Reframing Societal Discourse as Requirements Negotiation: Vision Statement

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Abstract-Challenges in spatial planning include adjusting settlement patterns to increasing or shrinking populations; it also includes organizing food delivery in rural and peripheral environments. Discourse typically starts with an open problem and the search for a holistic and innovative solution. Software will often be needed to implement the innovation. Spatial planning problems are characterized by large and heterogeneous groups of stakeholders, such as municipalities, companies, interest groups, citizens, women and men, young people and children. Current techniques for participation are slow, laborious and costly, and they tend to miss out on many stakeholders or interest groups.

We propose a triple shift in perspective: (1) Discourse is reframed as a requirements process with the explicit goal to state software, hardware, and organizational requirements. (2) Due to the above-mentioned characteristics of spatial planning problems, we suggest using techniques of requirements engineering (RE) and CrowdRE for getting stakeholders (e.g. user groups) involved. (3) We propose video as a medium for communicating problems, solution alternatives, and arguments effectively within a mixed crowd of officials, citizens, children and elderly people.

Although few spatial planning problems can be solved by software alone, this new perspective helps to focus discussions anyway. RE techniques can assist in finding common ground despite the heterogeneous group of stakeholders, e.g. citizens. Digital requirements and video are well-suited for facilitating distribution, feedback, and discourse via the internet. In this paper, we propose this new perspective as a timely opportunity for the spatial planning domain - and as an increasingly important application domain of CrowdRE.

Index Terms-Spatial planning, CrowdRE, requirements engineering, video

I. NEGOTIATION IN PUBLIC SPATIAL PLANNING

Public decision-making often takes place in the tension between innovative, competing ideas, and controversial opinions. Informal interest groups tend to be large and heterogeneous, with implications for the possible modes of discourse: There are commercial and other private stakeholders representing different roles, ages, positions, and intentions. Complex dependencies and technical language will not reach all of them. In many spatial planning problems, it is not easy to involve all relevant citizens and get all affected groups involved in the process of discourse and decision-making. Only a small selection of stakeholders participates in decision-making processes. Typically, only a few active "speaker" comment and express

their opinions in interviews, focus groups, or feedback. Due to the varying educational backgrounds, stakeholders including informal interest groups need to be supported in different ways. This will enable them to contribute to informed decisions.

Town hall or other plenary meetings are costly, difficult to schedule and thus, rare; a discourse that relies on continuing communication and discussion will suffer from long pauses, oblivion in-between meetings, and the need to spend a significant part of the precious meeting time on updates and explanations. Larger stakeholder groups will hardly ever meet.

When citizens and members of different societal groups meet, there is not necessarily a common language or common ground to build on. Providing information in an adequate form is essential to bridge those gaps. This information will have to convey basic facts: stakeholders need to be informed about different alternative solutions, both in the large and in detail.

This situation has a lot in common with the communication gap between customers, requirements engineers, and developers of software [1]. However, the style of interaction between software customers and developers tends to be more solutionoriented and less emotionally loaded than spatial planning discourses. In a software project, parties start from the assumption that they want to create useful and usable software. The overall goal will be similar across different proposals.

Therefore, we suggest pretending to plan for software that will support solving the spatial planning problem. In order to specify that software, diverging opinions on solution alternatives must be resolved, too. Although software may be only a small part of the solution, the stronger focus on technical services instead of human convictions can help to make the discourse, in general, more effective. We are aware of the limitations of this proposal; technocratic approaches are definitely not the best or only solutions to societal problems. However, the attitude of defining and discussing and negotiating the supposedly easy technical part could indeed stimulate and facilitate discourse. In fact, many of the traditional, long-lasting discourses lead to a second round of defining software support. When that happens, building on existing requirements *already* adopted during the first round of discourse can save time and money. We approach this vision in an interdisciplinary way.

RE is a discipline with a long history of taking its application domains very seriously. It provides cross-cutting techniques for all phases of the requirements analysis. Interviews and workshops are already used by both requirements engineers and by spatial planners; other techniques have not gained much attention in the planning field: Examples include goal modeling, exploration of work processes and user interfaces through use cases or mockups. We propose to consider the entire range of formal and informal RE techniques, and videos in particular. Videos are the best documentation option for communication between people who are globally distributed [2]. This medium provides the benefit of capturing extensive verbal and nonverbal information [3]. Furthermore, videos are easy to share and can be used by anyone [4].

In order to motivate our approach, we introduce spatial planning in Sec. II and show a real example in slightly more detail (Sec. III). In Sec. IV, we identify relevant RE techniques. In particular, we highlight techniques from CrowdRE which closely match the needs of public discourse. Sec. V presents related work. In Sec. VI, we outline our plans for evaluation, which will require long-term interdisciplinary collaboration. Sec. VII concludes the paper.

II. THE DOMAIN OF PUBLIC SPATIAL PLANNING

Spatial Planning takes place in a field of different initiators, performers, and dimensions of formalization. Planning processes can be initiated by the state or municipalities (topdown) as well as by citizens or other private stakeholders (bottom-up). Formal processes are characterized by binding and formalized procedures and outcomes, while informal processes are not regulated by law and their outcomes can be binding only for the administration, but not for other stakeholders (see Fig. 1). Due to political decision processes, participation of public agencies, public participation, regulated sequences and weighing alternatives, planning processes often take years from creating the project or plan idea to realization (*challenge 1*).

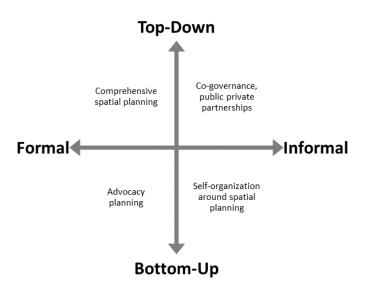


Fig. 1. Different types of spatial planning, based on [5]

In bottom-up processes, communication and coordination of the different stakeholders - mostly non-decision makers is quite important. In top-down spatial planning, the role of public participation differs in formal and informal processes. According to Arnstein [6], formal planning processes include participatory elements on the level of informing and consultation, which means information on the plan is provided; public agencies, authorities, and citizens are entitled to formulate their views during the plan preparation procedure. However, informal approaches are comparatively free of legal limitations and open for the active shaping of the project. Public participation concentrates on achieving consensus [7].

Although public interest in projects and participation is comparatively low at the beginning of the planning processes, the possibility for citizens to yield their interests is very high. The possibility of influencing the project will drop during the project period, but the public interest will rise (see Fig. 2); this is called the paradox of participation [8]. Therefore, early public participation makes sense and could be highly effective, but struggles with attracting participants (*challenge 2*).

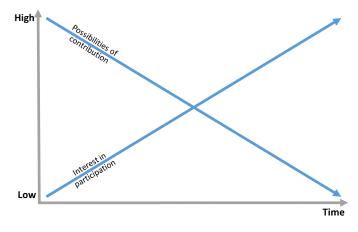


Fig. 2. Paradox of participation, based on [8]

In comparison to Requirement Engineering, public formal planning as a process is less "user-oriented" and less oriented towards stakeholder participation. Instead, it focuses on the general welfare and weighing of private and public interests. As the request for public participation is getting stronger during the last years, many municipalities implemented informal participation in planning processes. CrowdRE with its participative elements offers potential to be implemented in participation phases of informal and bottom-up spatial planning processes. The combination with Requirement Engineering seems to be even more useful if the project's realization can benefit by the Requirement Engineering techniques for eliciting, negotiating, and validating varying perspectives. The following example is used to demonstrate where CrowdRE could be added to spatial planning projects.

III. REAL EXAMPLE: FOOD SUPPLY IN RURAL Environments

Many rural areas in Germany are facing severe challenges regarding the local food supply. Due to demographic and structural changes, retailers are moving from smaller to bigger villages, to small towns, or even concentrate on greenfield developments outside of settlements. Consequently, local residents in rural areas face long-distance driving to stores and supply facilities. As a consequence, residents become more dependent on motorized private or public transport. Public transportation in a sparsely populated area is often insufficient.

A. Proposed Solution of the Example Planning Problem

In this setting, local citizens cooperating with transdisciplinary research processes develop ideas of a new local supply infrastructure. The following example "LieferBar" [9] aims at finding out whether and to which extent social networks as well as the readiness to cooperate among stakeholders – in view of difficult demographic and economic preconditions – may contribute to context specific solutions for local food supply in affected municipalities.

The modular infrastructure of "LieferBar" is based on a vending machine concept, providing drawers for different goods adjusted to local and current needs. Producer, distributors and service providers – such as bakeries, farmers, grocers, postal services, pharmacies, libraries or bicycle shops – rent a drawer to offer their goods and services. The approach leads to lower personnel cost, and local residents have shorter ways. The supply infrastructure can combine constant supply, as for imperishable goods or permanent services, with oncall purchase. Coordination and on-demand supply require a software application to coordinate supply and demand, and potentially optimize delivery routes and schedules.

B. Challenge of Participatory Decision-Making – In a Crowd

In situations like rural supply on demand, there are several options available: (a) Goods could be delivered by different stores independently and according to a statistic of past demands; alternatively, (b) customers could order specific demands individually over the internet; stores could coordinate their deliveries. (c) For urgent needs, even private parties and citizens could offer to pick up goods in town if they happen to be there anyway. All of these options have advantages and disadvantages for various stakeholders. Developing a solution in the traditional way would take years; ideas that were innovative in the beginning, such as "LieferBar" may be outdated by the time of implementation. After the principal decision has been taken, software development starts, almost anew.

In this paper, we propose to use RE and crowd-based approaches for speeding up the process and for stimulating a lively early debate. In particular, we want to include the issue of software support in the early phases of planning alternatives. In the above-mentioned example, options (a,b,c) will require substantially different software support. By focusing on the software requirements early reverses the typical order. We expect a more concrete discussion much earlier in the process and an excellent interface to a potential software acquisition or development phase.

The intention behind the software-inspired process is to offer rich information earlier and in a more captivating way, thus getting stakeholders involved, discussing on a more concrete level. Ideally, the presentation of potential solutions via mockups, videos, and simulations should help to avoid the participation paradox (see Fig. 2). Furthermore, crowdbased approaches, which have been successfully established in planning processes can be used to make the evaluation of realized projects much more attractive.

IV. RELEVANT RE TECHNIQUES

In this section, we briefly review a selection of well-known RE techniques with respect to their suitability for spatial planning. Other techniques may be considered as well, but are not listed due to space restrictions. TABLE I summarizes the focus of following RE techniques and indicates their relevance for spatial planning.

A. Established RE Techniques

Interviews and workshops are used in both spatial planning and RE. Those techniques are best suited when a defined and limited set of people should be asked intensely about their requirements and opinions. Interviews tend to address one or only a few participants representing the same stakeholder or interest group. In RE, interviews are typically used in elicitation and validation. Workshops offer an opportunity to stimulate discussion among several people or different stakeholder groups. Workshops are typically used in creative decisions or in requirements negotiation, where diverging opinions are allowed to clash and be discussed. The success of a workshop crucially depends on preparation. For example, preparing and discussing goal models assists stakeholders in focusing.

Goal models show dependencies between stakeholders due to resources, tasks, goals, and soft goals. There is more than one notation for goal models (e.g., i* [10] and KAOS [11]), but the principle use of goal models is similar. Since interest groups have goals by definition, capturing and modeling those goals may be a good idea and stimulating for certain phases of discussion. However, goal model notations are not straightforward to understand for non-technical stakeholders, and goal models do not easily scale up for large problems with many stakeholders or interest groups. This example of a popular RE technique shows the limitations of adopting RE techniques for spatial planning: Representations must be comprehensible to the citizens and stakeholders they are supposed to support.

A persona is a real-looking profile description of a (mostly fictitious) person. It should be easy to understand. Thus, personas are a good medium for overcoming abstract explanations or discussions that are difficult to follow for many people. Creating concrete, but fictitious representatives of difficult-tograsp and often abstract entities may be a useful technique for spatial planning. This technique enables stakeholders and developers to develop empathy and deeper emotional understanding for the situation and demands of the modeled person or entity such as residents or local suppliers.

Use cases are a very popular style of describing an interaction between an actor and a system for the purpose of fulfilling a goal of that actor [12]. Since use cases are mainly

| RE technique | Purpose | Relevance for spatial planning |
|---------------------|---|--|
| Mockup | Rough, static sketch of GUI or other perceivable aspect | Any device or user interface stakeholders may face in one of the discussed options. This can include paper forms and technical interfaces. |
| Prototype | Executable software with limited and focused functionality or user interface | Applicable in later phases, requires some level of programming. For complex tasks. |
| Vision Video | Represents envisioned scenarios, alternative options, or narrows in on aspects under discussion | Appropriate for a broad audience; very concrete. Can be produced at different cost levels (Smartphone to professional). |
| Interview | Focused transfer of information from interviewee to interviewer | Essential for in-depth elicitation; does not scale up to larger crowds. |
| Workshop | Exchanging opinions, using group dynamics for developing new proposals | Size determines the character and potential outcome. Participation of crucial stakeholders is essential; should not take too long. |
| Goal Models | Mainly for eliciting and negotiating goals and rationale | Applicable to small expert subgroups, not to a crowd of all stakeholders. |
| Use Case | Semi-formal representation of interaction between actors and system | Several variants available; can be selected and tailored to different situations of use. Not as concrete as videos, but can be more detailed. |

 TABLE I

 Relevance of RE Techniques for Spatial Planning

textual and written in natural language which is only slightly regulated, most people would be able to understand the core of a use case when it is explained by a developer. However, there are more aspects to a "full-fledged" [12] use case, such as trigger, guarantee, pre-condition etc.. Those aspects are more sophisticated to understand. For that reason, use cases are either reserved for an advanced group of stakeholders – or use cases must be adapted, simplified, or complemented by more accessible representations. There are a large number of alternative representations of scenarios [13]. They are more or less adequate to bridge the communication gap between the heterogeneous crowds of stakeholders in spatial planning.

Videos are a comparatively new addition to the toolbox of scenario representations. They are intended to represent visions, alternative options, or usage of a future system in a very concrete way. Fricker et al. [14] propose videos of stakeholder discussions as an ideal medium for improved requirements communication. Karras et al. [3] emphasize the potential of vision videos which are used as early prototypes that require no coding at all. Xu et al. [15] proposed an evolving video artifact in which portions of mockup videos are replaced by screencast video clips step by step. Many authors who advocate videos for RE highlight their ability to communicate effectively with various different people. Thus, videos are useful to provide concrete contextual information in town hall meeting as well as for the crowd.

Mockups and prototypes are useful in general. They can assist in different phases of interest group discussions. Videos are a new type of prototypes; they require no programming and show a selected scenario in a dynamic representation [4].

B. Techniques of CrowdRE

Many RE techniques were initially tailored towards individual software development for a defined customer. In product development, market-driven development, and in spatial planning, however, there are various solution proposals available, and rather sizable crowds of stakeholders who should be enabled to participate. Since the definition of *CrowdRE*, several techniques were identified that are specifically appropriate for a large and mixed crowd of stakeholders. Spatial planning problems usually have exactly that profile.

CrowdRE starts from the *assumption* that there is a crowd of participants who are able and willing to communicate via electronic media. Thus, they can receive electronic messages at short notice and have the technical infrastructure for responding. A crowd could emerge from a generic social network, e.g. Facebook. It could as well be organized via a designated tool or platform on the internet. This basic assumption facilitates the following four services, according to Groen and Koch [16], see TABLE II:

 TABLE II

 CROWDRE-Services and Examples in Spatial Planning

| Service and examples | Purpose and examples |
|--|--|
| Crowdsourcing Web-based prototyping, usability testing, online discussion, forums, community management, design decisions | Using the crowd as input Shaping idea, public participation, weighting alternatives, searching for practical applications of proposed solution |
| Text Mining Social network analysis, recommender systems (requirements writing, prioritization, voting) | Extracting higher-level concepts from social media Situational analysis, goals, weighting alternatives, opinion forecasts |
| Usage Mining Data mining of use or queries, prototyping, vision videos | Monitoring user behavior and drawing conclusions Public display, public decisions, public participation |
| Motivational Instruments Feeback, gamification | Attracting stakeholders Participation alternatives, incentives for participation |

These services can substantially improve the spatial planning process: Instruments used for motivation can attract interest groups and individuals at an earlier phase, mitigating the abovementioned paradox of participation (see Fig. 2). Once involved, stakeholders have the opportunity to receive information in various formats and respond (see *assumption*). The abovementioned techniques of RE can also be applied and combined. The activated crowd can now receive any electronic document, video, or message that seems appropriate. Their ability to respond instantaneously adds an important driver to the discussion. Speed becomes important in order to sustain the interchange within the attention span of the public.

Exchange on the internet facilitates asynchronous communication, overcoming the challenge of finding a suitable time and place to meet in person. Stakeholders can view visualizations and provide their feedback and opinions without attending a meeting. Software requirements arise as a side-effect of supporting the decision-making process, which gives software development a clear head start.

Not all stakeholders will have the infrastructure, the permission, or the desire to interact in the crowd. Therefore, RE and CrowdRE techniques are not supposed to replace face-toface communication, but to improve preparation, information, and evolution of alternative options, since the turnaround time can be shrunk. There will still be town hall meetings; they can benefit by using the material emerging from crowd collaboration, thus making better use of the invested time and effort. Videos, text mining of discussions, monitoring of data and usage can tie together virtual and face-to-face discourse.

V. RELATED WORK

We suggest supporting crowds of stakeholders in spatial planning problems by treating them like a crowd of software customers, even if no software is supposed to be developed.

Arias et al. [17], [18] approached a similar problem from the opposite angle: Citizens of Boulder discussing flood mitigation options started with a highly concrete "language of pieces" (trees, houses etc.) to visualize their ideas. As the discussion went on, they accepted more abstract visualizations (colored blocks, blue lines for Boulder Creek), which could easily be manipulated and analyzed on a computer. In this paper, we argue for an approach that does not assume long-term collaborative learning but offers concrete visualizations like personas, mockups, and videos. They can help to bridge the communication gap caused by an abstract and vague presentation. Brill et al. [19] had compared video-based requirements to text and use case-based requirements and found both useful, but with complementary strengths and weaknesses. In our current student software projects, a Cyber Crime Unit of the Hannover police was involved. A different project dealt with the local hospital Radiology Unit, yet another one with the North-West German Volleyball League. Understanding these different domains turned out to be much easier using 2-minute vision videos that were created after the third week of requirements elicitation. Video seems to be well-suited for focusing interactions on complex future software. Koch et al. [20] present a very inspiring case of using personas to a planning situation very similar to our food supply example. They designed a strategy for volunteers to pick up food for their neighbor. Our current work also starts with traditional RE techniques but then proposes to explicitly extend it to CrowdRE and videos. We also propose to adopt a softwareoriented perspective from the beginning, no matter whether a software is already on the plan or not. Evans-Crowley and Hollander [21] described the possibilities of working with

virtual web-based participation in spatial planning processes. The authors recommend planners to embrace new digital tools but also point out that the access to high-speed web and devices or the acceptance of digital approaches leads to different accessibilities for citizens to digital participation processes.

VI. FINDINGS AND EVALUATION PLAN

A. Summarizing the Core Contribution

Spatial planning deals with large crowds of stakeholders who should participate in decisions that will shape their environments. The planning process extends over months or years, and by the time stakeholders get aware of the alternatives, their influence has already decreased (see Fig. 2). Spatial planning wants to create and support highly innovative and timely improvements, but there are many challenges preventing the effective participation of interest groups and individuals.

RE, on the other hand, is a discipline focusing on the exchange with domain experts, customers, and many different stakeholders – for the purpose of developing software that matches user needs and requirements. CrowdRE even offers techniques and services tailored to make use of the internet, and improve communication drastically.

We envision applying RE and CrowdRE techniques to spatial planning processes even if it is not yet decided to buy or develop software for any of the new and innovative proposals. We think that this turn in perspective will make discussions more concrete (less vague and abstract) and more attractive to citizens. Since many innovative solutions finally *do* require software support, this approach also provides faster and better-prepared entrance into the software development phase.

B. Status of the Vision and Planned Evaluation

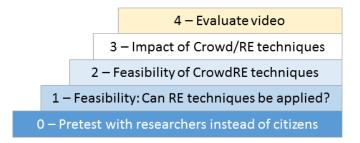
This work is part of the $4.5M \in Mobilise$ initiative of the Universities of Hannover and Braunschweig in Germany. In the *Mobile Man* project (part of that initiative), five faculties collaborate in order to investigate intelligent mobility at the intersection of computer science, RE, geo-informatics, law, ethics, and spatial planning.

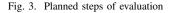
We saw a surprising tendency of discussing societal issues from a purely technical perspective, e.g.: *What can autonomous driving do? Can I predict from your past travel behavior where you will be going tomorrow?* Despite this technology-driven debate, we are convinced that the fast-growing opportunities from autonomous driving, intelligent and individualized navigation, mobile information and booking systems will soon call for the input from empowered citizens and stakeholders. It is only fair and economic to use known and established techniques (of RE and CrowdRE) for getting stakeholders involved in organizing more effective participation.

We plan to apply CrowdRE techniques and services in several situations during the *Mobile Man* project. Spatial planning will be an early application domain. Since planning processes are very long-lasting, we do not have them at our disposal. Instead, we will apply the proposed reframing to a discourse *among participating scientists* first. They can be considered a technology-friendly selection of stakeholders for a pretest.

Once this first hurdle will be taken, the authors of this paper (requirements engineers and planners) will apply the approach when the planners get called into the next applicable situation.

Evaluation is planned to go through several progressive steps, as sketched in Fig. 3. After the above-mentioned pretest with researchers, we will investigate (1) whether the RE techniques can be applied in a way allowing the general public to participate effectively. (2) CrowdRE techniques are more sophisticated and require access to computers or smartphone, and an ability and willingness to engage in a process of informed decision-making and technology-supported feedback. (3) The impact of all techniques will be assessed qualitatively and finally quantitatively. If possible, we will use the new techniques as treatment of an experiment and compare its influence with reference to a control group which uses traditional planning and participation techniques. This observational approach will be triangulated by a survey in both groups, soliciting opinions on the techniques used. (4) As a final component, we will ask for contents and analyze whether the treatment group can recall and explain complex information better when it is presented as videos rather than text.





C. Threats to Validity Ahead: Research Challenge in the Crowd

There are numerous potential threats to validity that require our attention in this research. We are aware evaluation will take a lot of time and effort. Therefore, we have prioritized evaluation activities and will try to take one step at a time (see Fig. 3). Field studies in real planning situations can be treated like case studies and analyzed according to the guidelines provided by Runeson et al. [22].

VII. CONCLUSION

RE helps spatial planning in decision-making by offering tools and techniques. To handle large crowds of stakeholders, digital artifacts are particularly welcome: Artifacts can be displayed in meeting rooms, sent to homes and smartphones. Feedback can easily be given and channeled back to moderators. Mechanisms of CrowdRE can be applied and developed further. The result of this interdisciplinary approach always includes software requirements; they can be used directly for developing innovative software, which will speed up the implementation of a decision. In other cases, requirements remain a by-product and annotation of the original planning decision. We are convinced that this can empower citizens in their new role as software customers and, thus, focus societal discussions.

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