Participatory approach for assessing institutional resilience: a case study of crises in Austria

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Abstract
This paper outlines the procedure of employing novel software tools within a series of participatory workshops designed for measuring and monitoring the resilience of Austria’s socioeconomic system based on network analysis and systems research. This study employs the principles of the four-stage adaptive cycle to quantify the perspectives of major stakeholders regarding resilience readiness in Austrian society and to explore the implications. At the FASresearch company in Vienna, 278 representatives from 15 key sectors of Austrian society were asked to estimate the resilience of their respective sectors and identify the key resilience factors for each sector. Results pinpoint the most critical stakeholders and resilience factors, highlight the importance of quality relationships among stakeholders, and indicate that while stakeholders accurately perceive the stages of growth (r), equilibrium (K), and regeneration (α), they tend to underestimate the significance of the final (Ω) stage of the adaptive cycle, characterized by disturbance and collapse of outdated systems. Improved recognition and preparation for each stage may result in the increased resilience of each sector to potential crises in the future. Notably, perspectives regarding resilience in the face of a crisis were gathered prior to the occurrence of the COVID-19 pandemic. Thus, in addition to fulfilling an analytic-diagnostic function, resilience monitoring techniques are also intended as an adaptive tool for novel resilience management.

Keywords  Adaptive cycle · Austria · Climate change · Network analysis · Participatory research · Resilience · System dynamics
1 Introduction

The term "resilience" originally refers to the capacity of an (eco)system to remain stable in the face of crises, that is, to be able to return to its original state after a disturbance (Gunderson & Holling, 2002; Holling, 1973; Walker et al., 2004). However, with regard to social systems, it cannot be assumed that a system can return to its exact pre-crisis state after a crisis has occurred. Instead, systems go through an adaptive cycle, which includes the stages of growth (r), equilibrium (K), crisis/destruction (Ω), and reorientation/innovation (α) (Burkhard et al., 2011; Holling, 1986). Resilience, in this context, refers to the ability of a system to go through the adaptive cycle, repeatedly. The crisis is a necessary, inevitable part of this cycle, leading not only to the destruction of system elements, but also to the emergence of something new and potentially more resilient (Fath et al., 2015), as summarized in Fig. 1.

The adaptive cycle provides the theoretical framework for this study and presents the question of what qualities systems should possess in order to be resilient. On the one hand, the factors identified in the resilience literature (resilience factors) can be found in recent comprehensive literature reviews (e.g., Conz & Magnani, 2020; Kharrazi et al., 2016; Negri et al., 2021). But, what role do these factors play, and which of them can be influenced at all to increase resilience? The objective of this study is to assess the resilience of 15 key sectors of Austrian society in the face of numerous crisis scenarios, and to identify key factors that may offer options for strengthening resilience.

![Fig. 1 The adaptive cycle applied to the growth and development of social institutions and firms (Fath et al., 2015)](image-url)
2 Rationale

Recent years have seen a number of studies focused on institutional resilience in the face of disasters such as climate change (Smith et al., 2018; Grefalda et al., 2020), pandemics (Goyal & Gupta, 2020), and economic crises (Lang, 2012), etc. An essential dimension of resilience is social cohesion (Fath et al., 2015). This refers primarily to the quality of cooperation between the social actors affected by the crisis or those involved in crisis management. In addition, as described in the literature review by Schiefer and van der Noll, it is about the combination of "short-term" and "long-term" variables affecting a system. Long-term variables comprise the consistent structural characteristics of a system that provide stability during the crisis (for example, cultural norms and values, established procedures and practices, etc.). Short-term variables refer to system features that change rapidly and provide tools and resources for transformation and innovation in the system (Schiefer & van der Noll, 2017). Long-term and short-term variables involve very specific social stakeholder groups (such as bureaucracy and administration on the one hand, and civil society groups and communities on the other).

The method of Social Network Analysis (SNA) is often used to identify potential participants in this stakeholder process without the risk of being influenced by political interests, in a systematic and scalable way. The SNA fuses quantitative and qualitative research methods (Yousefi et al., 2020) and comes from a repertoire of empirical social research (Wasserman et al. 1995). In contrast to the more common methods, however, it does not primarily investigate statistical and causal links between features of social actors, such as the budget managed by a ministry, the turnover of a company or the number of members of an association, but focuses on the analysis of relationships between stakeholders (Freeman, 2004; Serrat, 2017). This—the relationship as primary object of investigation—distinguishes SNA from other methods of empirical social research (de Nooy et al., 2012).

A central theorem of the SNA states that the stability of a relationship rises in accordance with the interdependence between sectors, represented by the number of common relationships (de Nooy et al., 2012). In this context, social networks and relationship structures are seen as channels for the allocation of social resources, including both material resources (such as financial resources and economic capital) and non-material resources (knowledge, information, prestige, recognition, and cultural/social capital). Because relationships provide the infrastructure for the distribution of these resources, the access that an institution has to social resources depends on the size and structure of the network within which it is embedded (Freeman, 2004; Serrat, 2017). That is why relationships are critical to consider in the resilience of networks.

In recent studies (Nyam et al., 2020; Sisto et al., 2021), a participatory approach is often preferred over purely statistical methods for quantifying socio-ecological concepts. This is demonstrated particularly well by Costa et al. (2021) in their paper addressing urban blight. There is also precedent for using the participatory approach to quantify systemic resilience. Walker et al. (2002) present a 4-step framework to include stakeholder input for resilient management of socio-ecological systems. Steps 1 and 2 include eliciting stakeholder’s knowledge of the drivers, followed by assessment of controllability of the drivers, and visions of the future. Steps 3 and 4 include looking at attributes that affect resilience and evaluating the process and results. More recently, Flynn et al. (2018) use the participatory approach to target future planning under climate change. They make an important point that each scenario created during a workshop is a “highly contextualized ‘snapshot’” of those particular set of conditions and circumstances. While these workshops are
never perfectly repeatable, and the timing of current events may impact the results, more research is needed to assess the robustness of these approaches. Allington et al. (2018) add an important extension to stakeholder studies to engage systems modeling while assessing sustainable futures. Denney et al. (2018) focus on the power relations between stakeholders and researchers conducting participatory workshops. They conclude it is particularly important to be cognizant and self-reflective when the research teams have asymmetric power dynamics with the local participants, else critical information may not be forthcoming. Kishita et al. (2017) use expert workshops to envision sustainable energy futures in Japan. Their focus is on attributes that make resilient futures able to avoid the collapse state. These examples, and others, serve as the scientific rationale for the research methods employed in the Resilience Monitoring Austria (ReM) project.

The ReM project discussed in this paper applied a participatory impact analysis approach for assessing stakeholders with different interests regarding complex crises situations. The resilience factors correspond to the success factors of the participatory impact analysis. Ultimately, we aim to identify which factors are involved in each stage of the adaptive cycle and which of these factors offers options for strengthening resilience. As the connections across all the levels of time and stakeholder interest are beyond the power of adaptivity and performance, they require a scientific instrument that can be used to record, analyze, visualize, and evaluate the relationships between social actors. Social network analysis serves this purpose and was primarily used in the analysis of the network of Austria and its stakeholder networks in this study. However, network analysis can generally be applied to all types of elements and relationships, and therefore it was also central to the analysis of the relationships between resilience factors and crisis scenarios. The scientific-theoretical relevance of the ReM project is that three different theories and methods were utilized, further developed, and above all combined in a new way: (1) the resilience concept and adaptive cycle, (2) social network analysis, and (3) impact mapping. In this paper, we posit that the three approaches complement each other well, and ultimately we combine them to construct a composite Resilience Index.

3 Methods

The study was designed by the scientific team at FASresearch—a network consultancy firm located in Vienna, Austria with over 25 years of experience in applying the science of networks. There, stakeholders were asked to contribute data in terms of their own experience and knowledge. Based on the rating of degree and quality of the public participation outlined by Shirk et al. (2012), stakeholders had the role of contributors in our research.

Analyzing the topic and developing the “resilience monitor” was a multi-method approach of quantitative and qualitative, top-down and bottom-up processes. The practical implementation was thus split in five phases:

Phase 1: Pre-selection of system-critical nodes (social actors) through the use of social network analysis based on publicly available data.

Phase 2: Workshop-based participatory impact analysis with representatives of those previously identified stakeholders in the network analysis, in order to identify critical factors and variables for their short-, medium-, and long-term ability to act under difficult conditions (crisis scenarios).

Phase 3: Evaluation of the degree of crosslinking/connectivity between those who are in a position to impact the critical factors, in order to take into account their experiences.
Phase 4: Telephone and computer-based interviews with experts in order to increase credibility/meaningfulness of the knowledge gained from the workshops and to make the dataset more robust.

Phase 5: Testing of results and conversion into a comprehensive resilience index for the stakeholder groups as well as in respect to the different crisis scenarios.

3.1 Network analysis

Through previous projects, FASresearch has compiled an extensive database of Austrian partners, which was used here to identify actors for inclusion in the survey and workshops. In addition, this step included preliminary quantitative measurements regarding the connectedness of the “Austrian Network, that is, the structure of the relationship among different stakeholder groups.” A network analysis of the socio-economic-cultural system of Austria was performed during the first stage in order to identify key institutions whose members can be selected to participate in the stakeholder workshops. This was done as part of a comprehensive analysis of the state, economic, and civil society networks in Austria with the help of SNA software.

The network analysis utilized data from the FASresearch network monitor. FASresearch has generated relevant data since 1999 on the basis of surveys as well as publicly available information (commercial register, club register, official calendar, membership lists of clubs, advisory councils, commissions, web pages, etc.), continuously and systematically collecting data on institutional relationships of organizations within and between social spheres of politics and state, economy, and civil society. At the time of analysis, the database contained information on the affiliations (current and past) of 117,518 individuals to a total number of 30,312 companies, institutions, and events. From these data, a so-called two-mode network was generated because as such, it contains two types of network nodes: Persons and Affiliations. This network was transformed into a one-node-network of affiliations which consisted of 14,722 companies, organizations, and events with a total number of 93,523 interlocking memberships current at that time. To further reduce the number of organizations, statistical and network analysis criteria were applied. With regard to the business sector, only the top 50 financial companies (banks and insurance companies) in terms of total assets and the top 250 companies in industry, trade, and services in terms of sales were left in the network. In the political and government sector, all positions below the federal state level were excluded from the analysis. And in the civil society sector, the 200 clubs and associations with the greatest network embeddedness measured by common network centrality measures (brokerage in terms of betweenness and closure in terms of the number of triadic relationships) were selected.

Figure 2 shows the visualization of the power network of Austria that resulted from this procedure. The network nodes represent the companies and institutions, and their size refers to network centrality. A connection between two institutions indicates that there is at least one person who holds a leadership position in both institutions. The thickness of the lines refers to the strength of the relationship between two institutions. Lastly, the colors relate to the clusters identified in the network as part of the Louvain cluster analysis. The Louvain clustering method determines network clusters on the basis of modularity. Modularity means that there are zones (sets of actors) in the network, for which networking is denser within the zones than between them (Blondel et al., 2008). Based on the distribution of relationships, nodes are assigned to clusters. The kinds of institutions that are in the
clusters can subsequently be used to interpret the content of the clusters and to describe them.

The names refer to the institutions within each cluster that dominate with regards to network centrality as well as turnover or total assets. This does not mean, however, that, e.g., exclusively industrial enterprises exist in the largest cluster of "industry." Rather, each cluster contains affiliations from all sectors—state politics, economy, civil society, and events. The most important institutions and events are thereby categorized according to their network centrality into three groups. A summary of the number of institutions included in each cluster can be found in Table 1.

The result of this procedure was a list of 492 companies and institutions (politics and administration: 206; economy: 157; civils society: 129) from which the potential workshop participants were selected. This was followed by a three-stage relevance-impact analysis in order to create a sample as balanced as possible from the list obtained from the network analysis. For this purpose, seven subgroups with the relevant stakeholders were created for each crisis scenario. Subsequently, representatives from business, politics, and society were filtered out within the subgroups, and these in turn were subdivided into nationwide, regional, and local stakeholders. In this way, the process ensured that these six dimensions were taken into account in the composition of the workshops. This resulted in a total of 386 organizations that were invited to participate in the workshops which fit to their expertise.

The original aim was to hold two workshops for each crisis scenario, each with 12 expert participants, in order to achieve the broadest possible spread of stakeholders. The invitations to the workshops were issued in a three-stage process: In the first step, all relevant contacts in the system-critical organizations were contacted by mail. The contacts should have decision-making authority in an area relevant to the crisis scenario (e.g., for

Fig. 2  Network of Austrian social actors
the workshop on the information supply crisis, the cybersecurity experts in the most important telecom companies were contacted). The cover letter included a concise summary of the research project ("resilience folder"). In a second step, all participants invited in writing were contacted by telephone. Thirdly, a reminder was sent by e-mail to all interested experts shortly before the workshop.

Invitations to attend a workshop went to all 386 organizations of which 62 stakeholder representatives agreed. Thus, a response rate of 15% was achieved. For this reason, two workshops could only be held for three crisis scenarios (health, technology, and environment). For the remaining scenarios, only one workshop was held in each case. In total, four planned workshops could not be held because the minimum number of participants could not be reached.

Nevertheless, it can be stated that the workshop participants are proven experts in the respective subject areas. In addition, it was ensured that representatives from all administration levels (federal, state and municipal) were represented in the respective workshops. A total of ten workshops were held in the course of the project.

### 3.2 Workshop

The aim of the workshops was to use the software tools to clarify the following questions with the input of experts:

- Which crisis scenarios are considered to be particularly probable and highly consequential?
- Which factors determine the successful completion of the resilience cycle in the case of a real crisis (there were seven different crisis scenarios adopted)?
- Which stakeholders actively influence the determined success factors, and which of them are therefore also essential for successfully coping with the assumed crisis situations?
- What is the quality of the cooperation between the relevant stakeholders in the stages of the crisis, in terms of provision of the relevant resilience factors?
Six hypothetical crisis scenarios were created for consideration on the basis of the Global Risks Report 2014 of the World Economic Forum. The seventh scenario, a geopolitical crisis with terrorist attacks in Austria—as a consequence of massive escalation of political disparities in the Arab world and Ukraine—was subsequently added in the fall of 2014 due to the daily updated political situation. Thus, the following seven scenarios were selected:

1. Outbreak of a pandemic (health crisis).
2. Collapse of central infrastructures (information supply crisis).
3. Climate catastrophe (ecological/environmental crisis).
4. Collapse of the European economic system (governance crisis).
5. Collapse of the Austrian welfare system (social crisis).
6. Collapse of the European banking system due to debt (financial crisis).
7. Terrorist attacks in Austria as a consequence of a massive escalation of the political unrest in the Arab world and Ukraine (geopolitical crisis).

The composition of the circle of participants was derived from the Network Analysis described above. This yielded a list of 500 institutions and organizations from the fields of business, politics, and social enterprises. They all became relevant stakeholders in building a nationwide resilience strategy. The aim was to assemble a balanced population from the network analysis. For this purpose, seven subgroups with the relevant stakeholders were created for each crisis scenario. Subsequently, within the subgroup the representatives of economy, politics, and society were filtered out, and these in turn were divided into nationwide, regional, and local actors. This process was to ensure that these six dimensions are included in the composition of the workshops. This resulted in a total of 386 organizations that were personally invited to their expertise-appropriate workshop event. Of the 386 invited stakeholder representatives, 62 participated in Part 1 of the workshop (15% response rate). For this reason, two workshops were held only for three crisis scenarios (Health, Technology, and Environment). The remaining scenarios were only discussed once each. A total of 10 workshops were carried out between July and December 2014.

3.3 Workshop evaluation

The Resilience Monitor generated a comprehensive output for each crisis scenario. The tables list 15 resilience factors in their respective expressions, as defined by the participants in the workshop. The output is divided into several parts. The first part includes matrices of interactions between the resilience factors in each of the five stages of the adaptive cycle for each scenario. The ratings were on a scale that went 0, 1, 2, 4, and 8, where zero signifies no mutual influence of the resilience factors and eight represents a heavy interaction. Additional color-coded matrices show the cross-impact of the workshops, indicating when participants agreed in their ratings or that the thresholds of participants’ ratings differed significantly. Furthermore, the most influential success factors are defined and resilience factors are classified according to average liabilities.

The second part of the workshop results focused on the influence of the resilience factors, with figures illustrating the relevance of the 15 resilience factors in terms of their active (i.e., influencing) and passive (i.e., influenced) properties, and their significance in the Resilience Cycle. Success factors where the active value is greater than the passive value are of particular importance in terms of design capability in each scenario.
so-called unspecified factor sites are the success factors with a neutral or buffering function and are not considered further as they have no direct influence on increasing the resilience of the system within the crisis situation. This assignment provides information about which success factors are of particular importance.

The final section looked at how the resilience factors are influenced by the stakeholders and how they interact with their influence. Figures illustrate the contribution of all stakeholders to the predefined resilience factors in the event of a crisis. The influence of each stakeholder group was rated on the same scale from 0, 1, 2, 4, and 8. A weighted sum of the impacts illustrates the significance of the stakeholders in the development of resilience because it contains the cumulative influence coefficients for every stakeholder. In further figures, the stakeholders are ranked and represented by their impact on the overall system. Finally, the monitor provides a summary of key resilience factors and stakeholders in the assumed crisis, summarizes some key outcomes, evaluates the relationship quality between stakeholders, and provides an answer to the question of how well the mentioned stakeholders can work together under the given scenario. For reference, complete results for the scenario of Climate Change can be found in the supplemental material.

3.4 Survey

This additional step could not be anticipated before the project started, but only manifested itself with the knowledge gained in the project, so that an adaptation of the approach was necessary. The survey included decision-makers in the stakeholder organizations of Industry, Military, Politics, State, and Administration, as they were found to have the biggest impact on resilience factors. In this case, decision-makers were defined as individuals who are able to make and influence decisions regarding alternative courses of action for the function(s) they perform within the stakeholder organizations. These options for action concern, above all, the distribution of different types of resources (economic and human resources as well as social capital) to do certain things and to refrain from others. The target group was therefore defined as the top management level of companies and institutions with more than 50 employees. If necessary, the second-level management was used if it was better able to provide information about the relationships. Business leaders (or owners) and heads of institutions comprised 81% of all participants. The remainder were department heads.

The majority of respondents were in management positions as owner, director, or head of department or service (81%). Then follow Employees in Marketing, Advertising, PR (4%) and Human Resources (3%). In each case, 2% were persons from the Commercial Management, Finance, Accounting, and General Administration departments of the organization or office interviewed (Fig. 3).

At the beginning of the questionnaire, the respondents themselves had to become an actor in their assigned group. The six largest groups involved in the survey are economy, industry, services, social partners, bluelight organizations, municipalities as well as the federal states, and the area of science and education. Table 2 represents the relationships of the respondents to other groups of actors or Target Groups. In a second step, they had to specify with which of these groups they have relationships or contacts.

The workshop participants were then asked how likely they thought each crisis scenario was to occur. Their responses are shown in Fig. 4. The survey then measured respondents’ perception of how that crisis will impact their area of influence (Fig. 5). Finally, participants were asked to assess the level of cooperation that may be expected
between the groups of actors in the event of a crisis. This deals with the relationships of the various actors in the different stages of a crisis. The results demonstrate the average assessment of cooperation of the respective stakeholder group in the five stages by the other groups. However, the mean values of the individual crisis stages cannot be interpreted absolutely but must be viewed in relation to the assessments of the other actors in the respective crisis stage. The mean value per crisis stage serves as a reference.

Fig. 3  Professional titles of survey respondents as a percentage of the total number of respondents

Table 2  Relationship of respondents to other groups of actors (Target Groups)

| Target Group                                      | Proportion (%) |
|---------------------------------------------------|----------------|
| Business/Industry/Service                         | 55             |
| Infrastructure/Telecom                           | 40             |
| Financial Industry                               | 19             |
| Advisory/Consulting                              | 34             |
| Media                                             | 52             |
| Politics                                          | 57             |
| State/Administration                             | 49             |
| States                                            | 44             |
| Communities                                       | 51             |
| Emergency Services                               | 32             |
| Civil Society/NGO’s/Churches                     | 32             |
| Social Partners                                   | 40             |
| Interest Representative/Lobbying                  | 26             |
| Science/Education                                | 26             |
| Military                                          | 13             |
| Judiciary                                         | 16             |
| EU/Multilateral Organizations                     | 14             |
Respondents were asked to indicate with which actors they have relationships or contacts in the course of their work. Most of the contacts are with politics, business, industry, and services, closely followed by the media and communities. Respondents are the

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**Fig. 4** Likelihood of each crisis scenario occurring according to workshop participants. Responses recorded on a 5-point Likert scale range from Unlikely (green) to Extremely Likely (red). The numbers represent the percentage of participants who chose that particular response.

**Fig. 5** Impact of crisis scenarios on respondents’ area of influence according to workshop participants. Responses recorded on a 5-point Likert scale range from Unlikely (green) to Extremely Likely (red). The numbers represent the percentage of participants who chose that particular response.

Respondents were asked to indicate with which actors they have relationships or contacts in the course of their work. Most of the contacts are with politics, business, industry, and services, closely followed by the media and communities. Respondents are the
least connected with the military, the European Union and other multilateral organizations, as well as the judiciary and the financial industry.

In the subsequent part of the survey, respondents were asked to rate how they assess the collaboration with the stakeholders with whom they relate in the five consolidated stages of a crisis (Fig. 1). The results are presented individually for each area. The five crisis stages:

- **Status Quo** ("before the crisis")—How well do we collaborate in the deepening, standardization, and practice of the proven? How well do we accept and train work-sharing roles, functions, and expertise? How well have we formed shared resources and buffer capacities?
- **Crisis** ("initial stage")—How well do we collaborate in the joint implementation of contingency plans? How smoothly do the processes run in a crisis situation? How does joint access to resources work?
- **Destructuring** ("continuing / increasing crisis")—How well do we collaborate in improvising? Do we have common access to resources that guarantee a minimum of survivability? Can we accept new roles and new players / circumstances in a crisis situation?
- **Exploration**—How well do we collaborate in trying and exploring new and unusual options? Do we have enough room for experiments? Are we open?
- **Reorientation**—How well do we collaborate in the reorientation and implementation of "Lessons learned"? How well do we collaborate in abolishing that which is no longer proven and in the enforcing the new? Do we have sufficient support of decision-makers who are "above us"?

## 4 Results and discussion

### 4.1 Expected probability of event

Overall, most respondents (70%) considered pandemic outbreaks to be highly unlikely. In the group of blue light organizations, this proportion is comparatively lower at 65 percent. However, only 5 percent thought that the outbreak of disease is extreme and very likely. Around 67% of respondents believed that geopolitical conflicts were unlikely. Within the sectors of Economy, Industry, Services, Telecommunications, Consulting, and Advocacy or Lobbying, the proportion was slightly higher at 73 percent. On the other hand, 11% of respondents believed geopolitical conflicts to be extremely likely. Similarly, 67% considered an infrastructure failure unlikely, while 10% believed that this crisis could happen. Again, the sectors of Business, Industry, Services, Telecommunications, Consulting, and Advocacy or Lobbying were comparatively optimistic that this is unlikely to occur (75%). More than one half of the respondents (53%) believed that government failure is unlikely. On the other hand, there were 20% who believed it to be extremely likely. Comparatively, the sectors of Blue-Light Organizations and Business (28%), and Industry, Services, Telecommunications, Consulting, Advocacy or Lobbying (24%) were more prone to think that the government will fail. Social conflicts were thought not probable for 45% of respondent, while 22% think these were extremely likely. There were hardly any differences between the subgroups here.
4.2 Expected impact of the individual crisis scenarios

While the previous section focused on the expected probability of events to occur, here respondents report their perceptions of how that crisis will impact their area of influence (Fig. 5). Overall, in the event of crises likely to occur, respondents have a major impact on their own area of influence. Although ongoing climate change will persist in the respondents’ opinion, the impact on their own areas continues to be considered as rather low. According to respondents, the lowest impact will be climate change ~ 41% believed it will have little or no effect on their own area, and 23% expected a large impact. The group of social partners is more likely to see greater impacts of climate change (32%), but again, those who think that climate change has less impact on their territory (38%) were more prevalent.

A government failure shows a strong effect attributed by all groups. Overall, 44% of respondents expected extreme effects, while about one quarter (27%) believed that a government failure will have no impact on their own area. The group of blue-light organizations (51%), social partners (50%) and the group of science and education (60%)—rather state-related organizations—expected more extreme effects in the event of such a crisis. In terms of geopolitical conflicts, too, participants expected more impact on their own area (40%) than not (21%).

The occurrence of a financial crisis in Austria is largely considered probable. More than one-half of the respondents (54%) believed that this would have an extreme impact on their own sphere of influence; one fifth (20%) is of the opposite opinion. In particular, the group of blue-light organizations (68%) is more likely than average to expected greater impact. An infrastructure failure is largely considered unlikely. However, if this occurs, 56% of the actors expected extreme effects on their own sphere of influence while 16% believed that this would have only a minor impact.

The group of blue-light organizations expects comparatively larger effects on their own area (79%), and around six out of ten respondents (62%) expected extreme effects on their own area in the event of social conflicts. On the other hand, there were 13 percent who believed that social conflicts would have no impact within their own sphere of influence. The effects of pandemic outbreaks were most commonly articulated, with around seven out of ten respondents in total agreeing, although an outbreak of disease is widely considered very unlikely. The group of blue-light organizations and the financial industry were more likely to expect a greater impact on their own area.

4.3 Assessment of co-operation in case of crisis—comparison by actor group

Cooperation between the business, industry and services groups with the other stakeholders was largely very good to neutral in all stages of a crisis. It showed that the quality of the cooperation before a crisis—so currently—was best, slightly decreased over the initial stage destructuring, and again increased in the exploration stage to reorientation.

4.4 Assessment of co-operation in case of crisis—comparison after crisis stages

According the cumulative assessments (Table 3), depending on the stage of the crisis or the respective mean value, the following picture emerged: the cooperation before the
crisis was rated relatively well in general, deteriorated drastically at first in the initial stage and even more in the destructuring stage. Collaboration in the exploration stage, that is, when it comes to breaking away from old methods that may not have led to the desired success, and finding new approaches to crisis intervention, proves to be overall even less satisfactory. It requires a degree of openness and courage to experiment, which does not seem to be sufficiently present in the relevant actors. The realignment or the shared implementation of “lessons learned,” which sometimes includes an appropriate error culture, was the area that is generally seen to be the most critical. Naturally, resilience is greatest in the normal state and decreases linearly during the crisis. Coping strategies in the event of a crisis are present, but often not adequately used or adapted.

### 4.4.1 Cooperation in the preliminary stage: status quo

The handling of the status quo, i.e., the training and standardization of proven methods as well as the acceptance of division-based roles and expert knowledge, were rated relatively well. Who were the three leading and weakest players in this field? Excellent cooperation is shown here by the blue light organizations, followed by representatives of the national defense, and members of the local government. On the other hand, the financial industry, the EU and other multilateral organizations, as well as the infrastructure and telecoms sectors, were in deficit, albeit to a lesser extent.
4.4.2 Cooperation in the initial stage

A little worse than pre-crisis cooperation, but still relatively good. It describes the initial stage of cooperation, which focused on the effective implementation of existing contingency plans and access to shared resources. Once again, the blue light organizations and representatives of civil society, NGOs, associations, churches, and communities were leading the way. On the other hand, cooperation with members of the finance industry, science and research, and once again the EU and other multilateral organizations is less successful.

4.4.3 Cooperation in the destructuring stage

According to the individual actors, the cooperation in the destructuring stage works less smoothly. There is a certain degree of spontaneity and improvisational skill required to ensure a minimum of survivability if existing crisis plans do not work. The blue-light organizations, civil society actors, NGOs, religious communities and representatives of the state’s defense do the best in this area. On the other hand, cooperation with members of banks, financial service providers, members of the EU and multilateral organizations, as well as academics and researchers is problematic.

4.4.4 Cooperation in the exploration stage

Despite worsening at the beginning of the crisis, the cooperation seems to be working in this stage. The basic requirement is flexibility and openness in order to break away from the existing patterns, and the willingness to open up to the new, sometimes unfamiliar options. Good performance is again shown by the Blue Light Organizations, which were all said to have excellent crisis management, followed by civil society actors, NGOs, churches and the consulting sector. However, deficits in the cooperation were attributed to members of banks and financial service providers, the EU, and other multilateral organizations as well as members of the federal government.

4.4.5 Cooperation in the reorientation stage

Although the cooperation between the individual actors seems to work well in terms of trying out and exploring new measures in crisis situations, there were visible deficits in terms of implementation. So the reorientation stage is the stage where cooperation in general works the worst. Even if the desire for reorientation and the required openness and experimentation were present, the implementation fails in the long term. The best way to do this is to cooperate with members of the blue light organizations, civil society, NGOs and churches as well as the business, industry, and service sectors. By contrast, representatives of the EU, multilateral organizations, the judiciary and the financial industry rank at the lower end of the value spectrum. They were generally said to have the worst cooperation in this field.

4.5 Resilience index

The overarching aim of the resilience monitor is to develop a single index that indicates the stakeholder resilience. Although such single index ratings can be oversimplifications, this summarizes information from three dimensions: (1) stakeholder relationships,
(2) stakeholder impact on the resilience factors, and (3) stakeholder impact on the crisis scenarios.

Dimension 1 is based on the idea that a higher quality relationship between stakeholders entails a smoother flow of resources (material and non-material) between them, thereby increasing resilience of the stakeholders in the face of a crisis.

Dimension 2 aims to impact the stakeholders on the resilience factors, where the following values from Fig. 6 flow into the resilience index:

This figure shows the influence of stakeholders on the resilience factors, the latter being additionally weighted depending on the quotient of asset value and liability. This means that the impact of the stakeholders is stronger in the resilience index when it comes to factors that are highly active and have little passive effect in the system of resilience factors. In other words, factors which are important for the beginning of the process of resilience enhancement (renewal, system thinking, new roles / behavior change).

Dimension 3 refers to the impact of the scenarios on each other. Financial crisis, government failure, and social conflicts were cited here as scenarios that had the strongest impact on the other crises (triggering or even amplifying them).

With regard to the question of how well the stakeholders are coping with the crisis scenarios, the following assumptions are made:

1. Stakeholders are resilient when they have a good quality relationship with the other stakeholders.
2. Stakeholders are resilient if they have a strong impact on the resilience factors.

![Fig. 6](image-url) Impact of stakeholders on resilience factors, calculated using the average of ratings in eleven resilience workshops. Included are stakeholders who were evaluated in at least two workshops. High activity resilience factors are strongly weighted.
3. Stakeholders are resilient when (1) and (2) apply to scenarios which have a strong impact on the other scenarios.

The resilience index of the stakeholders is calculated as follows:

$$I_R \text{Stakeholder} = \text{Relationship quality} + \text{Impact of resilience factors} + \text{Scenario impact}$$

The three dimensions that make up the resilience index were normalized to values between 0 and 1. The resulting index (the sum) can therefore assume a maximum value of 3.

Figure 7 lists the stakeholders according to the index calculated in this way, based on all three dimensions:

The list is headed by the stakeholder group of Science, Research, and Education. This area was credited with the best average relationship quality, and it has a strong influence especially on the resilience factors in the cultural dimension (beginning phase), which is the case for scenarios with a strong impact on other scenarios. The largest average impact on the resilience factors is made by science, research, and education in scenarios of governmental crisis, social conflicts, as well as climate change.

Particular emphasis must be given to the importance of this stakeholder group with regard to the establishment of systemic thinking. Science and Research develop systemic thinking, and the task of mediation would fall upon the educational institutions, especially of course, upon the schools. It is found that at the beginning of the process of resilience strengthening, a cultural change is necessary. Cultures in general, or organizational cultures in particular, do not change easily; and most of all these changes are not the effect of control, conscious intervention, or strategic measures. Cultures are among the slow social variables, their change is subject to long-time cycles. Cultural changes primarily concern not the social actors, but relations that exist between them. Cooperation and collaboration are the key to cultural changes toward more systemic thinking.
The stakeholder ranked second in the sense defined above is Industry. As for relationship quality, Industry is in the middle. Of all the stakeholders, industry has the largest average influence on the resilience factors. Most of all, it is essential in defining standards in the period before the crisis and thus in the development of a common crisis understanding. It also has an impact on the openness to new solutions. The special strength of the industry lies of course in the production of resources, but it also has an impact on skills and on cultural factors. And finally, industry has the biggest impact in the financial crisis and government failure scenarios, which have a special effect on other crisis scenarios.

The third most influential stakeholder is the Multilateral Organizations, including the European Union. Although it is difficult to do for the different stakeholder groups, it is obvious that the European Union is not attributed the resilience factor proportional to its real political weight. Multilateral Organizations / EU, above all, are a strong influence on the setting of standards before the crisis, on systemic thinking (also before the crisis), and on cooperation during the crisis. In terms of relationship quality, this stakeholder group is also in the middle. Above all, it maintains good relations with science, research, and education. Multilateral organizations and the EU are central to, financial crises, social conflicts, and climate change.

The military follows the multilateral organizations in terms of influence. It must be added that with the Armed Forces, their influence on the resilience factors was only assessed in the scenarios of Geopolitical Crisis and Infrastructure Failure. It seems that the federal army has a particularly strong impact on the following critical and passive resilience factors: application and implementation of contingency plans, provision of the crisis infrastructure, and cooperation between the stakeholders. "Critical" and "passive" means that the factors are strongly related to the other factors, which also involves many other stakeholders. The quality of relations of the Federal Army is considered very well classified.

Conversely, based on the reviews made in the workshops, a comparatively low resilience was seen in the municipalities, the social partners, the counselors, and the citizens. The communities and the citizens were found to have a rather small impact on the resilience factors. Both social partners and the counselors may be more concerned with the poorer relationship quality that comes into play with this classification.

4.5.1 Resilience with regard to the crisis scenarios

The results in this section are based on the workshop results regarding the scenarios, compared (with caution) to how resilient the political, economic, and social systems of Austria are in the face of these crises. Once summarized, the Resilience Monitor exists in three interconnected dimensions (Fig. 8).

The stakeholders were assessed based on the quality of their relationships to each other. In addition, they have an impact on the resilience factors (was also evaluated by the workshop participants) and on the scenarios (can be calculated from the average of the reviews). Within the resilience factors, this was determined by the participating experts based on how they interact with each other. These reviews also allow the factors to be compared to each other regarding their influence in the various crisis scenarios. And, the scenarios themselves finally became part of the participatory impact mapping in terms of their impact on the probability of occurrence and the impact they have on each other. Three dimensions of the resilience index can now be deduced from the three levels in Table 4.
The resilience increases, according to the model of the resilience monitor, if the stakeholders can work well together and if they have a strong overall influence on the resilience factors. A strong active effect (high influence-ability) of the factors also increases the resilience. And, as far as crisis scenarios are concerned, we assume that the resilience is greater when the effects of the crisis are not so great, when the likelihood of occurrence is lower, and if the impact of each scenario on the others is not so strong. These statements are operationalized as follows:

- **Relationship Quality**: Average of all ratings made for each scenario.
- **Impact on Factors**: Average of Impact of Stakeholders on the resilience factors for each scenario.
- **Criticality**: Average of the product (Active value * Passive value) of each factor for every scenario.
- **Activity**: Average of the active value of the factors for each scenario.
- **Impact**: Average of scores for each scenario.
- **Risk**: Average of scores for each scenario.

**Table 4** Dimensions of the resilience index of scenarios

| Resilience is high… | Stakeholder | Resilience Factors | Scenarios |
|---------------------|-------------|-------------------|-----------|
|                     | Relationship Quality | Criticality | Effect |
|                     | When the relationship quality of the stakeholder is good | When the impact of the resilience factors on each other is low | When the effects of the crisis scenario are low impact |
|                     | When the stakeholders have a strong impact on the resilience factors | When the activity of the factors is high in the respective scenario | When the risk of the scenario occurring is low |
|                     | (Impact on Resilience factors) | (Activity) | (Risk) |
|                     | | | When the impact of the crisis scenarios on other scenarios is low |

Fig. 8 Three interconnected dimensions of the resilience monitor

**Table 4** Dimensions of the resilience index of scenarios
The values of these indicators are, if necessary, "reversed" (the larger the value, the higher the resilience), and normalized to a value range between 0 and 1. The sum of the individual values then gives the resilience index, which accordingly can assume a maximum value of 7. It must be added that for the scenarios of governmental crisis and social conflict, no ratings have been made for the resilience factors and therefore, the average values of the other scenarios were used for the criticality and the activity.

The concept also shows that there is not a single resilience factor par excellence, but rather that statements about them only make sense in relation to the comparison of the crisis scenarios with each other. Figure 9 shows the scenarios ranked according to the calculated index:

The highest is the resilience of Austria’s political, economic, and social systems when it comes to the outbreak of a pandemic. This scenario has the highest values in relationship quality and in the influence of stakeholders—in a health crisis, stakeholders are most likely to do something at national level, according to the assessment of the participating experts. In addition, the probability of occurrence and the implications for other scenarios are classified as low.

This is followed by infrastructure failure, a scenario where risk and impact were also not classified as high and where the overall relationship quality of stakeholders is good. Conversely, resilience in the face of a possible financial crisis is by far the lowest. Financial crisis increases the probability of occurrence, the consequences, and the impact on the other crisis scenarios, and the influence of the resilience factors appears extremely low, along with the relationship quality of the stakeholders (in particular the financial company). Resilience is also low in the face of a geopolitical conflict. In this case, above all, the criticality of the resilience factors (their mutual influence and thus the overall complexity of the scenario) and the consequences are big.

Overall, it seems plausible that in crisis scenarios whose causes are more of national (or even regional) origin that resilience at a national level is higher compared to complex forms of crisis with international or global causes. Now it could be argued that the indicators of the scenarios (impact and risk) cannot be directly influenced by the stakeholders and therefore could not be used to calculate the resilience index. Figure 10 shows the scenarios ranked by the index, calculated using only the indicators of the stakeholders (relationship quality, factor impact) and the resilience factors (criticality and activity):

![Resilience Index for Crisis Scenarios](image-url)

**Fig. 9** Resilience index for crisis scenarios
Even with this type of calculation, it remains that resilience is greatest in scenarios of health crisis and infrastructure failure. This is followed by scenarios of social conflict, government failure, climate change, financial crisis, and geopolitics. This means that the more international or global a crisis scenario is, the lower the resilience is estimated. This shows the absolute necessity of international cooperation and highlights that the European Union and other multilateral organizations are more important than the workshop assessments originally estimated.

5 Conclusions

The Participatory Impact Approach (PIA) utilized here was developed by FASresearch in a number of trials that have some of the same features described in Walker et al. (2002), namely, collection of stakeholder input on drivers and ranking of the effectiveness of the drivers. While other approaches have relied heavily on backcasting, the resilience index proposed and developed here shows some of the same features of reaching desirable futures with the added benefit of assessing the participants’ level of influence. The final product of this project is a software tool for measuring and monitoring the resilience of a socioeconomic system. The HTML5 based software (with the working title: "Resilience Monitor") not only includes the whole process of creation and calibration of the index, but also delivers the results in a resilience dashboard. This is not only intended to inform decision-makers about the state of the sectoral and geographical resilience of Austria, but also provide indications about adjustments and possibilities of intervention in the system. Resilience monitoring thus fulfills more than merely an analytic-diagnostic function, it is also intended as an adaptive tool for novel resilience management.

The complete process from the identification of the factors to the calculation of the resilience index are intuitively displayed in the web application so that the individual steps can be carried out at any time by the systemically relevant actors. Specifically, the resilience monitor is divided into three modules, which are completed one after the other by the user:

1. Scenario Impact Mapping.
2. Participatory Impact Mapping.
3. Stakeholder Impact Mapping.
5.1 Resilience monitor module 1: scenario impact mapping

The first module deals with various crisis scenarios in terms of probability of the occurrence and the possible effects as well as regarding the interactions that exist between them. One of the implications of Scenario Impact Mapping is that the participating experts discuss to what extent the different crisis scenarios are related to each other. For example, if one particular scenario could reinforce or even trigger another. To depict this, the scenarios were represented by an Impact Matrix whose cells contain the values to which the participants have agreed, indicating the strength of the connections between the scenarios. This means that all the criteria met are those that allow a network analysis: There are a large number of network nodes (the scenarios) and many relationships between them. The result of the evaluation can also be in the form of a graph showing how the different crises are related to each other. Additionally, the network analytics are applicable as evaluation tools (key figures on the center of the scenarios, key relationships, possible clusters of crisis formation).

5.2 Resilience monitor module 2: participatory impact mapping

This module provides the user with interactive bar charts and scatterplots as well as preliminary feedback about which factors from his/her point of view is particularly critical for the resilience of the system and how they relate to each other. The second module of the resilience monitor also involves an impact matrix. Participatory Impact Mapping evaluates the impact of the relationships between the resilience factors. Resilience factors are the criteria for successful resilience of an organization or a social system in a specific crisis scenario. They are now treated like the variables in the sensitivity concept. It is assumed that there are causal relationships between them and that the variables together form a system with the causal relations, which as a whole is the resilience. This system can in turn be represented as a network—the factors of resilience are the knots and the reciprocal influences are the relationships of the network.

Active and reactive factors can be color-coded, the size of the nodes represents their significance in the overall system, and various other evaluation tools of network analysis are also applicable here. This includes reduction of the network, identification of key factors and key relationships, determination of factor clusters, and above all, identification and representation of the chain of effects existing between the factors. Factors with a large number of outgoing arrows (active factors) are assigned to the beginning phase; factors in a dense network of incoming and outgoing arrows belong to the critical phase; and those with a larger number inbound arrows are the reactive variables and belong on the result phase.

5.3 Resilience monitor module 3: stakeholder impact mapping

Module 3 is about identifying the stakeholders hit by the crisis and involved in crisis management. Furthermore, the resilience factors identified in Module 2 can be used to conclude which stakeholders are particularly significant in which phase of the crisis. One of the central hypotheses that emerges from the combination of network research and the concept of resilience is that social cohesion plays an important role among actors playing different roles in the resilience cycle or stages of a crisis. It is these
connections beyond the role that enable a system or organization to transition from one stage of a crisis to the next (and thus coping). Therefore, in module 3, the cooperative relationships between the stakeholders (how well they work together during the different crisis stages) are analyzed network-analytically. Again, the data are in the form of a matrix listing the stakeholders and into which the ratings of the relationship quality are input. The network is in turn visually presented and evaluated using social network analysis, with particular emphasis on identifying any lack of cross-role collaboration.

When applied in the context of a participatory workshop, it is clear that the Resilience Monitor (ReM) was successfully able to yield a Resilience Index for Austria, accounting for the relationships between stakeholder groups, resilience factors, and crisis scenarios, as well as interactions within these variables. In addition to being user-friendly, this software provides comprehensive results, presented in a variety of visually intuitive ways, and can be utilized in different contexts to gauge the resilience of any given system. It can further be concluded that in addition to fulfilling an analytic-diagnostic function, resilience monitoring techniques can also serve as an adaptive tool for novel resilience management.

Given the current circumstances, a final word is in order regarding the pandemic outbreak scenario, which has come to pass since these data were collected. It is worth noting that this scenario was deemed by the experts as the least likely and the one for which they were most prepared. While Austria did engage in a strong, initial national response to the Covid-19 crisis, the actual outcome must have been less successful than perceived by those surveyed here. In particular, two lessons can be learned. First is the cascading effect that one crisis has on another, particularly that the pandemic response initiated an economic crisis. The interdependence of these two factors was not wholly considered in resilience preparedness. Second, the pandemic is truly a global event and that actions taken at a national scale cannot fully address the situation. This highlights the importance of international coordination and collaboration to deal with a collective vulnerability. Lastly, it is important to remember that the Resilience Monitor proposed here is intended to be an ongoing monitoring system that can inform and adapt from real world events. Our work provides the baseline look at Austrian resilience but continued surveying and monitoring is needed. Undoubtedly, the Covid-19 occurrence will be grounds for many future studies on resilience and crisis management.

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