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Co-Design and Co-Decision: Decision Making on Collaborative Design Platforms

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Abstract

On the background of an increasing interest in participatory approaches in urban development, a multitude of participation methods has been created and tested over the past years. They key issue decision making in participatory settings, however, remains an open question, especially in digital forms of participation. While in conventional non-participatory approaches, decisions are made largely without public communication, common-use participatory formats either follow a highly diffuse way of decision making, or fall back onto limited methods such as voting or tally sheets. Responding to the rising demand for digital participation in urban design, this paper investigates effective decision making in participatory non-digital workshop formats in order to translate them into digital formats. The article reviews key challenges in urban design decisions, interprets them on the basis of participatory approaches, and proposes decision making models suitable for translation into digital tools. The paper refers to decision making in contexts such as law, design or engineering and demonstrates how principles borrowed from such realms can be adopted for formalizing the demand description (User Story) for the development of digital interaction tools. This paper is associated to the EU funded Horizon2020 project "U_CODE Urban Collective Design Environment" which creates a new co-design platform for massive participation in urban planning and design.

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Keywords: Urban design; Urban development; Decision making; Workflow, Design Science

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1. Introduction

The last years have witnessed an increasing interest in participatory approaches in urban development. Citizens demand direct involvement in urban development projects beyond the level of mere information. They ask for active roles in the overall process as co-creators and decision makers. Thus, it has become difficult for municipalities and governments to carry out large scale development projects without appropriate involvement of civic stakeholders. Subsequently, research on, and application of participatory methods and tools is increasing, and there is a growing body of knowledge on the issues of participation, co-creation, and co-design.

A key issue in this context is the question of decision-making. On the one hand, design and planning projects – not only on urban scale – are to a large extend decision-making problems. Designers and planners need to select appropriate and feasible solutions from a variety of possible answers to their given problems. On the other hand, many of the formal procedures established in public and planning law (e.g. building permits or formal public consultation) were implemented to support efficient decision making in the face of complex planning and construction endeavors.

On the background of emerging participatory approaches in urban planning and design, the established (formal) decision making processes need to be reconsidered. New procedures are needed that allow quick and reliable decisions also with the involvement of much large stakeholder and decision-maker groups. The experiences and lessons from a wide range of participatory projects all over the world have formed a rich knowledge basis for this. While a multitude of successful methods and tools was created and described already, participatory decision-making still remains an open question. While there is much research existing on design participation in general, the decision making principles in participatory approaches are still not clarified. Validated tools and methods to supply decision-making are hard to find; most of the established decision support systems focus on business decisions by single persons. Nonetheless, well-established participatory workshop format such as Design Charettes, Bar Camps or Open Spaces more or less tacitly employ decision-making procedures in order to progress the projects at stake to their next level, e.g. with well-known instruments such as voting or tally sheets. While they may be effective in creating some solution and decision, it is doubtful whether the results do fully reflect the necessary levels of knowledge, fairness, and reliability. Further research is due which shall reflect concepts from social psychology, organization learning, and design management.

The strong demand for participation instruments has shifted the interest of all interest groups to digital formats. As conventional participation events (workshops, debates, public presentation) suffer from only involving a small and highly selection-biased participant group, digital tools promise participation on a higher quantitative and qualitative levels. First, they may enable participation on a massive level by addressing thousands of participants online, thus turning into genuine crowdsourcing or citizen science. Second, digital tools may reach user groups that are otherwise out of reach for ordinary participation formats, be it for geographic, social, or cultural reasons. As a consequence much effort is currently invested in the development of digital participation tools, the U_CODE project being one of them.

In the area of digital participation the above mentioned deficit in regards to decision making attains special urgency due to the strong effect that such massive participation tools may have. Decisions made on a participation platform potentially involve thousands of contributors and may lead to forceful impacts on communities and societies. A thorough understanding of how decisions are prepared, how they come about, and what responsibilities are involved seems necessary. This paper wants to address this key issue and sketch a first guideline how decision making in digital participation tools may be conceived. The idea of the paper is to review proven and effective decision making processes in conventional (non-digital) participatory workshop formats, and translate them into digital tools and processes. The paper presents ongoing research in the context of the Horizon2020 project U_CODE, which is tackling the issue of massive participatory design and subsequent decision making problems. The text discusses in how far such a translation is possible and meaningful, and outlines the limits of the approach.

2. 2. Problem Description & Theoretical Background

2.1. U_CODE Urban Collective Design Environment

The H2020 project U_CODE aims to create a co-design platform for urban design that allows participation for a large number of (simultaneous) participants. Besides technological and conceptual challenges ranging from the implementation of interactive public co-design spaces to the definition of suitable interaction technologies, decision making emerged as a key issue in the course of the project when a procedural blueprint for the digital platform was schemed, the so-called Minimal Viable Process (MVP) (Figure 1). The MVP describes the entire process from project initiation towards the output of a valid design scheme. It comprises the necessary participatory features and functions, and assigns roles to project stakeholders and participants. The MVP includes following key processes all of which imply aspects of decision making by one or multiple stakeholders:

- Project Initiation (decision whether a participation project is run or not)
- Co-Briefing (collecting and prioritizing design relevant information)
- Co-Designing (co-creating design alternatives and selecting favorites)
- Professional Design (creating design alternatives and selecting quality solutions)
- Ranking Voting (public assessment of selected solutions)
- Integration (integrating public assessments and results from social media analysis)
- Approving (gaining acceptance on the side of project owners / initiators)
- Formal Assessment (checking proposals against building codes and regulations).

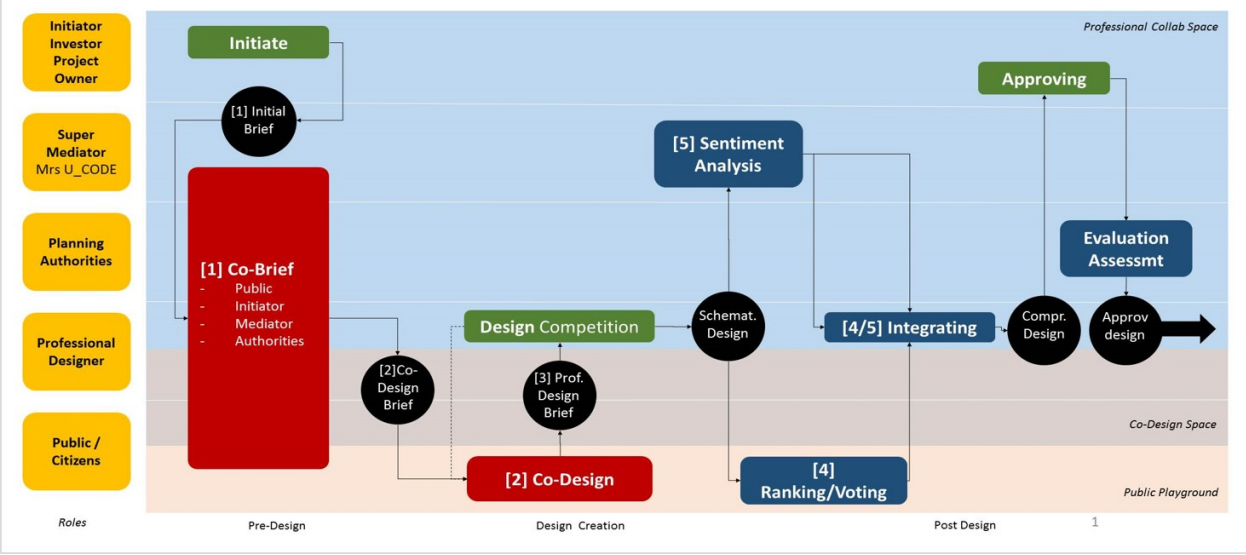

Figure 1 Minimal Viable Process (U_CODE)

Any of the steps indicated above converges into points where the future development of the project at stake is being decided. While conventional design practices have established effective forms of decision making such as competition juries, the case is more complicate in participatory co-design. How decisions are made under circumstances of massive public involvement demands closer investigation. In order to facilitate the overall co-design process and decision making on the platform, U_CODE has devised a new management role. The so-called Super Moderator (SuMo) is a person or a group of persons that manages the platform tool, moderates stakeholder groups, and ensures steady progress from start to end. To support the SuMo, a decision support tool as well as a process design tool will be developed within the U_CODE project. The scientific basics for this are outlined in this paper.

2.2. State of the art

Although only few literature can be found about decision making in digital participation processes, various researchers have already addressed the issue of design problem solving and decision making [1, 2]. In the field of architecture and urban design, Christopher Alexander has argued for a rational process in decision making [3]. However, it was Herbert Simon´s systematic description of the design sciences as problem solving processes which made decision making a central concern in the design field [4]. Contemporary concepts draw for instance on gaming approaches where decisions are achieved in a playful and informal manner [5]. In systematic form, Anderson et al. have described the problem solving process with following steps: 1) Identify and define the problem. 2) Determine the set of alternative solutions, 3) Determine the criterion or criteria that will be used to evaluate the alternatives, 4) Evaluate the alternatives, 5) Choose an alternative, 6) Implement the selected alternative [6]. Here, steps 1-5 are associated to explicit decision making. This present paper focusses on the steps 3-5: criteria setting, evaluation and selection of alternatives (step 1 represents the initial brief of an urban design project; step 2 can be regarded a basic activity of any design endeavor).

Another important reference are models that describe the design process as a succession of divergent and convergent phases. A prominent example is the Double Diamond scheme (Figure) often used in Design Thinking [7, 8]. The basic pattern connects a divergent phase dedicated to the production of alternative variations with a convergent phase which assesses the variations and selects an appropriate solution to continue with in the further process. This diamond shaped basic pattern can be sequenced to form a chain of diamonds (hence “Double Diamond”) [9], with some models presenting complex versions of this principle [7]. The divergent stage of design processes is well described and understood [10, 11]. There is relatively rich knowledge about the stimulation of creativity and the generation of alternatives [11]. This is represented in Figure by the divergence / ideation stage. The convergence phase, significantly, is explicitly based on decision making, an aspect often neglected in the literature and practice of Design Thinking. The selection of “survivor” variations resp. the exclusion of insufficient ones needs a) an act of deliberation as well as b) decision making criteria and values. Anderson et al. have highlighted the definition of criteria (step 3) as a prerequisite for any later assessment of solutions. Few theories in the context of design theory have explicated this critical step on which much the overall process and its results rests.

Jannack et al. [12, 13] have suggested to distinguish three modes of creativity. Beyond artificing creativity (Mode 1) which is about ideation and the production of new objects, there exists also a problem solving and organizational creativity (Mode 2) which solves problems by re-arranging structures, and, importantly, a value-setting creativity (Mode 0), which establishes the measures and criteria upon which the pursuit of Mode 1 and 2 depends. It has become clear that – instead of a creative over-production of ideas or solutions already at the outset as a result of direct entering into creative Modes 1 and 2 – an early-on definition of success criteria is necessary to ensure that useful concepts and solutions are being focused upon in the ideation and problem solving modes. While such approach may be less dynamic and somewhat limiting at the outset, it navigates all later creativity into a valid direction.

2.3. Hands-on decision tools – Decision making in workshop formats

Observations of workshop facilitated by the WISSENSARCHITEKTUR Laboratory of Knowledge Architecture have provided a resource for the systematization of decision making processes in participatory or co-design settings. It was observed that the implementation of architectural methods such as sketching, modelling or hands-on building is a successful way to increase collective creativity and innovation. Yet it is not only the creative techniques that are influencing the workshop decisions and results. The design of the procedure as well as the pre-arrangement of tools, methods and sequences has emerged as a key driver for successful interdisciplinary cooperation [12, 13]. Since 2011 the laboratory has tested different workshop formats for participants like technology cluster managers, teachers, political decision makers, or scientists. The workshops commonly focused on the collaborative generation of scientific projects or industrial products. Gräning et al. [14] have stated that the implementation of a so-called “Impulse Team” to review, edit, and evaluate the generated pool of ideas is a key feature to process successful collaboration and co-innovation (Figure). In the specific case, the Impulse Team members of Silicon Saxony´s Cyberphysical Systems

cluster had to decide upon ideas for technology and business ventures created by technologists and managers. Complex decision criteria were generated for the assessment e.g. level of complexity, feasibility, degree of innovation, attractiveness, need for this product, research demand, application areas, competencies, implementation.

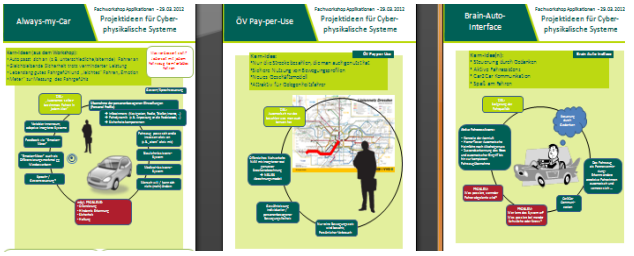

Figure 2 Ideas edited by the CPS Impulse Team

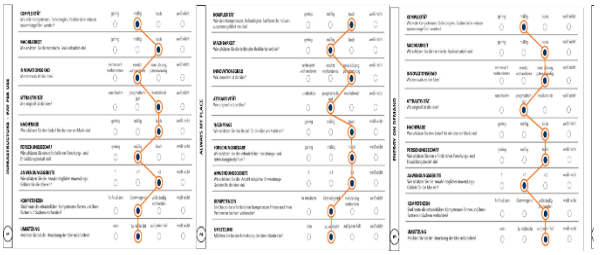

Figure 3 Assessment template for CPS challenges

Another rich resource for identifying rules for collaborative decision making are co-design workshops on topics of workplace design. In multiple occasions, researchers of the WISSENSARCHITEKTUR Laboratory of Knowledge Architecture have motivated employees of software, design, and engineering companies to determine the key features of their work environment. Here, pen-and-paper methods and well-facilitated face-to-face interactions were sufficient to enable large groups of people to simultaneously co-design and co-decide. The largest number of people handled so far were 120 participants co-designing one urban quarter at the same time in one space over the period of 4 hours (Figure 3, 4). The expertise and knowledge accumulated in such experiments was funneled into workshop designs for the U_CODE project itself, which is to enable co-design on a massive digital scale. The demand comes from all stakeholders in participatory urban design – that is: citizens, investors, political decisions makers, authorities, planners and managers. As face-to-face and pen-and-paper approaches are no sufficient methods here, the insights from above mentioned techniques need to be transferred to intelligent ICT solutions which can address much larger audiences and safe resources on scale.

Figure 3 Co-deciding architectural features of a company HQ

Figure 4 Co-deciding the U_CODE project roadmap

3. Methodology

In order to derive valid principles for decision making in participatory urban planning, the following sections of this paper will 1) describe a general typology of decisions to be taken in design work, 2) transpose the decision-making typology to massive co-design context, 3) provide use cases and user stories for a co-design platform component to be developed, and 4) sketch a decision support tool.

3.1. Typology of Decisions

The decisions that must be taken throughout the stages of a co-design process (see section 2.1) differ in their nature. In early stages such as the co-briefing, decisions are case-by-case decisions e.g. about items to be included in a design brief. In the latter (co-)design phase, decisions attain a more comparative character e.g. when from different proposals a top-runner must be identified. It is noteworthy that complex decision problems may arise with conflicting – if not paradoxical – situations. For example, a public voting for a design proposal may offensively contradict expert's votes, or a public voting contradicts the success criteria that were defined by the same public earlier in the same process. From the MVP, the following key types of decisions were derived which – explicitly or implicitly – apply to any kind of design work:

- Priorizing / ranking design information according to pre-set values
- Selecting / unselecting solutions according to pre-set criteria
- Value setting, or definition of decision-making criteria.
- Stakeholder setting to define who contributes to the process.

Priorizing / Ranking: A key type of decisions in any design context is the assessment of the quantity and quality of information on which the design work will be based. Despite maximum information provides good basis for design work, the infinity of data of any surrounding context needs to be limited by some criteria. Only a shortlist of items can be taken into consideration. To establish such a set of constrains for design work, a priorization of information according to project relevance is due.

Solution Selection: A basic activity of design work is the selection of appropriate solutions from a range of alternatives. In order to narrow down the number of possibilities generated in the convergent phases of a design process (e.g. by brainstorming, sketching, test modelling) insufficient alternatives must be excluded, and more proper ones singled out for further refinement. This process too is based on implicitly or explicitly defined fitness criteria.

Criteria / Value Setting: As shows in the two paragraphs above, the ability to carry out ranking and selection rests upon the setting of key values and quality criteria for the project intended. Anderson et al. have highlighted the definition of criteria (step 3 in the list above) as a prerequisite for any later assessment of solutions. The value or criteria setting contains two steps: 1) different criteria have to be collected, 2) every criterion has to be weighted (multi-criteria analysis according to Bujis and van der Meer [15].

Stakeholder Setting: A crucial aspect in co-design processes are the stakeholders in charge of decision making, the contributors of values and judgements. Thus the definition of persons and groups who need to be involved in decision making is a key decision in itself which determines to large extent the level of participation, transparency and democracy of the entire process. Next to the definition of involvement, the definition of veto rights is important to avoid decisions in favor of impossible solutions.

3.2. Adaptation to massive co-design

While experienced designers in a conventional design process can fall back on their own professional knowledge and rules, co-creative crowdsourcing projects involving a large number of lay participants cannot draw upon such resources. All of the three decision types described above must be reinterpreted on the background of massive participation thus.

For decision-making in collaborative projects the criteria setting regards the criteria themselves as well as the involved parties and stakeholder groups. In order to make public co-creation a goal-oriented process, the criteria setting must take place before any design information is gathered or solutions are generated. While in small-scale workshops it may possible to define criteria *a posteriori* i.e. after a creative process has commenced, such process is rather dangerous in public co-design settings.

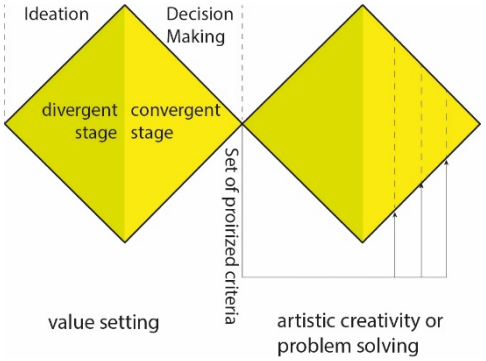

Figure 5 Double Diamond of decision making

To create a meaningful digital process with a participants number >1000, it is very necessary to clearly outline the overall process as well as the basic criteria to prevent later disruption, and to facilitate a smooth procedure in general. This approach is displayed in Figure 5 with the first "diamond" – here the value setting happens; whereas the second "diamond" describes the creation of alternatives. Both diamonds feature divergent stages of idea creation plus convergent stages of decision making. The criteria set up in the first diamond is the basis for the second diamond´s decision making about actual design alternatives.

It`s important here to juxtapose the different stages of the overall MVP (initiating, briefing, designing etc.) with the different stages of the double diamond (divergent ideation / convergent decision making) as implicated in most of the MVP stages.

3.3. Criteria / Value setting in U_CODE:

To enable reliable decisions on the basis of shared values, design criteria must be defined and weighted prior to the start of the decision making process. As a value template for the Super Moderator, we have set up a proposal of (unweighted) criteria (Table 1) for each step of the whole MVP. It may be modified according to the requirements of each project or even set up completely new. Once weighted, every criterion needs to defined in regards to its degree of fulfilment. The fulfilment of certain criteria may be mandatory, while others remain optional. This activity of criteria setting also provides an opportunity for higher-level participation in accordance to the first diamond in Figure 5. Just as the urban design proposals, also the criteria list and weights may be co-developed with the stakeholders, for example by way of a brainstorming tool. Another approach to the same end is a gaming environment stimulating stakeholders to weight different predefined criteria. Interestingly, such interaction may reveal the priorities of the stakeholders, especially of the public whose general value-set is otherwise hard to define. With a more practical approach, however, the SuMo may define and weight the criteria himself. Table 1 makes a distinction between content-based criteria, such as attractiveness or also formal quality and process criteria (written in italic) such as emotion level or the number of winners.

Table 1 Criteria for decision on different project stages

Initial Brief	Project volume, duration, brief, project concept, definition of target group, simplicity of description
Co-Brief	Content-relation, formal quality, comprehensive as possible, basic project information, multimedia
Co-Design	Compatibility to the Co-Brief, originality, attractiveness, level of collaboration
Design Competition	Compatibility to Co-Brief, cost-effect, technical integrity, versality, number of top running projects
Sentiment Analysis	Influence to design process, level and value of information, Emotion level, publicity, analysis scope
Ranking/Voting	Differentiation, level of information, information content, scope of participation
Integrating	Coherence with previous decisions

The definition which stakeholder groups need to be involved in decision making shall depend on the stage of the process, as in different stages different stakeholders are engaged. There is a preset defined with the MVP (Table 2) but the SuMo may modify the setting according to project context and aims (optional participants in brackets in Table 2). For the actual decision making, the SuMo (or the public) defines prior to the process the influence of the vote of the different stakeholders, as well as their right to veto. There should be also a procedure of exclusion, e. g. professional designers who have a vote for the Co-Design are not allowed to join the design competition. With this approach a jury systems occurs.

Table 2 involved parties to decision making in different stages of the process

Phase	**Involved Parties**
Initiation	Organizers (Super Mediator and Investor)
Co-Brief	Super Mediator, Authorities, (Public)
Co-Design	Public, Authorities, (Professional Designer), (Project Owner)
Design Competition	Professional Designer, Authorities, Project Owner, (Public)
Sentiment Analysis	Super Mediator
Ranking/Voting	Super Mediator
Integrating	Super Mediator, Professionals (Authorities and Professional Designer)

After the different parties have voted with the weighted criteria, the SuMo concludes the votes and determines whether the output has achieved the required quality. He decides whether a) the project proceeds to the next step, b) runs through the last step again or c) is cancelled. For example: according to predefinitions, an overall fulfillment rate of >80% may bring the project to the next step of the MVP, a rate between 80% and 15% may necessitate to repeat the last step, while a rate below that would stop the process entirely. Obviously these values are subject to discussion, however, they shall be properly determined by the SuMo and / or the involved stakeholder groups, including the public and the project owner.

3.4. Use Cases / User Stories in U_CODE:

In order to implement a decision-making component for the envisioned co-design platform in U_CODE, use cases and user stories were derived. Being a typical approach in software development, they specify the features and functionality of the future component by lining out specific demands of specific users. Commonly, user stories follow a descriptive pattern that proceeds from the definition of a role ("As …") to an activity to be carried out ("… I want to …") to a defined output ("… so that…"). Apart from established roles (authorities, project owner, design jury) decision-making is most crucial in the cases of new decision makers being in charge in the co-design process, i.e. the citizens and the SuMo. Thus the user stories below describe the components features only from their perspective.

Table 3 User stories for decision making

As	**I want to**	**so that**
Citizen	be presented criteria and value scales that are easy to understand	I can compare different alternatives without problem
Citizen	attach relative weights to a list of criteria	I can express which criteria are of importance for me
Super Moderator	determine the influence level of stakeholder groups	the level of stakeholder influence can be adapted to individual stages of the process
Super Moderator	allow citizens to determine the influence level of the participants	the overall process is as transparent and participatory as possible
Super Moderator	determine criteria and their mandatory level, attach relative weights and a measuring scale	I have a possibility to make a sustainable decision

3.5. Platform Decision Making Tool in U_CODE:

On the basis of the user stories, a first edition of the U_CODE platform´s decision making component was designed which can be configured by the SuMo in respect to crucial decision-making steps throughout the overall process (Figure 6). In essence, the tool supports decisions about the further progress of a co-design project (Proceed / Return / Stop). Besides the design of the overall process in itself, this is the very responsibility of the SuMo who is in charge of determining the following decision influencing factors:

- parties involved
- parties´ degree of influence
- veto rights
- decision making criteria,
- mandatory degree of criteria
- relative weight of criteria
- type of scale and value
- fulfilment degree of summarized criteria.

It has become clear that the participation level of the entire process depends on how criteria and responsibilities in the multiple decision making steps are set. Key factors e.g. involved stakeholders, stakeholder influence, decision rules etc. need to be responsibly defined by the neutral SuMo. For a number of factors, however, it is possible that citizens too involve in the setting of the decision making tool. While this is a task hard to communicate to a public audience, it nonetheless maximizes the degree of transparency and participation. Easy to communicate participation may be possible in the setting of influence, the criteria selection and – before all – the weighting of criteria.

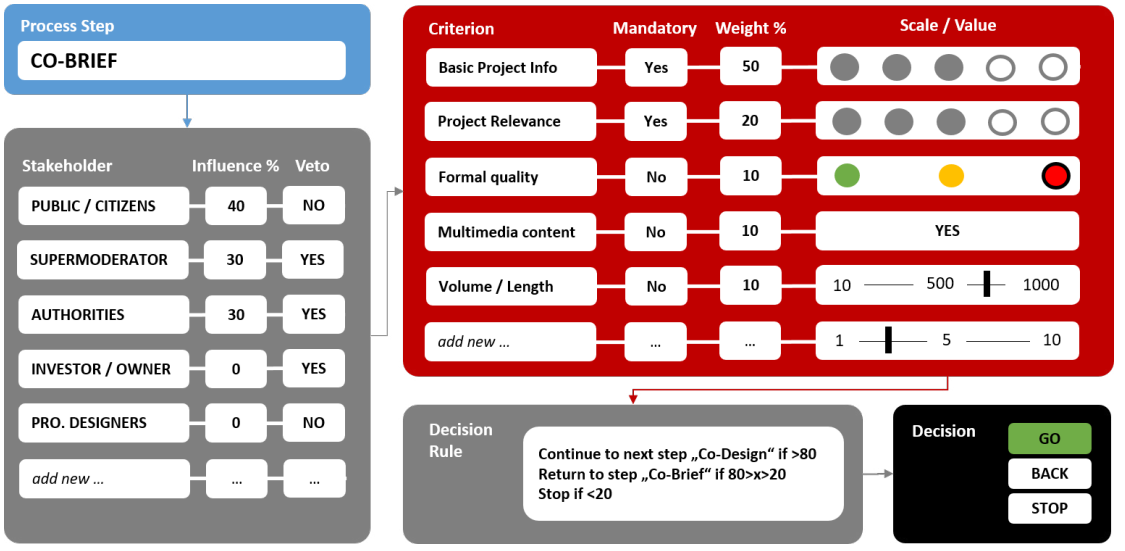

Figure 6 Scheme for the U_CODE decision support tool

In the concrete tool, the factors above are presented as individual menus to which either the SuMo or other stakeholders can attach values. Within U_CODE basic settings for the decision making tool will be prepared to function as fallback option. However, it is the obligation of the Super Moderator to assess the appropriateness of these pre-sets, and alter or create new settings in accordance to specific projects.

4. Conclusions & Outlook

The paper has presented a decision making tool as part of a co-creative digital platform for urban design. It addresses an eminent problem in participatory design processes, especially in digital-based format: How to derive from a multitude of opinions and votes a reliable decision about the path to be taken in a co-design process and which solutions to follow. The tool enables decision making with a large number of participants (“crowd”) and supports the

facilitator of co-design processes (SuMo) in complex decision making situations. For this, the SuMo is equipped with an instrument that sets all decision influencing factors in accordance to the intended level of participation. The SuMo can safely derive decisions re. the further progress of a co-design project, while being able to show and explain all factors in a transparent manner. What is more, the definition of the factors (e.g. setting of influence degree, definition of stakeholders to be involved etc.) may become in itself a participatory process, as it can be negotiated with stakeholder groups, especially public citizenship. From the user stories and further technical detailing, a functional component will be created and tested in near future. The component will possess a GUI custom tailored to the usage by a SuMo. Further it will possess interfaces to other core components of the U_CODE platform, e.g. ranking / voting engines, interactive design tools, and social media analyzer. The decision making component will be implemented as part of the U_CODE platform within project time. Beyond U_CODE, the sketched tool provides a methodical basis and a beyond-the-state-of-the-art instrument for other crowd-sourced design endeavors. Finally, the project extends the state of research in problem solving and decision making theory in the context of the design sciences.

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