Vicus – A Persona for Towns

Towards Innovation Management through Co-Creation and Predictive Situation Analytics

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Abstract. Digitization of towns in concepts such as "Smart Cities" pose a new challenge for software engineering. Software is usually developed for selected target groups, represented as personas with clear requirements. But solutions for cities or smaller towns affect all its inhabitants directly, so that performing stakeholder identification and prioritization based on characterizations such as personas will not do justice to all these stakeholders. Conversely, the government, industry and citizens of each town have specific interests, properties and needs, which can and must be understood when realizing new solutions for a town. This paper proposes a new elicitation and analysis method in the form of a so-called *Vicus*, through which a town can be characterized by gathering relevant information about a town. The Vicus facilitates the generation of new creative ideas as well as the reuse of already successfully implemented solutions in towns that reveal similar patterns in their characterization.

Keywords: creativity techniques, requirements elicitation, requirements engineering, Smart Rural Areas, user requirements

1 Introduction

Software engineering traditionally has built software solutions for specific customers and specific target groups of users. This includes software applications for particular businesses (e.g., an ERP system) or specific purposes (e.g., a bookkeeping app). Even software "for everyone" assumes a selection effect, in which particular types of users are more likely to install, for example, a game or graphics editing software. As a result, there still is a prioritization of certain user types who are served by certain use cases. Digitalization has resulted in new and broader target groups. For example, approaches towards "Smart Cities" that serve an entire city must focus on all citizens, not just prevalent subgroups. Think for example of an improved waste disposal system or technical approaches towards improving the infrastructure. Not addressing all classes of citizens will exclude subgroups that are also directly affected.

Developing solutions for an entire town (from smaller settlements to metropoles) is costly. Not only must it address many stakeholders at once, but it requires the use of a creative approach due to the innovative nature of these new solutions. We assert that the possibility of reusing solutions that were already successfully applied in another town will save costs, because the labor-intensive process to deploy a solution in one

town does not have to be repeated as such. However, due to inherent differences between towns, a successful implementation in one town does not necessarily transfer in the same way and form to another. For example, between a town with a supermarket nearby and another where the nearest supermarket is 5 kilometers away, the need for a grocery delivery service will be quite different, and may additionally be affected by the mobility of the inhabitants, depending on their age and public transportation options. Thus, in order to determine what solutions from other towns best fit the needs of a town's inhabitants, town-specific aspects must be understood so it can be assessed if these towns share relevant characteristics. We may then be able to predict that the configuration of solutions of the one town can be replicated in the other town with minor tweaks, by which the existing implementation serves a basis for fast rollout with further tailoring made after deployment.

However, it is unclear what characteristics of a town affect the acceptance and functional appropriateness of digital solutions. Moreover, experiences from project contexts have shown that is challenging to elicit concrete needs from citizens and determine fitting solutions with them using survey techniques [1]. Not only must citizens be motivated to contribute information and ideas in joint sessions, but it also requires an active involvement of local businesses (who are potential sponsors of realizations and beneficiaries of new implementations) and the local administration (who approach the implementations from an organizational and legal perspective). Uniting the many views calls for more thorough assessments.

A creativity approach is required in order both to facilitate idea generation with citizens and to enable the analyst to infer similarity patterns from particular knowledge and observations. Similar to design patterns and software architectural patterns [8], the concept of software requirement patterns exist. However, an appropriate pattern similarity identification approach for the reuse of proper solutions for a particular town in another town by the application of clustering and classification methods is still needed.

In this paper, we will present initial ideas to formalize the approach of characterizing towns through a template that we coin as *Vicus*. With this paper containing a representative example of an envisioned use of the Vicus, we would like to provide a basis for discussions in order to obtain feedback on the idea of the Vicus, by which we will make a first step towards answering the following research questions:

RQ1a: What are suitable characteristics to typify a town by?

RQ1b: Where do we get which information for which purpose?

RQ2: How can the use of a Vicus facilitate creativity in stakeholder discussions and analysis sessions?

RQ3: How can demands of a town be predicted and fulfilled before issues arise?

This paper is structured as follows: chapter 2 presents related work, and chapter 3 the methodology on how we elaborated the current proposal for a characterization of towns, along with an exemplary characterization using a Vicus. This is followed by an outline of the expected benefits in chapter 4, a presentation of possible application contexts in chapter 5, and currently open questions and challenges in chapter 6. We conclude in chapter 7.

2 Related Work

The persona [3] is a creativity technique often applied in situations where it is difficult to elicit requirements from particular stakeholder groups. Personas cover typical needs, goals and tasks of a particular class of users. This information allows an analyst to feel empathy for this user, which makes it easier to reason about potential requirements this user will or may have, and to make decisions about the user experience that the system is expected to deliver. As the name implies, personas primarily focus on individual humans. Due to the various social, geographic, and organizational (i.e., government and industry) perspectives on a town, personas are not sufficient to provide sufficient means to analyze a town as a whole. To really improve a town, the solutions must address the characteristics of the town, which underlie the needs, challenges and opportunities of its inhabitants. Analogue to user-centered design [2], an approach for inhabitant-centered design is required that takes the characteristics of a town into account. The characteristics of a town will depend on the geographic location of the town (e.g., a town at an estuary versus one in a desert area), while others will be related to social or cultural aspects (e.g., the city center is a large no-driving zone). Municipalities and government bodies increasingly make the data they collect about a town's social composition and infrastructure available as well, such as the DataLab of the municipality of Amsterdam,[1] who develop their own solutions and provide resources to developers for solutions.

One way of making a comparison is to follow a traditional Business Intelligence approach. For example, when a parts manufacturer has to decide between three potential locations for the new logistics center, an analyst will gather facts, make calculations and present a proposal. We assert that the challenge of developing ideas for the digital enhancement of towns can also be assessed by gathering knowledge about the respective towns. But due to the many social aspects, observational data are needed as well, so that the degree of similarity can be measured or estimated.

3 Solution Idea

To characterize a town and facilitate the elicitation of town requirements, we propose the "Vicus", a template similar to a persona, but with adapted contents to account for the specific characteristics of a town. In order to systematically and consistently document relevant information, the initial content categories for a Vicus have been created in several steps. First, we obtained an overview of typical publically available information on towns, such as typical demographics (e.g., number of citizens, classification of citizens according to age, tendency of demographic development) and election results. We then held an internal expert workshop with people with prior experience in the performance of digitalization projects in rural areas. Here, we elicited what knowledge we would need to successfully assess a town on its digitalization potential. This knowledge includes the actual needs of the citizens in different districts, resources of the local industries to improve their production processes, and the government that aims to improve town's educational, industrial, residential and infrastructural aspects. We will have to identify for and from which stakeholder this information is required

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[1] http://data.amsterdam.nl/

(e.g., the number of bus stops can be obtained from public information and is required for assessing the public transport system), and which contents of personas can be reused in the Vicus. We compared the workshop's results with the gathered information to identify which aspects that help understand town-specific characteristics were missing.

Along with the content categories of the exemplary Vicus, a set of guidelines for the elicitation of their contents has been established. This is a combination of some preparatory work to collect data online, requesting information from the local government, and direct interactions with relevant stakeholder groups (e.g., inhabitants, local industry and representatives of the administration). These content categories form an initial draft that we propose as starting point for further investigations, discussions and evaluations.

To illustrate the envisioned benefits of a Vicus and predictive analytics, we will use the example of the unsatisfactory mobility situation in "Anytown". Using a Vicus, among others the information in Table 1 was gathered, consisting of factual data and observations. This elicitation of the as-is situation revealed problems for two of the three dominant age categories. Middle-age adults commute by car or bus, mostly to the nearby city. However, senior citizens have difficulty reaching the points of interests in town, while youth have difficulty taking a bus home at night from the city after a night out with their friends.

Table 1. Fictional instantiation of the Vicus template's content categories for "Anytown". Presented categories are shortened, and other categories such as "economy" and "geography/environment" are omitted.

Town Name	Anytown	
General Demographics		
Founded	1208	
Population	10,000	
Population trend	Decreasing	
Area	25 km^2	
Prevailing Age Categories	24% seniors age 65 up 26% adults age 40–50 years 23% youth age 15–20 years	
Social Cohesion	- In-migration in last 12 months: 34 people - Migration in last 12 months: 41 people	
Points of Interest	- Shops (dress shops, grocery stores, pharmacies) - Town hall - Schools - Central graveyard	
Other Observations	There is a stronger distribution of the points of interests than in comparable towns. Attractive locations for teenagers, such as clubs, are missing.	
Regional Infrastructure		
Nearest Large City	Metropolia (15 km, includes an airport)	
Bus System	12 bus stops in town, 3 bus routes	

A Vicus for a comparable city provided a fitting solution that worked very well in the other town. Because of the already decreasing citizen count, the local bus system could not be expanded as this would make public transportation too cost-intensive. Instead,

the bus system was expanded and made more flexible by adding smaller busses on demand. Their routes are adapted to the citizens' specific needs. A route calculation system calculates the best route and the best time for the busses to pick up citizens. In the mornings and afternoons, the youth are transported to and from school, and in between senior citizens have a faster connection to the center, the graveyard and the shopping center at the outskirts of town, and night connections bring partying youth and visitors to concerts, cinemas and theaters back home from the city at night. Citizens are informed about the time and the place when and where the next bus can pick them up. Based on the Vicus, an alternative solution that was proposed, which suggested a mobility concept based on car sharing, could be excluded for not being suitable for Anytown because commuters own a car and the public transportation is mainly being used for age groups who do not or may not drive a car.

4　　Expected Benefits

The Vicus is a template that analysts such as requirements engineers, interaction designers, and process experts can use as an analysis tool to obtain a better understanding of a town before making decisions about improvement measures. Potential benefits of a Vicus particularly include the solution reuse through predictive analytics as well as its use as a trigger for public creativity.

The primary benefit of a town characterization in form of a Vicus is the possibility of reusing solutions and countermeasures applied in towns with similar characteristics to towns in which these solutions and countermeasures were successfully applied. The needs of a town's inhabitants and the applicability of solutions can facilitate an early detection of reuse potential through a systematic application of the Vicus. This potential is only given if a Vicus has already been created for a town with similar characteristics. However, we also see application potential within towns for which a Vicus was already identified and known to the groups of stakeholders. One possible use is the identification of threats for the town to unperceivably slide into an undesired situation, with the possibility of specifying countermeasures for this threat. Another possible use in addition to the Vicus presenting the actual (as-is) situation is to specify a secondary Vicus that describes a desired (ideal) situation. A comparison of the two Vici, which would currently be manual but which could be supported by algorithms in the future, enables identifying the gap between the two representations, and measures can be defined to reduce this gap (akin to Higgins' self-discrepancy theory [3]).

With the help of predictive analytics of Vicus data, desired situations can be achieved and undesired situations avoided. Predictive analytics analyzes statistical data of particular causes, effects, interdependencies, and impacts of events. This includes techniques such as clustering, classification, regression analysis, and association analysis.

This has several benefits. From a societal viewpoint, the appropriate countermeasures can be introduced faster to prevent the population from being dissatisfied due to unfulfilled needs, the local industry can expect a competitive advantage by better understanding the complex economic relationships, thereby making better founded decisions. Finally, the government can better control the development of the town by steering the settlement of people and businesses, but especially of the satisfaction of inhabitants.

Although simple issues and solutions can be revealed through short interviews of the stakeholders in the town, complex coherences can be revealed easier with the help of predictive analytics. The amount of data that have to be analyzed to detect new patterns and coherences is provided by a vicus, but the amount of data must grow in order to increase the potential success of the predictive analytics.

5 Application Potential and Challenges

In the scope of "Smart Cities", many initiatives are specific to one city, for which the Vicus could help determine collaboration potential with organizations in other cities and other countries, and the transfer potential of existing solutions. However, we not only see potential for large cities where solutions have already been implemented. Due to wide-scale urbanization and in comparison to the benefits that cities can offer, rural towns often face a decline in their attractiveness for individuals, families and businesses to settle and stay there [4,5]. This phenomenon often goes hand in hand with the demographic development of an aging population in rural areas [6]. The visibility of their advantages over urban areas, such as more breathing space, larger homes, tranquility, and access to nature can be highlighted with digital solutions in place. Such areas are also particularly interesting for innovation, because inhabitants are typically well-informed about their town's needs and problems. In Germany, several initiatives aim at emphasizing the strengths of rural areas by compensating or reducing potential drawbacks with the help of innovative digital solutions. The projects "Digitale Dörfer"[2] (German for "Digital Villages") and "eDorf"[3]) aim at establishing innovative ideas for neighborly support among citizens. The projects evaluate the deployment of digital solutions in selected towns and show that implementations of digitally enhanced shopping, logistics and collaboration ideas can be successful.

6 Challenges

As the Vicus is still in a conceptual state, we still face several challenges and open questions. We composed an initial set of criteria that are used for characterizing municipalities, but more research is needed to elaborate and detail the set of criteria. For this purpose, the discipline of urban development and planning can provide valuable inputs. We also identified that objective and structured measures (e.g., number of inhabitants) do not provide sufficient data to make strong inferences about the similarity between two towns. This is why subjective measures (e.g., observations) are needed, though this may threaten the validity of such observations. Moreover, if these observations cannot be formalized by a certain structured, it may not be possible to compare such observations. Open questions remain the time and effort required to elicit the relevant information for a Vicus, and which degree of detail of each content category is required for which kind of analysis (e.g., generating ideas vs. predictive analysis). Lastly, the Vicus has been designed for analyzing towns in rural areas. What changes must be made to

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[2]Digital Villages, see www.digitale-doerfer.de
[3]Electronic Village, see www.edorf.bayern

the content categories of the Vicus so it can also be applied in urban(ized) areas remains to be established.

7   Conclusion

The usage of personas as a creativity trigger supports the generation of ideas to solve potential inferred problems of typical representative stakeholders. We have sought to provide an approach that allows the assessment of towns similar to a persona. Two large projects aiming at the typing of towns in Germany[4] took local politics and socio-economic and demographic factors into account, and created two of the most substantial collections of typed towns and villages in existence with 125 typified villages and 3,000 typified towns, respectively. However, a concrete involvement of citizens to reveal innovation potentials or to predict municipal challenges by a supported joint communication between government, industry, and citizens does not take place in these projects.

Recent initiatives to improve the quality of life in cities and rural areas through digitalization required means to assess how well innovative ideas transfer to other areas. The Vicus is a proposed solution to collect relevant information on towns in a structured way, so that it can serve as a creativity trigger for identifying unsatisfied needs in these areas along with the appropriate digital solutions to address these needs. Moreover, the Vicus can support predictive analyses in which the characteristics and needs of towns can be compared to determine the reproducibility and viability of existing solutions in another town before these are being deployed. In future work, the Vicus should be specified and evaluated systematically through case studies in order to measure and quantify the benefits it can deliver. We intend to further develop, apply and evaluate the Vicus concept within research projects in the nearby future.

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[4] See http://www.leader-vulkaneifel.de/2016-01-25-12-24-46/projekte/die-projekt and https://www.bertelsmann-stiftung.de/de/unsere-projekte/wegweiser-kommunede/projektnachrichten/neue-demographietypisierung/