Qualitative Scenarios for supporting regional public foresight

Insights from practical student projects

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Abstract: *In the face of mounting challenges such as limited financial and human resources, global forces like climate change and digitalization exert increasing pressure on cities and municipalities. To address the uncertainties inherent in these developments, the qualitative scenario method offers a structured approach for exploring diverse future pathways by involving a broad spectrum of stakeholders. At Ruhr University Bochum, students have collaborated with representatives from the Bochum municipal administration and civic stakeholders to develop forward-looking scenarios that not only communicate scientific insights and raise awareness of potential futures but also serve as a basis for long-term strategic planning. In one case study, students devised four scenarios outlining various impacts of climate change on the city, while in a second, they partnered with the Smart City Innovation Unit to examine the implications of digitalization for municipal governance. This article discusses how qualitative scenarios can support regional public foresight and the value of the scenario planning as participatory method, while also addressing the inherent limitations of the method in the context of regional public foresight.*

Keywords: *qualitative scenarios; public foresight; scenario planning; participatory methods*

1. Introduction

In recent decades, municipalities have been confronted with a wide range of challenges. As climate change progresses, extreme weather events such as heat waves, droughts, and heavy rainfall are occurring more and more frequently

(Stott, 2016). In recent years, for example, more record summers have been recorded in Germany and in 2021, entire parts of municipalities were destroyed by heavy rainfall (Ludwig et al., 2023). In addition, there are extreme situations such as the Corona pandemic, in which cultural institutions, schools, and childcare facilities were closed and employees had to shift to working from home or deal with loss of income in short-time work. In addition, the migration movement from the Middle East since 2015 and the war refugees from Ukraine since 2022, municipalities have been faced with the challenge of offering people accommodation and prospects. At the same time, the precarious financial situation and the increase in cyber-attacks on public institutions further threaten municipalities' room for manoeuvre. Furthermore, municipalities must manage broad structural transformations in the transport sector and energy supply in order to implement the change from a carbon-based to a sustainable society locally. From this, the claim can be derived that municipal management is more difficult today than ever (Roos & Schmitt, 2022).

These areas of tension do not seem to be easing in the near future and present municipal decision-makers with the task of developing long-term strategies to enable democratic and solidary coexistence on the ground.

This article addresses two different groups. On the one hand, it is shown to what extent qualitative scenarios can support municipal decision-makers in the development of long-term strategies to deal with multiple challenges. For this purpose, the scientific method of scenario planning is first introduced (section 2). The focus is on the purpose of scenarios and the emergence of foresight methods since the 1950s. Subsequently, the development process of qualitative scenarios is outlined on the basis of four phases (section 3).

On the other hand, with the help of a detailed description of two student practical projects, it is shown how teachers and lecturers can implement the method of scenario planning in practice (section 4). Both student projects were carried out at the Faculty of Management and Economics at the Ruhr University Bochum. Here, students developed qualitative scenarios together with representatives of the city of Bochum and civil society. In the first practical project, the students developed four qualitative scenarios that describe life in Bochum in the year 2046. In these scenarios, the focus is on the effects of climate change and the associated environmental and social lines of conflict. In the second practical project, students turned to the topic of digitization and the role of Bochum as a smart city. In close cooperation with the Smart City Innovation Unit (SCIU) of the City of Bochum, five scenarios have been created.

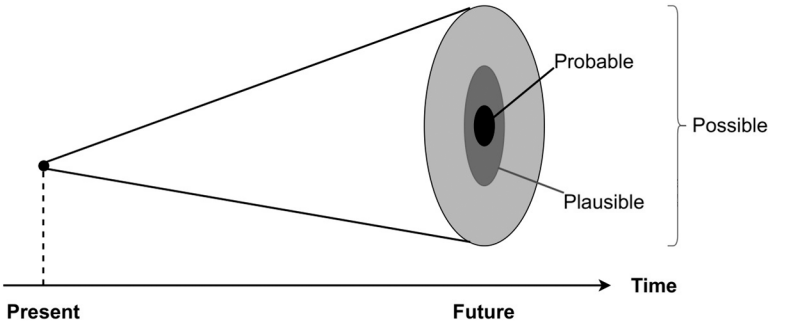
Based on the project descriptions, section 5 discusses the implications and limitations of applying scenario planning methods for public foresight. The students' experiences are compared with current discourses in the scientific literature. The article ends with a conclusion.

2. Scenario development as a scientific method

In this section, the concept of *scenarios* will be introduced and the emergence of scenario development as a scientific method will be described. The section concludes with a brief overview of the scientific fields in which scenarios are applied.

2.1 Definition of Scenarios

Figure 1: The scenario cone.



Source: adapted from Pillkahn (2008, 175).

In order for scenarios to support systemic thinking and holistic strategic planning, they must meet various characteristics.

First and foremost, scenarios must be possible. To this end, scenarios must be able to occur in principle and be based on well-founded assumptions about the future (Amer et al., 2013). In addition, the scenarios must paint a plausible picture of the future that is believed and accepted by users of the scenarios (Schmidt-Scheele, 2020). To ensure the plausibility of the scenarios, they must be consistent. Consistency is characterized by the fact that the assumptions

about future developments do not contradict each other from present factors. The individual components of the scenarios must therefore be logically compatible (Gausemeier et al., 1998; Schlösser, 2022).

Since qualitative scenarios are often developed with or for organizations such as companies or municipalities, scenarios must be relevant and helpful. They should be able to support decision-makers (Chermack, 2018; Durance & Godet, 2010). To this end, scenarios must systematically and comprehensively prepare complex relationships in a coherent manner (Amer et al., 2013). In addition, the development process of the scenarios must be prepared transparently. This means that the assumptions, materials and conclusions of the scenarios are made available to users (Durance & Godet, 2010).

In the following, the emergence of the scenario method will be briefly outlined and the difference between predictive, normative, and explorative scenarios is described.

2.2 The Origin and Application of scenario development

The following subsection explains three exemplary applications of the term scenario in more detail, highlighting the purpose of three different types of scenarios: *predictive*, *normative*, and *explorative* (Schmidt-Scheele, 2020).

Scenario methods emerged in the 1950s to develop more effective war tactics in military contexts. The main aim was to test different strategies in simulated environments and to use the allocation of scarce resources as efficiently as possible in order to achieve the best possible outcome (Bradfield et al., 2005; Mayer, 2009). In the course of the 1960s, the field of application expanded and scenarios were increasingly used in contexts to improve political and social decision-making processes (Amer et al., 2013; Kahn & Wiener, 1967). Social and political contexts are characterized by complexity and uncertainty (Roos, 2015, 2017). The application of scenario methods to social and political systems marks the beginning of modern scenario methods (Bradfield et al., 2005). Thus, from the 1960s onwards, scenarios were no longer used only to predict well-structured problems. Rather, scenarios are used to examine changes in the entire system. Scenario methods focus on the interactions between the influencing factors and system dynamics in order to gain insights into possible options for decision-makers (Hoffart et al., 2021).

Basically, scenarios can be divided into three categories: predictive, normative, and explorative. These categories are based on three fundamental questions that can be asked of the scenarios from a user perspective.

Predictive scenarios address the question *"What will happen?"* (Börjeson et al., 2006). This question is accompanied by the development of scenarios that assess the probability of each scenario (Hoffart et al., 2021). Computer-aided forecasting models are often developed for this purpose, which extrapolate past and present data into the future (Amer et al., 2013). Examples of such scenarios include emission scenarios that simulate long-term emission pathways (Schmidt-Scheele, 2020). It is important to note that scenarios are generally to be distinguished from forecasts, as they explore a range of possible futures rather than identifying the most likely future possible (Amer et al., 2013; Chermack et al., 2001; Hoffart et al., 2021). Even though predictive scenarios are assigned to scenario planning, they are more traditional forecasts.

Normative scenarios are goal-oriented and address the *question of how a certain goal or scenario can be achieved* (Börjeson et al., 2006; Hoffart et al., 2021). In this context, both desirable and undesirable futures are taken into account in the creation of scenarios. Based on the target state, it is then analyzed which planning steps are necessary to achieve this state. Therefore, normative scenarios are particularly suitable for political and strategic contexts (Durance & Godet, 2010).

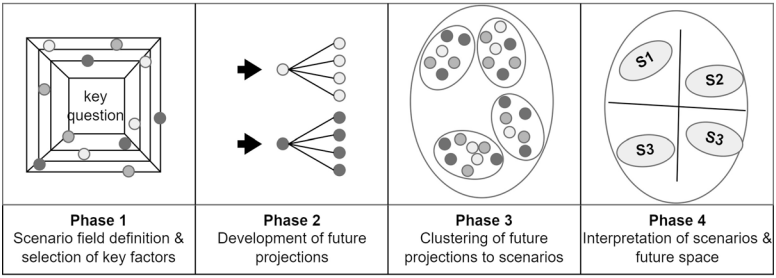
Explorative scenarios are designed to address the question *"What can happen?"* (Börjeson et al., 2006) by mapping out a wide spectrum of plausible futures without attempting to predict which will occur. Their construction and selection rest explicitly on the principle of plausibility: each scenario must be internally coherent and grounded in rigorous analysis of past and present trends, yet no scenario is assigned a probability of realization (Schmidt-Scheele, 2020). Instead, they focus on identifying key uncertainty factors—ranging from technological breakthroughs to socio-political shifts—and examining the complex interrelationships among them (Amer et al., 2013; Durance & Godet, 2010). By depicting alternative pathways, explorative scenarios enable us to anticipate how changes from the status quo might unfold and to prepare for a variety of contingencies. Typical examples include context scenarios, which explore possible future social, environmental, and political conditions, and socio-technical scenarios, which illuminate the dynamics of major systemic transitions (Hoffart et al., 2021). Ultimately, the exploratory purpose of these scenarios is not to forecast the most likely future but to reveal the breadth of what could happen, thereby enriching strategic decision-making under deep uncertainty (Amer et al., 2013).

In summary, scenarios can be classified based on their aim: predictive scenarios focus on predicting what will happen (often quantitative and probabil-

ity-based), normative scenarios focus on achieving a desired future state (goal-directed and value-laden), and explorative scenarios focus on understanding the range of what could plausibly happen (plausibility-based and uncertainty-focused). Scenarios in general serve as a tool to explore multiple possibilities under uncertainty, rather than providing single-point forecasts.

3. The Development Process of Qualitative Scenarios

Figure 2: The four phases of the scenario development process.



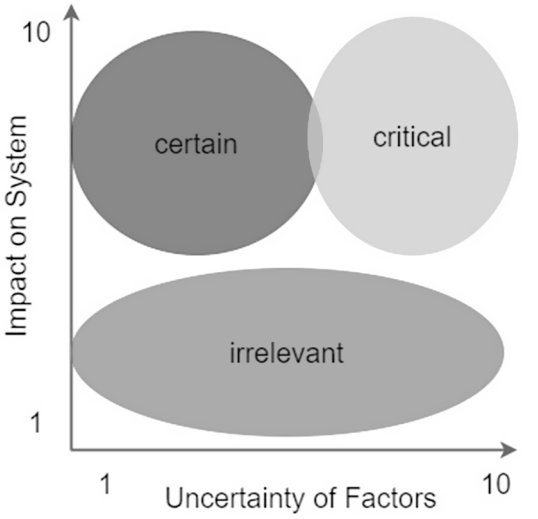
Source: Hoffart et al. (2021, 6).

The scenario field is used to develop a systematic representation of the interdependencies between different levels of the system. These can span different sectors and jurisdictions (Hoffart et al., 2021). In order to systematically capture the scenario field, qualitative methods such as literature analyses, participatory system mapping, or expert interviews are used (Ernst et al., 2018). The aim is to illuminate as broad an environment as possible in order to be able to identify a wide range of influencing factors. By means of the scenario environment, influencing factors are then compiled for the different levels of the system and evaluated according to their influence and uncertainty.

There are two ways to do this. On the one hand, a resource-saving and on the other hand a more resource-intensive method can be used to determine the influence and uncertainty of the factors (Pillkahn, 2008). Both approaches are used to identify key factors that can have the strongest influence on the development of the system. In system field analysis—as a resource-intensive method—all influencing factors are plotted in a matrix and the mutual influ-

ence of each factor on the others is assessed on the basis of an ordinal scale (Gausemeier et al., 1998). Since this approach was not used in the practical examples covered in this article, this approach is omitted here. A detailed description and practical application can be found in Hoffart et al. (2021).

Figure 3: A general Wilson Matrix.



Source: Adapted from Pillkahn (2008, 203).

The Wilson matrix can be understood as a more resource-efficient method (Pillkahn, 2008). Each factor is assessed in terms of its systemic impact and uncertainty with a view to future development. The rating scale is ordinal and extends from 1 to 10, where 10 expresses the strongest impact on system or the highest uncertainty.

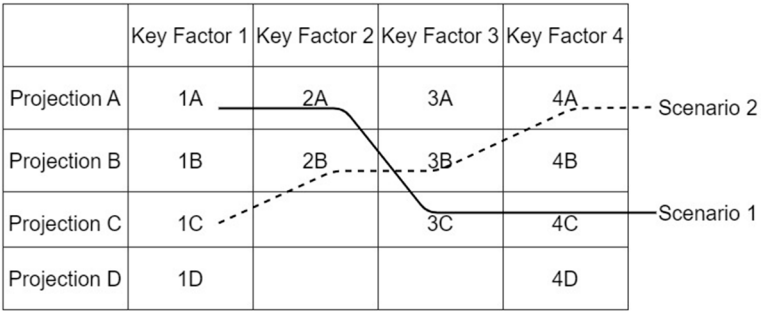
In the context of the practical examples presented here, the Wilson matrix was used to classify the influencing factors and thus identify the decisive key factors. Figure 3 shows a Wilson matrix as an example. The impact of the factors is plotted on the ordinate. The abscissa indicates the degree of uncertainty of a factor with regard to its possible development. The matrix can then be divided into different quadrants. A common subdivision can be seen in the Wilson Matrix shown here (Pillkahn, 2008). Factors that have a small impact on

the system, regardless of how uncertain their development is assessed, tend to be less relevant for the design of the scenarios. Particularly interesting for the further development of the scenarios are those factors that have a high impact. Depending on the degree of uncertainty, these can be divided into certain and critical factors. Certain factors are factors for which there are relatively precise estimates, even over long periods of time. Critical factors have both a high influence and a high degree of uncertainty. They are particularly interesting from the point of view of scenario development, as they allow great freedom in the further design of the factors. These critical factors tend to be the key factors of the scenarios (Gausemeier et al., 1998). However, certain factors that have a particularly strong impact can also be included in the set of key factors. The selection of key factors is not only based on the structural assessment of their impact and uncertainty. Rather, the selection of key factors also depends on the purpose of the scenarios and the interests of the stakeholders involved (Ernst et al., 2018).

After the key factors have been identified, projections are developed in phase 2. Projections express different possible developments of the key factors. As a rule, at least two projections should be formulated for each key factor (Haigh, 2019; Pillkahn, 2008). When formulating projections, it is important that they reflect contrary developments. For example, if one defines a price as a key factor, two obvious projections would be that the price will either rise or fall. Depending on the key factor and system environment, the number of projections varies (Hoffart et al., 2021).

In phase 3, the projections of the key factors are merged into consistent scenarios. As in phase 1, a resource-saving approach as well as a resource-intensive approach can be used for this purpose. The resource-intensive method is consistency analysis (Pillkahn, 2008; Weimer-Jehle, 2006). This method is based on the pairwise comparison of two projections of different key factors. Here, the simultaneous occurrence of the projections in a future is evaluated. Thus, the logical consistency of the pairwise occurrence of the projections is determined. This evaluation also takes place with an ordinal scale. Depending on the number of projections, consistency analysis can extend over a large set of projections and thus ties up large human resources and, if necessary, computational capacities (Weimer-Jehle, 2023; Weimer-Jehle et al., 2016). As part of the practical examples, we used morphological analysis as a resource-saving method.

Figure 4: General example of the morphological analysis.



Source: adapted from Pillkahn (2008, 204).

Phase 4 includes the interpretation, preparation, and communication of the scenarios. The depth and design of the visions of the future depends on the desired scope and the area of application. If the scenarios are used for public communication or as educational tools, then the focus is on communicating the scenarios. For this purpose, the scenarios can be prepared into stories in text form or transferred to other creative visualizations. In principle, there are no limits here (Pillkahn, 2008). If the scenarios are further processed in scientific contexts or in strategic planning, the focus is more on the interpretation and analysis of the systemic relationships of the key factors and projections in the individual scenarios. For example, qualitative scenarios are used in the development of emission pathways within the framework of the IPCC (Kriegler et al., 2014; O'Neill et al., 2014; van Vuuren et al., 2014), in the concrete simulation of transformation paths of energy systems (Hoffart et al., 2021; Pregger et al., 2020; Prehofer et al., 2021; Vögele et al., 2017) or in scientific advice to municipal decision-makers (Nilsson et al., 2017; Volkery & Ribeiro, 2009).

In the following section, two student projects are presented in which master's students from the Faculty of Management and Economics at the Ruhr-University Bochum have developed qualitative scenarios for and with the city of Bochum. These student projects show the didactic added value and strategic potential that lies in the development of qualitative scenarios. Municipalities in particular have a special role to play in times of crisis. They can be understood as representatives of politics and have the opportunity to shape transformation processes in a participatory and inclusive way in the immediate vicinity of

the population and to absorb the negative effects of the transformation. (Roos/Schmitt, 2022).

4. Application of Qualitative Scenario Development for Public Foresight

Due to advancing technological progress, automation, and digitalization, the task profile of universities is shifting. It is no longer just about preparing knowledge and bringing it closer to students. In the digital age, knowledge is archived and easily accessible. Rather, it is about empowering students to deal with complexity and uncertainty. Systemic and critical thinking can be named as two central building blocks here (Roos, 2024). The task profile of universities has thus evolved from the transfer of knowledge to the intertwined transfer of knowledge and skills in dealing with complex and uncertain issues (Ehlers, 2020). In order to meet these new challenges, seminars have been offered at the Faculty of Management and Economics in recent years that deal with the systematic and scientific recording of future developments. The two practical projects presented below take up this claim.

In the first practical project *Climate-resilient Bochum 2046*, the question was "What are the specific impacts of climate change on Bochum and what can be done to prepare for it?". In the second practical project *Smart City Bochum 2040*, the students were confronted with the topic of advancing digitalization. The focus was on the influence of digitization on the municipal administration and its possibilities for action.

To address these topics, students of the Faculty of Management and Economics have developed qualitative and explorative scenarios at the regional level. In the first practical project, the scenarios were developed *for* the city of Bochum. The students worked primarily independently and had the results evaluated by the Climate and Sustainability Unit of the City of Bochum[1]. In addition, the local working group of Scientists for Future provided its assessment of a sustainable city of Bochum in the light of the potential local effects of climate change (Ehrhardt et al., 2022). In the second practical project, scenarios were developed *together* with representatives of the Smart City Innovation

1 The evaluation took place in the form of a presentation of the results of the scenarios and an interview with Sonja Eisenmann as Head of the Climate and Sustainability Unit of the City of Bochum (Püttbach, 2022b).

Unit (SCIU) of the city of Bochum. The students of the Ruhr University Bochum prepared the development process and developed exploratory scenarios in two workshops with members of the SCIU.

These two projects show how the scientific method of scenario planning can be integrated into university teaching and collaborations between the university and the municipal administration can be established.

In the following section, the course and structure of the two practice projects is outlined. Both practical projects spanned a total of two semesters and focused on different phases of scenario development.

4.1 First practical project: Climate-resilient Bochum 2046

The first practical project spanned from April 2021 to April 2022 and included two seminars. In the first seminar, the students were introduced to the topic of the regional impacts of climate change and familiarized themselves with extensive teaching materials on qualitative scenario development. In the second seminar, the students concentrated on the scientific processing of the scenarios. Table 1 shows the four phases of scenario development and which tasks were implemented by the students in the first and second seminar. A special feature of the seminars was the project-oriented way of working. Instead of frontal teaching in the form of lectures, the teaching materials on the method of qualitative scenario development and the role of sustainability in macroeconomics were made available to the students in an interactive online course. The students and lectures then came together in seminar sessions and discussed the teaching materials together and trained practical steps of scenario development. For this purpose, there were several smaller group works in which historical stories from the last 30 years were collected, pop cultural narratives of the future were assessed and one's own attitudes towards the future were discussed. The aim of the joint work phases was not primarily to impart knowledge, but to engage creatively and critically with the future.

Table 1: Overview of development phases for scenarios for the project Climate-resilient Bochum 2046.

Phase 1	Phase 2	Phase 3	Phase 4
1.1. Objective & time horizont provided by lectures 1.2. Students researched responsibilities of municipalities & influence factors 1.3. Applying Wilson Matrix to define key factors	2.1. Students developed projections for key factors 2.2. Discussion of key factors with lecturers	3.1. Morphological analysis to construct scenarios	4.1. Developing narratives in form of persona 4.2. Presentation of scenarios to S4F and CSU Bochum 4.3. Second seminar on scientific preparation of scenarios 4.4. Preparation of student anthology

Source: own contribution based on the seminar documents.

In the first phase, the lecturers gave the students the question of the seminar and the time horizon for the exploratory scenarios. In addition, group work phases were planned in which the students were able to consolidate the method and already collect the first possible influencing factors. In their own work phases, the students researched the areas of action and responsibility of the city of Bochum and collected concrete influencing factors that can impact the scope of action of the city of Bochum against the background of advancing climate change. In order to narrow down the influencing factors collected and identify important drivers, the students applied the Wilson Matrix.

In phase 2, nine key factors covering political, ecological, techno-economic, and social factors could be identified together. In small groups, the students developed projections for the individual key factors, which were then discussed and adapted with the lecturers. In phase 3, the students developed four scenarios together with the lecturers based on morphological analysis. In the end, qualitative scenarios could be developed that define the framework conditions of the city of Bochum in 2046.

The fourth phase of scenario development was ultimately divided into two parts. In the first part, the students each wrote a term paper as part of their

final course assessment. These term papers dealt with different aspects of the scenarios. The seminar papers addressed the local effects of climate change, prepared the method of qualitative scenario planning, backed up the scenarios with scientific evidence and developed narratives to communicate the scenarios. In order to communicate the significance of the developed scenarios, so-called personas[2] were designed. This creative form of writing is about fictional characters going about their everyday lives in the respective scenarios and thus bringing the reader closer to the meaning of such a future (Torma/Aschemann-Witzel, 2024).

The second part of the fourth phase includes the second seminar. This seminar came about because the students expressed a desire to continue developing their scenario work beyond the framework of the first seminar by promoting the further processing and communication of the developed scenarios. In this seminar, the students worked almost independently. The aim was to produce a student anthology[3] in which the method and the results are prepared in such a way that they can serve as a working basis for interested parties and employees in the municipal administration. To do this, the students had to partially rewrite the existing texts from the term papers, compile a more solid empirical basis for the individual scenarios and enter into direct communication with the Climate and Sustainability Office of the City of Bochum. The anthology was compiled over seven months. After the publication of the student anthology, excerpts were presented in a public reading at the Bochum Theatre.

Table 2 lists the four scenarios that emerged in the practical project. The scenarios describe mixed futures in which the negative effects of advancing climate change take different forms. Particularly interesting are the social upheavals that will emerge in the city of Bochum in 2046 as a result of global developments. The scenarios vividly present the tensions between economic prosperity and socially acceptable redistribution and the dealing with climate refugees.

2 The scenario description in the form of personas can be viewed in the German-language student anthology (see Eckert, 2022; Leusmann, 2022; Püttbach, 2022a; Vollbracht, 2022).

3 The student anthology was edited by the lecturers. The individual contributions were written by the students of the seminars (see Roos et al., 2022).

Table 2: Overview of the four scenarios of the project Climate-resilient Bochum 2046.

Scenarios	Description
Waste Land 2046 – "We Told You So" (Alfers/Ruhfaut, 2022)	This worst-case scenario depicts Bochum in 2046 as the locus of pervasive system and ecosystem collapse. Extreme weather events, failing supply chains, and dwindling natural resources result in severe shortages of water, food, and energy. Widespread unemployment and social unrest dominate daily life, while only affluent households with off-grid power systems maintain reliable access to electricity. Motorized transportation has largely broken down; most inhabitants travel on foot or by bicycle. Trust in political institutions has all but vanished, and public protest remains absent, as citizens have lost all hope in governmental intervention.
Greentopia – "Too Good to Be True" (Alfers, Kruse, et al., 2022)	In this hybrid utopian-dystopian future, a rigorous sustainability agenda in Germany and Bochum has successfully averted major climate catastrophes. A pervasive "sustainability mind-set" combined with stringent consumption and production regulations ensures stable resource provision and a clean environment. However, elevated energy costs and strict usage limits place significant burdens on households and businesses, giving rise to a small yet vocal protest movement. The majority of residents nonetheless accept these constraints as necessary for long-term ecological stability.
Economy First – "Business as Usual" (Alfers, Westhof, et al., 2022)	Under this growth-oriented narrative, policymakers and corporations prioritize "green" innovation-driven expansion without implementing substantive social redistribution. Large firms embrace virtual working models, which exacerbates income and spatial segregation: wealthy populations inhabit secure suburbs or gated communities, while inner-city districts experience increasing poverty. Smart-city technologies are deployed chiefly for efficiency gains and surveillance, and broad segments of the populace see little benefit from overall prosperity. The middle class continues to contract, and public scepticism toward digitalization intensifies.

Scenarios	Description
Rotten Oasis – "Let's Make Things Better" (Alfers, 2022)	This scenario combines moderate climate impacts with a phase of economic stabilization, thereby averting acute systemic crises. A collective awareness of sustainability emerges, yet political urgency and financial resources for adaptation measures remain insufficient. During periods of drought and extreme rainfall, water and energy rationing are enforced, while technical interventions—such as air-conditioning units, façade greening, and communal "cooling shelters"—become commonplace. Local biodiversity suffers, and supply chains for industrial goods are robust but consumer-goods provisioning remains vulnerable. Municipal authorities respond reactively, and citizen-led initiatives assume primary responsibility for climate adaptation and the maintenance of social cohesion.

Source: The summaries and translations of the scenarios were created by the author.

The close and self-organized cooperation between students and lecturers in the practical project Climate-resilient Bochum 2046 and the resulting anthology gave the reason to continue the format. The second practical project will be presented in the next section.

4.2 Second practical project: Smart City Bochum 2040

The second practical project also spanned two seminars from April 2023 to April 2024 and focuses on the Smart City concept of the City of Bochum. Within the concept, innovation scouting and urban foresight on technological potentials and negative consequences for the urban population is planned. At the beginning of the seminar, the students of the practical project familiarized themselves with the topic of the smart city and the method of qualitative scenario development with the help of the methodological self-study course. In this practical project, the focus was on the collaborative development of scenarios *together* with representatives of the SCIU. For this purpose, two one-day workshops were organized, which the students planned and carried out together with the lecturers. Before the workshops took place, the students rehearsed the development of scenarios in fast forward under the guidance of the lecturers. For this purpose, there were several seminar sessions in which the basic concepts of scenario planning were explained and the creation of scenar-

ios was rehearsed. Table 3 shows the course of the practical project with regard to the workshops. The trial run of the students is not explicitly listed.

Table 3: Overview of development phases for scenarios for the project Smart City Bochum 2040.

Phase 1	**Phase 2**	**Phase 3**	**Phase 4**
1.1. Scenario field defined by students & lecturers 1.2. Collection of influence factors with SCIU members 1.3. Applying Wilson matrix with SCIU members	2.1. Developing of projections with SCIU members	3.1. Morphological analysis with members of SCIU to construct scenarios	4.1. Public presentation of scenarios to SCIU 4.2. Second seminar to further develop visual communication of scenarios

Source: own contribution based on the seminar documents.

In phase 1, the students defined the scenario field and the time horizon. The basis for this was public strategy papers of the city of Bochum, in which central topics and development paths of the city up to 2030 are outlined (Stadt Bochum, 2017; 2022). The first workshop took place about 6 weeks after the start of the seminar. At this workshop, influencing factors were collected on the basis of the scenario field. The students used participatory brainstorming methods. The members of the SCIU were divided into two groups and each group was supervised by students. The aim was to collect influencing factors, discuss their systemic significance, and assign them to the PESTEL[4] categories. In the second part of the first workshop, the influencing factors collected in this way were evaluated according to their systemic influence and uncertainty using the Wilson matrix. Finally, the factors classified in this way were discussed together and 12 key factors were identified. In this way, complex and supra-regional trends could be translated to the regional level (Nilsson et al., 2017) and the development of explorative scenarios for the city

4 PESTEL is an acronym of the terms Political, Economic, Social, Technological, Environmental and Legal and serves as a strategic orientation framework.

of Bochum could be prepared. After the first workshop, the students further specified the key factors collected and developed projections for each key factor. For this purpose, the notes from the first workshop from the discussion rounds were used to align the descriptions of the key factors and their projections as closely as possible to the ideas of the members of the SCIU.

In the second workshop, phases 2 and 3 were combined. First, the developed projections were discussed together with representatives of the SCIU and then scenarios were developed by means of morphological analysis. The students took the scenarios developed in this way into the seminar sessions and developed narratives, analysed the systemic relationships and reflected the results back with the SCIU. This resulted in five scenarios.

As before, the fourth phase of the project is divided into two parts. The conclusion of the first seminar was a public presentation of the scenarios, during which the development process was presented and the scenarios were discussed. The second part of phase 4 was implemented in a second seminar. The focus was on the creative preparation and broader communication of the resulting scenarios. Comparable to the creation of the student anthology, the students formed working groups that dealt with different areas of responsibility. The goal was to develop a video that conveys the central aspects of the scenarios in a scientifically sound way. To this end, the students contacted advertising and graphics agencies, drafted a script, interviewed scientists about the various focal points of the scenarios and organized a final event in which the results were presented to a wider public (RUB, 2024).

Table 4 lists the five scenarios developed and includes a brief description. Central topics of the scenarios are the development of the global security situation, the financial situation of the city of Bochum and the structure of digitalization. Both the international geopolitical balance of power and the local implementation of digital services in private or public hands play a central role here. The scenarios can rarely be assigned to a dystopia or utopia and can thus be used as cause for thought for the further development of the smart city concept.

Table 4: Overview of the five scenarios of the project Smart City Bochum 2040.

Scenarios	Description
Plenty of Light with a touch of shadow	By 2040, Bochum benefits from deep global integration and successful digitalization: stable, diversified supply chains and a sustainable energy infrastructure underpin a thriving economy. Key public services have been partly privatized, yet a strong sense of community—fueled by citizen engagement and private foundations—ensures social cohesion and effective crisis management. Although municipal budgets remain tight, widespread trust in digital technologies and robust cybersecurity enable seamless communication and low levels of crime.
The Division	In 2040 the world has fractured into national blocs. "America First" politics and trade conflicts have stalled globalization, leading to deindustrialization in Germany, the disappearance of the middle class, and a surge in populism and right-wing policies. In Bochum, empty coffers and high unemployment have driven privatization of essential infrastructure and pervasive surveillance, while affluent groups seclude themselves in gated communities. Smart-city technologies are deployed primarily to control disadvantaged populations.
We – But not all	Amid climate change and social tensions in the 2040s, tightly knit local communities emerge in Bochum, but mutual mistrust deepens between them. Despite ecological pressures and constrained household budgets, the broader population remains indifferent toward digitalization and smart-city initiatives. Key services such as infrastructure, education, and healthcare are largely privatized, and shortages of skilled workers combined with low urban density hinder progress.
Digitalization as the last hope	By 2040, Bochum faces economic stagnation and depleted municipal funds, yet progressive policies and a creative civil society view digital transformation as the key to renewal. Through targeted partnerships and investments in education and training, the city strengthens its digital competencies and develops innovative solutions for mobility, energy, and administration. Digitalization becomes the driving force behind sustainable growth and renewed social cohesion.

Scenarios	Description
The Great Crash	Following a period of global cooperation to combat climate change, society has become fully digitalized: AI-optimized supply chains, intelligent energy distribution, and interconnected communication define daily life. Then an unforeseen threat—whether an "AI virus" or cyber terror attack—brings all digital infrastructure to its knees within days. In Bochum, supply chains falter, panic buying spreads, and without Internet-based administration and services, societal functions grind to a halt.

Source: The summaries and translations of the scenarios were created by the author.

The description of the two practical projects is intended to show how versatile the scenario planning method can be used. On the one hand, the practical projects have contributed to students of the Faculty of Management and Economics dealing with interdisciplinary issues. On the other hand, the students were able to gain experience in dealing with experts from municipal administration through the independent structure of the seminars and had to organize project management independently. In the following section, the applied method of scenario planning and the experience gained in the two practical projects against the background of regional political decisions will be reflected.

5. Reflections about Qualitative Scenarios for regional public foresight

The description of the two practical projects shows how flexibly the scenario planning method can be applied. It can be applied in various degrees of depth and professional expertise. While scenarios developed by students will inevitably be more superficial than those developed by experts of the respective fields, current debates in the scientific literature can be transferred to the practical projects. Regardless of the depth of the scenarios developed, the process encourages collaborative work between the participants and promotes the reciprocal transfer of knowledge between universities and practice.

In the following section, the core benefits and limitations of qualitative scenario planning as a foresight method will be discussed and the experiences of the two practical projects will be reflected against this background. Project diaries and reflection reports of the students, which they have written to accom-

pany the projects and discussed with the lecturers in feedback meetings, serve as the basis for this reflection.

The work in the practical projects has clearly shown that scenario planning is a method with which complexity and uncertainty of long-term developments can be captured and communicated in a structured form (Durance/Godet, 2010; Hoffart et al., 2021). Particularly in regional contexts such as urban and spatial planning, decision-makers are confronted with complex and transdisciplinary challenges (Dixon/Tewdwr-Jones, 2021). These experiences are also reflected in the students' reports, which highlight the competence development of design thinking and ambiguity tolerance (Ehlers, 2020). In addition, there is a strong focus on the integration of inter- and transdisciplinary dimensions, which are addressed in public foresight in the form of social, technological, economic, environmental, political, legal, and value-based (STEEPVL) factors (Szpilko, 2020). This confronts regional decision-makers with a holistic problem and enables them to develop strategic decisions as a group through the participatory development of shared visions (Burrows/Gnad, 2018; Ravetz/Miles, 2016; Rijkens-Klomp/Van Der Duin, 2014). Here, existing thought patterns and assumptions about the future are challenged and compromise is supported by the joint development of futures (Amanatidou, 2017).

Although this process was not evaluated on the part of the municipal administrative employees in the course of the practical projects, the students report joint learning effects in their project diaries. This showed that the students were able to broaden their economic view from their studies. Above all, the close cooperation with the SCIU in the Smart City Bochum 2040 project showed the students how administrative work processes differ from academic work. These different logics represent a central challenge in the application of scenario planning processes in public foresight. The scientific approach to the future focuses on systemic relationships between inter- and transdisciplinary factors, which are analyzed in time horizons of decades. Whereas the strategic work of administrations and public organizations tends to take place over shorter periods of up to 15 years. This is a structural conflict that can hinder the development process and the practical use of public foresight for political work in municipalities (Bourgeois et al., 2017; Rijkens-Klomp/Van Der Duin, 2014; Tatar et al., 2020). However, the SCIU is a special working unit within the municipal administration. The members of the SCIU work in different areas of the city administration and at the same time belong to a working unit that deals with long-term developments of a smart city and is granted fixed

working hours for this purpose. As a result, the SCIU offers great potential for incorporating findings from scenario planning into the day-to-day work of the municipal administration.

In addition to communicating with the city administration, the students had to moderate different perspectives and interests in their own group. Although this also led to tensions because the workload was distributed highly unequally at times and students held conflicting opinions about the contents of the anthology, this was actively addressed in the group and led to the development of communication skills and the strengthening of one's own self-efficacy. The students emphasise the self-organised character of the project work, which strengthens the group structure and encourages students to proactively stand up for themselves and the project. In particular, the acquisition of offers from various publishers for the publication of the student anthology in the project Climate-resilient Bochum 2046, as well as the contact with graphic designers for the preparation of the scenarios in the Smart City Bochum 2040 project, confronted the students with rather unusual tasks that are not required in regular studies. The students reported that they regularly had to leave their comfort zone due to the varied tasks and at the same time had the feeling that the project team supported them in these steps.

Within the practical projects, the lecturers were able to gain insights into the personal development of the students through the diaries and feedback discussions. However, this also reveals a fundamental problem of the scenario planning method. The learning effects described by the students cannot be directly attributed to the scenario planning method itself. Although the collaborative nature of the method promotes democratic decision-making and self-efficacy, these effects are difficult to attribute directly to the scenario method (Amanatidou, 2017; Rijkens-Klomp/Van Der Duin, 2014; Tatar et al., 2020). Especially in economics studies, the focus is often on written exams as a form of examination. Here, scenario planning proves to be a helpful method for breaking up isolated teaching and learning formats and bringing those involved into direct exchange. Especially against the background of advancing digitalization, the mediation and testing of collaborative and transdisciplinary approaches plays a greater role (Ehlers 2020).

In addition to the process-oriented effects of scenario planning, which have a positive effect on group dynamics in an organization and the individual development of strategic thinking in complex and fundamentally uncertain contexts, scenario planning is subject to material limitations. The presentation of the two practical projects shows that scenario planning is a time-consum-

ing and financially intensive method. Both projects lasted one year each. Of course, this is partly due to the university context, where semester times have to be adhered to and exams have to be collected. Nevertheless, well-founded scenario planning can extend over several months to years and requires intensive group processes to be effective (Durance/Godet, 2010; Hoffart et al., 2021). The two practical projects took place as part of regular courses and the publication and visualization were partly co-financed by university funding programs. Thus, in addition to the personnel leave, there were no additional costs for the city of Bochum. Nevertheless, the high intensity of scenario planning can be a central obstacle in the practical application of public foresight. However, this use of time and personnel resources is not inherent in the scenario planning method, but is much more due to the complex challenges of participatory processes and a sound scientific foundation.

6. Conclusions

This article has shown that qualitative scenario planning offers a systematic method for addressing uncertainty in long-term municipal strategy development. The method is based on identifying a scenario field, isolating key factors, formulating projections, and combining them into consistent futures. Rather than predicting the most likely outcome, scenario planning seeks to map out plausible alternatives that can challenge assumptions, highlight systemic interdependencies, and provide a structured basis for strategic reflection.

The two student projects presented here illustrate how this scientific approach can be adapted in practice. In both practical projects, students experimented with the method, engaged with municipal stakeholders, and translated abstract foresight concepts into narratives and visualizations. These projects demonstrate that universities can serve as experimental spaces where exploratory foresight methods are tested, refined, and foster transdisciplinary exchange. They also reveal the dual challenge of linking academic processes—which operate with long time horizons and systemic perspectives—to administrative practice, which is often bound by shorter planning cycles and functions in different institutional logics.

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