols in land use plans, transportation flows etc. show clearly that conceptual representation is broadly used and accepted also because of the enormous boost given by computer development and GIS. The problem of these kind of media is that "few people could relate the information on the maps to what they knew existed in the real world. And even today many people are not entirely comfortable with the graphic convention of maps or plan views." (ibidem) On the other hand, experiential simulation should be totally understandable by everybody so: are they useful in participatory planning with citizenship? There could be a link between a conceptual and an experiential representation? Surely the before-said conceptual simulation could be useful for the preparation of more precise experiential simulations. Eye level perspectives are the dominant form of imagining a place, with the combination of measured drawings like maps, an important lesson about scale in city design can be learned. (Bosselmann, 1998) In fact, "since the experiential reality of a project is an essential part of its comprehension, connections must be forged between simplified abstractions and the complex texture of experience. This multilevel comprehension calls for multiple media at different levels of abstraction with understandable links between them." (Appleyard, 1977, page 61) In other words there is the possibility, by using different media, to understand much more of the represented real world. In fact, degree of abstraction helps us to selectively grasp details at different levels of complexity making the use of different simulation tools useful and desirable.

3.3 Experiential simulations

An introduction to perception and experience

The perception of the environment is both the study subject of a specific branch of psychology and the main feature to being simulated in an experiential simulation. This is a very complex process and several premises must be done.

First of all, it's fundamental to define, even if in a simplified way, this complex process under the point of view of urban disciplines. Thus, it is roughly possible to fix into four main elements the physical world: humans, non-humans, built environment and climate. These components are subject to mutual influence, this interaction is defined as "ecosystem". A very similar concept is "atmosphere" being "the complex interaction of the physical features of the environment that contribute in creating the peculiar physical identity of space." (Piga and Morello, 2015, paragraph 20) Thus, a space is basically a physical environment with some interconnected features forming its identity, what happens when a space with an atmosphere is perceived? Through perception a space become a place and an atmosphere becomes an "ambiance" which is "the physical atmosphere processed through human senses, culture and personal experience". (ibidem)

Experience of a person could be defined as the knowledge acquired through the involvement or exposure to an event or an object, in our case, the environment. This concept involves several aspects like intellect, perception, cognition, memory, emotions and other psychological issues. Hence a clarification is needed.

The two concepts of perception and cognition of an environment were clearly separated in theoretic bibliography. The latter

interpretation could be misleading in recent years since several scholars used the word "perception" as the process of receiving data from the environment in a "objective" way, while now this term is intrinsically linked (and often used instead of) cognition. They have been joined in a common theory because we are not neutral passive receivers of external stimuli since our brain activity highly affects our perception of the world.

This makes the two acts of perception and cognition strongly related in an active process (Arnheim 1969), to be more specific, the receiver moves from a perception through senses (nerve impulse) to a perception through cognition (conception, interpretation, experience, and thus knowledge). Consequently, it can be argued that reality is never perceived as it is, we can only conceive an outer reality through the interaction of our body and mind, involving the actions of sensing, perceiving, experiencing and knowing. (Piga and Morello, 2015) For this reason "perception varies with particular events and experiences" (Appleyard, 1977, page 58) especially with view, people generally have a different perception according to the context (location, time of day, degree of exposure) and purpose for being in a particular place (recreation, passing through a landscape, residence or employment). (GLVIA, 2002)

Besides environmental variability or personal purposes, there are other personal conditions that could affect perception in both temporary and permanent nature. Under the first we can find the physical and mental conditions and emotions emerging during the act of experiencing. Under the second category it is possible to find "bias" that could have been accumulated over a lifetime, those are personal history, culture, education, professional skills and memories. Long term experience is basically determining the character of a person and, even if it evolves over time, it is long term enough to consider it as a permanent condition.

The personal sphere is not the only dynamic factor in the perceptive process, in addition, all the interconnection in an environment are dynamic, changing by time and space as the living experience does. In fact, perception occurs in the present time, being conditioned by past experience contributing in drive people's future actions.

In this regard, it is important to underline that the built environment is mainly composed by architecture and urban furniture: the first

presents physical permanent conditions (stable over time) and the second presents physical semi-permanent conditions (more susceptible to modifications). From this viewpoint, nature and climate are partially influenced by design since the adoption of elements such as trees and shelters could contribute to the micro-climate conditions control. Generally, climate presents physical recursive conditions like seasons and day/night cycle to take into account just like temporary conditions represented by flows (people, cars or animals). (Piga and Morello, 2015)

Defining features

In summary, humans construct reality differently, in a subjective way. This means that even if the physical perception of an environment passes through the same sensorial source, the cognitive perception deriving from it is different from one person to another. Thus, what is an experiential simulation? it is a representation of urban places experience as they could be experienced or perceived in the real life, mainly through vision. (Sheppard, 1989) (Bosselmann, 1998). Experiential simulations have a low degree of abstraction in the representation of reality. Hence, two main issues must taken into account: firstly, the simulation itself is a simplified but realistic and accurate restitution of the environment, secondly, the process of re-sensing the simulated environment by the perceiver represent a further simplification (and some technical difficulties to faithfully reproduce this relationship as well). For achieving best results, a further investigation of the previously introduced complex human/environment relationship is needed by stressing the engaging dimension of reproducing the atmosphere of a place.

How can experiential simulations reproduce the experience of a place if the latter is so problematically diverse? One of the possible strategies is to reproduce the form and appearance of the sensed environment, replicating visual images of what the environment might be like. It is from these sensory representations that people can "build" their own realities. It must be said that such experiential simulations are most likely to be successful in the representation of the first encounter with an environment. In this specific case, a person is especially aware of environmental qualities being less prone to make inferences about their social, economic, and other dimensions perceiving it mainly through its physical image. In fact, more familiar environments become increasingly colored by personal activities and social relationships, becoming very difficult to simulate. A number of important environments are particularly susceptible to this "first-encounter reality", those are:

1. New environments, intended as newly constructed or primary impact in its first materialization (like a public presentation);
2. Public environments, intended as "infrequent contact" experience.
3. Infrequently visited environments, like tourists centers, resorts, recreation places, shopping centers.
4. unlived-in environments, like power stations, bridges, transmission lines, landscapes, places of beauty, undisturbed areas and freeways.
5. Choosing lived-in environments intended as places in which a person or a family decide to live in, to buy something, etc. (Appleyard, 1977)

In an experiential simulation there are, in addition to the before mentioned fundamental features, three crucial aspects to take into consideration: immersivity, interactivity and multi-sensoriality: These features should make the personal experience more engaging and dynamic, contributing in the comprehension of the simulated scene. (Piga and Morello, 2015)

The multi-sensoriality feature must be underlined since, often, the chiefly visual character of experiential simulation is considered as the only sensorial one. This kind of representation should "show details and complexities in much the same way as the eye obtains a visual image of the world" (Sheppard, 1989 page 80) however, visual character of an area could be not enough since information given by the other senses are fundamentally part of the perceived

reality. Perception is never a static process since it involves in the space and time the movement of the body, this is to say that the perception of a place passes through all 5 traditional senses. For what regards experiential simulations, sight and hearing are surely the most important. They behave as distant receptors (Hall, 1992, first edition 1966), in other words, they are fundamental in projecting ourselves in a complex environment by grasping data from a far source. Normally, we look in the direction of our motion but we also visually scan the environment to locate ourselves in space and understand what's happening around us. (Danahy, 2001) On the contrary, hearing is omnidirectional since we can perceive sounds coming from behind and even beyond a visual barrier. Generally we can understand the location of the sound source around us, contributing to guide our motion in space. A very important dimension of city soundscapes must be explored, since everyday life is rarely silent and presentations with no sound seem distant from the real world. The most convincing sound background are traffic, trees, birds, and people's chatter but beside impressionistic sound accompaniments, it is surely desirable a more accurate prediction of traffic-noise levels that, once calibrated, could give to an audience a proper sense of real sound. (Appleyard, 1977)

Even if the sense of smell is more restricted than the previous ones, it must be said that a persistent and diffused odour strongly identifies a place, triggering and stimulating brain activity once experienced. The sense with shortest range of action is touch. Through the skin it we can feel temperature which greatly contributes to our feeling of comfort. The latter two senses cannot be easily simulated as well as taste (which is not even useful in the perception of the environment). Conversely, other two systems could define the experience: the kinaesthetic (motion) and vestibular (balance). (Lange, 2005) The latter two senses could stimulate a persistent perception of immersivity, giving the idea to be part of an environment by allowing the movement and the cognition of space.

Immersivity can be part of a simulation according to the medium used: a focus on media typologies must be done. In fact it is possible to categorize media basing on their specification such as staticity or dynamicity, bidimensional or three-dimensional, immersive and not immersive. These definitions help in understanding the

potentiality of a medium in terms of possible user experience of non-real environments. (Piga and Morello, 2015)

From the net page image it is possible to understand how an increasing level of immersivity can be reached by using different media. It is crucial to remember that multi-sensoriality aids in the perception of an environment as immersive but the main point here is differentiate among visual medium. It is clear that a simple photo or image is not so representative of a place from the experience point of view, it is surely more descriptive to have a photo set, a video or a free roaming VR environment. Hence these solutions represent only the first step into the visual immersivity of media. Planar, cylindrical and spherical representations increase the sense of immersion comparing to normal images. This happens because they are perceived as dynamic: the environment represented seems part of a more complex system and the perceiver feels to be part of it by being interconnected. Obviously, spherical representation are the most complete under this viewpoint since all possible visual angles are linked in a comprehensive image, enabling motional perception of the depicted environment. Static images can be considered dynamic as well if they are big enough to allow people visually wander inside the boundaries of the canvas: panoramic images are a typical example of this category. (Danahy, 2001) According to the expected level of immersivity (from planar to cylindrical and and spherical perception of the depicted environment), these typologies of simulation permit to look around but cannot allow to freely move inside the space by changing the visual angle of the viewer (although some video can change it, it is still not free). Virtual Reality can overcome this problem by allowing to move freely in the simulated environment, and in addition, can simulate the visual perception of a digital environment by using an Head Mounted Display with lenses. The result is more engaging, time consuming and expensive even tho the level of detail is less realistic than normal images. This typology of medium influences content communication since emphasis is placed on one aspect rather than another (Piga and Morello, 2015) in fact who prepares VR simulations arbitrarily decide what's the feature to be tested by adding details to a specific location or a specific process or action. The overall level of accuracy of virtual environments could affect a simulation evaluation by users, depending on the

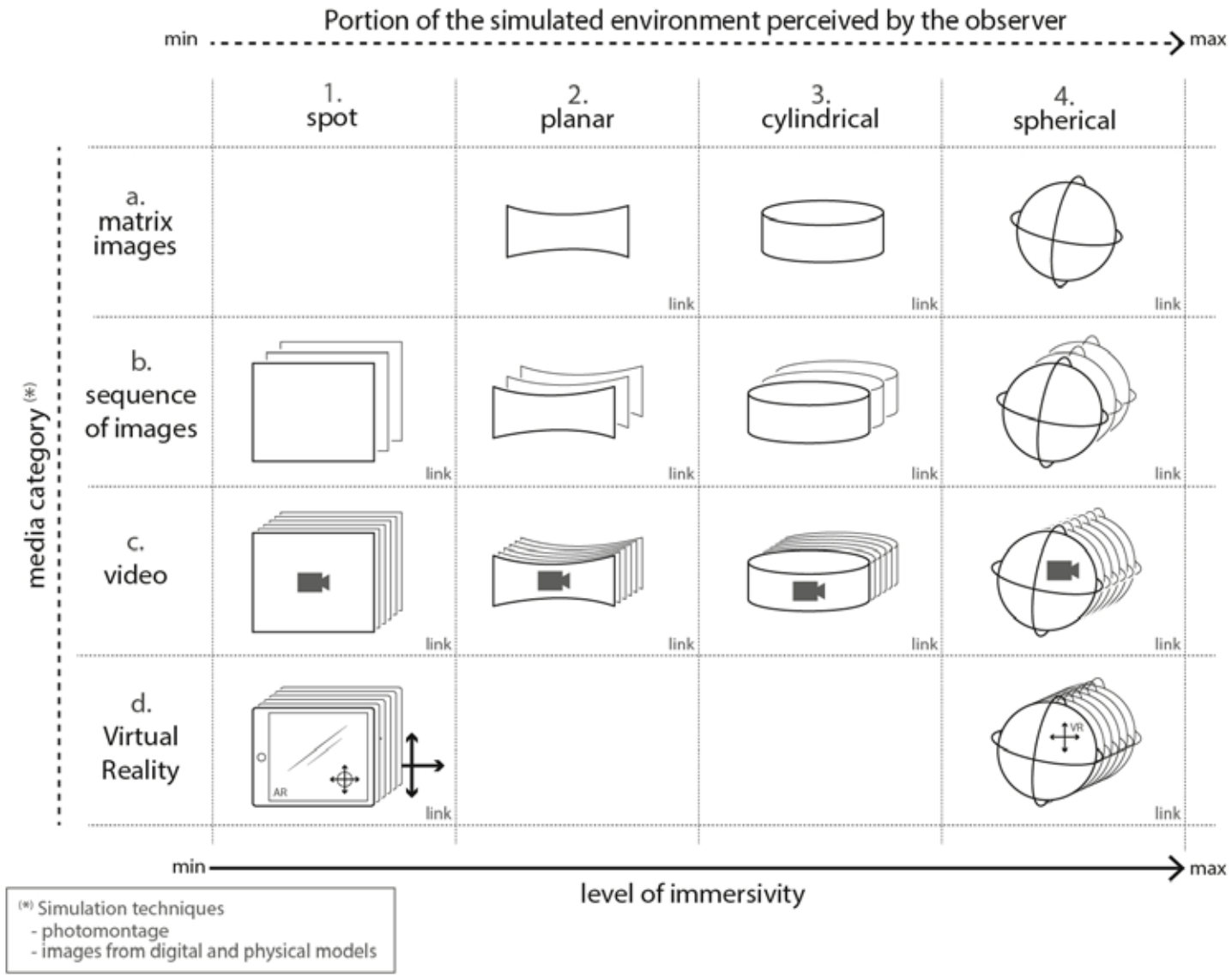


Fig. 13 Matrix of simulation tools
Source: Piga and Morello 2015

level of detail or on the technology used. (Sheppard and Cizek, 2009)

Virtual reality allows to introduce the last crucial aspect of an experiential simulation: interactivity. Sense of realism (in particular sense of a place), engagement and understanding are dramatically increased by interactive fruition of a simulation. (Appleyard, 1977; Bosselmann 1998; Danahy 2001; Lange, 2005; Roupé & Gustafsson 2013). In fact, it is much easier to add dynamic elements into digital models comparing to physical one, even if possible with some efforts. Such dynamic elements could be all the temporary aspects that affect the environment like flows of people, plant life and seasonal changes of vegetation, daytime and night-time conditions. A valid solution to deal with the complexity of environmental setting are game engine technologies, hence, the user can select different climatic conditions as well as timing to test and understand alternative atmospheres. If the integration of an agent-based simulation into the model (i.e. flows like people, cars) is accomplished, it could totally increase the perception of livability of the depicted environment. (Piga and Morello, 2015)

To conclude, in order to reach maximum levels of multi-sensoriality, immersivity and interactivity from an experiential point of view, three issues must be taken into account:

1. The perceptual relationship occurring between user and simulation, that is, in terms of visual perception, mainly due to the ratio between the size of the simulation and the position of the perceiver. (Bosselmann, 1998)
2. Dynamic aspect must be taken into account. It has been previously defined as the interactive aspect of a simulation, implying the motion of temporary elements and the movement of the user that dramatically increase the realism of a scene (Klatzky et al, 1998; Danahy, 2001; Roupé et al, 2013; Lange, 2005).
3. The reactivity if the simulation in terms of responsiveness to the stimuli inducted by the user. This is because the user is not only a perceiver but also an emitter that provides new inputs to the simulated environment.

(Piga and Morello, 2015)

How a simulation should be: characteristics and external factors

It should be clear that accurate simulations are very useful tools to depict and experience non-existing environments, even if they still are reductive simplifications of the real world features. In this paragraph it will be defined when the efficacy of a simulation is compromised, potentially at three different levels: the first is the simulation itself, the second is the human/simulation relationship and the third are external factors like the presentation format of the simulation, which refers to the context where the simulation is displayed, and the user's personal background.

Donald Appleyard (1977, p.57) affirms that a simulation must be realistic and accurate, comprehensible and evaluable, engaging, cheap and flexible. Applying this approach on merely visual simulations for the evaluation of projects, Stephen R.J. Sheppard (1989, p.59) stresses that simulations have to be understandable, believable and unbiased. These three characteristics must be achieved through 5 principles: representativeness, accuracy, visual clarity, interest and legitimacy.

Bosselmann (1998, p. 199) recalls previous principles indicating that simulations should be: understandable, open to evaluation, complete, accurate, engaging, detailed and realistic (in terms of response equivalence).

Previous principles were mainly about forms of distortion due to the simulation itself (the medium and construction of the simulation) and man-simulation interaction. Hence, a comprehensive list of characteristics that minimize the risk of bias could be:

Realistic. For its nature, a simulation should be realistic in terms of believable representation of real world features. Realistic and correct simulations are defensible, they can convince users that the real scene would look like (or be like) the represented scene. In fact, slick graphics and other presentation features like music are often criticized as attempts to bias the audience as well as simulation that looks "too good to believe".

Moreover, it should be interpreted correctly by users as much as the simulated real world process or system. The latter aspect is called "response equivalence" by psychologists and it should

be verified in order to not compromising the whole process. In fact, it should include all the features recalling an atmosphere of a place since can unconsciously affect the understanding and evaluation of users (climate condition, building aging and other lifelike details).

Representative for evaluations. A simulation must be representative in terms of representation of key features to evaluate. This aspect will gain importance in the next paragraph about simulation for project evaluation.

This is valid for:

- qualitative content and description of features to test like level of detail and resolution; materials and textures, lighting and colours, shapes, etc. In fact, it is common to have insufficient information for a presented project, making impossible to demonstrate nature and appearance of a building or urban design. Hence, the problem is the lack of design detail: the technique of showing too abstract masses or "envelopes" of buildings, even if photomontage is used to superimpose them on a real site, often pushes for more requests of specific informations or better representation with more architectural detail and character.
- Important and typical views of a new project into an environment: an important view should give distinct and significant more information than another one. Without representative set of views certain aspects of the project are likely to be ignored, their total number depends on the nature of the project. A common problem is the omission of sufficient views and context allowing people to judge a project fitting in its surroundings. Thus, interpreters can't understand the effects of the first to the second.

Accurate. A simulation should be accurate in terms of correctness of data, in fact, it should show views of the simulated environment with no significantly different appearance from the real world. In subject matter it could refers to presence or absence of objects in the scene: there should not be omissions of significant part of the project or the environment in the scene. Moreover, there should not be noticeable difference in the representation of design scheme and context, being an homogeneous representation.

The assumption of an always trustable computer graphic, which is just because it was drawn by a computer, is rapidly overcome by realizing that the original data may have been inaccurate.

Accuracy is important because it is seldom misleading, however, some forms of inaccuracy may actually improve people's understanding of a project, those are the abstractions already mentioned with conceptual simulations. On the other hand, very abstract simulations exaggerating particular features of the project could lead to less favorable judgements.

Inaccuracies can occur for a variety of reasons:

- medium used
- original incomplete or conflicting information
- personal skill or approximations in production phase
- highlighting positive aspects of a project, biasing judgement

If a simulation is representative and accurate, once demonstrated, it also defensible and seen as legitimate. "Legitimacy means establishing the authenticity of products and process, and providing some accountability for future problems or disputes." (Sheppard, 1989, page 100)

Readable and understandable in relation to human optics and perception, considering resolution, foveal and peripheral vision. (Dahany, 2001)

A simulation is readable when the visual content of the image is clear and not ambiguous, presented with no loss of details, contrast or other visual "effects" distracting the user. In fact, a visually unclear simulation fails to communicate the correct information, leading to wrong interpretation, confusion, less credibility and contrasts among actors.

Dynamic to generate interest and engagement. (Pietsch 2000, p. 252) To be sure that people would grasp as much valuable information as possible, the communicative power of a simulation must be sided with engagement to avoid boredom. A sufficiently interesting simulation involves people in a direct way and in the way it is presented according to the contents, their complexity etc.

On the other hand, a too interesting simulation becomes a form of counterproductive entertainment. "The audience may become so involved, or so fascinated by the technique, that they lose

sight of the real issues or are left with a favorable impression that may be erroneously transferred to the project." (Sheppard, 1989, page 99) Engagement is not the only factor involved with dynamism, as previously mentioned, the possibility to drive through cities at accelerated speeds created a new image of the city, different from the one obtained by walking. Urban form at high speed is not only perceived as less detailed but also distorted in terms of distances. Thus, "Dynamic forms of representation are becoming necessary to explore our changing understanding of space." (Whyte, 2002, page 32) Our experience of travelling through cities at speed, in the car and in new media such as film, computer games and videos, has led to increased interest in time and movement as design generators. The duration, flow, pace and rhythm of our actions affect our understanding of the city (Borden, 2001). In fact, no motion at all is surely not desirable since "the lifelike realism that the moving image offers was a leap forward in the representation of reality. Two kinds of movement contribute to this sense of realism. First, there is the animation of the scene. [...] Second, a sense of personal movement within a scene is immediately engaging to a viewer, who begins to feel like a participant rather than an observer." (Appleyard, 1977, page 69)

- The dynamic animation of a scene makes it vibrant and perceived as "alive", this is the case of usually in-motion features like smoke, dust plumes, water, machinery, vehicles or other object that can be very important in attracting attention to projects. (Sheppard, 1989)
- The movement imagined by Appleyard was probably not the high speed one, but rather a normal walk with possibility by the user to freely change their point of view without being limited by borders and frames: a free roaming simulation could also evaluate the willingness of a person to go in a desired direction and thus letting him/her to choose a favourite view. A dynamic simulation showing moving views is potentially more rich in informations, making a project more evaluable in the judgement of impacts and quality, therefore reducing the possibility of biases. Moreover, walking speed seems to be fundamental for a right timeflow perception and thus city scale. This relationship has been highlighted by Peter Bosselmann which argued that a walking distance in Venice seems to be longer than the same distance in other cities, this

is caused by the scale differences and quantity of close details. Several consideration may also be given to the seasonal differences in effects arising from the degree of vegetative screening and/ or filtering of views that will apply in summer and winter. A dynamic simulation should provide possibility to change climatic features of an environment to let the assessment being done on average and worst case situations (like leaf covering and minimal vegetative screening). (GLVIA, 2002)

Day and night cyclical changes must be assessed as well, forcing designers to provide alternative uses of public spaces or to assess the impact of a project in different time of a day.

Cheap and Flexible in order to avoid excessive absorption of resources in the creation phase, although budget depends on the client's demand no one wants a too much expensive testing phase. In order to save more time and money, flexibility is also well considered since allows to test as many different features as possible with few changes.

(Appleyard,1977)(Sheppard,1989)(Bosselmann,1998)(Piga and Morello, 2015)

Last two characteristics are indeed not necessary for a simulation to be less prone to biases but are surely well regarded during the creation phase. Conversely, a big risk of biases is represented by the so called external factors, that have been described as characteristics affecting the simulation independently from its quality or nature.

Problem of personal bias is quite complex. A simulation should be fair and unbiased, in other words should lead to " user reactions and judgments similar to those that would be obtained with views of the real scene. This is what environmental psychologists call "response equivalence"". (Sheppard, 1989, page 55) The causes of personal bias are poorly understood: in fact, causes of confusion and distrust can be discovered quite rapidly by listening to people's reaction to simulations and asking them questions, conversely, the interpretation of what is misleading in a simulation for a specific person can be dangerous. It is not even easy to measure how much biases can occur in a given simulation since people react in a different way according to their previous knowledge, attitude toward a project (prejudices for or against the proposed design scheme), familiarity with medium and other

factors. Biases occurring at a personal level affect perception or, in this case, simulative effectiveness.

There are temporary conditions of the person which are both physical and mental: the first category is about human well-being, not only from the health point of view but also climatic one. The amount of humidity and temperature play an important role, although they are perceived subjectively some "standard ranges" and average optimal situations can be easily found. The second category is about human's mental state, any kind of negativity highly affect the experience creating a distorted image that often cannot be logically explained. Positivity is not so dangerous but still represents a biased "vision". A good mental state to start a simulation should be peaceful and calm, so that any other kind of reaction post-test could be recorded, being part of the results. Among them, emotional statements should also be part of an experiential simulation outcome being very useful at an aggregate level to judge both the project and the validity of simulation.

Permanent conditions are not situational but could have been accumulated over a lifetime. They are easier to expect if some questionnaire about personal identity are presented but, at the same time, are more affecting than temporary one: history, culture, education, memories and professional skills constitute main part of our personality.

Hence, a more focused consideration could be made about professionals and general public: a very important characteristic aiding comprehension is familiarity with the medium. In fact if the medium is too abstract or just unfamiliar it demands more effort than the expected, being seen as unrealistic. Conversely, professionals are used to abstract media obtaining more information and perceiving more accuracy from them. General public is more familiar with television, films, cartoons, photographs, and, of course, real-world experience.

3.4 Experiential simulation media

A focus on traditional media

A simulation can take multiple forms according to the type of media used as support. As already mentioned, one of the most important features for a simulation medium is to allow a certain kind of flexibility. In recent years, media that can quickly change their content have an advantage since design is more likely to be modified during the process. This is due to the amount of alternatives desired by the increasing number of people eager to participate in the decision-making process. Thus, another aspect to take into account is the medium accessibility: media allowing unskilled users to equally participate to consultations are surely desirable.

Each of the media available has its merits and disadvantages, the use of a medium highly depends on the simulation setting chosen for the decision. (Appleyard & Craik, 1974) Moreover, the simulation criteria (aspects to evaluate) may be in conflict or poorly studied if just one medium is used: these conflicts suggest that simulations meeting all criteria have to be formed from combinations of media.

Obviously, the set of suitable instruments for the preparation of visual impact assessment documents is limited to the kind of support usually employed for presenting these data, in other words, paper. Conversely, public consultations seems to be more subject to innovative methodologies and tools.

The most used representation for communicating the environment for public consultation, are abstraction of the real world that aid comprehension by simplification. They are architectural plans, sections, elevations, master-plans and landscape plans (maps). These traditional media have endured

all technological developments (even if they can be obtained easily with a computer) because their dimensional accuracy is essential to the representation of environmental modification under a technical point of view. Construction projects, land use, property ownership etc. must be delivered with an high degree of accuracy and no ambiguities about location and size of projects, in this sense they are considered as realistic.

In particular, maps are indispensable tools obtained using overlapping layers of contents. The base can be taken by a satellite view (giving visual information of the ground aspect) or can be the result of an abstraction of informations, being for example a white base with black shapes representing buildings spatial size in plan. In each case, the method used is not representative of the reality with 100% accuracy "Because the richness and complexity of the real world cannot completely represented, they must, out of necessity, select from reality an abstraction of actual conditions." (Bosselmann,1998, introduction)

The informative overlapping layers are in nature different according to the significant, taking form mainly with shapes, lines and points. It's not rare to see maps with an area (i.e. study area or project area), or punctual markers (i.e. photo locations).

In urban planning one of the fundamental tools/media are land-use plans, they are very distant from the reality and yet can be deceptively close to it. The objective of these neatly bounded maps is to express in a kind of ordered way the messy world outside by using colors, aiding comprehension. (Appleyard, 1977)

Other traditional media are closer to the reality under the perception point of view, having a special role in the description of the landscape character and key views: photographs and photomontages. "Photography is based on a convenient geometric fiction called "central projection" [...] or linear perspective, a technique that offers a somewhat limited representation of reality" (Bosselmann,1998, page 1) in fact the main problems could be both technical and "human" based. The distortion caused by focal length could generate unrealistic element bendings, "it would be possible to overcome some of the problems inherent in linear perspective by keeping the zoom lens fixed at 65 mm and using the camera to scan the scene." (Ivi, page 9) Bad use of aperture, shutter speed and ISO could make the outcome more or less out of focus or lightened. On the other hand, a biased

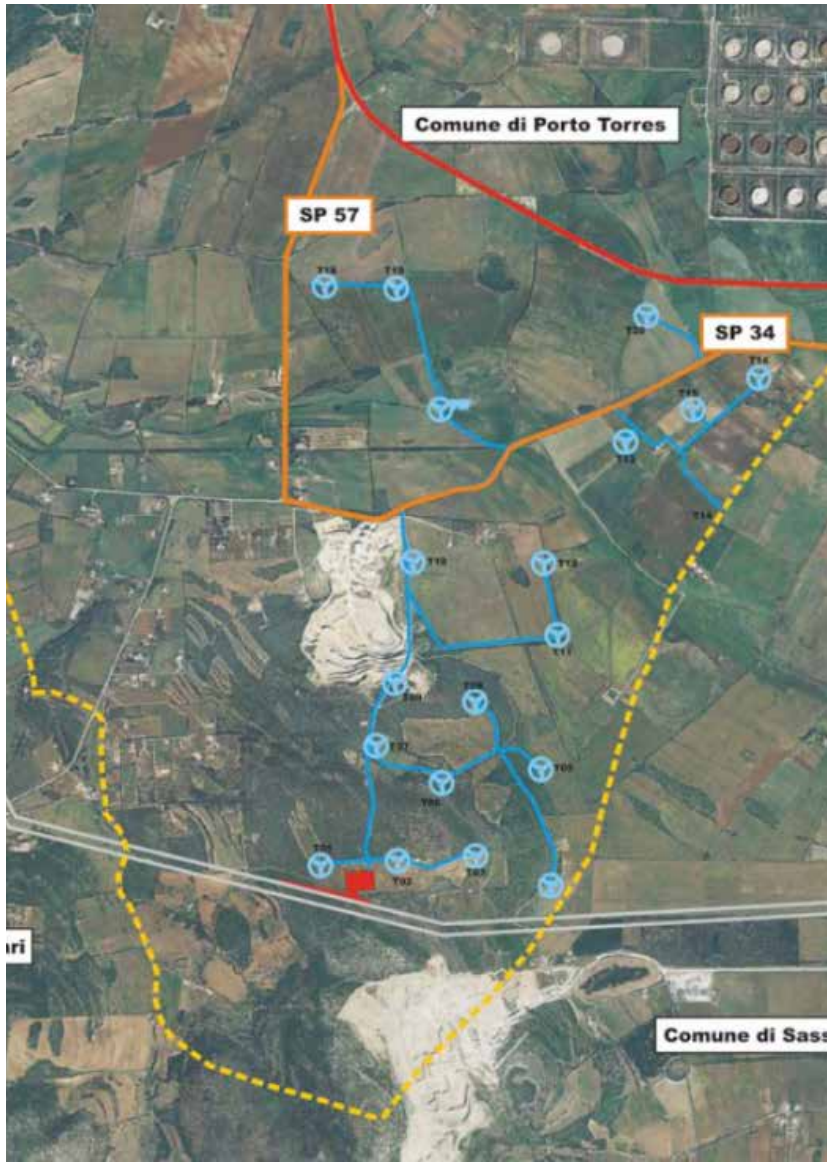


Fig. 14 map of an EIA: wind power plant by Icaro
Source: www.icarocortona.it

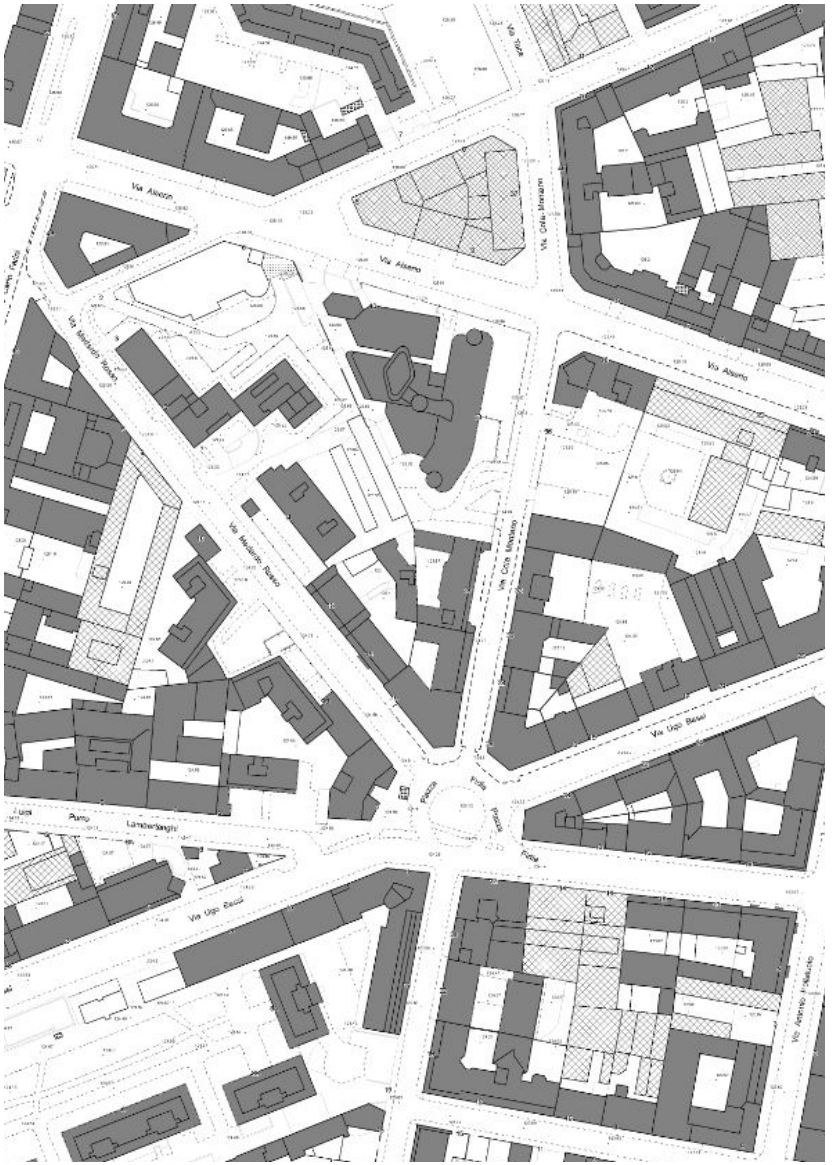


Fig. 15 “Carta tecnica regionale”
Source: Comune di Milano, 2012

choice of viewpoints could be misleading as well as photo editing. Needless to say, photos need to be impartial and objective to avoid misleading impressions: the choice of viewpoints should be justified, the location and precise direction of view must be shown on an accompanying map. Seasonal and atmospheric effects and lens type and focal length must be stated, together with reasons for the choice of lens.

Photomontage has been firstly used by Henry Peach Robinson in 1857. It is a technique mostly used for artistic purposes and one of the most used for simulating a future environment in last 60 years.

Photomontages and photo manipulations allowed the creation of a broadly used technique, which is a step by step process of editing (dropping, cropping, dragging, merging, color adjustment, lighting corrections, background laying) to combine an existing photo with the image of the proposed action or project in the same place as it would take once completed. It has the advantage, once compared with actual situation, of having the same position and timing moreover since technology helped in having more realistic and hard to detect manipulations in outcomes. In



Fig. 16 Private house, photomontage
Source: https://www.thecartogroup.com/verified-views-lvia/



Fig. 17 Power plant, photomontage
Source: https://www.thecartogroup.com/verified-views-lvia/

particular, some softwares allows an “aiding” mode to create such manipulations, creating 3D objects directly in place.

In recent years the before-said softwares have the power to crate, through accurate and flexible 3D modelling, photorealistic images with rendering process. Without going too much in technical details, rendering is based on a set of technologies simulating photons and light rays emitted by a light source. In a further phase, those rays “bounces” and are reflected by the so called physical materials, conceived to have a lifelike lighting behaviour. The outcome could potentially be a very close representation of reality in relatively few time, being one of the most advanced way to create a visual simulation. From this point of view static perspectives, and more recently dynamic (videos), remained the most common way of simulating environmental experience since the invention of the perspective, being prone to a set of long-standing potential problems that make the value of “ad hoc” representations highly contextual from a simulative point of view:

- Visual descriptions of design projects could have an important gap with real world in terms of total amount of informations.



Fig. 18 Photorealistic render by Quixel
Source: https://quixel.com/

In fact, the latter is influenced by cumulative, evolving and multisensory features that couldn't be easily represented with merely visual tools.

- The static nature of images is not suitable in the representation of dynamic and in-motion elements. On the other hand, videos can just selectively show them.
- "far too frequently the represented world has a blue, sunny sky. The direct sun that shines and the direct light that illuminates the streets in the simulations evoke a different mood from that of indirect or diffused light." (Bosselman,1998, page 205)
- "perspectives used to describe many projects are usually taken from the viewpoint that shows off the building to best advantage and minimizes its impact on the surrounding environment. Frequently, these views are not ones from which the building will be most often seen." (Appleyard, 1977, page 74)

Another common problem of images, and traditional media in general, is their attempt to capture what humans can see through eyes by using limited and narrow field of vision given by cameras that, compared to the human eyes, is very reductive.



Fig. 19 Biased and "too good to believe" render
Source: MVRDV studio

To date, we are not aware of a study that examines if computer-generated renderings can be used as a proxy for the built environment in psychology research. Data have not been collected to empirically validate that photorealistic renderings can be used equally as photographs for the environmental assessment. Once compared, renderings often lack in detail contained in photographs but this depends on the skill of the individual in creating a 3D scene. However, a study highlighted that renderings are useful tools for communicating design ideas, having the same "usability" of photos and actual built space. In fact, there is generally a lack of evidence to support statistically significant differences in environmental assessments across physical environment, photograph, and rendering (Acemyan & Kortum, 2018).

Nevertheless, experiential simulations (as they have been described in paragraph 3.2) in this field are rarely taken into account, preferring the choice of simple 2D representations that are actually the overwhelming majority of "experiential" simulations, being basically just "visual".

As previously mentioned, a very used presentation tool in the past, although it is still preferred in some instances, is the physical model (maquette).

They are made of cardboard, wood or plastic: material properties indicates a certain texture feel being quite different from the ultimate surface of a building. Usually, details are omitted or overly simplified to avoid distraction from the building, for example street furniture is left out. Surrounding buildings are even more abstract and usually are made in other materials to highlight the project.

The most important feature of physical models is their tangibility: this makes them stable, constant, touchable, directly measurable, handleable and therefore more "real" than some images produced ad hoc.

On the other hand, digital models are intangible, distant and ephemeral by only giving the illusion of tri-dimensionality by reproduction on a planar screen. Despite all the disadvantages, computer graphics provides a flexible technique of great potential use to professionals, being nowadays less time absorbing and often cheaper. Moreover, "computer-generated perspectives, if they are understandable, seem to be accepted readily by lay



Fig. 20 Comparison between real scene and rendered scene
Source: Acemyan & Kortum, 2018

people as objective and accurate tools in support of final, detailed simulations." (Sheppard, 1989, page 101)

In any case, these and other characteristics show how the two types of models must not be seen as alternatives, but rather as complementary (Piga and Morello. 2015).

Nowadays, a growing range of visualization techniques is available, and computer technology and multimedia now present significant opportunities for landscape and environment professionals, planning and design work. At the upper end of the range are three-dimensional computer simulations, such as virtual reality models built up from ordnance survey, digital terrain maps and data from aerial photography, drawing on a sufficiently wide area to demonstrate the context of a proposed development.

Once the three-dimensional model has been created, it becomes possible to view any aspect of a development from any viewpoint contained within the boundary of the model. These techniques have great potential, especially in relation to linear developments such as roads and transmission lines, as once baseline conditions are modelled, variations to a scheme can be relatively easily produced and compared. There is, however, a responsibility to make a discerning use of technology, in some instances blending traditional techniques with the new, to ensure that the choice of graphic technique is determined by the need to communicate the required information in the most accurate way.



Fig. 21 Physical maquette of Milan, Porta Nuova
Source: Laboratorio di simulazione urbana “Fausto Curti”



Fig. 22 3D City model of Göteborg
Source: Roupé, 2013

Virtual reality

Physical maquettes are still used for project presentations and sometimes are expressly requested due to their communicative power and immediate readability. On the other hand, it's impossible to deny that a more digital and "online" oriented methodology and workflow are taking place into decisional process. Some authors explored the potentiality of 3D online visualization for what regards urban planning and urban design projects, allowing people to immediately and easily have access to complex but manageable data directly from their personal computer. (Wu et al, 2009) Other researchers argued that virtual reality can support innovative activities by allowing experimentation in depth, involvement of the public in the innovation process due to possibility to capture ideas generated (Watts et al., 1998). In fact, the process of built environment design has been revolutionized by digital media (Mitchell and McCullogh, 1995) and young designers are more trained in the use of graphic software than ever. This aspect is developing a kind of "visual culture" linked to computer-graphic practice that is influencing the vision of the world, changing the former visual culture of the "paper world".

The term "virtual Reality" was introduced in the 1980s. The Oxford english dictionary defined it as a technology that uses a computerized clothing to synthesize a shared reality. (OED, 1989) Then, in 1999, the US National Research Council (NRC) mentioned both simple systems (home videogames, producing 3D graphical displays and stereo sound controlled by an operator using a joystick or computer keyboard) and more sophisticated ones (machines for pilot's training and immersive entertainment experiences). (NRC, 1999: box 10.1)

Finally, virtual reality can be defined as the systems and techniques that provide the feeling of presence in a three dimensional computer generated world. This sensation of presence is the result of the user's ability to interact directly and in real time with the virtual environment. (Okeil, 2010)

The term "virtual reality" could be misleading since it can describe same or overlapping groups of technologies including: "virtual environments", "visualization", "interactive 3D", "digital prototypes", "simulation", "urban simulation", "visual simulation"

and “4D-CAD”.

Synthetically, VR can direct attention to either VR system and VR medium.

In the first case the focus is on the support for the medium: it is comprised by a hardware and software, input and output devices, data and users.

Hardware and software are crucial for a well made virtual reality simulation, both of them must be reliable according to the goals. Due to the contamination of game technology, graphics in VR simulation are becoming almost photorealistic, able to catch all the visual and auditory aspects of the real world translating them into digital information, that can also bring the spectator to feel also other senses involved in the experience.

Main goal of input and output devices is to make interaction with virtual environments more intuitive. These include methods for position tracking devices, allowing head and eye movements of users to be tracked, and control devices as well as visual, aural and haptic input and feedback. Users’ experience will be highly shaped by the kind of devices used as output, according to the type of device, a VR system can be classified as immersive, non-immersive and augmented reality:

- Immersive systems totally surround the user, supposedly providing an unmediated experience. They do this through specialist hardware such as head-mounted displays, requiring high-end computing power to provide a high realism environment. In this regard it is interesting to mention a multi-users simulation created in the laboratory of UMB (Department of Landscape Architecture and Spatial



Fig. 23 A man wearing Oculus Rift, a Head-Mounted Display

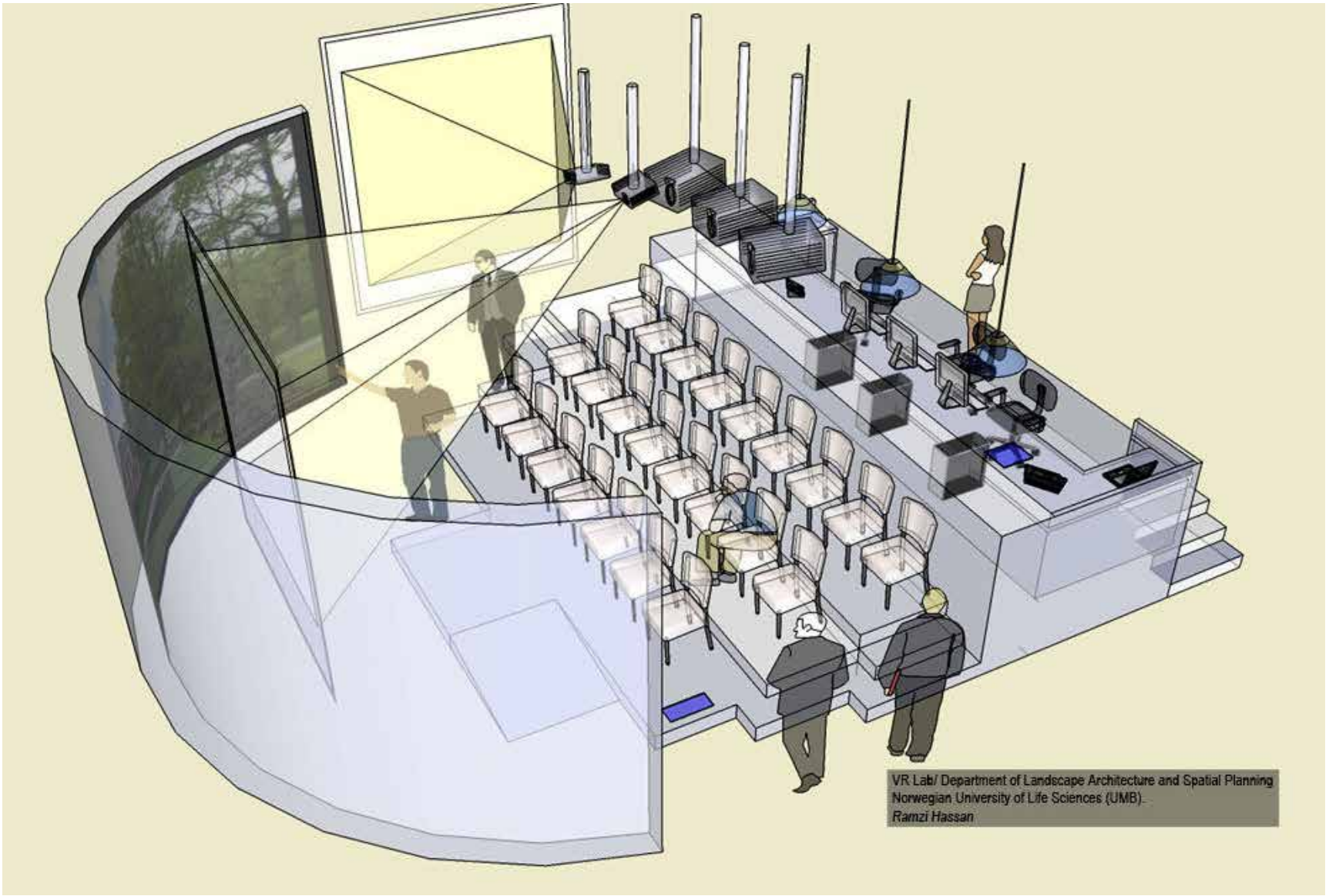


Fig. 24 The multi-users immersive system at UMB

Source: Dannevig and Thorvaldsen, 2007

Planning, Norwegian University of Life Sciences) in Norway. It is a surrogate of the more famous CAVE system (Cave Automatic Virtual Environment) that allow the fruition of virtual reality content of projects to more than one person at the same time. It is important to specify that CAVE system has the potentiality to overcame a common problem of fully immersive systems like HMD, in fact, for them it is possible to find a lack of safety feel and control in the users. The subject sees a displayed stimulus while receiving oral instructions from a researcher who they cannot see, which thus generates a lack of dominance. (Trujillo et al. 2017)

- Non-immersive systems typically use more generic hardware: the same software techniques are used but the system does not totally immerse the viewer. Sometimes described as window-on-a-world systems, they allow the user to see virtual reality through a screen or a display that does not take up their total field of view.
- Augmented reality systems overlay virtual and real world imagery allowing the user to interact with both the virtual and real world. Its description deserves a whole paragraph to be faced because is one of the most promising technologies in this field.

(Whyte, 2002, page 4)

A key part of the VR system is the data. Models may be built within the virtual environment, but are more usually imported from CAD. They can also be obtained directly from the physical world using techniques such as 3D laser scanning,photogrammetry or geometry capture from film.

Regarding VR as a medium, the focus is on the virtual environment and the model created with a PC, VR as a medium has three defining characteristics, this set of features are general and regards the medium itself by definition:

1. interactive (users can interact with the models)
2. spatial (models are represented in 3 spatial dimensions)
3. real time (feedback from actions is given without noticeable pause)

Moreover, for a lifelike representation of the environment, the graphic should be photorealistic while rendered in real-time. (Whyte, 2002)

To be precise, there are multiple potential visualization output

of a virtual reality model. Using game engines is obviously possible to generate an executable file that, following previous characteristics, reproduces in a photorealistic and interactive way a portion of the real world, fully explorable in both immersive and non-immersive way.

Another possible outcome are 360 degrees panoramas (both video and images). These typology of representations allow a full immersion by using HMDs or CAVE system but can be also visualized through a planar screen like a normal image or video but allowing to change view angle and rotating the camera to look around. 360 videos and images can be obtained also by filming the real world with special cameras or using camera software to attach several images together but, intuitively, this use do not allow to foresee the impact of a future environment. There have been several studies about validation of media from a psychological point of view: 360 panorama and VR formats more closely approach the physical environment, both in terms of psychological and physiological responses, compared to the photographs (Trujillo et al. 2017). This probably happens because users could look around increasing their sense of presence (Alshaer et al., 2017). Moreover, VR format reached the closest approximation to physical life conditions, which may be due to the influence that interactivity has on the sense of presence (Haans and Ijsselsteijn, 2012), as there have been proven effects of free navigation at a neurophysiological level (Clemente et al., 2014). Hence, VR appears to be the most appropriate display when trying to evoke physiological responses in environmental studies. (Rodríguez et al., 2015)



Fig. 25 360 panorama image taken from a VR model. Distortion allow a correct visualization in a “spheric” format.

Courtesy: Elia Luongo

4 Public participation

State of the art

Public participation in decision-making processes regarding plan and project proposal has been considered as a fundamental step and a proof of democracy and transparency. In this chapter it will be described the legislative origins of this practice in USA and EU, methods, tools and innovation.

4.1 Consultation process

Definition of the framework

Great interest has been given to public participation in last years for what regards urban context modifications, programmes, plans and projects affecting big portions of cities.

In June 1992, an international meeting of more than 170 countries all around the world discussed in Rio de Janeiro about common programs and objectives to achieve in the 21st century. The outcome is the famous "Agenda 21", on which large agreement has been reached on sustainable development and environmental safeguard. This document is formed by 40 chapters divided in 4 main parts. Chapter 28 in particular is about local governments and communities initiatives in sustainable development, in fact, every local administration should include citizens, local organizations and private enterprises in drawing up local agenda 21 programmes. In this viewpoint, it is a process shared with stakeholders toward a common goal for 21st century. Several others international meetings have taken place, going very close to a common "real-actions" plan. This desire for citizenship inclusiveness pushed local, regional, or less commonly, national government to take a position and consider the importance of public involvement in decision-making process. In fact, consultations can be a valuable tool in seeking understanding an agreement about key issues and can highlight local interests and values, which may otherwise be overlooked. It may involve the regulatory authority, statutory consultees, amenity and conservation bodies and local residents: without effective consultation, the overall process may be depleted since the overall engagement in a genuinely open process can make a real contribution.

Consultation may take a variety of forms and fulfil many purposes like gathering specific information about the site or canvassing the views of the public on the proposed development. It offers the opportunity to gain advices and help from a wide range of organizations, individuals, local communities and interest groups on a formal and informal basis. A consultation with regulatory authority can help during the initial stages of project planning, it aims to establish the likely acceptability of the proposed development and the preferred development site as well as terms of reference, methodology and assessment techniques. The more interesting part of early public participation is probably when it's not always in full agreement and thus it may serve to resolve some issues and to clarify any remaining objections. Later in the assessment process, consultation will be more concerned with information dissemination, particularly to the statutory consultees and regulatory authority.

The latter should have a strong interest in the landscape and local interests, it should encourage best result for the developer, successful implementation and monitoring of scheme proposal.

It is important to underline that consultation can be a difficult process for several reasons:

- Regulatory authority, or consultees are not necessarily representative of the local people's opinion. The latter could be sought directly, through exhibitions, meetings, questionnaires or by other means.
- The likely reluctancy of the developer to release information about the development for reasons of commercial sensitivity or uncertainty. Moreover, there may be a perception that inviting discussion and debate upon a project leads to unnecessary interference.
- Statutory consultees and public may be suspicious about the consultation process and could be uncompromisingly hostile to the proposed development. Concern could be so biasing and people so involved that may need to be persuaded that the offer to participate is genuine. In such circumstances, a poorly managed programme of consultations could generate adverse publicity.
- These difficulties include trading off the costs and time required to participate and citizens accessing the often complex language of planning (Baker et al., 2007). For these

reasons, only a small proportion of citizens actually engage with urban change through the planning system (Conroy and Evans-Cowley, 2006).

- Communities are often involved too late in urban planning debates, when development plans are already in place (Baker et al., 2007).

Having clear those problems, a set of general principles has been found:

- Genuinity and openness to avoid concern by local people and regulatory authority;
- Carefully planned timing of consultation to avoid loss of time or useless debates;
- Requests for participation should be timely (to be useful to the process is requested not to participate just in some final debate);
- Objectives of consultation should be clearly stated, to avoid misunderstanding.

Public consultations may be set in different circumstances, for example they can be part of environmental impact assessment previously mentioned.

Consultations within NEPA

To recall the US NEPA, it is important to underline that, in its principles, it entails public participation during the process:

- Transparency;
- Information accessibility;
- Diligence in engaging the public/stakeholders;
- Attention to vulnerable populations (environmental justice);
- Involvement in all project stages and in all categories of environmental review.

Agencies are in fact required to provide meaningful opportunities for public participation, including the beginning of analysis by a federal agency and when a NEPA document is published for public review and comment. The assessment process differs among federal agencies, thus it is important to review the agency's NEPA implementing procedures in order to understand if a specific step in the process is available for public involvement. Some agencies inform citizens of NEPA related actions by publishing information in the Federal Register or in the Agency websites, by placing notices in newspapers and/or through direct

mailings. A complete set of guidelines is available in CEQ's "A Citizen's Guide to NEPA", which describes NEPA process and provides information on how citizens can get involved.

Council for Environmental Quality require through a general regulation (valid for all the agencies) the public involvement before decisions are made, in fact agency cannot issue a decision on a proposed action until:

- 90 days after notice of filing of a Draft EIS;
- 30 days after notice of filing of a Final EIS.

In this time the Environmental Protection Agency (EPA) notices the availability in the Federal Register of filing an EIS with accurate scientific analysis, expert agency comments, and public scrutiny. It is important to underline that documents concentrate on truly significant issues rather than amassing needless detail.

CEQ encourage good practice for actions with national concern by mail on request, mail to national organizations reasonably expected to be interested, and publication in the Federal Register. Regarding local concern, it has been suggested to notice every noteworthy process in local newspapers and local media, posting on and off site where action is to be located, direct mail to owners and occupants nearby affected property, publication of newsletter and notice to potentially interested communities around.

Although EA is a flexible process in format and timing, CEQ established minimum public participation requirements:

- Publicly available documents;
- Assessment of impacts;
- Consideration of alternatives particularly where there are unresolved conflicts concerning alternative uses of resources;
- List of agencies and persons consulted;
- Mitigation if impacts would potentially be significant without mitigation.

One important chance for the citizenship to get involved is the scoping: it is a process providing an opportunity to get information on issues to be addressed in the EIS. In fact, if a federal agency requires the full assessment through EIS, a Notice of Intent (NOI) is published in the Federal Register determining the beginning of the scoping process. A NOI provides a description of the proposed actions and of the scoping process, including any scheduled meetings and how the public can get involved. As previously mentioned, agencies use different methods to involve

citizens and in particular for scoping they can be:

- public meetings;
- conference calls;
- formal hearings;
- informal workshops;
- submitting written comments.

Moreover, when an agency published a draft EIS, there is a minimum of 45 days for the public to comment on the document (i.e. via email or public meetings). On EIS document, a list of information is shown such as project name, lead agency, location, dates comments and contacts. This procedure is granted by NEPA (Section 102)(2)(c) that directs federal agencies to prepare publicly available "detailed statement" with every proposal for legislation or major Federal action significantly affecting the human environment. After the final EIS is delivered there is further time for public review and the same happens after the agency's record of decision, monitoring and evaluating process. (www.epa.gov/nepa/what-national-environmental-policy-act) (National Environmental Policy Act Regulations, Guidelines, Experience; US environmental protection agency, 2012)

Consultations in EU

In European Union, EIA works in a different way due to the community guidelines, directives and conferences. One of the key conferences was Aalborg, Denmark 1994. Hence, environmental concern pushed for a common idea of sustainable city concept: among proposed principles there were social justice, sustainable economies and environment. All the cities that agreed with it recognized as fundamental the introduction of efficient planning policies for land use and, locally, the inclusiveness of communities and stakeholders into the decision-making process. This has been translated in a broad use of public consultations to create a common point of view among parties, assessing alternative scenarios of plans, programmes, projects and in general everything affecting local communities.

In 1998, another danish convention in Aarhus regarded public participation. The outcome of that event was an agreement on three pillars:

1. informations access,
2. public participation in decision-making processes

3. access to justice for environmental matter.

The second pillar of Aarhus convention has been integrated by the EU directive 35 of May 26, 2003.

The first step of a consultation process is up to the proponent, s/he (or they) should find a proper location (site selection) and an initial design for the development layout producing two key documents:

- land use and landscape strategies to evaluate and address constraints, taking advantage of environmental opportunities for each option available
- comparative appraisals of alternative options, to identify those with least overall adverse environmental effect on the landscape and visual amenity.

Once the preferred development option has been selected, a consultation process can start. The main task now is to fill the knowledge gap between citizenship and technicians. A simple meeting is usually not enough to explain scheme design and projectual choices for two reasons, the first is the likely complexity of the proposal (moreover if EIA is required), the second is a more likely contrasts with local citizenship. The latter often happen because "people's impression of a brand-new place, built all at once and obviously designed by only one team of people, is often negative" (Bosselmann, 1998, page 192), so is up to proponents to demonstrate their choices and good intentions. Emotional statements, however, do not assist in making balanced and reasoned decisions: it is very important that alternative views of a place are well described and represented in order to have a common unbiased starting point of discussion. At this point, well managed consultations may be twofold important: they can be a place of informations exchange as well as a review platform for the project itself. The first aspect is more problematic because of time, luckily EIA can proceed on several fronts at once: site surveys and preliminary assessments can be carried out concurrently with development of the initial project proposal and steps can be reiterated in the process to refine the design proposal. Since certain potential effects in the proposed action can be identified at an early stage from the knowledge gained from the site surveys, citizens could help since the beginning in addressing solutions. Other effects may become apparent as the assessment progresses, so a continuous information flow

and constant reviews are needed. The interim presentation of information about the project to interested parties can help to maintain goodwill, moreover if consultations are set out as soon as possible. An iterative design approach enables the site planning and detailed design of a development project to be informed by and respond to the ongoing EIA, as the environmental constraints and opportunities are taken into consideration at each stage of decision making. Some previous experience pointed out that an approach of this kind can be successful and cost-effective, reducing time required to complete the assessment. This iterative method is appropriate to any new development or whatever scale or type, whether or not a full EIA is required: it can help in avoid or minimise potential negative effects of the development and sometimes helps in seeking opportunities for landscape enhancement. Moreover, it can be helpful in providing evidence that alternative sites and/or designs have been assessed, and it is therefore important to record how the scheme has developed throughout the life of the project. This will demonstrate how landscape and visual effects have been taken into account and why some options have been rejected.

After consultations, professionals in the design team should:

- identify and develop mitigation measures
- indicate how the landscape strategy will work in practice,
- prepare landscape and visual impact assessments to address in detail the residual effects of the proposed development.

It must be specified that, in some instances, is possible to have a separate environmental assessment team, independent of the design team, which objective is to explicitly demonstrate the objectivity of the assessment and the lack of bias, particularly with respect to evaluation of effects and the likely success of any proposed mitigation measures. This choice could be recommended when the project degree of complexity is very high or when important impacts have been recognized.

Nowadays, in Italy there are several municipalities that have signed Aalborg documents, agreeing with sustainable cities programmes and fostering local Agenda 21 objectives.

Consensus and collaboration from local population has been identified as a fundamental factor in decision-making. Citizens must be informed about a starting process through publicly notices on newspapers, allowing a presentation of

instances in the next 30 days. Public consultations in Italy are fostered by ministry of public administration (Ministero della semplificazione e della pubblica amministrazione). In 2017 some guidelines have been reviewed and edited with the objective of explicitly clarify implementation criteria principles. The correct implementation of such guidelines (mainly inspired by international best practices) should make public decision more qualitatively informing, transparent, inclusive and efficient. However, these guidelines are very broad and regards more accurately public administration than environmental assessment. The most common form of participation is "indirect", concerning more the transparent availability of documentation than a real participative process. Both environment ministry and Regional government can, purpose public "investigations" (inchieste pubbliche) in which every citizen can participate to meetings with proponents and local government. This procedure is used in particular areas of administrative activity, where initial phase is complex, and when local administration deliberates territorial plans, urban plans, major projects with large impact on the city, economy and safeguard on health and environment.

Hence, public participation is intended to inform general public, collect feedbacks and proposals, being a relevant aspect for the concept of participative democracy, linking administrators and citizens. In italy, public consultations are regulated by D.lgs 152/2006 (Testo Unico) that, following Aarhus convention, foster public involvement for decision affecting environment. Thus, national EIA regulations include this procedure as well as some regional laws, often calling it with different terms leaving contents substantially unchanged. In fact, at a local level, other possibilities for public involvement are regarded depending on local laws (Regione, Provincia, Comune). Even though this meetings are "formal", bottom-up activities (if responsible and managed) in this sense are always well regarded and considered. Generally, public participation is up to local government, being a proof of democracy and fundamental part of the decision-making process. It represents the greater interest of public for decisions affecting their life as citizens and an increasing awareness and concern about environment modifications. Hardly a pian being developed today does not include various degrees of public involvement.

4.2 Participation practice

Experiential simulations for consultations

With the entry into force of EIA procedures in the US and in Europe the environmental safeguard and aesthetic qualities became fundamental aspects to protect. From that moment, both landscape and inclusiveness in decision-making process have been considered as precious resources. Every proposed action with economic, ecologic and social impacts on local communities or the environment must pass through strict procedures for approval. This kind of regulation, however, is mainly composed by principles and general goals, avoiding to go into details of normative coercion. In fact, they seldom stipulate how the aesthetic, environmental and public-involvement studies should be conducted and almost never explicitly require the use of simulations in the assessment documents. Thus, as understandable the use of visual simulations has begun to grow rapidly in the private sector for project planning phases, being surprisingly not so used for assessments of aesthetic and visual impact.

According to the typology of proposed action, it is possible to find a common character inside environmental impact studies, that is the visual analysis. "A visual analysis or visual resource assessment is the study of the appearance or visual qualities of environments and proposed environmental changes. lts purpose is to identify existing landscape values and resources, determine how these would be changed by new projects, and suggest ways to conserve or enhance these values and resources where appropriate." (Sheppard, 1989, page 39)

In fact, when a public consultation is set up concurrently to an

environmental study or prior to a plan/program draft, there is often need to carry on visual analysis in order to forecast possible adverse effects. The latter, could generate discussions and controversies which often need a mediator to be solved. There is a great risk that public express negative decision basing on poor or wrong information that, on the other hand, limits the eventual developer in the defense of his project due to the lack of hard evidence with which reject biased accusations. Thus, simulations can catalyze a good outcome being analyzable data available to environmental professionals, (primarily for aesthetic and visual impact assessment) and a presentation device or a sample for testing people's reaction, measuring attitudes and responses to project or plan. (Sheppard,1989)

Good simulations have the potentiality to make people focus on real issues by allowing an evaluation without useless debates on the adequacy or correctness of the data but it is fundamental that people of all educational levels should be able to understand a proposed simulation and they should be able to evaluate them on the basis of their concern.

In this viewpoint, a simulation is basically a communication tool: it must send an effective and believable message to whomever is supposed to receive it. An experiential simulation, or more precisely a visual one (depending on media), is a form of communication that tries to represent a future environmental condition by helping people to visualize what they actually would perceive in the real world. In other words, the communicated message should convey the right impression in the sense that it represents reality as far as possible.

Good simulation can catch and highlight possible problems time before final solution is built, making possible to solve many contrasts between actors involved in the decision making process like clients, public agencies and citizens. Taking into account all the implying factors of public consultations it should be clear that participative planning/design and public assessment procedures are very difficult and hardly applicable unless a favourable climate for dialogue is set. This is mainly due to several proposed changes that must be introduced with transparency, flexibility, concretely, and institutional trust.

In this way they can actually contribute to building a strong spirit of belonging and a common vision, or common project, for the

transformation/development of an area, in terms of responsibility and cooperation.

From the point of view of the regional institution, participation represents the opportunity for re-launching urban planning in its operational and implementation side; can give a strong impulse to the identification of projects and the pursuit of concrete actions of transformation for the improvement of the effective quality of the life of the citizens and the socio-economic dynamism of the territory.

Actors and political implications

As previously mentioned, it is possible to set up public participation at the very beginning of a decisional process. Thus, four main involved actors can be identified: developers, professionals, institutions and public.

- Developers have a fundamental role since they are the project proponents. The priority of the developer is to communicate to citizenship what is the idea behind his proposal, trying to gain consensus. They have a list of reason why their proposed action should be completed and could use simulations in order to achieve their objective. However, for most projects, costs are a severe limitation on the media used for this purpose. On the other hand, for large projects considerable sums are spent on simulations, moreover if the process involves publicity due to the large public interest. (Appleyard, 1977) In fact, the main reason why a developer should have great interest in the use of good visual simulations is that they represent an insurance policy:

1. If the simulation indicates no problem with the project, the

developer's position is enhanced.

2. If the simulation shows problems, they can be fixed early in the process
3. if the developer decides not to modify the project, he cannot claim unjust penalization upon a denied approval.

(Sheppard, 1989)

- Professionals are a filter actor since they represent the link between the proponent's idea and the public's concern. In fact, "persuasion is perhaps the primary role that simulations play for them and their clients." (Appleyard, 1977, page 50) Professionals have a certain pressure to show the project as its best, highlighting positive aspects and hiding potential problems with selective omission. However, is common that some aspect of a project are not taken into account during a presentation because of good faith oversights: professionals can become so familiar and confident with a project that they forget they must explain it to others. "Designers also have an obligation to society – at least to the clients – in communicating an idea to laymen which is already clear in their minds." (Piga and Morello, 2015, paragraph 7)
- Institutions are planning commission and/or the city council, which often are the evaluators. They are are a central figure in the audience since they must pass on the project, naturally taking a more skeptical view of the simulations. Their attitude is focus on the comprehension of the proposals, evaluating their realistic character by checking their accuracy and to cut through any persuasive veneer. They should find omissions, misinterpretations and picking up unintended messages made during presentations. The reputation and behaviour of the other actors certainly affect their judgement as well as specific circumstances and setting. A simulation must be evaluable since the represented project is the subject of the public discussion, it follows a decision about which criteria should be set for the evaluation. "For instance, if we wish to evaluate a place for a number of qualities, these qualities should be simulated. One of the empirical questions yet to be tested is which dimensions of environmental quality can be accurately evaluated with experiential simulations." (ivi, page 61)
- The public is a heterogeneous actor, more precisely is

composed by different groups of actors with different purposes if a participation process has been started. Inside these groups there could be a local one like neighborhood associations, future users, normal citizens that have to live with the project and general public. Among them it is usually possible to identify the opponents. Their attitude is to search for important and forgotten aspects during the presentation, they could either show slides of existing conditions that have been ignored, or show other views of the project from different directions, under different conditions or with different consequences. Hence, it is not surprising that from both sides, proponents and opponents, biased or exaggerated images about the project are shown.

Hence, a generalized process for project visual analysis can be identified into four main phases: inventory, impact assessment, mitigation and monitoring. A public process can potentially pass through every step of a visual impact assessment, forcing the proponent and professionals to provide a non-technical interpretation of discussed data. This aspect is not irrelevant because a technical simulation for professionals has different defining features compared to a simulation for general public. As just remarked in last paragraph, simulation for professionals are focused on technical contents that could be cryptic for others, being the gap dividing them from their audience. Conversely, experiential simulations could fill this gap, requiring almost no prerequisites.

In recent years the production of photo-realistic visualizations represents both an advantage and a big risk of bias for evaluators. The latter aspect is more likely to happen when simulations are used in a misleading way for commercial purposes. (Appleyard, 1977) For this reason Stephen R.J. Sheppard (1989, 2001, 2005) invokes an ethic for visualizations. Moreover, some agencies are considering preparing their own simulations for applicants' projects. This can become an integrative part of the review process, avoiding the risk of deliberately biased simulations. (Sheppard, 1989)

Hence there could be another influencing actor in the public arena, a kind of "third party" laboratory focused just on environmental simulation. It should work in this sector with the principle of neutrality: "not a neutrality of values, that would

be neither possible nor desirable, but a neutrality of position. A neutral stance toward the parties in a dispute is best maintained by insisting that all representations be treated as public property." (Bosselmann, 1998, page 201)

As previously mentioned, in US starting from the '70 this role was often played by Berkeley Environmental Simulation Laboratory which has worked to some controversial project, this past experience has been described in the book "Representation of Places" of Peter Bosselmann, going through some example of discussion and debate upon new american development plans using physical maquettes as main medium for public meeting.

Political implications involve the stakeholders in different ways, for example, in 1987 there was a debated plan for a new development of west side Manhattan highway: local TV used to broadcast an animated film about different scenarios of the project. Public response wasn't positive as expected since the production of the movie raised questions about who commissioned that work, being the reflection of the adverse position that usually urban design and planning projects generate. "Parties in conflict over a project rarely perceive information or a representation as neutral. They question who benefits from it and who controls it." (Ivi, page 102) In fact, the distorted debate is due to the selection of informations: "by selectively stressing the damaging elements of a proposal, groups in opposition try to persuade decision-making bodies and the public at large to reject it. Promoters of the design are equally selective in stressing the project's merit." (Ivi, page 103)

Berkeley laboratory worked to create simulations for the proposed development, in order to create unbiased views for the stakeholders and citizens as realistic as funds permit.

One other example of Environmental Simulation Laboratory experiences take place in Times square, in this case a proposed development of this area in New York City led to an increased gap between proponent and New Yorkers. Since the main debate was about height limits, the creation of a model with this evaluation criteria was needed. Hence, the point was that planning commissioners and council members were ready to advocate changes after having seen "visual evidence" of the proposal.

The municipal Arts Society commissioned a Times square area model prior to a public hearing in the fall of 1985. It was

a physical model of about 5 meters long representing buildings, signs, billboards, cars, people, statues and trees. "The idea was to simulate alternatives as realistically as possible" (Ivi, page 109) so photographs of facades were applied to model surfaces and new development could be inserted and assessed by public and press. This method allowed an exchange of proposal and counter-proposal on building's height and big light signs, being the proof of the model efficacy in converting and "materializing" abstract rules in physical environment. It finally helped in establishing height limits and bulk controls for buildings. For these reasons the public interest in simulations led to the establishment of a laboratory in NYC because "The times square project has spurred community groups in Manhattan to use modelling and animation techniques to explain the effects of city planning policies on their own neighbourhoods" (Ivi, page 118)

A similar episode happened for the development proposal of downtown San Francisco, where the creation of a physical model helped citizens to compare scale of the new with scale of familiar, something impossible to do with just images.

All the previous cases have political implications as a common feature, how can the representation of a place be so important in political issues? Bosselmann argued that it does by giving evidence of someone's intent to change an environment. For this reason "good representations should be understandable and open to evaluation by those who will be affected by design. Representation should be complete, accurate, engaging, detailed, and true to the sense of those who will experience the designs once they are built." (Ivi, page 199)

Experiential simulations created by Berkeley laboratory were made using an innovative machinery explained in the previous chapter, allowing citizens and planning commissions to have a "real" idea of some proposals consequences.

This has been possible thanks to the relatively free presentation format chosen for public consultations, notwithstanding the need to have a properly informed and participative audience.

In fact, in both formal and informal meetings a simple and effective communication method should allow the audience to fill the gap with professionals, guaranteeing a certain kind of precision and strictness for proposed contents.

Despite choices on "best" methods and media for an optimal

communication, a presentation of the simulated environment should be supported by common and useful tools. For example, flyers and questionnaires usually have written text and images allowing people to manage informations with their own time, both as regards printed versions and online navigation.

A more used and natural way to present is the language. Being able to describe functional and social aspect of projects, this form of communication in this context is just an indirect way of describing the visual appearance of a place. From an experiential point of view, language has little objectivity, in fact, in project presentations it is usually employed to amplify visual content directing attention to some particular features. (Appleyard, 1977)

The main difficulty in this kind of meeting is surely respecting timing and schedule, chances for questions and remarks are often very short and must have some rules.

Moreover, since shown materials should be easily reachable in different time/place for transparency principle, a digital version of the presentation should be prepared and uploaded online as well as record of the speech and final decision. Having had a preview on public arena, methods and guidelines for public participation, a focus on consultation methods is desirable to better understand how in practice consultations work.

Consultation methods

As previously mentioned, there could be a series of consultation methods for many decisional process phases, the method chosen depends on the purposes (either gain or give informations) and on availability of resources (both time and economic). Public participation can happen either in indirect or direct mode.

Indirect participation examples are by correspondence: mail, writing notes etc. are useful tools for consultation but there could be misinterpretation of data without an expert mediator. Forms of indirect public involvement are useful for expanding awareness of a certain topic and thus, foster direct participation.

Nowadays, a very big step forward regarding indirect participation is represented by the creation of online platforms on which upload virtual simulations, hence, geographical and numerical data can be integrated with a simple 3D environment allowing interested people to check online and leave feedbacks. "When used in conjunction with geographic information systems (GIS), impact analysis, and forecasting tools, visual simulation has emerged as one of the most powerful tools to engage citizens and lay decision makers" (Kwartler and Longo, 2008, page 19)

Another example of common indirect consultation methods is by leaflets and mailings (questionnaires). This kind of tools are often used to collect several data for an aggregate statistic. Questions composition is fundamental for achieving a good result and much literature has been produced about the topic. It's important to underline that without professional consultant is very difficult to produce an efficient questionnaire, due to several problems related to people's behaviour towards a set of aimed questions. Questionnaires need to be distributed widely to such locations as schools, clinics, post offices, community centres, religious buildings, bus stops, shops etc.

Information dissemination can be achieved using a number of mechanisms including the broadcasting media, in particular newspapers and radio. The public participation/consultation and information dissemination activities need to be planned and budgeted. The social scientist team member should define how and when activities take place and also the strategy: extensive field work is expensive.

Forms of direct participation are "face to face" meetings, they

probably entails the most generic and common idea of public consultation. It's hold with project proponents and authorities and usually with an informative purpose, since testing local citizenship's ideas takes lot of time and is often counterproductive in some occasion. However it represents the most clear and direct channel of information from official sources, often trying to be proof of goodwill. In some countries, open public meetings are the most common technique to enable public participation, however the sort of open debate engendered at such meetings is often both culturally alien and unacceptable. Where resettlement is proposed, extensive public participation must be allowed which will, at a minimum, involve an experienced anthropologist or sociologist who speaks the local language. He/she can expect to spend months, rather than weeks, in the field (Environmental impact assessment of irrigation and drainage projects, T.C. Dougherty, A.W. Hall, HR Wallingford, United Kingdom 1995). This common consultation method usually is considered as a "top-down" process, thus is not surprising that materials presented are considered as biased and too good to believe. Experiential simulations used in this situations are most likely to be images (perspectives) like renders, videos or some catchy drawings. Moreover, participation in these meetings could be felt as alienating, leading towards attempt to using creative methods to involve and enhance the citizen's role in planning, and to help overcome some of the barriers associated with 'formal' consultation methods.

A more informal consultation can be more useful in some cases: presentations and not official (without authorities) public meetings have the benefit of being considered more bottom-up approaches and thus arguments can be discussed with less biases and ideally in a less forced way. A third party actor as an expert mediator could be the perfect choice to avoid wrong focus and interpretations about some topics and to be considered in conflict of interests. Such informal meetings are events or presentations usually organized by local associations and actively involved citizens, but also socio-cultural organizations or universities. The latter could have an important role in being both creators of simulations and mediator in these processes, universities equipment could be used as well in order to catalyze a good outcome.

Methodologies such as co-creation and living labs (Desouza and Bhagwatwar, 2014) have been used to encourage participation using alternative participation methods, which see people, the public and private sectors working together to identify problems and develop solutions.

A similar form of consultation is the exhibition. It could be managed as a place for give informations, show proposals, receive direct feedbacks etc. The degree of involvement is higher than informal meetings because everybody can give ideas, tips and review the work in a suitable time and in a less chaotic way. This kind of presentations usually take one full day in order to guarantee several time slots and are located in a reachable place: some example could be a park or a plaza for outdoors and libraries or public buildings for indoors.

A more involving form of consultation is the workshop: it is a highly structured meeting, usually composed by few people, with a clear and common objective or vision. Main benefits of having a workshop is the likely production of results from a team working on specific issues arising from discussion with local citizenship and reaching high degree of coherence in the decisions. One common task for workshops is to improve mitigation measures in late phases of decision-making process, or marginal details of a project public part.

A good example of workshops experience are the so called charrettes. They are concentrated, multidisciplinary planning or design activities characterized by an intense period of work and periodic reviews of the products of that work with the public.

In a short period of time, typically a week, a charrette can produce highly developed design alternatives and plans with citizen buy-in. During the public involvement part of a charrette, citizens and stakeholders work as a team with designers and planners, and use maps and drawings to develop design alternatives. (Kwartler, Longo, 2008)

Whatever method is chosen, methodology and answers must be clearly explained in the final report as well as result interpretation. (GLVIA, 2002)

VR uses and public participation

Virtual reality can be used for several task, being a highly flexible simulating tool for different sectors. Major business drivers for its use are simulation to test product quality and safety, reducing cost of errors and redesign work, reducing lead times, incompatibilities on site and wastes.

Many sectors are starting using it for many purposes like work coordination among different professionals in construction, mechanical and manufacturing sectors, in short, professionals can better visualize a product data being able to create prototypes (finding possible faults earlier in a phase which allow cheaper corrections) and considering different alternatives (exploring completely new solutions). It can be used to test complex products and behaviours like in the case of flight simulators, where gathered data is used to improve both vehicles and people' skills. Other simulation using VR include mass movement of people, transportation, logistic, and finally construction sector.

In the private sector there is an established use of VR in the design review of standard and customized housing and interiors. In fact, designers and professionals identified clients review as a major business driver for the use of VR: "Within the construction sector, virtual reality has often been described as most useful for the architect, allowing them to walk the client around a new building before it is built." (Whyte, 2002, page 53) Some organizations are interested in improving clients' understanding of design options and also to improve their own understanding of evolving client requirements.

VR has the power to change the way we learn about space and the way we communicate our insights to others, facilitating wider understanding of the built environment and to enable clients, managers and end-users to contribute their experience. It is indeed particularly appreciated by clients although some problems arise. For example design choices are limited to predetermined options and, more worryingly, VR could not give the right balance between participation and control. The highly realistic visualization may impress clients in a way that could focus their attention to irrelevant issues at early design stages and may make design look fixed: "The problem with using virtual reality for client review is that you can give wrong

ideas so incredibly easily." (Ivi, page 85) In fact, pen and paper sketches and cardboard models continue to be used in early design because they support ambiguity, imprecision, incremental formalization of ideas and the rapid exploration of alternatives. This is particularly good at the beginning of the process because "if the building design is very sketchy [...] can't go to 3D because it becomes real". (ivi, page 95)

Within the public sector, motivations for using virtual reality are related to the perceived public good, rather than to the reduction of business risks. An increasing number of Municipalities and government agencies are looking to use 3D models for urban management and planning, infrastructure management, planning approvals and location marketing. There are three main brakes on its development:

- Large costs for a virtual environment creation and implementation in decision-making processes.
- Difficulties to gain acceptance as an "alternative" to traditional workflow.
- Lack of suitable hardware and software.

These are the reasons why there have been many calls for wider government funding, advanced technology is costly but an improved input and data management allow large-scale urban models to be built in increasing numbers to represent cities from around the world. Geographic information system (GIS) integrated with 3D models is being used to enable a greater range of evaluable alternatives, to allow real-time environment policy forecasting, impacts analysis and to increase readability of data by residents and interested parties of planning processes. In fact, for decision-making process, virtual reality can be used to visualize data about the urban environment for a better comprehension, making the process more efficient. Municipalities and large private companies use it for the visualization of large urban data-sets, particularly in applications where rapid understanding of 3D data is important or where mistakes are costly.

Planning and design decision support systems (PDDSS) are planning tools that have been specifically designed to be integrated into the public decision-making process. They have the capacity to make sense of complex problems and issues for lay-people and professionals without simplifying or "dumbing" them down. At the moment they include powerful 2D and 3D

design and visualization tools. (Kwartler, Longo, 2008)

Opportunities for the use of digital participation as bridging devices have been explored previously, for example, using data (Le Dantec et al., 2015), images (Al-Kodmany, 1999), mapping and PPGIS (Dennis, 2006), mobile apps (Wilson et al., 2019), collaborative displays (Hopkins et al., 2004) and interactive web technologies and social media (Web 2.0) (Hanzl, 2007).

For this reason the use of technology for citizen participation is a mature field, with other technologies and tools being applied to make people aware of opportunities for participation in urban planning. (Wilson and Tewdwr-Jones, 2019)

One further use of VR is participatory design and planning, hence it is used to test and communicate design solutions and, more interestingly but less commonly, for generating design. The latter use is potentially the most useful in the field of architecture and urban planning and design, being able to directly involve the public allowing an interaction rather than a feedback. The aim is to listen to all involved actors to ensure that projects fit the needs of their future occupants (achievement of equal access for disabled people e.g.). The audience can in effect ask the architect or the expert to make modification in real-time, being able to see the change immediately and improving the decision-making process. Moreover, some professionals using VR emphasize how the medium enables to understand real-world data about the built environment: the majority of the customers have the need to visualize something that is perceived as real, or at least in a realistic context, being able to interact with it and browsing through the scene with no limits. However, there are many problems to solve in this regard. There is no adequate support for design within the current generation of applications and the preparation of such visualizations is still expensive. The well known sketch planning methods, which have also been used to mediate the use of technology by allowing people to sketch land allocation scenarios rather than needing to use a computer (Goodspeed, 2015; Goodspeed and Hackel, 2017), have been the starting point of the attempt done by Wilson and Tewdwr-Jones (2019) with the creation of JigsAudio platform. The latter allows citizens to leave ideas and memories about an environment with sketches, vocal memos and other means.

The advances in the usability of digital technology is surely

advantageous since it is important to design for those that do not have knowledge of computer interfaces (Golsteijn et al., 2015), or access to computers and the Internet. "'issues of access to technology are important ones, for any democratic model is problematic if it is predicated on access to something that not everyone has access to" (Brabham, 2009, page, 255).

Despite the implication of significant costs for large projects, investments in Virtual reality seems to bring business benefits and savings at the design stage and on site. However, VR cannot be used in an unstructured manner, conversely it must be part of a larger plan including potential options. It can be used to facilitate a discussion in a structured manner in conjunction with a range of other tools for involving all participants. There are many case studies about the use of VR tools for public participation, Whyte (2002) described many of them:

The first case study about innovative uses of simulative virtual environment takes place in Santa Fe in New Mexico: an area of the city was about to be developed with a scale and character at odds with the rest of the community. Local planners collaborated with the Environmental Simulation Center (ESC is an american studio providing innovative methods for planning and design using digital tools for aiding decision-making processes) to develop alternatives. ESC designed and modelled that part of the city using a community-friendly pattern, than, they used that model to show alternative population densities. The use of that tool allowed citizens to visualize implications of density, leading to a new understanding of the nature of place. In this case, a simulation through GIS and 3D visualization enabled consensus on proposed planning and design principles since the final solution was a higher density neighborhood mitigating sprawl.

The second case study takes place in Honolulu, Hawaii. The local department of planning is continually challenged to interpret proposed plans for developments and buildings, their task is to assess visual impact of proposed properties and views. In this case, the project area was surrounded by old building and was near one of the main road intersection of the city (a gateway crossed by tourists). The department was able to build a 3D model of the area in about two and a half weeks and this model impressed city and county of Honolulu officials, helping the department to secure the necessary funds for the project. Because of the success

of the project officials are considering a “virtual permitting” programme for Honolulu, requiring each developer or builder to submit 3D source data for their proposed project.

Virtual reality has also been used to market new locations. The japanese government developers used a 3D visualization of Kizu (a new development town) to allow many people to view the scheme and freely navigate through the model. The latter was used at the opening ceremony and placed at the station to the new town to allow for public viewing and orientation. The tool used for the event was aiding the navigation with north-up map, the viewpoint was reset after 300 seconds in order to allow the navigation to many consequent different users.

4.3 Case study of Città Studi

Premises

The internship in "Laboratorio di Simulazione Urbana Fausto Curti" in Politecnico di Milano allowed to explore the previous experiences about the use of experiential simulations for public participation. Hence, It's important to mention the case of via Celoria in Campus Sostenibile initiative. The regeneration project called "Ripensiamo insieme via Celoria!" (Let's imagine via Celoria together!) proposed an open meeting in exhibition format using immersive simulation tools (VR headsets). This kind of public consultation had good result regarding engagement and co-design, in fact it improves the understanding of the future built environment. (Piga et al, 2016) As already mentioned, in workshops and exhibitions the citizenship is fully and actively involved (everybody can have his space and time for comments) and thus presentation format can vary substantially, being more flexible or aimed according to the main goal (gathering information or testing the project with people's feedback). Hence is possible to explore new tools for consultation, less audience-oriented and more individually and technologically oriented.

Via Celoria takes place in the east part of the city, more precisely in Città Studi, a very peculiar neighborhood which is the seat of two universities, Politecnico di Milano and Università degli Studi (Statale). This case study has been chosen because of its location, being a filter road between the two universities with much potentialities.

An immersive visual simulation (360 panoramas) has been created to test citizens reaction to a proposed environment. One of the main limits was the lack of degree of freedom, thus, our contribution.

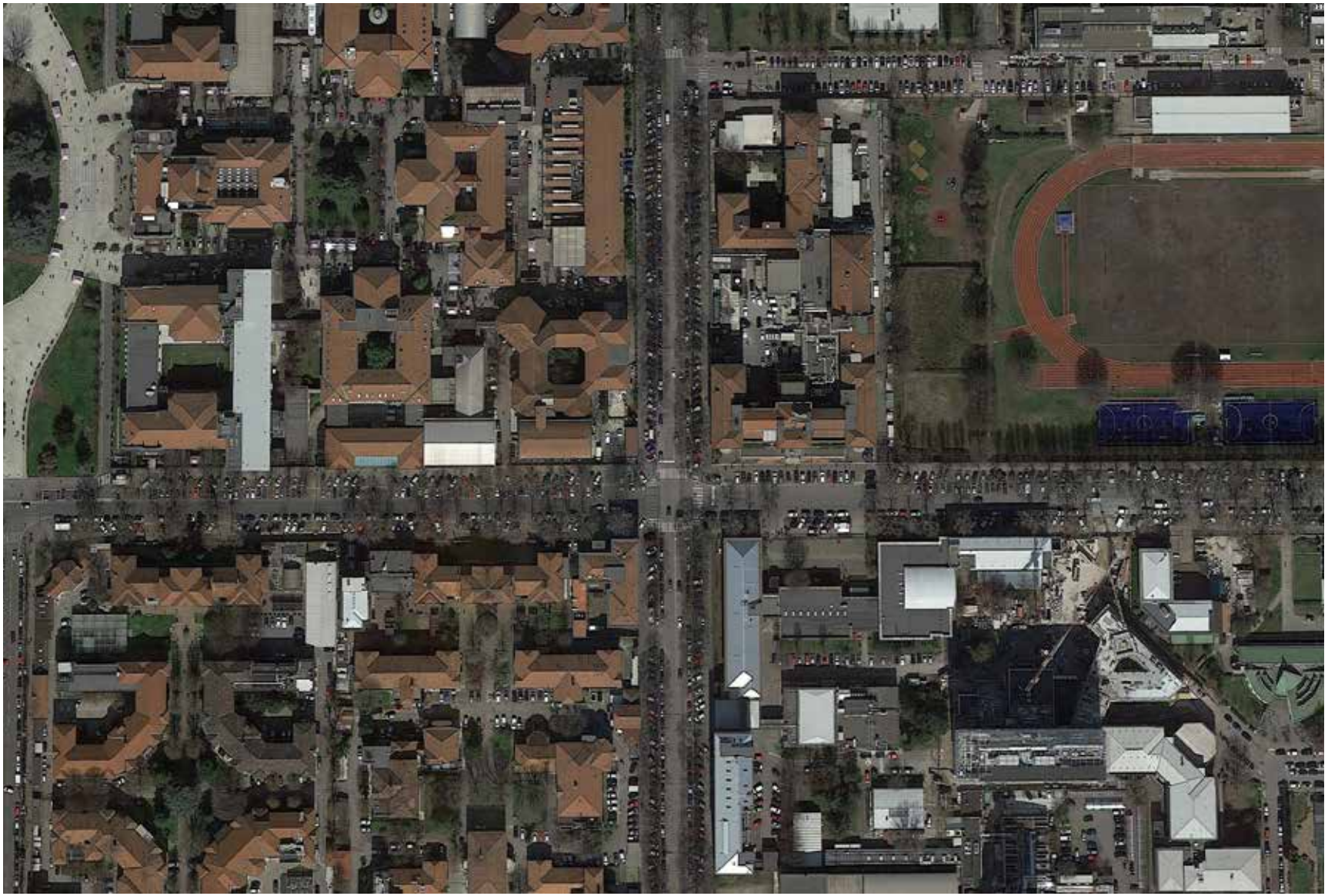


Fig. 26 Via Celoria, Città Studi, Milan

Source: Google Earth

Data gathering

As already mentioned, a key part of a virtual reality simulation is the data. Models may be built within the virtual environment, but this is not the case since the proposed representation comes directly from the real world. This is the reason why it has been found in GIS data a suitable source for a depiction of a urban environment. Moreover, for the built environment applications, many of the spatial models that are interacted with in real-time are created using data from CAD or GIS packages.

In our case, for the city of Milan and in particular for Città studi university campus, a common source to download geographical data has been the website of Città Studi Campus Sostenibile. Without going too much in deep, this website represent a common platform to upload and download materials (cartographic as well) regarding university campus of Città Studi, being a reference point for all the project, initiatives and events taking place in this part of the city.

Moreover, internship activity done in the laboratory of urban simulation "Fausto Curti" in Politecnico di Milano allowed us to start working on this data, having a solid starting point and a precise cartographic base. In fact, "Laboratorio di Simulazione Urbana 'Fausto Curti' (DAStU), collaborated with many public agencies of Milan and the cooperation of "Ufficio Tecnico Area Tecnica Edilizia" (ATE) and "Laboratorio di Analisi e Cartografia (DAStU) of Politecnico di Milano produced a list of manageable and accessible geographical data, analysis on the area of Città Studi and other materials. On the website it is specified that all the available data is continuously updated thanks to the joined work of the components, research groups and students.

Obviously, at the very beginning there already exist a 3D model of the area. A problem was the great complexity and the file dimension, along with a not so good optimization eventually derived by different modelling softwares and different people working on the same topic. Thus, it has been decided that repeating preliminary steps (in order to have a clean start) could be better than working on that original file. With base .shp file visualized with ArcGis software it has been selected all the useful layers to represent a physical condition: green areas, buildings, pedestrian paths, blocks (Isolati) and trees. All these layers have

been converted in .dwg forming base cartography that has been compared with existing data, highlighting discrepancies due to the different years of fly survey. With CAD data it has been possible to start working on the virtual environment of our case study.

Virtual environment

The creation of the virtual environment required great part of the total time, confirming the necessity to plan carefully the workflow having very clear the final goal. It follows a step-by-step proceeding.

- Everything started with a review of the .dwg file, deleting irrelevant details and lines that were too distant from our focus area. This operation took some hours but it totally worth since the final file was a lot lighter and manageable. All the lines and details included in blocks next to our focus area have been kept.
- Next step was to import those starting lines into a 3D modelling software, it has been decided to use Sketchup because of its simplicity in use. Along with this operation, a really basic 3D model of just buildings has been merged in order to save time in their creation. Hence, importing CAD file into Sketchup required a check for coherence of lines because some of them where overlapping or just representing wrongly some elements. Moreover, some buildings were

missing making mandatory to add them manually, creating volumes on the basis of GIS data.

- Review of this model took several hours of work, mainly from the volumetric viewpoint, the model showed some geometric errors due to overlapping and duplicated elements. The outcome was a blank 3D model, ready for the next phase.
- Texturing operation took less time than expected because of previous works, in fact, photos of the building facades were already available at the time of our model creation. It has been done a work of review and assessment of facades quality, substitution and improvements followed with same creation modality of previous images: photos of buildings have been taken from various angles during daytime with no direct light coming (no hard shadows) then, they have been merged together in order to lose no data and then "rectified". The latter term stands for an image distortion operation consisting in nullify perspective by stretching it, converting facade photo from trapeze shape to rectangle one. Some adjustments and corrections have been made using Photoshop software. Applying new images to the model eventually made it larger in dimension, requiring to delete not visible information.
- Next phase was a final addition of details, both in 2D and 3D. The first include white stripes of the road, differentiation in materials (different kind of asphalt e.g.), pedestrian ramps near crossroad etc. The latter were mostly block fences, street lamps, traffic lights, trash bins, bike racks etc. These models have all been created from scratch, taking as point of reference the real objects in the Via Celoria context. Clearly, the more data is created, the more the total model dimension (especially considering the geometrical data) will rise. We can translate this in two expression: better overall performance versus higher graphic level, and this is a trade-off present in the whole process of the application.

Finally, all the model contents were organized in different layers for a better management. Moreover, this differentiation allowed to work on the model in a easy way since, although our foresights, final dimension of this file was very large. One important feature of this model was the lack of realistic trees, in fact, they would be added in a further phase directly in the visualization software, being very complex objects affecting model performances.

Unity engine

After the completion of the modelling part, for our purpose we needed a software able to visualize the content created in real time. Unity (videogame engine) seemed to be one of the best choices for several reasons (free personal license e.g.) although its complexity at a first view.

At a first step, the 3D model files were imported into a "project folder", where all the "assets" (game elements like models, images, audio sources etc.) are stored. Fortunately, Sketchup files are directly readable into Unity, and that was very timesaving.

By importing 3D meshes into unity it also possible to set a collider, mimicking the physical behaviour of a surface, and textures. After this phase, the scene was created by placing elements in correct coordinates after drag and drop into the editor window. Main light source was the default "directional light" with some personalization in intensity setting.

The importance of the free-roaming exploration by the user has already been mentioned, thus, at this stage was necessary to introduce the First Person Controller (FPC) asset, which coincide to the user point of view into the virtual environment. In fact, a camera view attached to the FPC allowed to move into the virtual environment on a flat surface. This camera is comparable to the eyes of the user, implying coherency with player characteristics.

The following step was to give realism to the scene through the implementation of the material structures, to achieve a realistic look, being also coherent with the real world. In particular Unity support the real time Physically Based Rendering (PBR), which means that it makes the use of light rays theories, which, in few words, describe the process of a light source (in this case the sun) that spread from a point in space and hit the surface. The surface will have a material applied on it, and this material has stored different parameters that will result in a different response from a metallic or a plaster surface. Obviously, a set of different materials in the scene is a trade-off between realism and performance.

Adding vegetation was the next step, in particular trees and the various brushes gave a different character to the place, making it more "alive". To do so, some "prefab" (a sort of ready to use component in Unity) has been downloaded trying to reproduce the most similarly possible the real ones. Again, performance

dropped even if in a sustainable way. The implementation of a very small amount of wind effect created a little vegetation movement, giving a feel of realistic situation: playing the scene gave us confirm of the importance of such element of dynamicity. One of the last step in the realization of the Virtual Environment became evident the more we played the scene: the presence of cars. We were familiar with the actual situation on the street, where cars are probably the most noticeable aspect of it, with their invading parking and always present sound. Thus, we searched for light models to place all over the street. Thus, we found some basic model with good textures that somehow compensate the low-polygon structures. After this passage, we noticed how much cars were part of the context, hiding many parts previously visible. Last step of this process was the implementation of "Post-Processing" script, which simulated some of the real world effects. They mainly regarded:

- light captured by human view;
- colour grading regulation;
- camera distortion on sides (simulate the less visible peripheral areas by a human eye);
- general ambient occlusion;
- screen space reflections (a more subtle and realistic reflection layer);
- anti-aliasing technique (dividing objects and background with intermediate colours, making them blurrier).

With this final step, playing the scene was much more felt as wandering through Via Celoria. Unfortunately, the whole range of implementation we put into the scene had an heavy impact on performance when saw all together, and even if we paid attention along the process not to burden the scene excessively, we end up with a limited playability and a poorer experience than thought. Hence, the next section explain how we dealt with the trade-off between performance and graphic quality.

The process of optimization

The obtained VR application uses highly detailed and complex data, since sophisticated rendering is used, the computational time required may slow user movement to an unacceptable level. Data structures in spatial models are often optimized: having sufficiently good results in Unity was not enough in order to have flowing contents in terms of frame per second with VR. In fact, one barrier to the use of VR is the size of models. As Whyte (2002) pointed out, VR visualizations are very different one from another: there is the need for diverse strategies to build an interactive and real-time model, in our case there was priority in flawless visualization and photorealism. The balance of the two is the result of a trade-off between realistic rendered geometrical information and real-time interaction.

Interaction is affected by the frame rate, or rate at which the image of the virtual environment is being updated on the screen, and the system latency, or time required for the system to respond to user actions. The minimum requirement for interaction can be described as 10 FPS with latency of 0.1 s. It must be said that, in a virtual environment, a visualization of less than 30 FPS is perceived as scattered, while 60 FPS could be considered as a standard (in nowadays videogame sectors). This is surely something to take into account as well as the greater requirements (in terms of FPS) for a smooth visualization with a head mounted display.

Obviously, more accuracy in terms of realism implies a less smooth interaction with the VR model, this is why some clever simplification must be done. Some strategies could be:

- using texture maps, reducing geometric details of polygons
- use primitive solids, the lower the number of vertices, the better it is
- using distance dependent levels of detail (LOD) that is a replacement of geometry when the object is at a sufficient distance to not perceive the loss of detail. In short, the same model of an object is updated in relation with distance, with increasing details when getting closer
- using billboards (planar objects that are always facing the camera, working well for distant trees and grass)
- selectively loading objects: depending on the viewpoint, only visible objects must be rendered. This is called camera culling.

To sum up, "optimization allows real-time viewing by reducing the information to be processed and hence reducing the computational effort required during simulation. On any system, trade-offs are made between the amount of geometric detail (number of polygons), the rendering and lighting, and the speed at which navigation and interaction are possible." (ivi, page 21,22) Unity has an integrated system of analysis of what is going on in play mode, helping to understand where the problematic points are located. Some of those analysis info are located next to the window in play mode, visually expressing the number of vertices rendered, the current FPS, the number of draw calls (Unity calls for the Graphic Processing Unit (GPU) to render an object). With these real-time informations it become easier to understand which kind of issues are affecting the scene and therefore where to focus the attention. Thus, according to the data said above, we tested dozens of time the scene, and then we directed our optimization process on the following actions:

The reduction of models' vertices through geometry optimization. Millions rendered vertices created problems in some frames, in particular when getting closer to some points. Thus, we intervened directly on the models reducing the vertices, deleting some useless parts we did not see before, and adjusting others through an optimization of the geometry.

The reduction of models' vertices through texture substitution. The various models, in particular in some details, were burdening the performances without a correspondent boost in the visual content. Thus we decided to create textures, that would have become materials applied on much simpler geometries, instead of having them made by vertices.

The substitution of excessively heavy models. The tree models we had in the scene were actually non-optimized, having an overall high impact on performances. After the replacement, we realized that it was one of the most problematic issues making the play mode much more flowing than before.

Enabling the static batching. This is an option given by Unity for each game object. In short, if the object is a static mesh (such as buildings or street) made by components with the same material applied, it will draw one call to the GPU instead of drawing calls for every component. This action was the most efficient, if the time employed in doing is considered.

Employing camera-culling distance through layers. The camera in Unity has two important parameters regarding the clipping plane, which represent how far and how close the camera can see. If the far clipping plane is set to 1000, the camera will see until that distance, rendering everything (optimized or not). A solution in terms of performances and realism was found with camera culling per-layer. The latter is a buildable script which manage a clipping plane in relation to what is inside a layer. For example, we put the layers “ground”, “buildings” and “trees” at a 150 distance, keeping the rest of the objects at 100. That helped to see the main objects even farther, without a perceptible loss in performances.

After this process of optimizing the scene’s contents, the fps, draw calls and vertices counts was significantly improved, with an increase of fps from a minimum-maximum of around 8-24 (very limited) to one of 40-73 (acceptable). In theory, there is an unlimited possibility to improve the performances, but there is always a trade-off with the graphics, which in our case were very important, thus we decided to stop at this point.



Fig. 27 Screenshots of the experiential simulation of Via Celoria

Source: the author



FIg. 28 Screenshots of the experiential simulation of Via Celoria

Source: the author

5 Methodology Proposal

Application of experiential simulation in public participations

In this chapter it will be proposed a standard methodology for the application of experiential simulations in public consultations. The latter could gain many benefits in this adoption but the tools must be used in a logical way and the overall process must be managed in a multidisciplinary way and according to the objectives.

5.1 Application steps

Research objectives and advantages

Main objective of the research is to find a standardized methodology to create and apply experiential simulations in the explained legislative context. As already said, a simulation is an approximate imitation of a real-world feature, taking multiple forms according to the purposes. New tools and methods are being developed thanks to technology advancements, giving more opportunities and forcing further studies to test their efficiency. Professionals use them highlighting pros and cons in the private sector but, on the other hand, public sector struggle to introduce them, making the study of effectiveness more difficult. However, same type of simulations could be effective in different situations, hence, for public participation it must be taken into account the use of different media or presentation formats according the users (audience). Next part of this thesis is totally devoted to a more practical research on this theme, with the goal of exploring possibilities for public participation with new tools for experiential simulation.

Setting up a process of public participation represent a proof of transparency in decision-making. In recent years, principles and guidelines have been fully conceived by member states but a proper legislative tool is still missing. It is actually up to local government to either start a process of public participation and thus, find the proper methods to do it.

In our case, the focus is placed on the relationship between public consultation methods and experiential simulations, mainly for what regards visual studies. First of all, it is important that the methodology used is clearly set out since public participation extent is quite broad. For what regards EIA procedures and

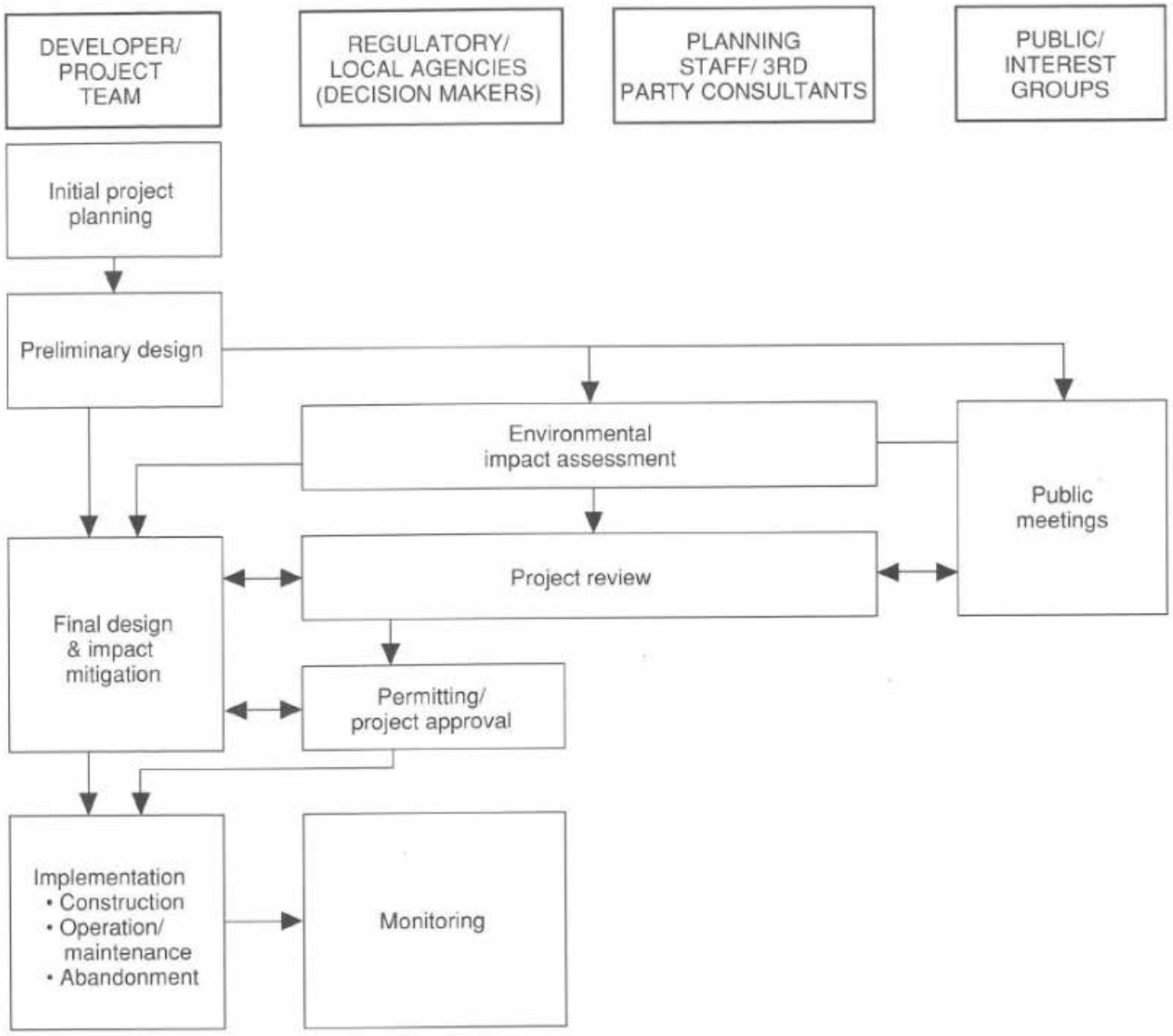


Fig. 29 Simplified outline of the project planning process
Source: Sheppard, 1989

impact assessment of projects and plans, standard methodology normally include a baseline survey, identification of effects and sensitive receptors, description and quantification of the changes to the baseline, and the evaluation of predicted effects, together with criteria used and the measures proposed to avoid, reduce, remedy or offset negative effects. Hence, the description and assessment of a proposed action visual features, as to say environmental physical changes, will be object of study of the experiential simulations.

On the other hand, public participation for planning can take place in a top-down or bottom-up way. The first involves regulatory authorities, planning consultees and citizens. Hence, the common form of consultation are formal meetings to explain a project or plan nature, with few time for citizens feedback. On the other hand, bottom-up approaches allow the creation of a vision, like shared values and goals upon which the community could find agreement that politics should not ignore. These type of consultations involves citizens, local associations, professionals and institutional representative. Hence, the forms of consultations are informal meetings, exhibitions, workshops etc.

As said, experiential simulations could be useful in public consultations, especially thanks to their potential in foreseeing and assess the visual impact of a proposed action. Generally, simulations for visual analysis should be accepted and actively put into practice. Cities, national and regional agencies regulating land use could gain important advantages by using good simulations: they could avoid to take a passive stance by reacting in a case-by-case way and starting to influence the process by encouraging or requiring simulations as a part of project approval. Developers provide many professional products (reports and plans) that are routinely reviewed in draft form before being released to the public and final decision-makers, a similar process could include preliminary simulations as well. After that, the public agency should express an opinion about the project. In this regard, clients should obtain simulations and documents about preliminary review early enough in order to change the design project instead of searching for a compromise in a advanced phase of construction. A new set of simulations could show the improved design in a detailed way, publicizing the process as a prove of good faith efforts in developing a well-

designed project. (Sheppard, 1989)

With actual legislative tools, this methodology can be just be suggested and not imposed. Obviously, it is not desirable nor useful to force a public consultation process to start over every public or private proposal of a landscape change, for this reason consultations are up to the local government. Moreover, in EC directive it is specified the extent in which a proposed action requires a study of environmental impact assessment, usually, public consultations are set up in same circumstances. Most common situation that are likely to generate public consultations (and visual impact studies) are project or plans located in (or visible from) areas recognized as visually sensitive, such as National Parks, wilderness and recreation areas, coastal zones, greenbelts, conservation zones, historic districts, population centers, scenic highway corridors and design-review overlay zones. This automatically exclude all minor projects for which a study of this kind would be useless and bureaucratically too long. Obviously, if the regulative authority would consider some non-involved project as controversial or visibly/aesthetically impacting, then it should be possible to officially ask for a specific study/participative process. These requirements are decided by local government and regulatory authorities as well as the use of simulations as assessment tools.

The latter however, require a certain kind of strictness and precision: either the reader of the assessment or the audience of a public participation process (planning authority, member of the public, planning inspectors etc.) must be able to recognise that a rigorous process has been applied. Since the use of experiential simulations for visual assessment is not taken for granted, a step by step approach is recommended.

1st step:
define simulation purposes

According to the typology of consultation chosen (or available) and consequently its goals, it must be cleared out what are the simulation purposes. An experiential simulation can be helpful for the project design team (professionals) since allows a certain kind of flexibility and try/error approach. In fact, it is possible to immediately take a look to design scheme ideas and proposals, more recently it is possible to emulate (even if with some limits) flexibility of hand-sketches making fast changes with no waste of time. These communication features are useful to explain the project to people unfamiliar with it as well: experiential simulation should be user-friendly and accessible,so that a client in private sector or audience in public meeting could have the same cognition of spaces designed by others (review of project nature).

Regarding more technical steps of visual impact studies, experiential simulations could help in create a visual inventory of the landscape being meaningful in the description of the existing landscapes, sites, built projects in terms of overall visual character, scenic or visual quality and viewing conditions. Its value is, however, limited: people affected by the project to assess is likely to know the actual situation in a good way. Conversely, they are more interested in the visual impact assessment, which is the process that includes project description, visual prominence, view obstruction, design quality, landmark status and orientation, visual compatibility, observers' reactions and overall visual impacts. Hence, experiential simulations could be fundamental in a correct depiction of design schemes and visual impacts in all representative points of view.

Often, along with design schemes, mitigation measures are taken into account. Studies on project impact often use simulation to depict mitigated conditions, or to design or develop the mitigations themselves, assessing their effectiveness or success. For example they could be prepared to show how much vegetation would be needed to screen the worst parts of a building, to test different mitigation proposals and before/after comparisons.

After this decisional phase, experiential simulations could have a meaningful role in illustrating results of environmental studies

and in aiding construction of projects as planned, being highly understandable by lay people. Moreover, they could be useful in the final phase of a project or plan, once final solution is achieved. In monitoring phase, simulations could be a "visual baseline or standard against which the actual performance of the project can be measured. This is particularly useful in questions of long-term compliance with stipulated or expected conditions". (Sheppard, 1989, page 24) Hence, simulations allow the decision makers to form their own opinion on project impacts and thus verify or check the conclusions reached in the environmental assessment. "A simulation becomes a far more precise tool with which to judge the performance of a project in meeting expected goals or criteria for aesthetics. (ivi, page 49) In many cases, at this stage, the public becomes an interpreter whose opinions are weighed in making the final decision.

2nd step: define simulation setting and medium

After the definition of the purposes, the simulation maker, whoever he is, must deal with some technical aspects regarding the simulation setting and medium. The first is the way a simulation is presented, for example, in a public meeting. Hence, schedule is strict and time is very important: there should not be any waste of precious time during a presentation and relations with the public must be logically managed. This form of public consultation, however, is not the most suitable for co-design processes but just for explanation and description of visual studies. In exhibitions and workshops it is possible to have longer time for the audience to express their ideas and concern. Moreover, another limit is the budget for the overall presentation, including simulation cost. Obviously, larger funds (and time) allow better representations but this is not necessary implied. As already said in literature review, a simulation must be cheap in order to avoid excessive absorption of resources in the creation phase, moreover, it should allow a certain kind of flexibility to test as many different

features as possible with few changes. These limitations are related partially to the work in the creation phase but mainly to the medium used to simulate the experience of a place.

The choice of the medium reasonably result from several aspects like: purpose of the simulation, schedule (time), budget, required level of details, professional' skills and availability of suitable tools. Among all the possibilities, virtual reality is the medium with highest potential in the representation of the reality in this field. First of all, it can be used in several different ways according to the main goals and purposes to achieve. It is a flexible tool that can be used by each actor for decision making processes, however, it requires awareness in order to avoid misleading results. In fact, there are issues regarding the extent to which virtual reality allows citizens to visualize alternatives enabling participation in the planning process. "Virtual reality does not necessarily increase participation, but it may be used to help participatory design as one tool within a wider tool kit." (Whyte, 2002, page 130)

Secondly, VR can be considered as an interactive, spatial and real-time medium which allow professionals to product prototypes for good experiential simulations. It must be kept in mind that models created for the use within professional teams are very different from models for client's interaction, planners and end users in general, making information share very difficult without necessary fixes.

Thirdly, technology companies have found practical applications for the use of virtual reality across a range of different activities. The possibilities are so many that competitors, planners, regulators are using it, while customers and citizens begin to demand or expect its use. Organizations are using VR in conjunction with range of other advanced technologies, such as object-oriented CAD, parametric modelling, laser scanning, photogrammetry and GIS. The use of these other technologies influences the strategies that organizations develop for building and optimizing VR models and for translating data to VR systems. (Whyte, 2002)

On the other hand, one of the main problems in the use of VR in public sector in general regard the use of copyrighted material: ownership and access to models. The creation and effective use of urban models for public good require the use of intellectual property, thus, the relationship between public good is an issue

that needs to be dealt with. In fact, many companies are loath to share their information and make them available to public for a number of reasons. Because of this, many cities and urban areas have no common base map onto which data can be superimposed. Many attempts to integrate informations are motivated by a desire to make government more transparent, increasing the information available to citizens. Obviously, not all the data can be made public for reasons of security and commercial sensitivity.

3rd step: creating an experiential simulation

In previous chapters, it has been described the list of characteristics of experiential simulations derived from years of studies on this topic by several scholars. Hence, those principles were referring to simulations without a consideration on the medium or system used. For what regards VR, it should follow the same guidelines to achieve response equivalence from users.

A VR simulation is realistic if it depicts a virtual environment in three dimensions using photorealistic textures and lighting, this depends on many factors, rendering engine in primis. Level of details must be very high and all the features recalling an atmosphere of a place must be inserted (climate condition e.g.). Accuracy must be achieved by a correct management of the initial data and in case of a designed project, there shouldn't be noticeable difference with the context or, in other words, there should be homogeneity of features being equally readable. Once the virtual environment is complete, it must be explored and perceived in a free-roaming way, being sure to insert not so

limiting boundaries. This aspect is very important since it must allow a certain degree of autonomy for users, to evaluate freely the content of the virtual environment so that they can have an idea on the basis of their own concerns. This simulation has to be interactive and dynamic to generate interest and engagement. Real time interaction is fundamental to perceive the environment as "alive", making this feature the base for the use of VR.

Finally, it must be multisensorial as much as the possibilities (mainly video/audio sources).

According to Whyte (2002, page 131) there are three main "creators" for a urban VR model:

Central technical department. In some companies, a specialist visualization group within the organization uses virtual reality on all projects. In this case, innovation is well regarded, allowing a more strategic approach. Main risk is that technical staff may fail to apply correctly such technology at the projectual level.

Design staff. In other companies, virtual reality can be introduced at the project level by the staff working on a particular project. However, any innovation implemented at the project level may not become known within the organization and be reusable on other projects.

Commissioned. In other cases, the creation of a VR model can be created by, or in collaboration with, a service provider, such as a university or a commercial retailer. In this scenario, usually both the models and the viewing facilities are provided by this third party organization. Outsourcing allows companies to reduce their risks, whilst leveraging benefits from the technologies. It increases flexibility, enabling a company to move to different solutions faster as it is not locked into particular sets of technologies because of staff competencies.

For whoever is supposed to make a simulation, the creation phase must be carefully described, specifying used techniques so that the procedure is replicable and the results can be clearly understood by a lay person. This description must use a clearly-defined and agreed terminology, avoiding generalisations; this is valid for landscape and design description as well. In doing this, it must be as impartial as possible, stating the basis upon which each judgement is made. Moreover, it should be highlighted properly how special interests (cultural, historical, ecological) has been treated. (GLVIA, 2002)

4th step:
managing the process and feedback

Process management and feedback gathering are the key moment of the whole consultation activity. Just before going through this step, the created simulation should be reviewed or appraised by an appropriate person or agency in order to screen for possible problems and then presented to the public or other audience. (Sheppard, 1989, page 106)

Boffi and Rainisio (2017) suggested that, in an interdisciplinary perspective, a process that includes designing a space, testing it through simulations and then communicating it to citizenship in order to obtain a feedback cannot be handled only by designers. This process should involve different competencies because an environmental change implies effects on social behaviour as well, for example stimulating the formation of new groups. "Underestimating such aspects would lead to a great misconception of the social consequences of this activity, which indeed is not simply a collection of information from passive individuals but instead a call to engagement to active citizens." (page 47)

The effectiveness in managing the activity is fundamental to make a proposed simulation perceived as a neutral informing tool rather than a biased and non-valuable tool to cheat citizens. This aspect is crucial considering the decrease of trust in institutions that is observed in many western countries, in fact, it can be considered either a general obstacle to the development of active citizenship, or a catalyzer of less formal forms of participation. Hence, "is fundamental to conceive experiential simulations as part of a deliberative process aimed at involving citizens, and not as a technical tool to inform designers only" (ibidem). From the psychological point of view, people's feedbacks are focused on subjective experiences and there is no cause/effect in responsive behaviours, thus, data gathering should not be considered as a neutral action. Psychological constructs are not directly observable but composed by related sub-concepts which can be measured by means of different tools. Among them, there are focus groups, interviews, questionnaires or validated scales, which can depict the construct itself in a wide range of shades. Different types of comments are expected: open comments are

more likely to be found in master planning exercises, thus the abstractness of the medium could become a generic canvas for people to communicate their views through.

Conversely, for other topics and planning, consultations on a specific issue might be faced with less freedom. These structured proposals can led to citizens commenting on issues that could be improved on, and led to suggestions that tended to fit in to an existing framework. This workflow must keep in mind that abstract comments requires more work to be integrated into the current material-based planning system. (Sarkissian et al., 2010)

Interpretation of data is not immediate and so is the the process that lead from a early design to a new one shaped by feedbacks. In informal consultations this process is continuous and more rapid than the formal counterpart, this aspect is probably the most interesting about workshops working on city planning. Appleyard (1977) proposed a communication model of the planning/review process in formal meetings:

- The proponent provides the simulation of the proposed action, basing on his/her intentions.
- The evaluators (planning commission, city council, planning staff, involved citizens) who receive the messages conveyed in the presentation could have an idea of the proposal. The latter could be influenced by news media or other contacts.
- Opponents could present their simulation of alternatives.
- Evaluators decide basing on their perceptions, being the main feedback to the proponents. It must be said that evaluation is affected by both simulations and settings (presentation).
- This communications process can be repeated several times during the course of a project, through the stages of design generation, design modification, and ultimate acceptance or denial.

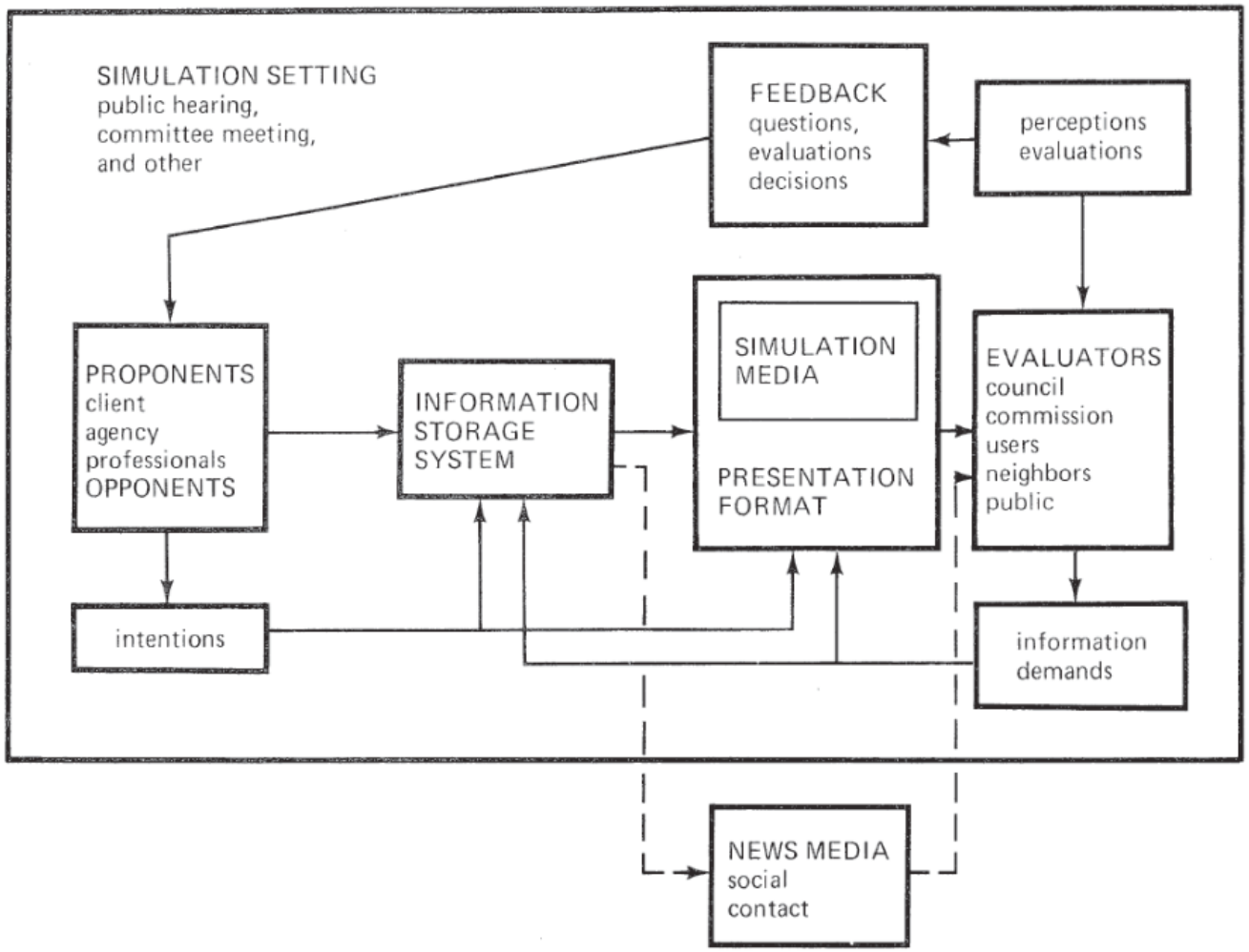


Fig. 30 Appleyard's communication model of a project presentation
Source: Appleyard (1977)

5.2 Conclusions and future work

Decision-making processes and public participation imply several aspects to take into account. First of all, the overall process is characterized by several interacting actors and stakeholders, thus a good management is needed.

Proponents should be aware of the possible public's requests and thus should find an agreement with local authorities for the best solution available, on the other hand, professionals should be the filter between proponents and the public keeping in mind that approaching this task in a overly-sided way is dangerous for both proponent's reliability and operation success.

There are guidelines for a correct methodology and nothing more is desirable since such processes are often too different one from another, thus it is conceptually wrong to impose a certain strict operational guide.

However, when public consultations are set in early stages, the outcome is often less prone to be subject of changes, compared to the initial proposal. This is possible thanks to participative design and planning but also to transparency demonstrated during the process. The latter is also the key allowing the use of such simulations in these delicate situations since the chance to be considered just biased instrument instead of real contributing tools is high.

In fact, the creation and the use of simulations must be cleared out according to the situations and actors involved. Nowadays, example of successful implementation of experiential simulation in public participation are relatively numerous and many of them regards more specifically virtual reality in all its form. The interaction between these tools and the public must surely be investigated further, in order to have a better idea of the usability in different situations.

Hence, the question could be on the extent on which simulation tools could foster public participation in order to obtain the so called honeypot effect. The latter allow people to observe and understand an activity before deciding to participate or not. Needless to say, it help overcome the self-consciousness and embarrassment associated with participation, and "allows groups to congregate spontaneously without specific coordination efforts [by the facilitator]" (O'Hara et al., 2008: 68).

To reach this effect, that tool should:

- Allow people to be expressive in how they communicate their feelings towards place (Frank, 2016).
- Be a technology easily understandable by participants (Goodspeed and Hackel, 2017)
- Be able to be used unsupervised and giving the respondent the time they needed to develop, reflect on and communicate their thoughts
- be seen to be part of a larger activity.

To conclude it should be explained what kind of role is desirable for experiential simulations in public participation, they can be used in a valuable way either as main tool to communicate the environment and as supportive tool for a participative meeting. Again, it highly depends on particular cases being a decision up to professionals and process manager, according to the objectives, purposes and resources.

As previously said, VR includes three sub-types of media: Immersive VR, non-immersive VR and Augmented reality.

All of them can be useful in public participation in different extents, hence a classification could be helpful.

Direct consultation (in all its different forms) is characterized by a high level of interactions and feedback. At the moment, aiding tools for public participation and design are present but still there is nothing with high photorealism and flexibility. Trade-off between these two features is surely something to deal with until next-generation tools will be developed. Choosing between immersion and non-immersion depends just on resources and eventually on situations. In this point of view many can be learned from computer graphics and video-games, apparently being the main driver in the development of this technology.

Just to mention two interesting cases of photorealism and flexibility in this regard there are:

ESRI CityEngine which is a platform gaining data from GIS, converting it in a decent 3D model through "modelling rules" allowing creation of large 3D data sets in few time. Hence the problem is surely the quality of output image.

Lumion LiveSync. which is a plugin for some software allowing an almost real-time rendering of 3D models, following changes directly in creation phase. Hence the problem is the difficulty and management of audience feedback while modelling.

Indirect participation could gain several advantages from technological advancements, remote accessibility to complex data is now possible thanks to large storage systems and internet browsing speed. Online platforms could show 3D data of GIS databases, showing experiential simulations of landscapes with simple but effective graphics. Moreover, implementation of 360 panoramas (visualizable just like a normal photo with no boundaries) could help to improve the readability of places and projects if a link is placed on other supports (maps e.g.). The possible use of cheap VR headsets like the Google Cardboard has reduced the fruition gap of these tools, making immersivity a closer feature.

Problems of remote experiential simulation are twofold: technical and methodological. On the one hand there is lack of important features like photorealism and interactivity due to low computational power and, on the other, people involvement in the process is in a way less than face to face meetings. There exist multi-user immersive VR experiences developed for enterprises, taking advantage of internet connection to "project" users in a virtual environment being able to see and interact each other even if divided by a long distance. Yet this is quite experimental and support just a low number of users, having costs among main brakes in its implementation.

Last but not least, augmented reality could be very useful as well. Yet we have several examples of its possible uses, being able to project virtual objects in the real world. Proposed projects could be visualized in place directly through the camera of a smartphone, making in-site visits paradoxically more "real" on a simulative point of view. Hence, main problems are surely the quantity of data supported by smartphone hardware and software and limits related to cost in both tools and time requested to visit a place.

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- (www.fao.org/docrep/V8350E/v8350e06.htm)