Urban pop-up housing environments and their potential as local innovation systems

Risk Assessment

Deliverable D5

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PREFACE

As part of the interdisciplinary research project "Urban pop-up housing environments and their potential as local innovation systems", six deliverables (D1 – D6) were generated in accordance with the project proposal, which reflect in detail the working process and outputs of the diverse tasks in the working packages. An overview of all deliverables and their key messages is provided in the Executive Summary (Deliverable D0). The individual deliverables were developed chronologically according to the project schedule and progress, and thus, completed at different time points in the project, reflecting the state of knowledge at the respective project status at that time.

Different SCI publications were also generated within the work-packages and are based on the deliverables, whereby some contents were deepened and further developed. In some cases, terms and terminology have also been adapted. The contents of the deliverables therefore partly represent “work in progress” at the respective times of completion of the working packages and writing of the deliverables. The contents of the published SCI-papers and the key statements in the Executive Summary (D0) are to be understood as the most recent and solid outcomes and conclusions.

CONTENT

1 INTRODUCTION

The models and respective model scenarios developed in this project were subjected to a simplified risk assessment in accordance with ISO standard 31000/ÖNORM D 4900, which is very frequently used in the field of organizational management. Even though only limited resources were available for this part of the project, it was to be expected that the results obtained would provide valuable information both on the basic risk assessment of the models presented or their formulated scenarios and on the applicability of this method in principle to the problem at hand in the project.

The risk management process suggested by ÖNORM D 4900 consists of a combination of risk scenarios and their evaluation by positioning in a reference system called "Risk Matrix". The Risk Matrix is based on the basic definition of risk, where risk is a relation between the magnitude of expected or observed damage and the probability or likelihood of the occurrence of the specific damage. Probabilities are mainly expressed as cases by population or batch size or as frequency (which is the occurrence of a certain number of cases by time). Usually, the goods to be protected are human health, the environment, and economic values. ISO 31000/ÖNORM D 4900 introduces social and political stability as a fourth property to be protected.

The ÖNORM risk assessment process starts with a system definition to determine the validity of the following risk assessment statements. A risk assessment without relation to a certain system is meaningless because a certain magnitude of damage has to be evaluated according to specific system levels as a reference system. The second step is the compilation of a suitable damage (or hazard) list which contains possible elements of the system which can be points of adverse alteration. At these points the system in question can be prone to damage. Simultaneously, such points can be used as opportunities to measure the condition of the system, and thus, to control and willingly modify the system. These damage lists can serve as starting points for developing appropriate and plausible risk scenarios in a next step. Risk scenarios are illustrative and precise descriptions of possible adverse situations. The assessment procedure will be completed by evaluating and positioning the relevant risk scenarios in the Risk Matrix. The position of a certain scenario provides some information on the importance and urgency of taking a certain risk treatment procedure. In this project a simplified risk assessment has been applied consisting of (1) a system border definition (see chapter 2.2), (2) the compilation of model-related damage lists (see chapter 2.3) and (3) a basic draft of model specific core risk scenarios (see chapter 2.4). To add further risk relevant issues from a stakeholder workshop a different risk evaluation method developed by the EPRS (European Parliament Research Service) has been used to integrate aspects not considered by the ÖNORM risk assessment process (see Chapter 3).

An interesting methodological consideration is the fact that in the present project a risk assessment method that has been tested in practice was applied to objects that do not yet exist per se, i.e., quasi ex ante. However, the risk assessment according to ON 4900 is well-structured and sufficiently flexible, so that a corresponding adaptation – albeit with certain limitations due to the restricted time – was possible. The attempt to apply a common risk evaluation standard and its methods to thought exercises was an interesting experiment to test the flexibility and adaptability of the standard. In general, it should be mentioned that the systematic analysis and assessment of risks should be conducted as early as possible because it can already influence the design process in a favourable way. The inclusion and integration of various concerned parties and person groups (in our case these would also involve intended user groups and neighbouring residents in addition to architects, engineers and city planning experts) is recommended. Finally, an accompanying risk assessment might be a suitable supplement for any analysis of innovation spaces in the sense of a possible risk-benefit analysis.

The risk assessment method was used to test whether this widespread procedure can also be used for these systems, and to develop a corresponding understanding of risk and safety-relevant aspects among the involved experts. In principle both of these aims could be achieved, but statements made in this context apply under certain conditions:

(1) A complete risk assessment of systems (e.g., hospital management, where this method is widespread), is a complex, interdisciplinary or transdisciplinary task, that requires intensive specialist communication and therefore time resources. In the present project, however, a risk assessment was only intended as a subordinate issue within the framework of WP 4.3 from the start, which is why the risk assessment was initially only carried out in broad terms (consisting of a system definition, damage lists, basic risk scenarios). In addition, the measures taken by the COVID-crisis management further restricted communication, which would have typically taken place in working groups. Nevertheless, the results obtained under these conditions provide good insights into the fundamental nature of the risk and safety-relevant aspects of the presented models. For a detailed risk assessment, a separate module would have to be provided in a possible follow-up project.

(2) A standardized risk assessment is usually only applied to systems and organizations that already exist, with the aim of effectively averting possible damage. This is not the case in the present study for several reasons: firstly, the models presented are primarily largely theoretical considerations that, although already highly developed in terms of planning, did not involve concrete plans for implementation. And secondly, these models were only developed during the project, as planned, since that was the main content of the project, so that a risk assessment, which is essentially dependent on the expertise of the experts involved, could only start at a relatively late point in time. Incidentally, this is a common problem with all assessment methods that are to be used ex ante and applies to ex ante LCAs.

(3) Ultimately, these and similar assessment methods, even if they are applied to existing systems, are heavily dependent on the basic assumptions made and the selection of the corresponding datasets. Therefore, interdisciplinary procedures are more suitable, as new knowledge stocks are built up in cooperation and constantly re-evaluated in a participatory manner. Interdisciplinary risk assessment is therefore preferred for emergent developments, such as regulating the use of new technologies or in crisis and disaster management.

With regard to the models or scenarios, a distinction can be made between model-specific risks and non-model-specific, i.e., generic, risks. While scenarios such as "Life on track(s)" (model "TinyTainer") or "DonAutonom" (model "Binnen bleiben") show risks that are caused by the potentially hazardous location (abandoned railroad yards, riverbanks), other scenarios or their underlying models are mainly subject to hazards that are either technical, urban planning or social. In the case of GapModule, for example, the high planning and construction costs should be mentioned, and for other scenarios ("LifeSharingToGo") the generally very long lead time. “BeatTheHeat" also has an increased planning and coordination effort in advance. Risks that are independent of the models are primarily (1) the unwillingness of owners to make vacancies available for the construction of temporary forms of housing, (2) the tendency of residents – for understandable reasons – to settle permanently in the temporary environment provided and therefore to create a quasi-permanent residential relationship from a temporary relationship of use, and that (3) in the case of an inhomogeneous group structure and a lack of integration into the social environment, potential sources of conflict are created at the local level, which can lead to an increased effort for order and control.

1.1 RISK AS A SCIENTIFIC TERM

The term „risk“ appears around 1500 in late medieval naval contracts as “risicare” or “rischio” which means that someone is willing to jeopardize something (usually a certain amount of money) in expectation of a certain benefit. This was normally the case when providing financial support for longer-term commercial expeditions to new and then rather unsafe geographical regions. These sorts of contracts should protect the investors against complete loss of their capital expenditure. Insofar, these contracts are some early forms of insurances.

Bernstein (1995) introduces the revolutionary idea that the boundary between modern times and the past is the mastery of risk. The concept of risk combines several new ideas in a striking way: first, the future is no longer something predetermined which human beings will helplessly run into, but the consequences of multiple decisions, and secondly human beings are capable of taking these decisions and therefore shape their own surroundings and the future of the world they will live in. It is no surprise that for this reason this world must be described in a new way: not by a mere narrative but by close observation, documentation and examination. The future is not deterministic (and must then be “the best of all worlds”) but probabilistic. Of course, no benefit comes without certain disadvantages: this probabilistic turn offers the possibility for improvements where needed but this cannot be gained without the loss of existential security. If the future can be mastered by systematically studying hypotheses of the outcomes of our decisions we are then left alone as the sole responsible instance for these consequences, even if they were not intended.

The Society of Risk Analysis (SRA) lists several qualitative notions which could describe risks without specifying a universal definition (SRA 2015):

- the possibility of an unfortunate occurrence.
- the potential for realization of unwanted, negative consequences of an event
- exposure to a proposition (e.g., the occurrence of a loss) of which one is uncertain
- the consequences of the activity and associated uncertainties

- uncertainty about and severity of the consequences of an activity with respect to something that humans value
- the occurrences of some specified consequences of the activity and associated uncertainties
- the deviation from a reference value and associated uncertainties

In a nutshell the term “risk” encompasses at least two main criteria which must be considered: impact on a value (which in many cases might be a negative impact, thus a damage) and an estimation of the probability of this damage. In many cases probabilities cannot be given (because lack of data) or are not in the focus of the evaluation procedure (e.g., in toxicology). Here, risk assessment focuses on the magnitude of damage as soon as exposition can be assumed. This means that at least two dimensions are of foremost importance, this is to say a damage (as a consequence of some kind of hazard) and the addressee of this damage, which is the value which is impaired, reduced or destroyed (thus being the definition of “damage”).

Following Luhmann (1991) risk is the integration of the future into the present. Insofar, we must systematically estimate the consequences of our decisions first to make these decisions possible in the first place. This aspect of self-referentiality is mirrored by the way we build hypotheses about the functionality of the world in general: both – our hypotheses and our reflections on outcomes of our decisions – refer to the future and try to describe types of damages which have not materialized, yet. And – to complete a rather revolutionizing idea – these estimations of future damages are based on data regarding historical accidents and/or other adverse events. Thus, the concept of risk is equally based on future and past events which are closely interrelated to make the present controllable.

1.2 INTERNATIONAL RISK STANDARDS AND DEFINITIONS

Based on these considerations international binding terminology provides certain risk definitions which are normally used in risk assessment and risk management processes. The most important source (apart from the meanwhile outdated but seminal ISO-Guide ISO 73:2009) for risk assessment and risk management processes is the international standard ISO 31000 (ISO 2018), which has been integrated into the recent editions of the national standard series ON D 4900 (ASI 2021). Since its first implementation in 2004, several thousand risk managers have been certified according to this standard series – mainly in hospital management, but also in numerous organisations in the federal and private sector. An overview on the structure and the method of ÖNORM D 4900 is given in the following section.

The central definitions of ISO 31000 are given here as a guideline and general orientation mark how to conceptualize risk in systems in general. The core is ISO’s definition of risk as a “combination of the consequences of an event (hazard) and the associated likelihood/probability of its occurrence”. This is a rather neutral version to encompass probable (and possible) benefits of a certain decision. When dealing with safety the focus is placed on the negative consequences with the aim to prevent them. Classic concepts of risks have categorized consequences in three areas – human health, economic loss and ecological deterioration. The ISO 31000 interestingly adds to these conventional categories the important area of political and/or societal damages, such as the threat to societal stability, democratic freedom and peace. Consequences – according to ISO 31000 – are the “negative effects of a disaster expressed in terms of human impacts, economic and environmental impacts, and political/social impacts”. Initially, this may be a surprising extension of the scope, but given the fact, that natural and technical disasters might have (and in fact have already had) an impact on civil society as triggers for local crises this definition makes perfect sense.

1.3 RISK MANAGEMENT CYCLE

The risk management cycle addresses the fact that psychological, social, political and cultural factors must also be taken into consideration when assessing risks. This is seldom the case in classic risk assessment and is only now starting to be addressed. Within this project care was taken to incorporate these dimensions.

1.3.1 ÖNORM D 490x / ISO 31000

The ÖNORM D 490x series serves to specify and deepen the requirements of ISO 31000: 2018. It is shown how risk management empowers organizations and systems to deal with risks systematically. This standard series consists of six single documents, three of which are formulated as guidelines how to apply risk assessment methods, to implement the risk management process, and to ensure certain principles for emergency, crisis, and business continuity management. The documents are titled as follows:

- ÖNORM D 4900, Risikomanagement für Organisationen und Systeme – Begriffe und Grundlagen – Anleitung zur Umsetzung der ISO 31000
- ÖNORM D 4901, Risikomanagement für Organisationen und Systeme – Anforderungen an das Risikomanagementsystem – Anleitung zur Umsetzung der ISO 31000
- ÖNORM D 4902-1, Risikomanagement für Organisationen und Systeme – Leitfaden – Teil 1: Einbettung des Risikomanagements ins Managementsystem – Anleitung zur Umsetzung der ISO 31000
- ÖNORM D4902-2, Risikomanagement für Organisationen und Systeme – Leitfaden – Teil 2: Methoden der Risikobeurteilung – Anleitung zur Umsetzung der ISO 31000
- ÖNORM D 4902-3, Risikomanagement für Organisationen und Systeme – Leitfaden – Teil 3: Notfall-, Krisen- und Kontinuitätsmanagement – Anleitung zur Umsetzung der ISO 31000
- ÖNORM D 4903, Risikomanagement für Organisationen und Systeme – Anforderungen an die Qualifikation des Risikomanagers – Anleitung zur Umsetzung der ISO 3100

ÖNORM ISO 31000 contains generic principles and recommendations for the application of risk management in systems. The ÖNORM series D 490x "Risk Management for Organizations and Systems" shows how the ÖNORM ISO 31000 can be implemented in practice. The requirements of ÖNORM D 4901 are presented as verifiable requirements and can be audited and externally certified.

Basically, the standard is based on the usual sequence of risk assessment processes: risk analysis, risk evaluation, risk management and risk monitoring. This serial and rather linear process can better be thought of as a risk management circle, where identified, characterized and evaluated risks can be treated in regular intervals, thus using risk data of the last passage at a time for a new assessment. This should contribute to iterative improvement in safety. The risk ÖNORM D 490x management process is shown in Figure 1.

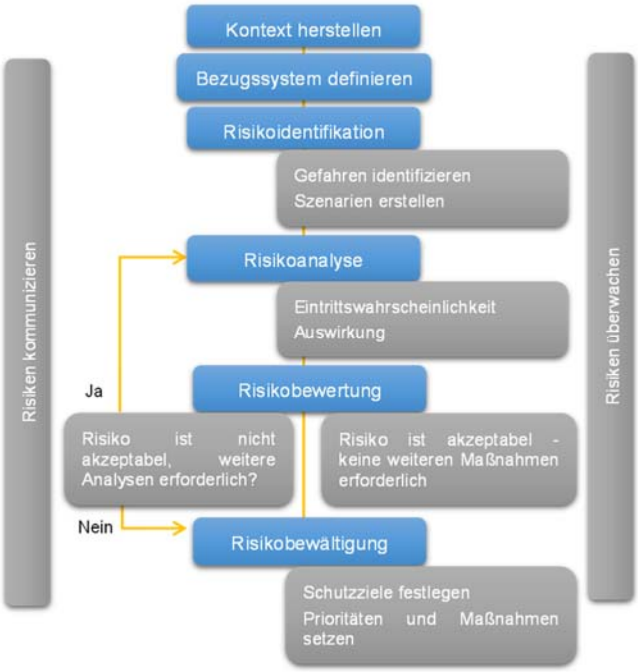

Figure 1: ÖNORM D 4900 risk management process (in German)

1.3.2 International Risk Governance Council (IRGC)

The rather technical approach of the risk management process of ÖNORM D 490x (although serving as a good basis) might not be sufficient to describe societal and political risk governance processes, which are manifold and complex and involve different actors with differing risk attitudes. Many risks are complex, uncertain, and even ambiguous and risks and benefits are tightly interconnected. To describe and assess these risks the Geneva based International Risk Governance Council suggests a more refined model, the Risk Governance Framework (IRGC 2017). The key elements of this framework depict the importance of complex risk communication processes at all stages (instead of the rather one-way communication process as part of risk management in conventional systems) and the simple fact that the phase of risk evaluation is not confined to a mere technical procedure. It also (and especially) contains a societal evaluation of risks which is influenced by group-specific risk perception and interest-laden media coverage. This parallel assessment is not necessarily connected, scientific facts are not the only aspects influencing the specific result of risk assessments of new technologies or potentially dangerous activities, but both are to be considered in risk governance to be successful. The IRGC Framework (see Figure 2) provides guidance for early identification and handling of risks, involving multiple stakeholders and consisting of the following five stages:

- Pre-assessment – Identification and framing; setting the boundaries of the risk or system.
- Appraisal – Assessing the technical and perceived causes and consequences of the risk.
- Characterization and evaluation – Making a judgment about the risk and the need to manage it.
- Management – Deciding on and implementing risk management options.
- Cross-cutting aspects – Communicating, engaging with stakeholders, considering the context.

Most of the aspects introduced and discussed in this report can be assigned to the first two risk assessment stages (risk analysis and risk evaluation) with some attempts to make recommendations for risk management (especially in Chapter 2.4. dealing with the development of pre-scenarios).

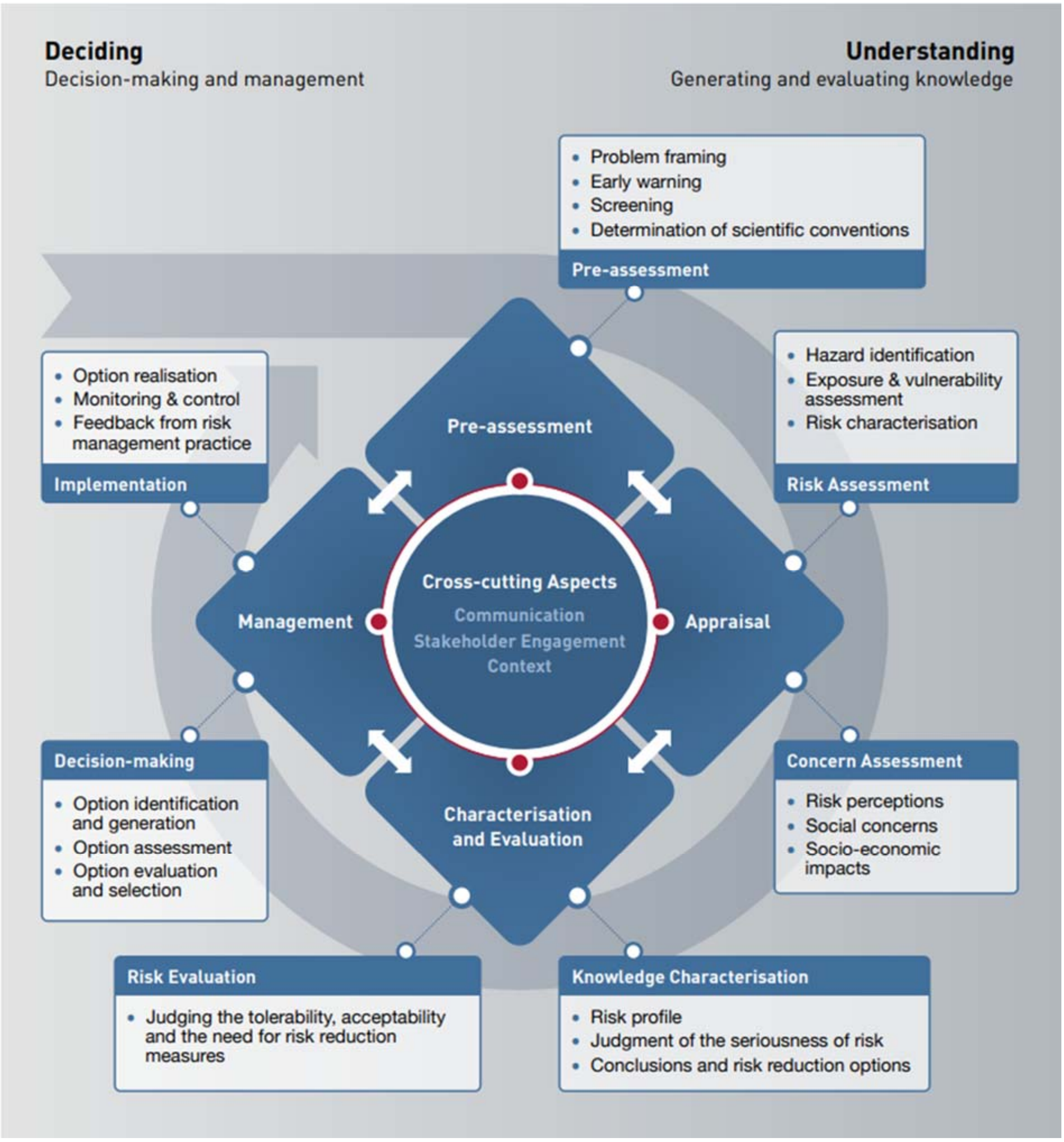

Figure 2: IRGC Risk Governance Framework (Source: IRGC 2017)

2 RISIK MANAGEMENT STANDARDS

2.1 METHODOLOGY

While in guideline 3 (ÖNORM D 4902-3) the standard suggests a series of methods to assess and evaluate risks, the main methodology is a simple risk matrix which combines the criteria hazard and probability (ÖNORM D 4091). It is a direct derivation of the principal risk definition (see above). In a first step a collection of factors has to be compiled (also called damage list, “Schadensliste”). These factors can be considered as (1) aspects which might affect the system and (2) as points where the system in question might be influenced. Like the HACCP method used in food production and hygiene these spots serve as critical control points where any changes of the system can be measured. This also means that at these points target values can be set and compared to the actual measurement values. Finally, as soon as possible deviations from these target values can be determined, risk management is able to formulate specific counter measures to address the possible risks. In a workshop held during this project such risk scenarios providing influence factors, possible deviations, and appropriate management activities to counter adverse effects have been developed as a thought experiment (see Chapter 2.3. for a categorized damage list for each model and Chapter 2.4. for possible scenarios).

2.2 SYSTEM DEFINITION

The first and most important task in early-stage risk assessment is always to agree on the specific system for which the risk statements should reasonably apply. Risk statements as to the magnitude of damage only make sense if they are related to a certain addressee or organizational level. A possible loss of e.g., 50.000 Euro might be negligible for a company as a whole, but on the level of a certain department or even for a specific individual this loss will probably or most certainly be of existential significance. First of all, the group used the respective model description as an output for the system description to create a list of damage or influencing factors and added a few categories from the user profiles, so that the following list of system areas appear: architecture, construction, sustainability, urban planning, social quality and specific usage of the models. We can then make the following basic statements about the system in question:

(1) These elements have a specific functional relationship and together form the system. It must be decided which elements are to be included. For example, the planning element or the disposal of a model after usage could be eliminated as marginal, but this does not necessarily have to be the case. For example, incorrect planning itself or incomplete crisis management can make the implementation of a model impossible, and thus represent a fatal risk for this project in advance. In this case the planning stage is not included in the system because of two main reasons: (1) the development of the models is regarded as perfect (the models in question being thought experiments – nothing will be really constructed during this project) and (2) the focus of risk management is on the possible implementation of these models.

(2) The system elements can be assigned to different spheres. Our system can be viewed as an encaptic (enclosing) hierarchy, namely mainly (a) predominantly technically oriented areas

(production, construction, etc.), (b) those elements which also consider the model in its environment (urban planning, environment), and finally (c) those that also contain aspects of use (user profile, reason for use). Here, too, one must make a decision as to which sphere is still included in the system and which is not.

(3) A risk-relevant statement can then (a) either only apply to the technical area (i.e., a technical safety analysis of the structure) or (b) the building in its environment (then urban planning and environmental conditions are added) or (c) even the building in a certain environment within the scope of a certain use. Consequently, a scenario and its allocation in a risk matrix can be carried out for each system level separately or for the whole system. For a risk assessment, one can select variants in all three spheres, which are assessed separately. In this subtask the goal was (1) to describe the system as comprehensively as possible and (2) to find suitable categories and influencing (damage) factors. Since this information then applies to all variants, all risk assessments using the same set of factors are comparable. The categorized list of damage factors is given in the following chapter.

Summarizing the considerations about the predefined elements and their assignment to the three spheres we get a three-layered, hierarchical system, where the upper layers contain the respective lower levels overall. This leads to a static depiction of our system in question which is shown in Figure 3.

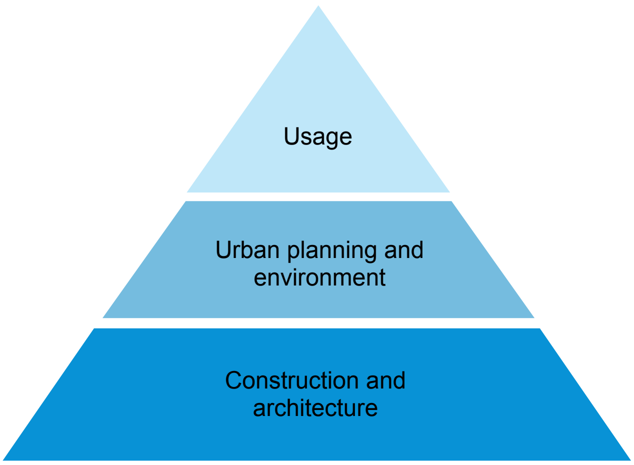

Figure 3: Spheres of the system

In short, these three spheres can be designated as:

- **USAGE**: aspects of the cause resp. the specific reason to build a temporary housing project, the specific type of usage including user group composition, behaviour, and preferences
- **ENVIRONMENT**: aspects of the natural, spatial, and urban environment, the building is erected in and aspects of urban planning requirements
- **BUILDING**: aspects of construction engineering and architecture, e.g. material, construction, dismantling, etc.

These terms will be used throughout the following chapters. A fourth "sphere" might be useful to be included, at least for further development of the ideas laid down in this report, because the planning process (be it a separate construction plan or as part of an overarching preparatory planning strategy) will be interesting for risk evaluation, especially during a specific crisis or disaster management plan. This fourth sphere will appear in yellow but will be excluded from this report.

In many cases systems are preferably considered as dynamic processes, the elements serving as cause-effect relationships. These relationships are not necessarily linear references but contain a great variety of influences (reinforcing, attenuating, neutral, etc.). In this case a simplified model of the whole process has been chosen to represent the system as a dynamic interdependency of the basic elements (Figure 4).

Depicting the system this way one can also ascertain that the individual process elements belong to different spheres: Production is more oriented towards technical aspects of the model, while the setup, and the environment depend on the type of usage and the preferences and the behaviour of the acting user groups.

To adequately depict the system, it is necessary to define its borders and to decide as to which system elements will not be part of the system. This requires a transdisciplinary selection process where relevant system elements are defined, evaluated, and finally chosen by negotiation of the concerned experts.

This way of representing a system also exemplifies that it is possible to derive and define (critical) control points in the process. Every system element consists of both certain items which can be hazardous or can be damaged and of people who act in a certain way to cause harm or damages (human failure). All these sources of possible damage can be assessed in a systematic way (as done by a HACCP) which serves as the basis for defining certain management activities to prevent these damages.

Figure 4 shows the system of temporary housing models as a process. It includes central elements and their relationship to each other. We see that elements from the fields of architecture and manufacturing clearly prevail. It can also be seen that temporary housing forms are used several times and therefore go through several cycles that are relevant for the assessment of risks.

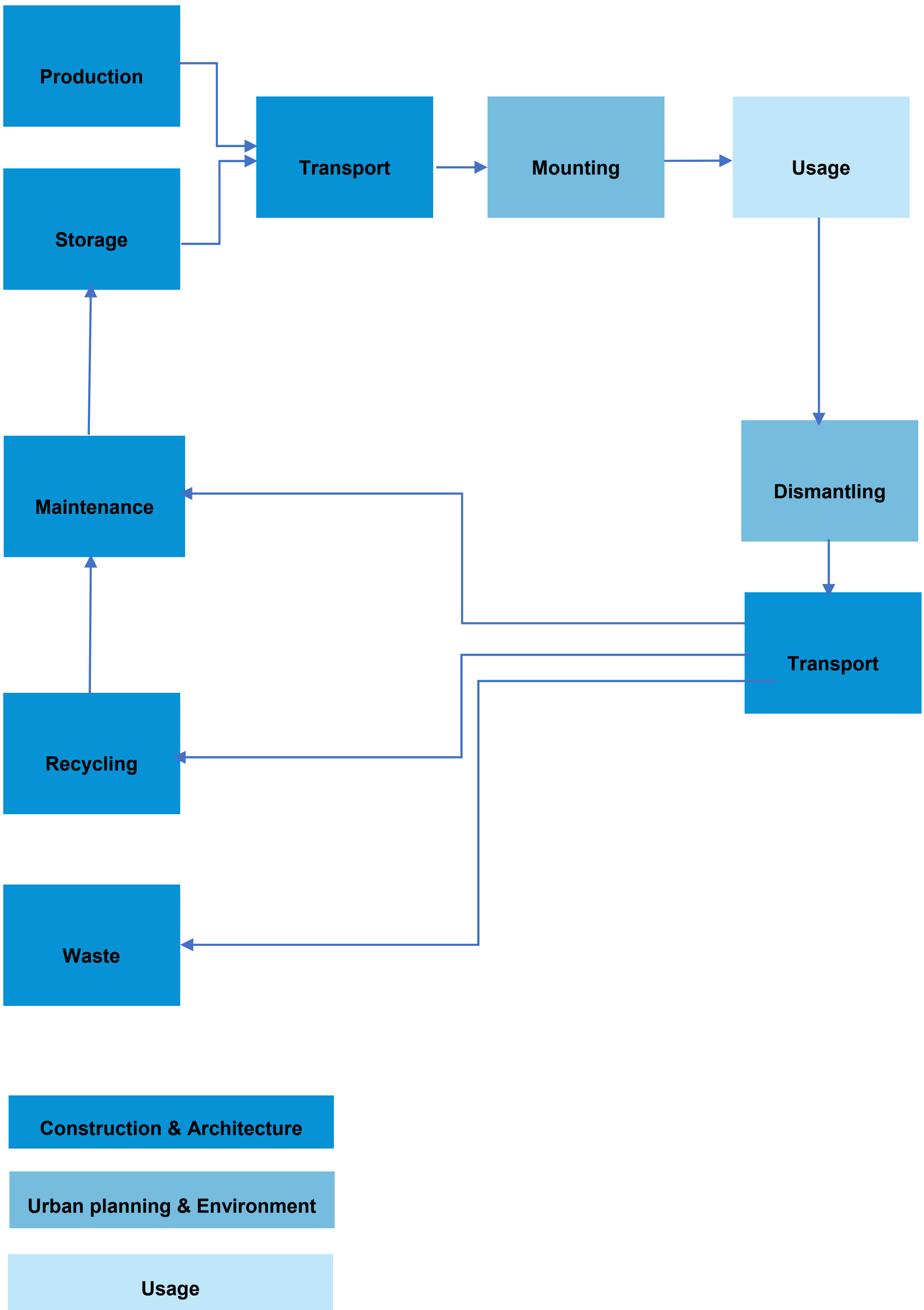

Figure 4: The system of temporary housing models as a process

2.3 DAMAGE FACTORS AND DAMAGE LIST

As already mentioned above, specified damage lists can be viewed as a categorized list of influencing factors, i.e. every damage aspect that is assigned to a category can be regarded as a factor that can influence the adjacent system element or even the whole system. In a risk assessment, which is carried out to improve the safety or security of a system, one assumes that these are factors that can adversely affect the system and impair or even destroy the normal functionality of the system.[1] However, this also means that these are elements in the system where the system can be influenced by a controlling entity, i.e., humans. At the same time these elements offer the possibility to measure, monitor and change the process. Therefore, these influencing factors can also be operationalized. At least one lower or upper limit can be specified below or above which the system is at risk.

A concise, albeit not comprehensive list of damage factors has been developed within several workshops involving all disciplines represented in the project team. These lists can serve as a source for describing the chosen models and their specific use in a comparative way. On the basis of this damage list it is possible to assemble case specific scenario templates by selecting the appropriate set of damage factors. The damage list is shown in Tables 1 to 3 for the three system areas construction, context, and usage.

Table 1: Damage list for sphere 1 BUILDING (construction & architecture)

Architecture		
category	**description**	**evaluation**
flexibility	adaptability, adaptive capacity (modularity, mobility of single elements, e.g., partition walls etc.)	easy – difficult (grade of modularity, time requirement for conversion or reconstruction)
suitability for daily use	accessibility (barrier free building)	yes – no (valid also for parts of the building, checklist)
	subsequent modification for accessibility possible	yes – no (resource requirements, costs)
living space	living space per person	threshold value (m²/person) → exceeding the threshold value
ratio private and common areas		ratio
comfort, convenience	temperature, humidity, dust pollution, noise, light pollution, odour nuisance	measurement values results from interviews, questionnaires
privacy	No partition – curtain, blinds – door - locked door – personal key etc.	technical provision for personal security: non-existent → poor → high perceived personal security: feeling unsafe – feeling safe

[1] Of course, such factors can also influence the overall system or one of its parts in a positive way (i.e., cause a benefit). This consideration is also important when temporary forms of housing are conceived as experiments/innovation niches.

Construction		
construction	Do-it-yourself (DIY) by users Skilled work Combined DYI - skilled duration	Yes – no Yes – no Ratio in % Construction time
dismantling **foundation**	Do-it-yourself (DIY) by users Skilled work Combined DYI - skilled duration	Yes - no Yes – no Ratio in % Construction time
	Existent Quality condition	Yes – no Material composition Age, wear, damages
Additional construction, e.g., scaffolding	necessary	Yes – no Resource requirements, costs, erection time
storage	Suitability for storage	Yes – no costs
infrastructure	Technical integration and direct accessibility of urban infrastructure	Yes – no (checklist for different applications) Resource requirements, costs
Noise insulation	Noise pollution	Low – high

Table 2: Damage list for sphere 2 ENVIRONMENT (urban planning and environment)

Sustainability		
category	**description**	**evaluation**
Resource efficiency	power consumption	Actual consumption (deviation from expected consumption)
Energy source **Material**	Types and proportions of energy sources	g CO_2/kWh
	Materials used	Measure of environmental compatibility Recyclability
Reusability	Degree of reusability	In % of the materials used
Encroachment on the environment	Intensity, reversibility, change in land use, sensitivity of the area	

Urban planning		
Integration	Integration into the cityscape	Yes – no Degree
Reachability		easy – not accessible
Public transport **Active mobility in the neighbourhood**		
Accessibility of central facilities		
Accessibility for assembly and dismantling		
Added value through new use	For the existing environment and residents	Assessment (politics, planning, neighbours)
Acceptance by the neighbours	Promotion/hindrance of neighbourhood formation, added value/depreciation	
Temporality	The use for living is not given up – transition to permanence	–low – high
Emission-dependent suitability for residential use	noise (mainly)	

Table 3: Damage list for sphere 3 USAGE (usage cause and user groups)

Social quality		
Neighbourhood internally	Conflict, rejection, group dynamics	
Neighbourhood, across projects		
Acceptance and appearance		
Total number of residents	Occupancy rate (limit value)	Under-occupancy/over-occupancy in absolute terms or % m^2/person
Change of user group		
Communication (internal, external)	Language and culture barriers Communication strategies and processes available/adaptable	high/low/surmountable Yes/no/conditional
Relationship between user and operator	Is a cooperation possible with the provider	Yes/no/conditional
Neighbourhood within the model	Model promotes neighbourhood formation	Yes/no
Possibility for appropriation	To feel at home, to feel like a person, indirect approximation through other indicators	Assessment by the users
aesthetics		

User groups		
Urgency	Urgency from the perspective of users (lack of alternatives)	in units of time
Level of need **Group composition**	own capacity Assets of the user	high/low
	homogeneity/heterogeneity	Evaluation according to certain parameters (age, gender, self-capacity, etc.)
Reason for use	Migration, evacuation, isolation	Degree of mental exceptional situation, Crisis intervention
Reliability of duration of stay	Forced unexpected move	–high/low

2.4 RISKS SCENARIOS

In a concluding workshop the interdisciplinary group started to design core elements of risk scenarios for each of the project models which could describe the structure, function and behaviour of these models when applied in specific circumstances. Scenario analysis is part of the risk management process suggested in ÖNORM D 4900 and a classic part of risk management in general. A risk scenario is a specific, illustrative, and understandable description of the possible causes and effects of events or developments on the goals, the activities of the organization and the requirements for them or on the functioning of a system (ÖNORM D 4902-2, p. 14). To design plausible risk scenarios for a certain system – in this case a specific housing model – usually concise damage lists (see chapter 2.3) are used from where a set of suitable factors are chosen to describe the scenarios. These sets are usually prefabricated forms (BMI 2018) to be filled in but can be adapted according to the actual case to be analysed. These forms contain information on hazards, probability of occurrence, geographical and temporal spread of damage, irreversibility and other factors, e.g. resilience of the system or resources to cope with possible damages. This makes it possible to compare different risk scenarios and different locations. In a next step the scenarios can be classified and arranged in a coordinate system or risk matrix which ranks the risk scenarios according to their magnitude of damage and the respective probability. Due to the limited time resources and to accelerate the process, a suitable set of damage factors was created for each model and possible adverse consequences have been assigned to each factor. This leads to basic types of possible damages which can serve as the basis for more elaborate risk scenarios. The dimensioning of a risk matrix and a classification of the risks was omitted because the whole process is very time-consuming and strongly depends on interdisciplinary communication. As a last step possible measures are suggested in the last column to deal with these risks. As a main result, we can see that there are risk scenarios that are specific to a particular housing model and those that are specific to a particular model.

These preliminary risk scenarios include a certain type of implementation, possible short-comings or points of specific vulnerability and suggestions for countermeasures to either avoid or at least decrease the connected risks. To distinguish between the three areas of the system definition and the six areas of action the terms “sphere” (referring to the system levels) and “area of impact” (areas of action) are listed in separate columns. The scenarios for the different models are shown in Tables 4 to 6.

2.4.1 Model specific risks

The model scenario “**Beat the Heat”** intends to offer cool living spaces for vulnerable groups of people during periods of high temperatures. This basic assumption for specific usage is more likely seeing as extreme weather periods, and thus heat waves in summer, will increase dramatically as a result of climate change. Specific risks regarding this model will therefore relate to appropriate materials and space where these temporary buildings can be erected. Eligible locations and spaces might already be blocked or built on, or even occupied by other groups of people. Regarding the condition and the quality of the public space they are intended to be built on, these spaces might degrade over time or change their quality during intensified use. Architectural or material related risks include the lack of appropriate materials, or the insufficiency of the materials used. For example, in could occur that cooler temperatures cannot be reached exclusively through passive cooling measures (either due to the model or the context), or the chosen floor covering turns out to be unsuitable. Societal risks might arise because of conflicts between the intended inhabitants and other stakeholders or the neighbourhood. Finally, especially in periods of extremely hot weather, specific health risks regarding the increase of cardiovascular problems are to be expected.

In the case of the model scenario “**LifeSharing to Go 2.0”,** model scenario specific risks strongly depend on the conditions of the space and the accessibility of the location. Possible risk treatment measurements therefore will be a matter of specific urban planning and regulatory factors. For example, if the chosen building site could be poorly accessible, lacking public transport options or connections to supply and recreational facilities. In addition, the existing regulation could not allow housing on the specific site or the owners are not willing to make industrial sites available for temporary usage. In both cases the applicability of this type of model and its scenarios will be limited. On the other hand, this type of scenario is prone to risks related to architectural and engineering aspects which could endanger the sustainability of the building (high CO2 emissions, low energy efficiency due to problems with PV installation or insufficient and/or unreliable hot water supply).

“Gap Modules” are planned to be erected in unused construction gaps. In these cases, the owners might be unwilling to allow access to these sites. The sites may also be of poor quality. In this case an in-depth assessment of the substrate and a permanent monitoring of the quality of the site will be a suitable risk management strategy. Using building gaps in well-developed neighbourhoods carries the risk that either an inhomogeneous and psychologically stressed group of inhabitants will feel uncomfortable in the unfamiliar vicinity and/or the neighbourhood residents will react hostile to the incoming group. In both cases this might increase the probability of social conflicts. This is further aggravated by the circumstance that such unused building gaps are insufficiently secured or otherwise difficult to monitor and can therefore be easily accessed by strangers and unauthorized people.

Similar is true for the model scenario "**Shop-Hopping Box**". In this case, too, the success of this model scenario depends on the suitability of the vacant site (in this case a specific building, e.g., abandoned shops) and on the willingness of the owners to make this vacancy available for temporary building. Like the Gap Module the site might not be available for housing according to existing regulations. Appropriate incentives might be a suitable risk management measure, as well as modified building directives. Other risks have their origin rather in the specific use and the composition of the user group. Lack of privacy, overcrowding or various kinds of harassment (noise, odour) depend very much on the specific behaviour of the users and their compliance with existing house rules.

The risks of the two last model scenarios (Life-on-Track(s), DonAutonom) depend very much on the extraordinary space they are built in. The possible dangers occurring can be attributed to the circumstance that the inhabitants are not familiar with the surrounding areas (abandoned train switching station, river). In the case of "**Life on Track(s)**" severe injuries or even fatalities can occur by tripping over tracks, falling from rail cars, getting into contact with overhead lines or running into still active train traffic. Especially in case of abandoned railway yards the sites might be poorly accessible and not sufficiently connected to shopping and recreational facilities, as well as to public transport in general. Moreover, psychologically stressed individuals might feel unwell in the rather narrow units, especially those who have already endured long and dangerous journeys, such as is the case for many asylum-seekers and refugees with positive asylum status.

"**DonAutonom**" is an unusual and rather experimental model scenario which uses ship hulls as possible sites for temporary living. Like "Life in Track(s)" the inhabitants will have to be very aware of the extraordinary condition of the surrounding area. This will also include specific training as an organizational safety measure. Ships are only inhabitable to a certain degree, many facilities on a ship have technical and specific nautical purposes and may create unfamiliar sources of danger such as tripping, slipping, falling and others. The immediate neighbourhood of rivers or seashores bear the risk of hypothermia and drowning, especially when children are involved. In this specific model scenario risks arise from the different usage of lower and upper deck which will affect the social quality of the scenario. Specific duties (e.g., the caring for the upper deck gardens or the compliance with neighbourhood rules) could be neglected and cause severe social tensions. Because of the rather different quality of life for the people inhabiting the units facing the river as compared to those living in the units facing the pier, social inequalities might develop and add to the occurrence of conflicts. Finally, the specific location might be rather remote and poorly connected to the urban infrastructure leading to a feeling of being isolated.

2.4.2 General risks

There are several risks which are common to all introduced model scenarios independent of their specific architectural, technical, or environmental conditions. First, people have the need to feel at home somewhere and to appropriate a specific surrounding. This might be valid to an even higher degree for people who lost their homes or were homeless and on the move for a long period of time. In these cases, the temporality of a specific model scenario will gradually evolve into a permanent status. The **loss of the temporal character** of the housing model is a general risk which is not easy to manage.

In contrast, a consequential risk of temporariness consists in the fact that inhabitants might face **homelessness after completion of the usage period** or in the case of an abrupt end to the project. In any case, vulnerable individuals may not fully possess the freedom to enter or to leave the project as they wish, due to the uncertain status of their existence. This might add to frustration and discontent which can also lead to social conflict.

Another risk source is the **composition of the user group**. If the group is very inhomogeneous, especially on a cultural basis, social tensions and in-group conflicts will be more likely to occur. Very different personal memories connected to the specific arrival in the host country or rather incompatible expectations relating to the stay and personal futures will also add to communication difficulties. Moreover, a lack of integration into the new and unfamiliar surroundings, be it by social, cultural, or political reasons, aggravates the situation.

Another important point is the **lack of accessibility** and suitability of the actual building site. Many sites will be rather remote and/or poorly connected to appropriate supply facilities and public transport. Apart from the problems related to long distances and the difficulties of daily supply, non-accessible sites might prevent a proper integration of the inhabitants and increase their impression of personal loss and isolation.

Some of the presented model scenarios have **unusual dimensions** or measurements, as they were not originally intended for residential purposes. In this case, the lack of comfort, the distance of the site to neighbourhoods and the lack of privacy could emerge as problems in this case. This could also exacerbate existing conflicts.

Beat the Heat

Table 4: Risk scenarios for "Beat the Heat"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
Inhabitants & users	Scenario/project viability	Nobody wants to move in	The original vision of temporary housing for those particularly vulnerable to heat waves is not viable for Vienna	Number of registrations	A different user group can be addressed
Architecture, construction	Sustainability	Cooler temperatures cannot be reached exclusively through passive cooling measures (either due to model or context)	Unsustainable cooling measures may become necessary, particularly if scaled up (lack of appropriate spaces)	Temperature control (threshold value can be defined)	The effectiveness of passive cooling measures for Beat the Heat is explored and tested within experiments. Additional shading, change of location.
Urban planning & politics	Social Quality	Shaded green public spaces are occupied by a small group of people	These spaces are not accessible to the public who may also want to flee from heat	Observations, interviews	Change of location
Architecture, construction	Construction	Rolled-out turf on parking areas does not flourish		Observation	Change of floor covering
Architecture, construction, inhabitants & users	Sustainability	Shaded green public spaces are left in worse condition than before the phase of temporary housing (due to construction or user behaviour)	Degradation of green spaces	Documentation (observation, photographs)	The model is applied in other spaces, such as parking spaces with rolled-out turf. The effects of the model on the environment are explored and tested within experiments
Urban planning & politics	Sustainability	Green spaces are blocked (built on)	Green spaces cannot function properly to reduce urban heat islands	Regular measurement of temperature and other climate factors	Change of location
Urban planning & politics	Scenario/project viability	No suitable locations are available in Vienna	The original vision of temporary housing for those particularly vulnerable to heat waves is not viable for Vienna	Site evaluation study (“Standortanalyse”)	Change of location

Construction, users	Social Quality	Noise pollution	the quality-of-life decreases. Noise pollution can lead to illness and stress.	Noise measurement	Reconsider the mix of user groups (elderly & young children) Reconsider the materials of the structures
Urban planning & politics	Social Quality	Negative interactions with the neighbourhood or individuals using surrounding recreational areas (e.g., vandalism)	The buildings could be vandalized (e.g., by spray paint) and the inhabitants could feel harassed	Frequency of complaints	Creating a barrier (e.g., fence) between the privately used living area and the publicly used space
Inhabitants & users	Social Quality	Overcrowding	In case of an unexpectedly hot summer an emergency-type situation can arise, and the model could be used to house more individuals than it was conceptualized for	Number of residents per m² (upper threshold) Amount of additional beds/sleeping areas than originally planned	
Inhabitants & users	Inhabitants & users	High number of medical emergencies due to heat	Even if Beat the Heat can provide cooler living than the original homes of the inhabitants, high risk of these vulnerable groups having medical emergencies during a heat wave must be assumed. Questions of liability can arise and willingness to inhabit the model may sink	Number of medical emergencies, assessments from medical professionals	Monitoring of the inhabitants by medical professionals
Architecture, construction		Lack of raw materials	The required raw materials may not be readily available		
Inhabitants & users		Acceptance and management of dry toilets	Inhabitants may not accept or properly manage the available dry toilets		
	Health	Quality of drinking water	The available water may not be of drinking water quality		
Social Quality	Social Quality	Inhabitants do not tend to the plants	Responsibilities divided among the inhabitants are neglected,	Monitoring of plants or referencing a duty-list	

			requiring the project team to step in		
Inhabitants & users	Social Quality	Conflicts between inhabitants	A stressful situation combined with living with strangers can lead to potential for conflict, which could greatly decrease quality of life	Frequency of complaints	

Life Sharing to Go 2.0

Table 5: Risk scenarios for "Life Sharing to Go 2.0"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
	Inhabitants & users	Inhabitants have nowhere else they can live outside of the temporary housing model	Inhabitants can be faced by homelessness after completion or in the case of an abrupt end to the project Inhabitants have no freedom to exit the experiment whenever they wish	Survey of alternative housing options for residents	Working closely with social workers
Inhabitants & users	Social Quality	Conflicts between inhabitants	Living with a user mix bears potential for conflict (e.g. due to communication barriers) which could greatly decrease quality of life Power imbalances can be prevalent	Frequency of complaints	Working closely with social workers and having a system for outside mediation in place
Social Quality	Social Quality	No interactions between inhabitants	The scenario fails as an experiment for new ways of interacting and living together	Monitoring use of common areas (e.g., booking frequency of common areas)	

Urban planning & politics		Poor accessibility, lacking public transport and access to public facilities, recreation areas	Failure of this scenario as an integration experiment, as inhabitants may become even more isolated Low attractiveness for people to participate	Connection and frequency of public transport, Equipment with public facilities	Special attention given to active mobility Explore the option of a temporary shuttle bus Organisatorische Maßnahmen (Bereitstellung von Angeboten)
Inhabitants & users	Social Quality	Overcrowding	The model could be appropriated for e.g., homing refugees and consequently overcrowded	Number of inhabitants per m^2 (upper threshold)	
Construction, users	Social Quality	Noise pollution		Noise measurement	
Construction, users	Social Quality	Odour pollution		Frequency of complaints odour pollution (thresholds)	
Architecture, Construction	Sustainability	High CO_2 emissions due to heating (old building substance, unusually large cubature of living area)	The building does not work in a sustainable way	CO_2-measurement and monitoring	Heating by means of biomass Top floor not designated as a living area (ceiling not sufficiently thermally insulated)
Architecture, Construction	Inhabitants & users	High waiting times for hot water	The inhabitants cannot access to hot water in reasonable time.	Time measurement (acceptance limit)	Keep pipe routes as short as possible from storage tanks
Architecture, Construction	Sustainability	Roof is not suited for PV (statics)	No PV energy available.	load bearing capacity of the building	Searching for alternative source of energy
	Scenario/project viability	Poor usage of outdoor space		Number of individuals/times	
		Private owners are not willing to make industrial spaces available	If no industrial buildings are available, the scenario is not viable	lack of offer, missing supply	Consider incentives
Urban planning & politics		Regulation does not allow housing	Scenario is not feasible	Alignment with building regulations	Clarification of legal options, selection of other areas with the appropriate zoning

Social Quality	Social Quality	Organization of community waste (lack of responsibilities).	Responsibilities divided among the inhabitants are neglected, requiring the project team to step in	Observation, frequency of complaints	Preparation of house rules
		Residents do not feel comfortable in the small housing units		Inhabitant survey	Reduced occupancy of units -> more space per person
	Health	Condensation due to the old building fabric mean risk of mould		Monitoring of humidity and formation of condensation water	Provide better ventilation

Gap Module

Table 6: Risk scenarios for "Gap Module"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
Users	Inhabitants & users	Inhabitants have nowhere else they can live outside of the temporary housing model	Inhabitants can be faced by homelessness after completion or in the case of an abrupt end to the project Inhabitants have no freedom to exit the experiment whenever they wish	see above	Working closely with social workers
Users	Social Quality	Conflicts between inhabitants	Living with a user mix bears potential for conflict (e.g., due to communication barriers) which could greatly decrease quality of life Power imbalances can be prevalent	see above	Working closely with social workers and having a system for outside mediation in place
Users	Social Quality	Overcrowding	The model could be appropriated for e.g., homing refugees and consequently overcrowded	see above	

Users	Social Quality	No interactions between inhabitants	The scenario fails as an experiment for new ways of interacting and living together	see above	
		Unauthorized strangers accessing private/communal spaces of the building (e.g., through public activities or events being held)		Frequency of complaints	
		Poor usage of outdoor space		see above	
		No/low willingness of owners to provide access to construction gaps	If no building gaps are available, the scenario is not viable	see above	Consider incentives, inclusion into the planning activities in new construction areas
Urban planning		Substrate unsuitable for construction (planning risk)		Continuous measurement of the quality of the building plot	In-depth preliminary investigation of the building plot, permanent quality control
Social Quality		Unintended consolidation (disregard of temporality) lack of deconstruction plan, use plan is not being followed		Decreasing tendency of residents to move; Use not according to use plan	Formulate contracts
	Health	Location of wet rooms in the interior can mean a risk of mould		Measurement of humidity, monitoring of condensation water	Provide and ensure better ventilation
		High effort for approval in relation to short usage	Complicates implementation and increases costs		
Users	Social Quality	Conflicts between inhabitants	Living with a user mix bears potential for conflict (e.g., due to communication barriers) which could greatly decrease quality of life Power imbalances can be prevalent	see above	Working closely with social workers and having a system for outside mediation in place

Users	Social Quality	Overcrowding	The model could be appropriated for e.g. homing refugees and consequently overcrowded	see above	
Users	Social Quality	No interactions between inhabitants	The scenario fails as an experiment for new ways of interacting and living together	see above	
		Unauthorized strangers accessing private/communal spaces of the building (e.g., through public activities or events being held)		Frequency of complaints	

Life on Track(s)

Table 7: Risk scenarios for "Life in Track(s)"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
Model, Context	Inhabitants & users, Scenario/project viability	Injury through overhead lines	Inhabitants can be severely injured. Fatalities could occur.		Safety measures
Model, Context	Inhabitants & users, Scenario/project viability	Injury through active train traffic	Inhabitants can be severely injured. Fatalities could occur.		Technical safety measures such as fences Organizational safety measures (house rules)
Model, Context	Inhabitants & users	Injury through tripping hazards	Inhabitants can be severely injured.		Technical safety measures such as floorboards Organisational measures (house rules)
Users	Social Quality	Negative associations, irritation, and sense of disrespect (people placed on trains)			

		Orientation of wagons is wrong (logistical challenge)			Final orientation should be decided before wagons are brought on-site (high coordination efforts with railroad operators) Crane or loading siding may be necessary if placed wrong
	Scenario/project viability	“Life on Track(s)” does not arrive at the site quickly enough to serve as disaster relief			Consideration of alternate uses
Users	Social Quality	Overcrowding	The model could be appropriated for e.g. homing refugees and consequently overcrowded	see above	
		Residents do not feel comfortable in the small housing units		Survey	Reduced occupancy of units -> more space per person
Urban planning & politics	Social Quality	Negative interactions with the neighbourhood or individuals using surrounding areas (e.g., vandalism)	Greatly dependent on location: the cars could be vandalized (e.g. by spray paint) and the inhabitants could feel harassed	Frequency of complaints	Creating a barrier (e.g. fence) between the privately used living areas and the publicly used space
Urban planning & politics		Poor accessibility, lacking public transport and access to public facilities, recreation areas	Failure of this scenario as an integration experiment, as inhabitants may become even more isolated Low attractiveness for people to participate	Connection and frequency of public transport, poor equipment with public facilities	Special attention given to active mobility Explore the option of a temporary shuttle bus Organizational measures (provision of mobility options)
Urban planning & politics		Bad or dangerous Accessibility of modules for active mobility	High effort for accessibility		

Shop-Hopping Box

Table 8: Risk scenarios for "Shop-Hopping Box"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
Users	Inhabitants & users	Inhabitants have nowhere else they can live outside of the temporary housing model	Inhabitants can be faced by homelessness after completion or in the case of an abrupt end to the project Inhabitants have no freedom to exit the experiment whenever they wish		Working closely with social workers
	Scenario/project viability	No/low willingness of owners to provide access to shop floors	If no shop floors are available, the scenario is not viable		Consider incentives
Social Quality	Social Quality	Conflicts surrounding communal used (open) spaces with other households of the building			
Model, usage	Social Quality	Noise pollution		Noise measurement	
Model, usage	Social Quality	Smell pollution		Frequency of complaints, odour threshold values	
	Social Quality	Lack of privacy	Despite being conceptualized for families or co-habiting individuals, the lack of closed private spaces may result in experiencing a lack of privacy	Survey	(The open layout is part of the concept. Acceptability of this aspect could be considered part of the experiment.)
Users	Social Quality	Overcrowding	The model could be appropriated for e.g. homing refugees and consequently overcrowded	See above	
Urban planning & politics		Zoning does not allow residency	Scenario is not feasible	Clarification with building regulations	Clarification of legal options, selection of other areas with appropriate zoning

DonAutonom

Table 9: Risk scenarios for "DonAutonom"

System level	Area of impact	Plausible Risk	Implications	Critical control point	Possible actions
Users	Social Quality	Duties are neglected	Responsibilities divided among the inhabitants are neglected, requiring the project team to step in to care for the gardens	Monitoring of plants or referencing a duty-list	
		Underutilization of the lower deck		Referencing room bookings	
		Degradation of open space of apartments facing the pier	Inequalities could occur through the difference in usability of the open spaces facing the river and those facing the pier		
	Social Quality	Disturbance through public events on lower deck		Frequency of complaints	
	Social Quality	Vandalism and illegal access of private loggias		Frequency of complaints, repair costs	Sufficient distance between ship and shore
		Private loggias facing the quay don't get used due to proximity to public open space		Observation survey	
		Gardening possibilities on the top floor get neglected	People don't care about the garden beds	Standardized observation, measurement of plant yields	Clarification of responsibilities
Inhabitants & users	Scenario/project viability	Nobody wants to move in		Number of registrations	Addressing of different user group(s)
Social Quality	Social Quality	No interactions between inhabitants		Monitoring of the use of common areas (e.g., booking frequency of common areas).	

	Energy	Since this environment is planned to be self-sufficient, it may run out of power in case of prolonged unfavourable conditions.		Monitoring of energy supply and consumption	Organize an emergency generator in time
Urban planning & politics		Bad or dangerous Accessibility of modules for active mobility	High effort for accessibility		
Urban planning & politics		Poor accessibility, lacking public transport and access to public facilities, recreation areas	Failure of this scenario as an integration experiment, as inhabitants may become even more isolated Low attractiveness for people to participate	Connection and frequency of public transport, Equipment with public facilities	Special attention given to active mobility Explore the option of a temporary shuttle bus Organisatorische Maßnahmen (Bereitstellung von Angeboten)

2.5 RISK MATRIX (EXAMPLE BEAT THE HEAT)

The last part of the entire process – which has not been included in this project – would be to select certain relevant risk scenarios and to place these scenarios and their variations in a reference system. Usually, this reference system is related to the system borders to be evaluated and expressed as risk matrix. A risk matrix is described by the relation of magnitude of possible damages to their assumed probability. Probabilities can be expressed either as the frequency of expected damages by the total number of cases or during a given time frame. Damages normally refer to certain values which can be endangered, minimized, or destroyed and usually describe damages as part of the fundamental categories human health, ecological systems, economic values or political/societal values such as social stability. A typical risk matrix is shown below in Figure 5. The red area is the area of non-tolerable risk scenarios – risks which will not be acceptable in any case, either because they have a very high risk potential or they are very probable and will cause not acceptable harm or loss. In case of human health this is usually the death of individuals or total disability. In case of economic risks this might be financial loss which exceeds at least half of the company's capital. The green area is the area of acceptable risks, meaning that the system is resilient enough and capable of dealing with these adverse cases without alteration or disruption of its normal functions. The area in-between is called a transition area which means that the system might be able to compensate these kind of risk scenarios but only by using additional means which have to be available in advance. These risks are normally part of a crisis management or business continuity planning process.

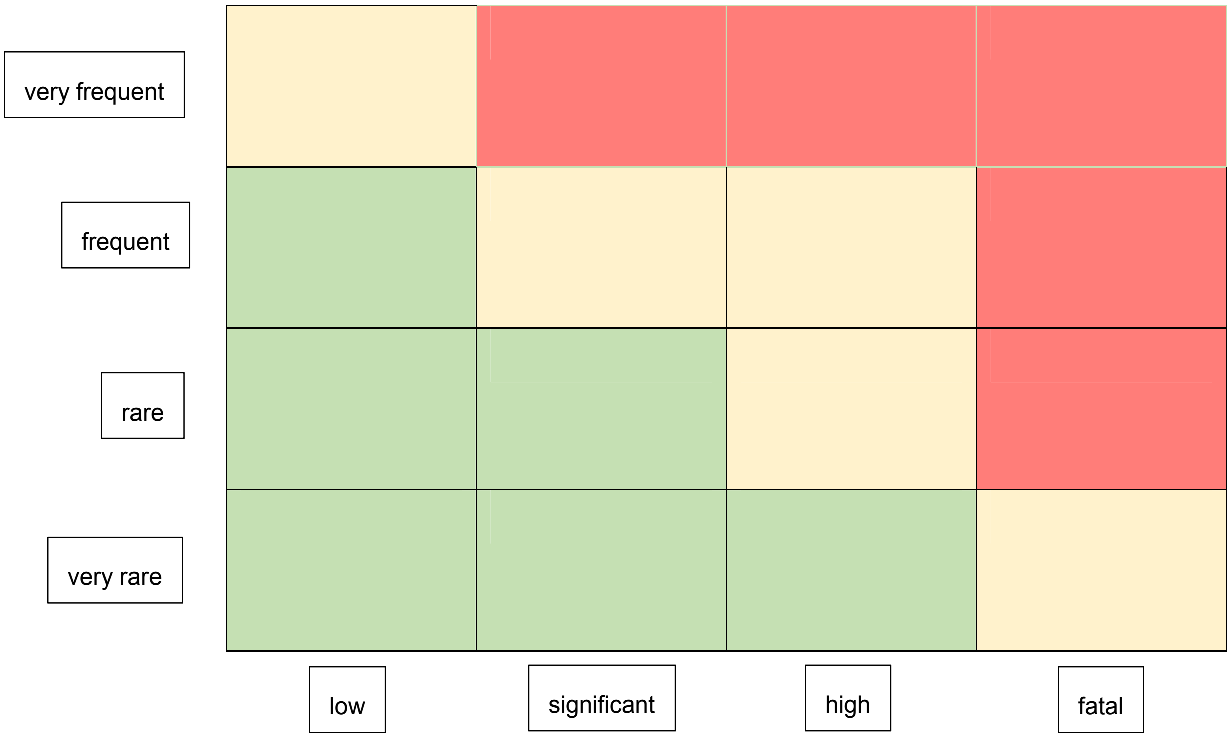

Figure 5: Generic risk matrix

List of relevant risk scenarios for “Beat the Heat”:

Table 10: List of relevant risk scenarios for “Beat the Heat

Scenario Number	description	Risk management measure
1	Nobody wants to move in	1a: improving communication 1b: addressing a different user group 1c: cancellation of project
2	Cooling temperature cannot be reached	2a: intensive testing before implementation 2b: usage of different materials 2c: usage of additional cooling technologies
3	Suitable public spaces are occupied by other people	3a: change of location 3b: modification of building (to share space) 3c: sharing space without building modification 3d: cancellation of project 3e: permanent conflict with other groups 3f: banning other groups by legal action
4	Degradation of green spaces	4a: usage of already sealed spaces 4b: usage of environmentally friendly materials and constructions 4c: usage only over very short periods 4d: remediation after deconstruction
5	Conflicts with the neighbourhood	5a: improve integration policy 5b: barriers between public and private spaces
6	Overcrowding	6a: longer planning periods (improving risk preparedness) 6b: limit number of persons per m2

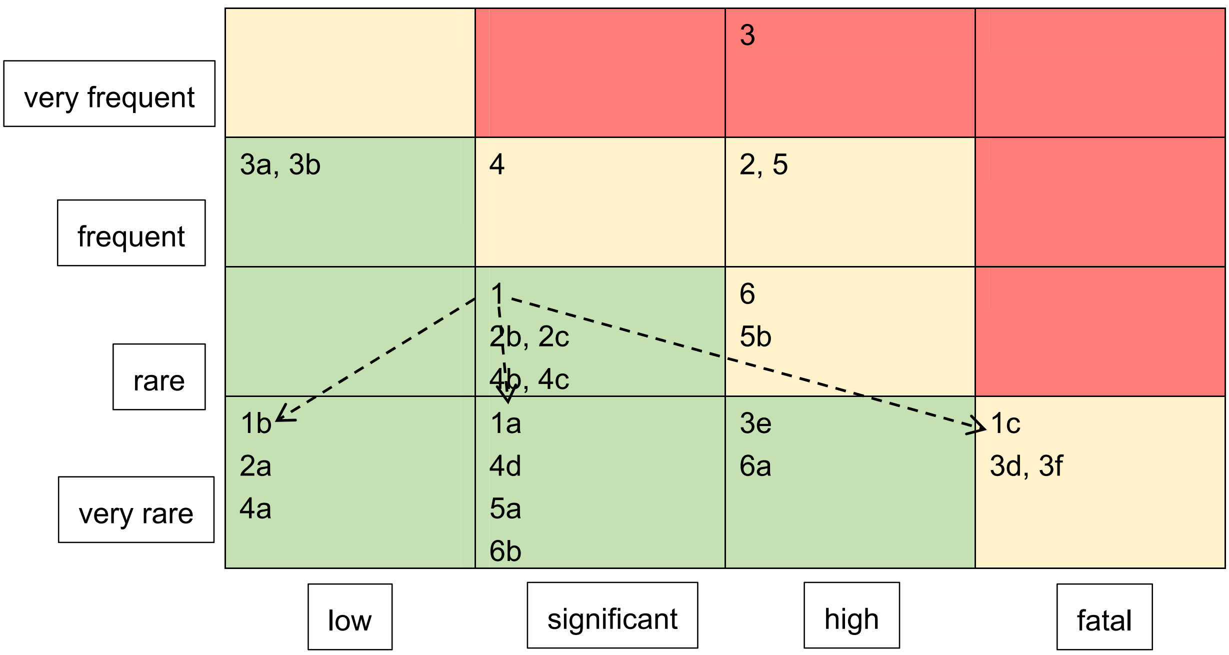

Figure 6: Risk matrix for “Beat the Heat”

3 STEEPED METHOD

3.1 METHODOLOGY

As stated above the rather technical risk assessment process provided by ÖNORM D 490x might not be sufficient in some cases, especially when discussing and evaluating risks of new technologies which are about to be implemented in society. Therefore, the IRGC risk governance framework introduces a parallel risk appreciation process which is held in public and is partly or totally independent from the expert driven risk evaluation. The results of these discussions can show considerable differences (e.g., the different evaluation of mobile phones or terrorist attacks on the one hand and the risks of cigarette smoke on the other hand). Apart from the conventional risk dimensions human health, environment, and ecology several political and societal aspects must be considered. At least ISO 31000 adds this dimension as a separate dimension to the classical list. The IRGC points out that appropriate engagement processes must be installed to integrate these aspects into an integrated risk evaluation which can serve as basis for qualified, i.e., informed risk governance.

Like the IRGC Framework, the STEEPED method suggests a system approach. This method has been developed by Scientific Foresight Service of the Scientific Foresight Unit (STOA), within the Directorate-General for Parliamentary Research Services (EPRS) of the Secretariat of the European Parliament and recently been revised as part of a STOA report on foresight-based policy analysis (EPRS 2021).

The STEEPED or 360° Envisioning Method uses seven dimensions (i.e., categories of consequences), the abbreviation indicates the categories in use: societal, technical, economic, environmental, political, ethical, and demographic impacts. These aspects must be considered in foresight from a great variety, if not all possible angles. The STEEPED scheme (Figures 7 and 8) is considered as a checklist for exploring a certain topic, be it a new technology or a risk relevant activity.

Figure 7: STEEPED wheel

In a second step these basic dimensions can be further elaborated into specific aspects which can be varied for case-specific purposes. This makes the STEEPED rather flexible because it can be – like the ÖNORM D 4900 method – easily adapted to the respective cases which will be evaluated.

Table 11: Table 11: STEEPED dimensions and aspects

Dimension	Aspect	Example given by STOA
Societal aspects	religion, ethnicity, employment status, financial means, wellbeing, presence of disabilities, habits	self-driving cars might be highly appreciated by individuals with certain disabilities
Technological	purpose of a technology, specific application, accessibility, efficacy, added value, dual use, research and innovation, challenges	Essential parts for new technologies (fibre optic cables for 5G); potential misuse of certain technologies (dual use, AI data tracing of persons without their informed consent).
economic	jobs (creation and losses), value creation, skills dependency, resource dependency, infrastructure dependency and affordability	Hydrogen-fuelled cars require a very specific (not yet available) hydrogen infrastructure, (production plants, hydrogen pipelines, hydrogen stations; storage systems) which might be very expensive
environmental	resource efficiency, energy efficiency, water efficiency, recyclability, sustainability, process safety, and product safety	Batteries for electric cars depend on specific minerals that are available in limited quantities on earth and are mined by exploitive methods
political / legal	liability, competition and market regulations	Resource conflicts (availability of rare earth materials); geopolitical monopolization (concentration of battery production in China) and development of material and goods dependencies
ethical	respect for persons, respect for the environment, the availability of justice, collective wellbeing, and individual freedom	Free choice and opt-in or opt-out of technologies; AI-driven surveillance issues or AI-based decisions with a vast impact on individuals (profiling for bank loans or job applications, privacy issues related to location and emotion tracing).
demographic	age, gender, household status, education level, occupation and place/region	Regional differences in certain diseases or digital (or other technological) divide because of accessibility problems

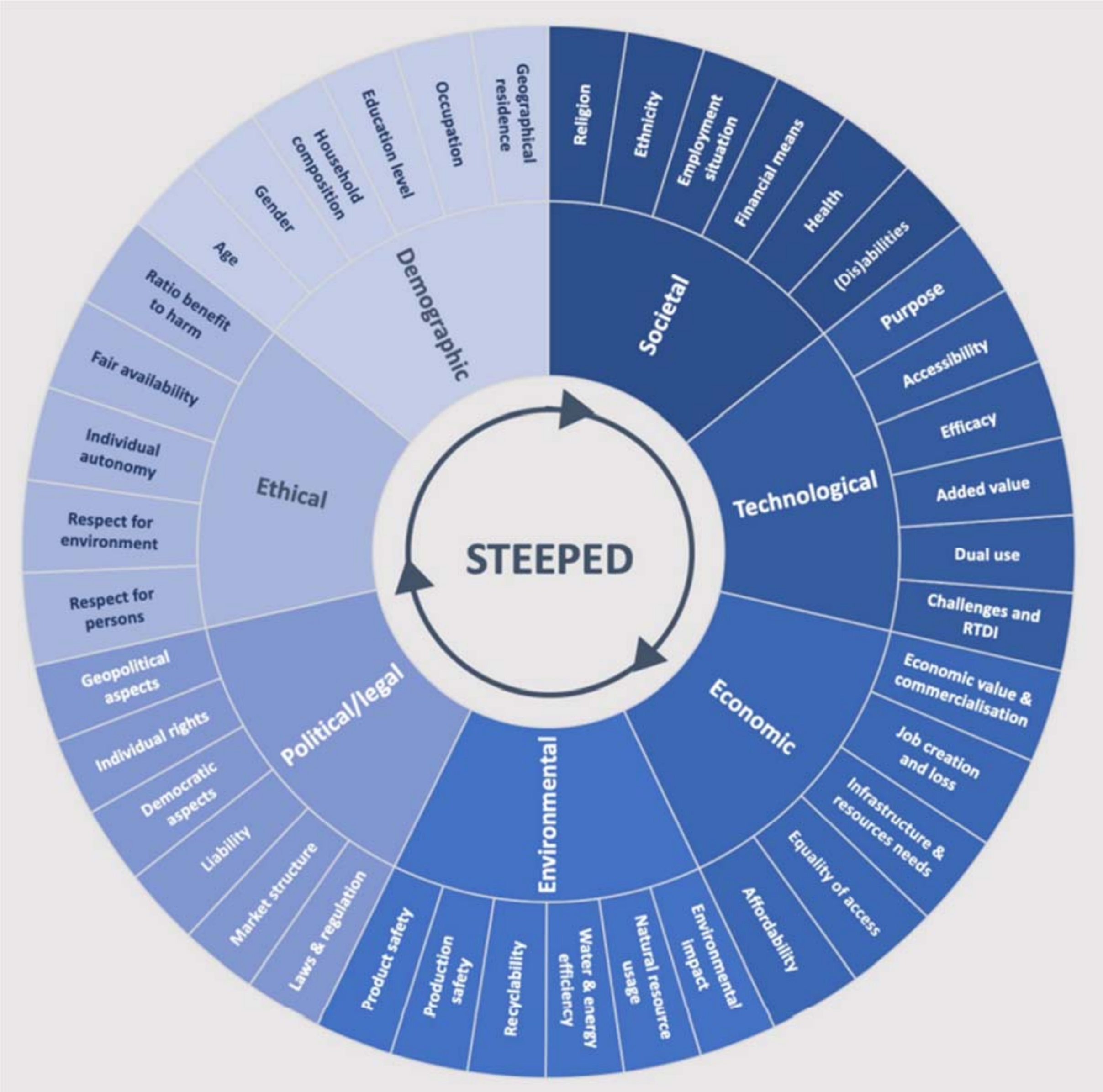

Figure 8: Elaborated STEEPED scheme (wheel)

3.2 CLOUD OF TERMS – WORKSHOP

In a transdisciplinary workshop (2nd stakeholder workshop, November 5th, 2020) participants from ministries, agencies, science, and civil interest groups were asked to identify drivers and inhibiting factors for temporary housing in Vienna. The discussion has been documented and analysed for main factors resulting in a network of relevant terms. A transdisciplinary discussion is most likely to give a very integrated and rather concise overview of a given topic. The purpose of this chapter is to test whether the 360° envisioning method described above can be applied to the result of this workshop. The network of terms it shown in Figure 9.

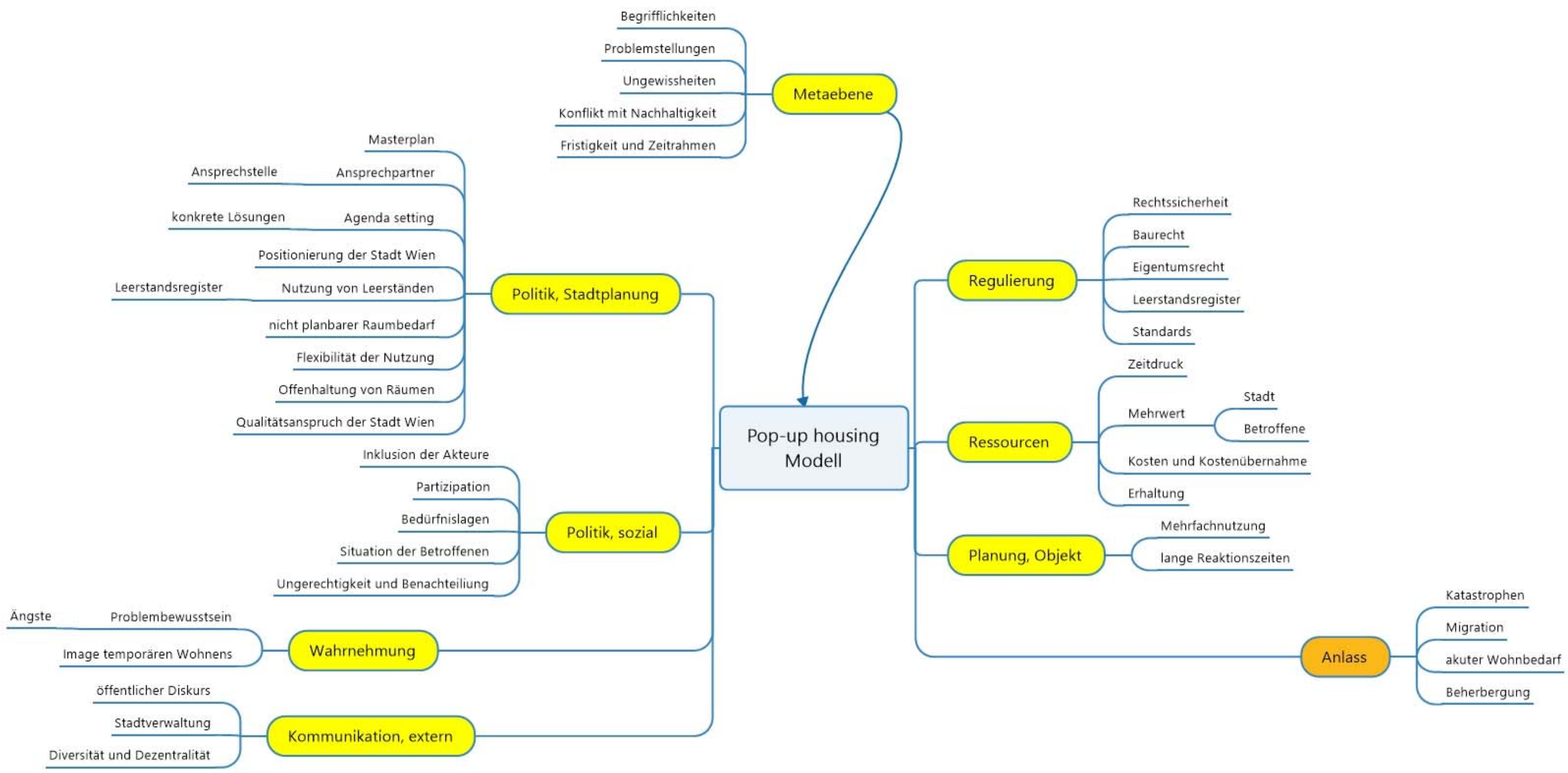

Figure 9: Network of terms (drivers and inhibitors for temporary housing; in German)

3.3 STEEPED LIST

It is noticeable that the technical dimension is entirely missing, and the environmental dimension only mentioned in a rather negligible way (the term sustainability has been quoted but only as part of a rather generalized discussion). On the other hand, the political dimension is particularly elaborated and differentiated into the urban planning strategy and socio-political aspects. Likewise, the legal respectively regulatory issues are well developed and highly differentiated. Of course, a list of main terms used in a debate reflects the composition of the participant's group but regarding their accumulated expertise and the time constraints the evaluation can still be regarded as concise as possible. Using the representation according to the STEEPED method the discussion might be depicted in the following way (Figure 10):

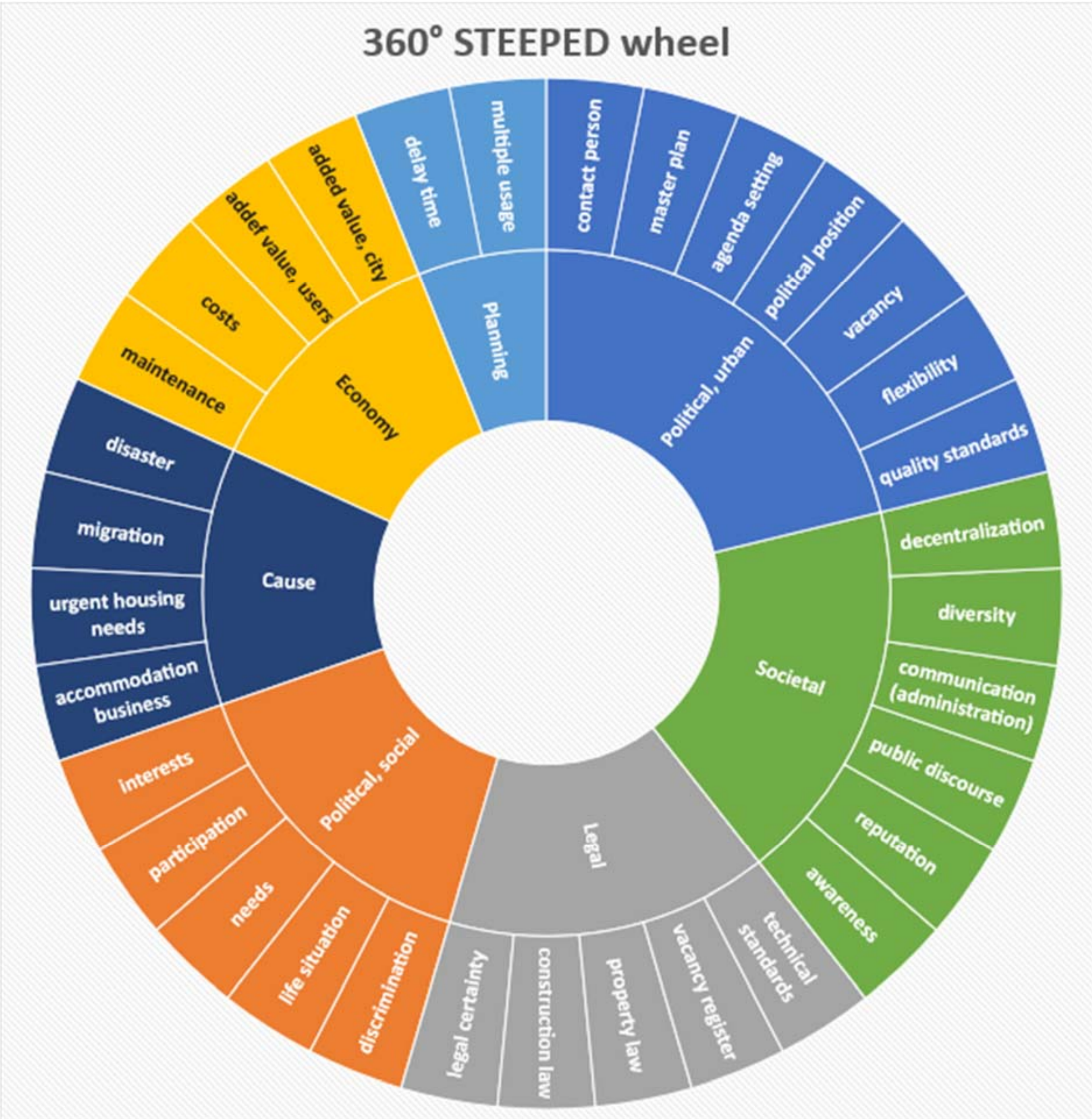

Figure 10: STEEPED wheel based on 2nd stakeholder workshop

4 CONCLUSION

A risk assessment according to ISO standard 31000/ÖNORM 4900, widely used in the field of organisational management, was carried out to evaluate the scenarios developed in this project. Even though only limited resources were available for this subsequent part of the project, we expected its preliminary results would offer valuable insights into both the basic risk assessment of the models presented and their formulated scenarios, as well as the applicability of this method in principle to the problem at hand in the project. An interesting methodological consideration in this project was that a risk assessment method that had been tested in practice was applied to objects that did not yet exist, i.e. ex ante. However, the risk assessment according to ON 4900 is both structured enough and sufficiently flexible, so that a corresponding adaptation was possible.

With regard to the models or scenarios, a distinction can be made between scenario-specific risks and non-scenario-specific, i.e., generic risks. While scenarios such as "Life on track(s)" (model "TinyTainer") or "DonAutonom" (model "Binnen bleiben") have risks that are caused by the potentially dangerous location (abandoned railway stations, riverbanks), other scenarios or the models derived from them involve risks that are either technical, urban planning or social. In the case of "GapModule", for example, the high planning and construction costs need to be mentioned, for other scenarios ("LifeSharingToGo") generally a very long preparatory phase. "BeatTheHeat" also requires more planning and coordination in advance, which also increases the preparation period for this scenario.

The developed cause and effect model can be understood as a temporal sequence of actions because the identified factors appear to be different phases or parts of different phases in the entire system sequence. In simplified terms, the system consists of the following three phases: Planning/decision → taking a specified measure → effect of the specified measure. In principle, these measures affect different groups of actors who also have different capabilities to influence which might also vary in the different phases. These actor groups belong are basically persons from politics and urban planning, user groups and residents.

The model introduces essentially the following factors which are of relevance for taking decisions and carrying out actions:

- Voluntariness: Has the situation been entered into voluntarily by the person or the group concerned, or has it been enforced, i.e. was it under external control?
- Controllability: Can the situation or the corresponding conditions of the situation be largely controlled by those affected (i.e., influenced in its course) or does it proceed without the possibility of influencing, i.e. it is practically necessary?
- Awareness of the problem: Is there a certain awareness of the problem among the persons involved, i.e., some increased attention to the decisive factors influencing a situation and the consequences associated with them, as well as to the possible measures to change this situation?
- Preparedness: Do exact ideas already exist for the specific situations that may arise, their characteristics (extent, urgency, probability, etc.) and are there already plans for measures to cope with these situations in existence?

- Urgency: Is the amount of time available for the reaction, orientation (assessment of the situation) and taking appropriate measures sufficient or not?
- Extent of the measure: How high are the requirements which are necessary to take a specific measure, e.g. how many people have to be accommodated, but also how much time or space is required to erect a building and to organize the accommodation?
- Duration of the measure: How long is the measure required?

There are a few other factors that seem relevant to risk evaluation, namely the depth of intervention or the intensity of the impact on the environment (environmental impact) or the reversibility of the intervention (reversibility). The familiarity of the situation also seems to play a role for the users, but also for the neighbouring residents. But the most important observation in this context is that both the factor "voluntariness" and the factor "controllability" play a central role and are well examined in risk perception research (Solvic et al. 1986). In principle, risk characteristics can be divided into risk-related and situation-related aspects. The risk-related characteristics contain factors to be considered as part or quality of the risk source itself. The perception of the specific risk appears to influence by the properties of the risk, such as the perceived dread, the familiarity with the risk or the nature of the risk. Voluntariness and controllability belong to the category of situation-related risks. Others will be the search for responsible persons (blame, scapegoating) or the perceived inequity or injustice of a risky situation or a possible damage (Renn 2008).

It has been shown that we can distinguish between general risks which might affect temporary housing as such and model-specific risks which affect the substance or the structure of a certain building type. Model-specific risks depend on the properties of the specific model scenario and can therefore be controlled and managed by technical and constructional means in most cases. General risks will influence all model scenarios to a certain degree. Examples are the possible tension between the non-permanent (temporary) purpose of the occasion and the attitude of the inhabitants to use these buildings for a longer time span respectively more or less permanently. Another general risk issue is the need for urban space to implement these buildings (most certainly as intermediate use) and the resistance of the site owners to make these sites available. A third issue which might turn out as unfavourable for temporary housing in general is the likeliness that internal or external social conflicts might develop over time, be it as consequence of an inhomogeneous composition of the user group or of lack of integration into the neighbourhood. Regarding the necessary (or at least politically desired) integration of the users into a foreign environment which they are not familiar with might conflict with the need of these people to be closer together, especially when they just underwent a series of stressful situations (migration, evacuation). And finally, some of the occasions for temporary housing (and temporarily inhabiting) are part of crisis management, but nonetheless unusual living conditions and will remain so.

The interdisciplinary approach used in this project made it possible to build up new knowledge in cooperation and to evaluate it in a participatory, multi-stage process. For this reason, the approach is particularly suitable for emergent developments, such as the regulation of the use of new technologies or in crisis and disaster management.

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6 FIGURES AND TABLES