ID 1396 | GEODESIGN AS SUPPORT TO OPINION MAKING, IN LOCAL, REGIONAL AND TERRITORIAL SCALE: CASE STUDIES IN BRAZIL

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1 INTRODUCTION – THE CONTEXT OF THE STUDIES

In Brazil, since the promulgation of federal constitution, in 1988, and the City Stature, in 2001, the interests about "participatory planning" became not only a desire but a law, determining that any decision in territorial planning should be constructed considering collective values. Notwithstanding, we observe lack of methods to support the intention, and in most cases a misunderstood about the sense of participation. The idea of "participation" is understood as to "win the game", and not to choose alternative futures that are more adequate to social, economic, environmental and cultural context. In this sense, the proposal of Geodesign (Steinitz, 2012), based on a framework that stablishes steps to be followed, is a very robust methodology to support opinion making and to arrive to decision making.

We conducted three case studies in Minas Gerais, Brazil, in different scales and challenges, but all of them in areas with conflicts of interests. The case study in regional scale was Quadrilatero Ferrifero, an area of 1.000.000ha characterized by historical cities, environmental resources, axis of urban growth and the most important economic area in the state due to mining activities of gold and iron ore. The case study in district scale was Pampulha, an area of 10000ha in the city of Belo Horizonte, projected by Oscar Niemeyer that had just been nominated as Unesco's heritage because of its unique modernist architecture and urban landscape. The goal was to discuss risks of not appropriated changings in the landscape, especially urban densification, damaging the harmony in visual axis. The case study in local scale was about a slum, an area of 25ha, with the goal to face complex problems and to give support to legal regularization, considering budget restrictions, fast changing realities and needs in urban and environmental improvements. All case studies demanded studies about systems that represented vulnerabilities and attractiveness in the areas, costs and targets to be respected and achieved, and definitions about groups of interests from different sectors of society.

The Geodesign methodology was proposed as an alternative to plans generally top-down oriented, time consuming and not able to achieve sufficient participation and community consensus on priorities. In parallel with the use of Geodesign Hub, we applied geovisualization tools proposed by Geoproea (UFMG) to create a collaborative environment and enhance stakeholders' participation, based on City Engine (ESRI) and Grasshopper+Rhino 3D simulations. We also applied possibilities of interoperability with other platforms, using an App from ViconSaga Web (UFRRJ and UFRJ).

The methodology is based on web platforms and the principals of social media in the sense of sharing information, constructing proposals and arriving to decisions. Geodesign hub is a platform to make people working together. The visualization and interoperability applications amplify the conditions in participatory process, as support to opinion making. The experiences proved to be very effective and robust, as participants started to understand that the objective was not to win the game, even though they played to win, but to construct together the most acceptable alternatives. The main outcome was the capacity to transform data into information and information into knowledge, in a sense that is been called "empowerment", resulting in more reflexive and critical citizens.

1.1 THE STUDY AREAS

We had the opportunity to develop three case studies applying the framework of Geodesign in Brazil, more specifically in Minas Gerais, a state in the center of the country known by its historical cities, the first network of baroque cities, developed from 1720-1800, recognized as the base of Brazilian culture. The region is also known as the base of modernism in Brazil, since the construction of the first city from republican and positivist value, Belo Horizonte, in 1897. As an evolution from positivism to modernist stile, in Belo Horizonte received the works of Oscar Niemeyer, a very important Brazilian architect. Niemeyer

projected a neighborhood named Pampulha, his very first important project, declared UNESCO cultural heritage in 2016.

Belo Horizonte is inserted on Quadrilátero Ferrífero (Iron Ore Quadrangle), known by the production of mining resources (gold, precious stones and iron), representing the most important economic base of the state, and one of the most significant in Brazil. Among the importance of architecture and urban network, mining activities and all the economic results related to it, the area is also characterized by a notorious landscape, genius loci of the state – a landscape of mountains in which the main rivers of the state are born, with expressive vegetation cover: forests and "campo rupestre", a native crop field that exists only in that biome, because of iron area.

In this complex territory, characterized by cultural and heritage interests (from baroque to modernism), economic interests (mining activities) and environmental values (mountains, river sources and native vegetation), as most medium and large cities in Brazil, there are also slums (they are generally around area of Belo Horizonte has 5 million inhabitants and the Quadrilátero Ferrífero has 3.5 million inhabitants. The three areas mentioned – Quadrilátero Ferrífero, Pampulha and the slum Maria Tereza were the three case studies in Geodesign. Quadrilátero Ferrífero is a region composed by Belo Horizonte and more 27 cities, in a territory of 12600 km2, around 140 x 140 km; Pampulha is a region in Belo Horizonte of 250 thousand inhabitants in an area of 50 km2, and Maria Tereza is a slum also in Belo Horizonte, that in 2010 had 400 inhabitants in 0,3 km2 (Fig. 1).

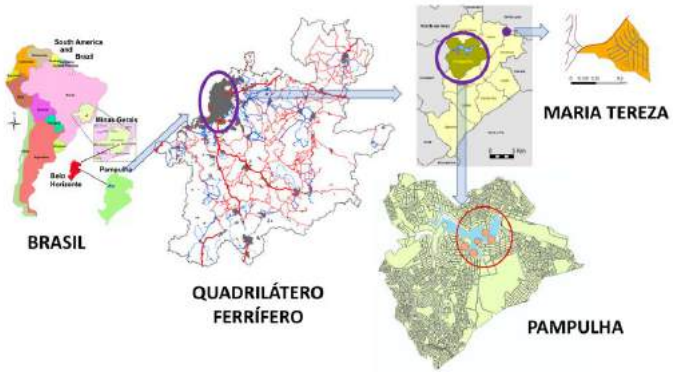

Figure 1 – Location. Source: The authors.

1.1.1. SLUM CASE STUDY – MARIA TEREZA

According to IBGE 2010 Brazilian latest demographic census, around 11.4 million people live in the 6.329 favelas (slums) identified in 323 of the 5.567 municipalities in Brazil. A favela is characterized by an illegal occupation of someone else's vacant land (public or private), lacking at the beginning public essential services such as sewers, waste management, and public facilities, and usually showing an organic morphology and dense built environment with little open space and green areas, usually on improper sites, steep slopes, flood prone areas or even environmental protected areas where the market can't go.

Illegal settlements may have very similar urban infrastructure and housing conditions compared to slums, only they occupy land which has been previously divided into parcels (lots) which have been sold in the informal market, meaning that families who occupy that land paid for it and feel they are owners, even though they don't have legal ownership documents. Being implemented without going through regular planning permit procedures, they do not follow official design criteria (minimum lot area, minimum street width, maximum slope and so on), do not obey environmental constraints (steep slopes, forested areas, springs and water bodies, flood hazard areas, and so on) nor have the basic urban infrastructure that, according to Brazilian urban legislation, is due to real estate developers to implement.

Belo Horizonte has 186 favelas classified as ZEIS – Special Social Interest Zones and 29 illegal settlements classified by AEIS, by the local Master Plan and Zoning, which means they are supposed to stay where they are and be subjected to upgrading programs. Aiming at urban and environmental improvements, as well as legal ownership regularization and socioeconomic community development such as jobs and income generation, these plans, based on a traditional thematic mapping method for both data

collecting/analysis and proposal strategies, have been, however, strongly criticized for being too technical, too time consuming (usually lasting three to five years), expensive and top-down oriented, lacking sufficient participation and the necessary strategic approach to achieve community consensus on priorities under severe budget restrictions to face very complex problems and fast changing realities.

In August 2016, a three-day planning workshop was conducted by then professors from UFMG GIS Lab and technicians from the municipal administration, at Belo Horizonte City Hall, using the Geodesign framework and geovisualization tools to create a collaborative environment and enhance stakeholders' participation for the development of a PRU for the Maria Tereza Neighborhood. (Fig. 2).

Figure 2 – Maria Tereza case study. Source: The authors.

1.1.2. PAMPULHA CASE STUDY

The recognition of the landscape value and the interest on preserving the essence of the place are quite recent in Brazil. Just from the City Statute (Estatuto da Cidade), law passed in 2001 (Brazil) and the approval of the Seal of the Brazilian Cultural Landscapes from 2009 (IPHAN) the landscape protection has been mentioned for the first time. However, there is still no instrument to guide the identification, classification, characterization and to propose sustainable manners to occupy and preserve the landscape. Our studies aim to understand, prospect and develop methodological possibilities, supported by geoprocessing technologies, more specifically the Geographical Information System and Spatial Assessment Models, to start the process of identification, planning and management of the landscape. The visualization and the decisionmaking processes regarding the landscape management are assessed using simulation models and field of view representations and analysis.

We chose case studies of urban area and of remarkable landscape, in different scales of approach. Pampulha was selected for zone scale. It is an area of interest for the study because it has recently received the status of World Heritage Site by UNESCO due to the presence of Oscar Niemeyer's work – a modernist set of buildings and surroundings designed in the 1940s. It faces significant growth and transformation of the area and the risk of loss of remarkable values could be observed. The revision of the Master Plan is required, managing the conflicts of interest. (Fig. 3).

Figure 3 – Pampulha case study. Source: The authors.

1.1.3. IRON ORE QUADRANGLE CASE STUDY

For the regional scale, presenting environmental and anthropized landscapes, the study case is about the Iron Quadrangle, area of remarkable landscape and that translates the genius loci of Minas Gerais state. The first travelers got to Minas Gerais led by the mountain chains of the Iron Quadrangle, where mineral resources were found and the first cities were established, which nowadays composes the Brazilian historical heritage. However, there is a dynamics transformation in the cities network, in the environmental values and in the remarkable landscape, due to the mining activities and the expansion of the urban areas.

The Quadrilátero Ferrífero presents the most important urban network in central area of Brazil, with 95% of population in urban areas, that grow together with mining activities in the landscape. It presents conflicts of interests related to environmental protection (as it's an area of water resources with headwaters and expressive vegetation cover), economic activities (mining exploitation and the spread of urban territories), cultural and scenic values (it's an amazing setting of beautiful mountains and presents historical cities from the XVIII century). (Fig. 4)

Figure 4 – Quadrilátero Ferrífero case study. Source: The authors.

2. GEODESIGN METHODOLOGY

The Geodesign, a spatial analysis methodology proposed by Steinitz (2012), is a framework that aims to establish the forms of participation of different stakeholders in the decision-making process. The methodology derived from Geodesing is based on a representation of the landscape by several variables and on the creation of a georeferrenced database, which enables the use of spatial assessment models. It consists of modeling steps aimed at characterization, process analysis, change analysis, calculation of impacts, and adjustments in decision making concerning land use organizations and environmental arrangements. Along the process, it is created the maximization of the common consent, having in mind that there is no absolute consensus, but it is possible to manage a collective decision. The main characteristic of the methodology are iterations, collective revisions and shared decisions (Goodchild, 2010, Campagna, 2012). It is a requirement that the actors involved understand the process, which justifies investments in clear visualization of the information to support the decisions.

2.1. THE STEPS IN GEODESIGN METHODOLOGY

The Geodesign framework (Steinitz, 2012) is based on 6 steps, divided into the goal do construct assessment and to support intervention. Each of these 2 goals are achieved throw the production of data, transformed into information and producing knowledge. The first iteration is organized to understand the area, answering “why” it must be studied; the second is a review of the methods and is planned to answer “how” it should be studied, and finally the third iteration is to perform the study answering “what”, “where” and “when” the proposals can be applied. (Fig. 5).

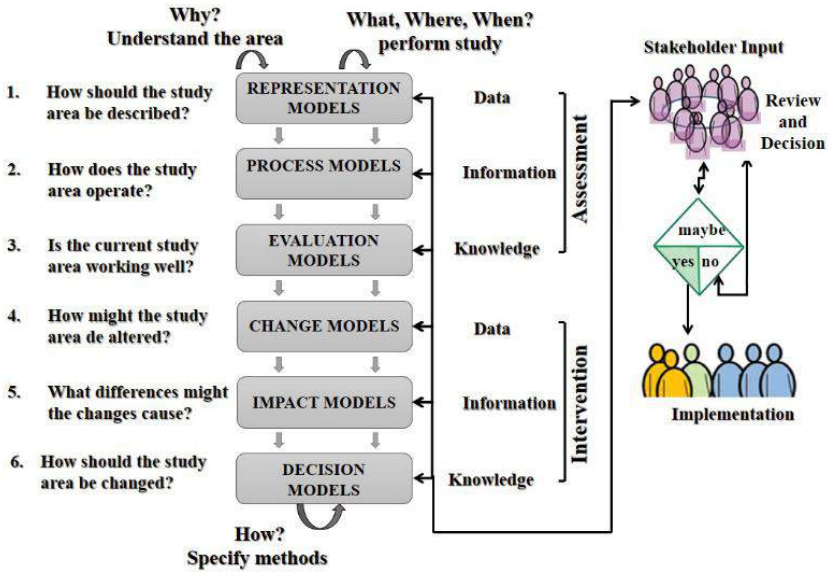

Figure 5 – Geodesign framework. Source: Steinitz, 2012.

2.1.1. STEP 1 - HOW SHOULD THE STUDY AREA BE DESCRIBED IN CONTENT, SPACE AND TIME? THE USE OF REPRESENTATION MODEL.

To propose the Representation Models the user must capture the essence of the place: it`s main characteristics, considering the vulnerabilities and the attractions to change. In all case studies data were organized and produced to represent the main characteristics of the areas, considering its genius loci, it demands, vulnerabilities and attractiveness.

In the case study of Maria Tereza (the slum) the main objective was to plan a better distribution of the many needs to requalify the area, that`s why the representation models were organized with data about exiting infrastructure, the land use, risks, environmental conditions and the commerce and services in the area. In the case study of Pampulha the main goal was to propose a plan to manage the growth of the area (densification) resulted by the very good existing conditions and to the increasing interests due to the recognition by UNESCO, but also in risk of losing this quality due to the changes. In the case study of Quadrilátero Ferrífero a big effort was done to produce new data, as the area is very complex, what resulted into inedited maps from the territory.

2.1.2. STEP 2 - HOW DOES THE STUDY AREA OPERATE? PROCESS MODEL.

Besides the study of main component variables that favor the space transformation, as catalysts variables, in all case studies it was important to investigate the process between the variables, which results in the characteristics of the spatial composition. The Process Models have the goal to transform data into information. In practical sense, it is the construction of distribution surfaces that tells about the characteristic of each spatial location according to the theme of interest.

In each situation an algorithm of distribution, concentration, combination of variables or neighborhood studies was applied. According to the objectives of the distribution surface we used Kernel Density; Delauney and Triangulated Surface followed by the calculation of slope; Multicriteria Analysis when the goal was to apply weighted sum of variables; Combinatory Analysis when the goal was to stablish some compositions in the place; Buffer zone to specify the areas of influence, and so one. (Fig. 6).

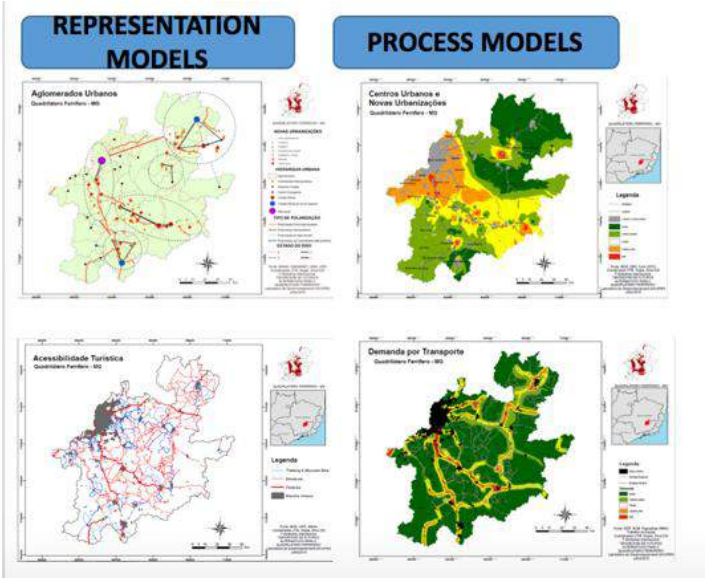

Figure 6 – From Representation to Process Model. Source: The authors.

2.1.3. STEP 3: IS THE CURRENT STUDY AREA WORKING WELL? EVALUATION MODEL.

The Evaluation Model transforms information produced by process model into knowledge. It means that after understanding the main vulnerabilities and attractiveness, it's possible to present a base to support the proposals of the projects and policies to the area. This knowledge of the possibilities and limitations of the place is described as feasible, suitable, capable, inappropriate to receive projects and policies of that theme, but also mapping the area where the resources already exists. These models are the base to construct proposals, and are the systems the participants receive to work with in the workshop meeting. They must represent reality to work as basis to the discussions and the construction of proposals. (Fig. 7).

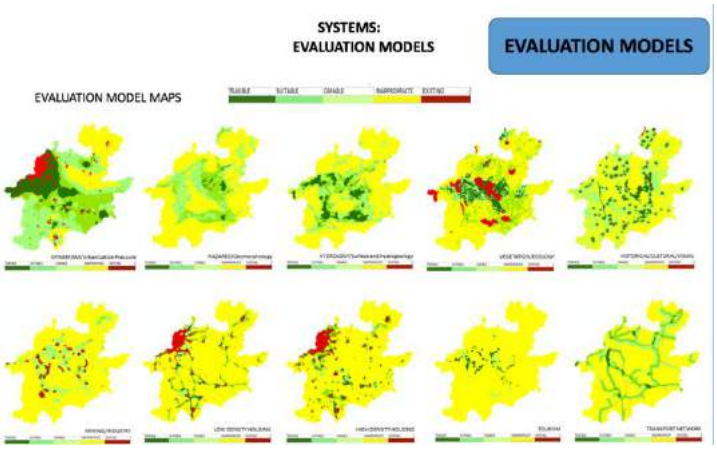

Figure 7 – From Process to Evaluation Models. Source: The authors.

2.1.4. STEP 4: HOW MIGHT THE STUDY AREA BE ALTERED? CHANGE MODEL.

Change models are the production of data in the phase of proposing interventions. They present data about the alternative futures proposed by the participants of the workshop. The participants of the workshop construct proposals of policies and projects to the area, according to each system. The proposals are presented in the format of diagrams. (Fig. 8). We observed difficulties presented by the participants in creating a relation between reality, mental maps and diagram designed. In some cases, people lost the sense of location, proportion and dimension while drawing their diagrams. As a result, we decided to face this issue improving possibilities of visualization as support to better understanding the process. The discussion of this aspect is the main contribution of this paper.

Figure 8 – From Process to Evaluation Models. Source: The authors.

2.1.5. STEP 5: WHAT DIFFERENCES MIGHT THE CHANGES CAUSE? IMPACT MODEL

The goal is to analyze possible different results to the alternative futures to urban and landscape areas. The coordinators must prepare an analysis of what means to propose a diagram (project or policy) of a system (theme) in a place of interest to other system. For example, according to the characteristics of the place, to propose a zone of commerce in an area of interest to housing can be positive or negative, going from most positive to neutral and to most negative. It is constructed a schedule of analysis in a matrix of systems impacts and cross systems impacts: the first one analyzing the combinations of the systems in general, in 5 levels of judgments (from -2 to +2, -2 meaning most negative, -1 negative, 0 neutral, +1 positive and +2 most positive) and the second one analyzing in detail if a proposal can increase or decrease the performance of an existing conditions. (Fig. 9)

The coordinators must also prepare studies about targets and costs. Targets can be understood as minimum values to be achieved in area to each system or limits of reference as maximum areas of proposals to each system (Fig. 10). To costs, the coordinator can give a value in hectare to deploy each system or theme. According to the matrix that are constructed, the user can obtain in dynamic cartography the result of each diagram that he proposes, because the impacts are calculated. It's presented in new maps simulating changes, but also in graphics that analysis how much it will cost and if the user achieved the target that was established.

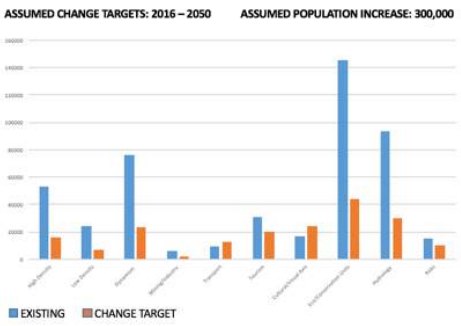

Figure 9 – Impact Analysis. Source: The authors and Figure 10 – Study of targets. Source: The authors.

2.1.6. STEP 6: HOW SHOULD THE STUDIED AREA BE CHANGED? DECISION MODEL.

It is necessary to have a broad condition to answer about the ideal landscape, considering expectations and collective values. The expectation is to use the processes and the tools to give support to decision-making about the alternative futures to the cultural landscape, choosing and proposing parameters, and structuring them in quantitative and qualitative references.

The meeting is organized to have rounds of proposals, going from 6 to 3 groups, and from 3 to just one group. The logic is the maximization of consensus. If it's not possible to arrive to a final proposal in one iteration (remember that the first iteration has the goal to answer "why" we are developing the case study), a second iteration must be done, to review the models and to answer "how", and then a third iteration can

be conducted to answer “where, what and how” the proposals can be implemented. In case study of Pampulha we could do 3 iterations, but Maria Tereza and Quadrilatero case studies we still should propose the reviews and the other iterations. (Fig. 11).

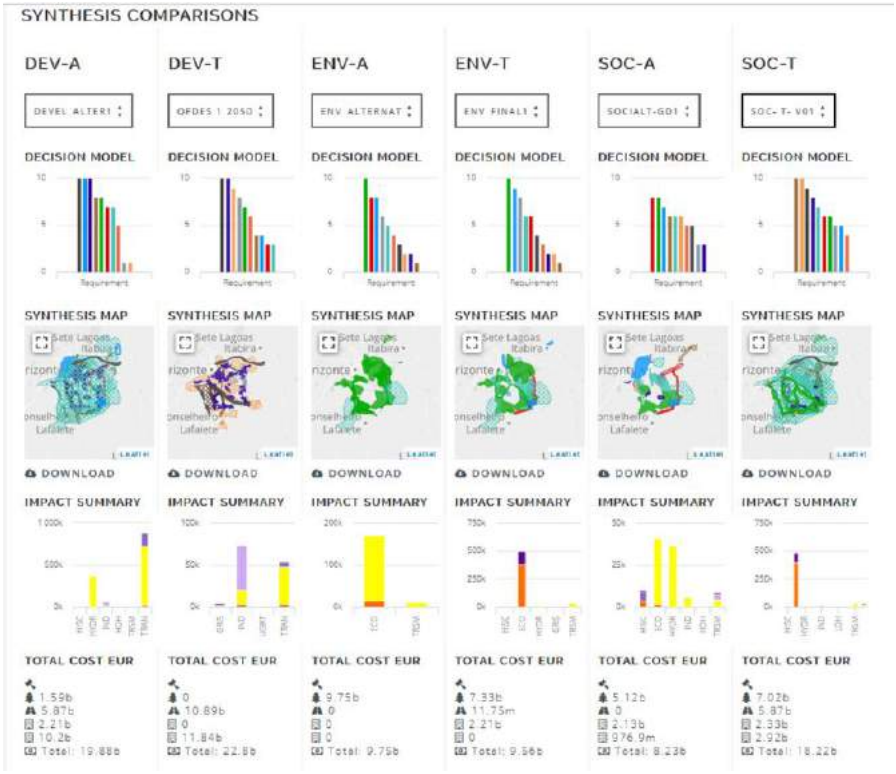

Figure 11 – The designs proposed and their performances. Source: The authors.

3. THE CONSTRIBUTION TO SUPPORT OPPINION MAKING IN DIFFERENT SCALES

While conducting the workshops we were very interested in analyzing how much Geodesign framework could really support opinion and decision making in very complex situations, characterized by conflicts of interests. Participatory planning in Brazil is still a goal to be achieved, and studies to support the processes must be developed. The Federal Constitution, approved in 1989, declares the obligation to involve citizens in all decisions about territorial planning, considering from land use to urban planning, but it was only in 2001, with the City Stature, that the first political instruments were approved.

We observe that the laws were important but not efficient to promote participation. Master Plans are voted in public meetings, with free access to citizens and their representatives, but the fact that they vote doesn’t mean they are really participating and been able to be part of the process. There is a lack in comprehension and visualization of the process (Zyngier and Moura, 2016). In the 3 case studies, we were very interested in controlling if participants were really understanding the steps and were really learning from the experience.

3.1. THE SCALE OF A REGION

In Quadrilatero Ferrifero case study we faced the difficulties in making people understanding the relation between reality and drawings, to understand the dimensions, to visualize alternative proposals and to have a common base to develop a dialog. It was the most difficult case study, because the goal was to promote participation based on defensible information and knowledge, and not only personal opinions or political opinions.

The main aspects were:

- The drawings and proposals were all completely out of scale: the users were constructing diagrams that were bigger than any other existing land use. They arrived at the point of constructing a diagram that covered almost the whole area, that has a media of 140 per 140 km.
- The users had lack of capacity of spatial location. Even using base maps, they had difficulties to understand the territory. The relation between reality, mental maps and digital maps proposed was very generalist. As a result, sometimes they were not accepting diagrams they believed were in conflict, but if they could understand better spatial references and scale they could see they were not in the same position, and the discussion could be: how far can a proposal be from another?

Some participants, as activists, didn't want to accept evaluation models proposed by others, even though the responsibility for each evaluation system was in charge of a professor from the theme. In this case, a process to promote visualization could be very interesting, to make people understand the construction of representation, process and evaluation models, so that they could recognize that the evaluations presented were sufficiently generic but also detailed to contain all their proposals and needs.

The lessons learned in this case study resulted in studies about visualization and interoperability that were tested in other case studies, and that are been in the research interest of the group. From this case study, it was developed a tool to facilitate the download and upload of the diagrams, to be seen in any other software. As a contribution to the Geodesignhub, we created a tool to promote interoperability, that could download the diagrams and designs and upload in any other application or visualization tool, as GoogleEarth or other one. (Moura et al, 2016b). (Fig. 12).

Figure 12 – Interoperability tool. Source: The authors.

3.2. THE SCALE OF A ZONE

The case study of Pampulha was about a very known zone in Belo Horizonte, that was in the central of attention as it was candidate to UNESCO's title. As it was a very known area, people were more able to present opinions and criticism about Representation, Process and Evaluation Models. But we also understood that the scale of work was quite adequate to make people feel comfort about having a mental map of the territory and going directly to discussions.

The main aspects were:

- A scale of "Zone", composed by different land uses and land cover, but connected to a common reference, because the zone has its limits and genius loci quite well defined and recognizable.
- The presence of spatial elements that could give references about dimensions, proportions and locations (as the airport, the zoo, the lake, the university, the boundaries and so one);

As a result, it was easier to the users to construct the link between reality, mental maps and digital representation. With a clear comprehension of the place, they were more able to discuss their ideas. To improve this condition, we developed, after the first iteration, a tool to improve the comprehension about combining variables to construct Evaluation Models. The tool was based in dynamic cartography and tested in in two platforms: City Engine and Grashopper + Rhino 3D. (Moura et al, 2016a).

The idea was to make people understand the role of variables and their combinations, as references to construct Representation, Process and Evaluation Models. Improving their capacity of understanding the logic, they could contribute more with suggestions in those steps, as we had already observed that they

were very interested in that. The applications developed had the goal to make people test Multicriteria Analysis in dynamic visualization, changing variables and their weight in a composition of an Evaluation Map. (Fig. 13)

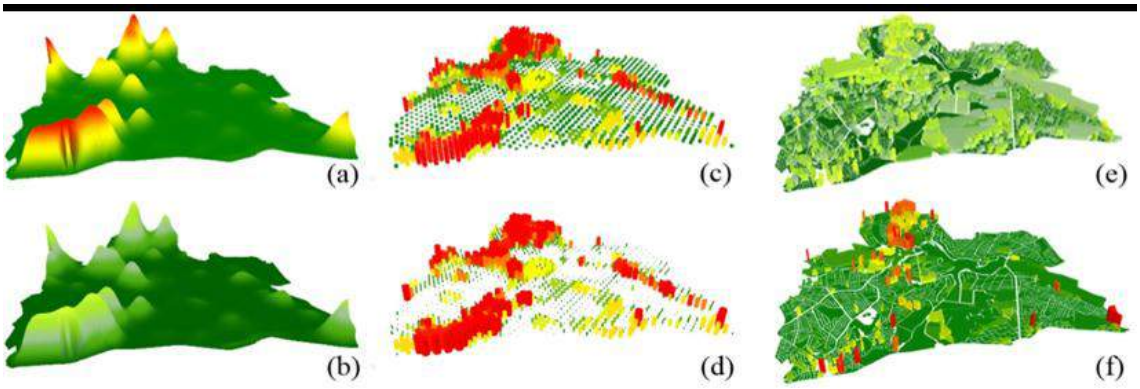

Figure 13 – Simulation of weights in Multicriteria Analysis – Rhino 3D and Grasshopper visualization facilities. Source: The authors.

3.3. THE SCALE OF A NEIGHBORHOOD

In the case study of the slum, as we had already observed the importance of providing a mechanism that people could understand the dimension of the diagrams. The need was presented to the programmer of the platform GeodesignHub that added the condition of measuring automatically the dimensions of each line of the polygon while drawing the diagrams. It was really very useful, and the measuring mechanism was added to the hub from that case study. (Fig. 14).

Figure 14 – Diagrams with measures. Source: the authors.

We also observed the importance of providing links from reality to mental maps and to digital designs. To keep the users always in touch with the idea of reality, a 3D Modeling, representing topography and the volumes of buildings was constructed, and during the workshop, while the participants were working in their proposals, a movie with the 3D representation was playing in the main screen of the room. We observed they used a lot the visual contact with 3D representation while they were projecting. (Fig. 15).

Figure 15 – 3D representation. Source: The authors.

To this level of local scale, neighborhood, the main aspects were: - The need to provide possibilities of automatically measure the dimensions, the faces of the polygons, because the lack of comprehension could result in diagrams very far from reality; - The need to improve the link between reality, mental map and digital representation while constructing the proposals;

4. CONCLUSIONS

Facing different scales of conducting a Geodesign workshop to discuss alternative futures to areas in conflicts of interests, we could contribute with tools and methods to improve the relation between data, information and knowledge. In some situations, we developed tools or procedure to contribute in the step of assessment (models of representation, process and evaluation), in others we contributed to the step of intervention (models of change, impact and decision).

This paper was more focused in situations that required improvement on visualization to face difficulties in constructing the between reality, mental map and digital drawings or projections. We also observe that different scales require more support of visualization tools to make that participants feel more secure to construct proposals. We may say that from this few case studies, that were not many but were very analyzed and observed, that the more the users don't connect with reality while taking part of Geodesign meeting, the more difficulties they will have to arrive to a common decision. Because sometimes, in the dynamic of combining diagrams and constructing a common design, they don't realize they are saying "no" to a proposal that is very similar to the one they say "yes".

The game of participation is very tricky because it has the risk to became just a game, in which people behave connected to the act of play and not connected to the act of using a tool to share opinions and decisions, even without realizing it. As much as we promote clear understanding of the steps and of the framework, the more these new digital and web-based tools can be used as a planning support system.

ACKNOWLEDGEMENTS

The Project "Geodesign and Parametric Modeling of Territorial Occupation: new resources of geotechnologies to landscape management of Pampulha Region, Belo Horizonte", was made possible in part by the support of National Coun- cil for the Scientific and Technological Development, Call MCTI/CNPQ/MEC/ CAPES No 22/2014, Process: 471089/2014-1, and "Geodesign e Modelagem Paramétrica da Ocupação Territorial: Geoprocessamento para a proposição de um Plano Diretor da Paisagem para a região do Quadrilátero Ferrífero-MG", Process 401066/2016-9, Edital Universal 01/2016 and to the Project "Programa Pesqui- sador Mineiro – PPM IX", Process TEC – PPM – 00059-15. We kindly thank Carl Steinitz for all his support in Geodesign concepts and methods, and Hrishikesh Ballal for the technological support.

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ID 1472 | SOCIAL MEDIA GEOGRAPHIC INFORMATION IN SPATIAL PLANNING

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1 INTRODUCTION

The term Geodesign has recently emerged among spatial planners and GIS scholars identifying an approach to planning and design deeply rooted in geographic analysis and able to inform collaborative decision-making. As an integrated and multidisciplinary process, Geodesign includes project conceptualization, knowledge building, analysis, alternative design, impact simulation and assessment, decision-making, collaboration and participation, involving political and social actors and relying on scientific geographic knowledge support. The main innovation in Geodesign compared to previous similar approaches may be found in the extensive use of digital spatial data, processing, and communication resources, such as Information and Communication Technologies (ICTs) and GIS, which in principles may enable a more effective use of scientific and societal knowledge in planning, design and decision-making (ERVIN 2011). As claimed by several scholars, planning professionals and industry experts, the current technology may be considered mature enough to exploit the ICTs support in the planning practices, overcoming many of the barriers which until now have limited de facto the usage of new geographic information technologies. In addition, since the last decade a growing wealth of both authoritative and user generated spatial data resources has started to be freely accessible, slowly shaping into reality the concept of Digital Earth (GORE 1998). The latter can be considered a driver for the creation of a working infrastructure able to facilitate the diffusion of Geodesign methods for it substantially hinder the traditional issues of lack of digital data availability.

Currently, two major categories of spatial data resources may be considered suitable for Geodesign approaches, namely Authoritative Geographic Information (A-GI) from Spatial Data Infrastructures (NEBERT 2004) and spatial User Generated Contents (UGC), commonly referred to as Volunteered Geographic Information (VGI) (GOODCHILD 2007). These two types of spatial information are notably different in nature, but together they might foster advances in planning and design practices exploiting informed decision-making and eventually contributing to more sustainable development processes. Particularly, a subset of VGI, namely Social Media Geographic Information (SMGI), which is the information produced and shared through social media platforms, might enhance the opportunities to collect not only geographic information representing the current conditions of the study area but also the perceptions of users about spatial phenomena.