A simulation exercise for incorporating long-term path dependencies in urgent decision-making

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A B S T R A C T

Urban policymakers of the 2020s must act within various types of wicked socio-ecological disruptions. Under deep uncertainty and time pressure, they must make decisions which will define the scope of possible actions in the future. Our aim was to develop a research instrument that would enable researchers and practitioners to learn about such policymaking. We designed and ran a half-day simulation exercise, the Policy Operations Room (POR). The participants were the top politicians and a group of senior experts from the City of Helsinki, Finland. The design of the exercise was based on a review of simulation and gaming research literature. The exercise managed to integrate – albeit imperfectly – the utilitarian and emancipatory dimensions in futures studies: it gave the participants the utilitarian possibility to practice decision-making and the emancipatory possibility to critically reflect on decision-making in wicked, science-based scenarios. It also gave the researchers a chance to witness urgent decision-making in action. Issues deserving further attention include the inclusion of social-political complexity in the scenarios and practitioner involvement in the design process of the exercise. All in all, the POR constitutes a unique way of integrating science-based assessment of future path dependencies into science–policy research and interaction.

1. Introduction

Policymakers of the 2020s face various types of wicked socio-ecological disruptions with long-term impacts, including populist nationalism, economic inequality and instability, rapid technological change, and hazards induced by climate change and ecosystem loss. Wicked disruptions are characterized by urgency, path dependence, complexity, uncertainty, value conflicts, indeterminate solutions and high demand for expertise (Hukkinen, 2016; Rittel & Webber, 1973). The decisions made now to address wicked problems carry significant consequences far into the future. The existence of sociopolitical feedbacks (Howard & Livermore, 2019) means, for instance, that today's decisions on how to lower climate emissions affect future capabilities to adapt to the effects of climate change. Yet decisions are needed urgently, despite contested values and poor knowledge of disruption drivers and decision outcomes.

It was against this background that we decided to explore with the City of Helsinki top-level climate policymaking that would be both urgent and far-sighted. Cities have often been highlighted in public discussions as meso-level actors that can act on climate both

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quickly (cities are compact and dynamic enough) and effectively (cities have legitimacy and power to coordinate collective action) – a sentiment that has grown stronger after the U.S. withdrawal from the Paris Climate Agreement in 2020. We designed and ran a Policy Operations Room (POR), a scenario-based simulation exercise. The objective of the POR was to enable the city's policymakers and experts (the exercise participants and co-organizers) and us (the research team) to learn about and develop the conditions for urgent decision-making that makes use of science-based assessment of future path dependencies. In our view, it was important to include urgent decisions as well as long-term consequences in the exercise, because the drivers of socio-ecological disruptions have persistent path dependencies: in the new reality of chronic environmental crises and contingencies, strategic decisions with long lead times (such as land use planning) should be updated rapidly and routinely to prevent disruptive consequences (such as catastrophic fires or flooding) decades into the future. The POR we designed addressed climate-induced socio-ecological disruptions, but the exercise is applicable to any disruptions demanding consideration of the long-term consequences of urgent decisions. We used quantitatively supported narrative scenarios, which were based on multidisciplinary scientific assessment, to "screenwrite" the exercise.

The POR is a key research and interaction instrument in WISE, a six-year multidisciplinary research consortium that studies and develops creative adaptation to wicked socio-ecological disruptions in Finland (https://wiseproject.fi/en). Other research tasks in the consortium feed into the POR with science-based scenario information on potential socio-ecological disruptions and observed societal challenges in coping with the disruptions. The POR is inspired by commonalities found in two strands of relevant literature: futures studies and simulation and gaming studies. Both identify the need to reconcile and learn from tensions between decision-making performance and critical reflection on the performance.

In futures studies, there is a formative tension between the utilitarian approach serving specific decision-making needs and the emancipatory approach focusing on knowledge that enables the critical assessment and overcoming of current conditions (Ahlqvist & Rhisiart, 2015). Ahlqvist and Rhisiart (2015) relate the emancipatory potential to reaching a "more sustainable direction", by which they refer to "a position of human beings or societal entities in which they reflect on their actions in multiple perspective, emphasizing e.g. political, ecological, technological, economic and value-driven levels in a balanced way, and not by privileging just economic competitiveness, national competitiveness or economic growth" (Ahlqvist & Rhisiart, 2015, p. 95). As the authors point out, a fruitful way to resolve the tension is by placing the polarities in dialogue: the methodological strengths of utilitarian approaches could benefit from the theoretical depth of the emancipators while emancipatory approaches could draw on the methodological robustness of the utilitarians.

We suggest that research on simulation and gaming offers a pragmatic and analytically sound way of combining the utilitarian and emancipatory approaches. In simulation and gaming, there is a parallel tension between performance and reflection on the performance. In a typical simulation exercise, such as an emergency preparedness exercise, the participants need to perform in the roles assigned to them and reflect on their own performance while doing it (Lee, Trim, Upton, & Upton, 2009). This creates a unique learning space for the participants, in effect creating a situation for "double-loop learning", or simultaneous learning how to do things and learning to learn how to do things (Bateson, 1972). From the perspective of futures research, a simulation exercise such as the POR achieves not only the utilitarian benefit by allowing the participants to solve specific problems efficiently but also the emancipatory benefit by facilitating the participants' critical self-reflection of how they converge on specific solutions.

The so-called experiential turn in futures studies has made interactive methods like games popular (see, e.g., Candy & Dunagan, 2017), but the general use of simulations and gaming as foresight methods has a longer history (see Vervoort, 2019). Nowadays, different kinds of experiential futures games are used to explore the idea of futures as multiple and socially constructed, and to allow the opening up and shaping of present worlds (Vervoort, 2019, 175; 180). Following Anderson (2010, pp. 785–786), we assume that scenario-based exercises make future actionable in the here and now through imagination – in the narrativization and visualization of scenarios – but also through performance: when the participants play a set of roles, the future is made present experientially in the stress or boredom of the exercise play. An exercise is an occasion for experiencing how a future might feel (Anderson, 2010), helping to bridge the gap between the physically present and abstract spaces of possibility (Candy & Dunagan, 2017).

The POR exercise was designed and ran in a pragmatic dialogue between utilitarian exploitation of scenarios and simultaneous emancipatory reflection of their usefulness by the exploiters themselves. Implementing the dialogue as a simulation exercise had several motivations. First, we wanted to establish experiential connections between the present and the future (Anderson, 2010; Candy & Dunagan, 2017). The idea was to let the policymakers live through their decisions by letting them encounter today's strategic choices as future policymakers. This is possible only through simulation and gaming. As the review in Section 2 shows, simulation exercises facilitating such encounters across time are rare. Second, "games open closed doors" (De Caluwé, Geurts, & Kleinlugtenbelt, 2012, p. 607). It is uncommon for researchers to get to witness strategic choices being made at the top policy level. This has to do with establishing trust and getting access, but also with the fact that typically decision-making is scattered in time and space. A simulation exercise can condense time and space. (Vieira Pak & Castillo Brieva, 2010; Wesselow & Stoll-Kleemann, 2018) Third, we wanted to be able to study what policymakers draw on when making important climate-related decisions (Gibbs & Flotermersch, 2019), but also to what extent and how they exceed the everyday policymaking practices via exercise participation and deliberation. Games and exercises can provide a safe environment for learning, by distancing the exercised decision-making from actual real-life impacts and thus relaxing the common political pressures (Mayer, 2009; Solinska-Nowak et al., 2018). Fourth, an exercise can gather policymakers with diverse values, interests and backgrounds, and create a space for social learning (den Haan & van der Voort, 2018). Although encouraging outside-the-everyday thinking, a simulation exercise asks the policymakers to argue for their ideas, thus maintaining political relevance (Parson, 1997). Fifth, we saw that the POR could be later developed from a research method into a decision-making instrument, which would integrate comprehensive science advice to the most complex policy challenges (Van den Hove, 2007).

The focus of this paper is on the design and execution of the POR exercise. We evaluate the success of the POR mostly in terms of its ability to provide a platform for social and experiential learning for the exercise participants. Although we briefly look at how the POR

managed to provide empirical data for researching urgent decision-making and its long-term implications, we leave the analysis of the decision-making data for subsequent research papers. In the rest of this paper, we summarize the literature review that guided the exercise design and provided us with criteria for evaluating the success of the exercise, describe the iterative and co-creative design and organization of the POR exercise, detail the execution of the POR, assess its successes and deficiencies, and offer some remarks on using the POR as a decision-making tool.

2. Drawing on past simulation and gaming research

To aid the design of the POR exercise, we conducted a review of research literature and simulation exercise manuals. More specifically, the purpose of the review was to look for insights and lessons learnt that we could use as guidelines for incorporating vital components in the exercise and to establish a set of criteria for evaluating the success of the exercise in providing a learning platform for the participants.

2.1. Exercise types and purposes

The reviewed literature identifies two broad categories of exercise: discussion-based and operation-based exercises. Table-top or desktop exercises and games are considered to belong to the former group, whereas functional or full-scale exercises which require an actual mobilization and use of resources are in the latter group (e.g., Grunnan & Fridheim, 2017, p. 84; United Nations Office for Disaster Risk Reduction, 2017, pp. 9–10). A considerable part of the literature focuses on *serious games* or *simulation games* which can be thought to form a subgroup of simulation exercises. These are games that are developed for educational purposes (Mayer, 2009, p. 825; Solinska-Nowak et al., 2018, pp. 1013–1014). As educational and engagement tools these games and exercises address various issues related to, for example, disaster risk management (see Solinska-Nowak et al., 2018) and sustainable resource management and climate policy (see den Haan & van der Voort, 2018; Flood, Cradock-Henry, Blackett, & Edwards, 2018). They incorporate roles to be played and might include a model of reality (e.g., a computer simulation or a board game) with which the players interact (van Laere et al., 2018, 17). Resembling an actual decision-making situation, the POR is discussion-based and – similarly to many discussion-based exercises – forces the participants to arrive at decisions at specific points. We refer to the POR simply as a simulation exercise.

Simulation exercises have become an established part of especially emergency management where they are used to test emergency procedures and to evaluate response skills. Additionally, different types of serious games, like policy exercises, are used in public policy making in order to analyze complex policy problems, such as energy reform or spatial planning. The exercises can represent both technical-physical and social-political complexities, and therefore allow the players to explore the interaction of physical and social systems in a strategic multiactor setting. (See Mayer, 2009) Games are often explicitly designed to raise players' awareness of sustainability issues (see Katsaliaki & Mustafee, 2015). Furthermore, exercises can serve scientific knowledge production (Boin, Celesta, & Overdijk, 2004, p. 382; Wesselow & Stoll-Kleemann, 2018, pp. 301–302): they are "dense methodological tools" which can "synthesize a complex system" and allow participant observation (Vieira Pak & Castillo Brieva, 2010, p. 1332). They can be used for "exploring the feasibility of future policy alternatives, for studying and motivating organizational change, and as research tools to study the processes or organizational change, policy-making and stakeholder interaction." (Johansson, Van Laere, & Berggren, 2018, p. 916).

2.2. Benefits of exercising

There is substantial literature on learning and its effectiveness in simulation exercise and serious game contexts (e.g., den Haan & van der Voort, 2018; Borodzicz & Van Haperen, 2002; Moats, Chermack, & Dooley, 2008). Exercises and games, as active learning methods, are said to have higher retention rate compared to conventional lectures (Gralla, Goentzel, & Chomilier, 2015, p. 116; Solinska-Nowak et al., 2018, p. 1015). They allow learning in a low-risk environment without real-life consequences and costs of possible mistakes (Mayer, 2009, p. 825; Solinska-Nowak, 2018, p. 1015). More specifically, simulation exercises allow *experiential learning* where skills are gained and applied in relevant setting by active involvement (Rijumol, Thangarajathi, & Ananthasayanam, 2010, p. 2), and *social learning* where a change in understanding is "achieved through interaction in collaborative and participatory settings" (den Haan & van der Voort, 2018, p. 1). Additionally, Parson (1997) argues that the learning potential of an exercise lies in the dual process of representation and deliberation. The participants represent themselves in the exercised situation but also deliberate on their performance and the situation in general from a position that is partly detached from the representation. In our view, it is especially this dual role of participants that allows the fusing of utilitarian and emancipatory approaches in the exercises.

Some studies employing quasi-experimental research design demonstrate that exercises have an effect on, for example, participants' perceptions of teamwork, training adequacy, job risk, and response knowledge (Perry, 2004; Peterson & Perry, 1997). Additionally, there are many case studies which document the development of different skills or increased knowledge after participants took part in an exercise or played a serious game (e.g., Metallinou, 2018; Miller, France, & Welsh, 2015; Mossoux et al., 2016). Simulation exercises are said to develop critical skills like decision-making and problem solving. They allow the participants to explore complex policy problems by showing the systemic effects of various dynamics and decisions. (Gralla et al., 2015, pp. 116–117) Furthermore, exercises can raise awareness of possible crises, which can motivate the participants to assess and develop the crisis management structures of their organization (Boin et al., 2004, pp. 381–382). Some reservations about the benefits of exercising are made in the research literature, and it is acknowledged that this topic should be studied more (e.g., Beerens & Tehler, 2016, 420). For example, exercises never match real events, and learning from them is in this sense always limited (Andersson, Carlstrom, Ahgren, & Berlin, 2014, p. 79; Boin et al., 2004, pp. 382–383).

2.3. Typical scenarios

A substantial number of simulation exercises covered in the research literature focus on the reactive management of an abrupt crisis (see also Boin et al., 2004). Their scenarios feature short-term disruptions, such as floods (see Solinska-Nowak et al., 2018), large-scale accidents (Berlin & Carlström, 2015; Gomes, Borges, Huber, & Carvalho, 2014) or earthquakes (Peleg, Bodas, Shenhar, & Adini, 2018; Simpson, 2002). Many games or policy exercises also address sustainable resource management or climate policy without including a sudden crisis as an element, for example by simulating land-use decision-making processes (see, e.g., Flood et al., 2018; Reckien & Eisenack, 2013; Wesselow & Stoll-Kleemann, 2018). In addition, there are some serious games that focus on the mitigation phase of disaster risk management and include a subsequent test of the players' decision: how the decision to invest in mitigation affects the players' survival of an upcoming crisis (see Solinska-Nowak et al., 2018, pp. 1020–1022). To our understanding, however, scenario-based exercises that would systematically follow through a series of urgent decisions – especially ones that are not made during one-off crises but in more chronic, wicked situations – and their long-term path-dependencies are rare.

The need for simulation exercises to include more complex, transboundary and surprising crises has been recognized (see, e.g., Boin et al., 2004; Edzén, 2014; Gomes et al., 2014, p. 780; Noori, Wang, Comes, Schwarz, & Lukosch, 2017, p. 951; Quarantelli, Boin, & Lagadec, 2018, p. 77). Most scenarios are fixed or predetermined, escalate despite participants' actions (Boin et al., 2004; Gomes et al., 2014), and do not allow adaptive behaviour and out of-the-box thinking because there is often a specific template for expected behaviour (Noori et al., 2017, p. 952). Edzén (2014) suggests that table-top exercises should focus on unsolved, wicked problems allowing participants to identify and tame the problems instead of letting them be tamed in advance by the exercise developers. Boin et al. (2004) suggest that exercises should also feature long-term and institutional crises, such as situations where the participants' institution loses its legitimacy.

2.4. Designing an exercise

Exercise manuals and research literature articulate several important design choices to consider when organizing a scenario-based simulation exercise. Organizing a scenario-based exercise is generally divided into three phases: (a) scenario development, (b) delivery, and (c) after action review (Moats et al., 2008, pp. 403–404). The design process starts by defining the research and/or learning objectives of the exercise and building the scenario accordingly (European Centre for Disease Prevention & Control, 2014, p. 26; Gralla et al., 2015, pp. 131–132). Designers should review the existing plans, systems, people, resources and previous exercise reports, and make a risk assessment to support the consideration of what needs to be exercised (World Health Organization [WHO], 2017, p. 9). Teams for facilitating and evaluating the exercise should be set up, and a stakeholder analysis could be done to help decide whom to invite to participate in the exercise (UNDRR, 2017; WHO, 2017). Including diverse participants allows multiple perspectives to be incorporated in the exercise (Parson, 1997, p. 275). Participant roles and communication rules among them should also be defined (van Laere et al., 2018).

2.4.1. Scenario development

Developing the scenario is critical as it determines the effectiveness of the training for the participants (Noori et al., 2017, p. 951; see also European Centre for Disease Prevention & Control, 2014, pp. 26–30). The scenario should be prepared by "comprehensive committee that has the necessary knowledge to develop a logical and appropriate storyline" (Moats et al., 2008, p. 404). The scenario is often divided into smaller incidents which are communicated to the participants by injects, such as phone calls, emails or reports, to allow participants' reactions to take place (European Centre for Disease Prevention & Control, 2014, p. 28; Noori et al., 2017, p. 951; United Nations Office for Disaster Risk Reduction, 2017, p.15). In a table-top exercise there might be discussion questions or problem statements that trigger discussion (World Health Organization, 2017).

Time-scale of the scenario, action options for the participants (fixed alternatives or continuous interaction with the simulation model), re-play ability and scenario adaptability or adjustment during the exercise should be considered as part of the design process (see, e.g., Moats et al., 2008, p. 405; Noori et al., 2017, p. 951; van Laere et al., 2018, p. 20). When discussing exercise design and learning, some authors argue that there should be an opportunity to meet the objectives but with enough challenge (Moats et al., 2008, p. 404), or that it is a good idea to balance the experiences of 'failure' and 'success' as educational strategies ('t Hart, 1997, p. 215). Citing relevant psychological studies, Ford and Schmidt (2000, pp. 206–207) recommend error-based learning which supports the development of adaptive expertise. Some authors underline that the success of the whole exercise should be measured based on the participants' learning and that there might be two types of failures that can inhibit learning. The first type occurs when the exercise does not address the right issues, is inadequately researched, badly organized, or unconvincing. The second type occurs when the participants do not allow the exercise to succeed, for instance, by refusing to enter into the spirit of the event or by allowing external issues to dominate their approach. (Lee et al., 2009)

One of the challenges of scenario design is the balance between inconceivability and credibility, so that the scenario has unexpected elements but not to the extent that it would be discredited by the participants (Boin et al., 2004, p. 389). The scenario needs to be designed according to whether the participants work at a strategic, operational, or tactical level (Grunnan & Fridheim, 2017; Stern, 2014, p. 72; p. 88; 't Hart, 1997). Writing about exercises for strategic leaders, Stern notes that scenarios are "more compelling and plausible when they display a simple and clean causal structure and complex, cascading societal consequences" (2014, p. 77). One approach to building credible scenarios is to base them on case studies of past crises (Stern, 2014, pp. 71–79). On the other hand, Grunnan and Fridheim (2017) point out that in table-top exercises it is more important to design a *detailed* scenario or good problem formulations. While too many details might lead to information overload, too little of them might make the scenario too generic and

decrease participants' motivation to play along (Grunnan & Fridheim, 2017). Computer-based simulations might be used as part of the exercise to provide a level of realism (see Moats et al., 2008).

2.4.2. Implementation and evaluation

In relation to the exercise delivery or implementation phase, the reviewed literature emphasizes that the participants must be properly briefed about the goals and rules of the exercise (UNDRR, 2017, p. 17; Van Niekerk et al., 2015; WHO, 2017, p. 24). The lead facilitator or moderator should keep an overview of the exercise and make sure the injects are given at an appropriate pace to keep the scenario active (UNDRR, 2017, p. 17). Especially in table-top exercises, the moderator should set a standard for the discussion and help participants focus on the relevant matters (Grunnan & Fridheim, 2017, p. 89). Debriefing and discussing the lessons learned with the participants immediately after the exercise could take even half of the conduct phase ('t Hart, 1997). Allowing the participants to reflect on the outcomes supports learning (Borodzicz & Van Haperen, 2002, p. 143). In addition to the immediate debriefing session, some authors and manuals recommend collecting written debrief or organizing another session some time after the exercise (see Borodzicz & Van Haperen, 2002, p. 143; European Centre for Disease Prevention & Control, 2014, p. 21; Sinclair, Doyle, Johnston, & Paton, 2012, p. 511). Debriefing sessions and feedback forms provide important data for the evaluation of the exercise, as discussed below.

Evaluation is an essential part of any exercise (Beerens & Tehler, 2016; European Centre for Disease Prevention & Control, 2014, pp. 21–23; Moats et al., 2008, p. 406; UNDRR, 2017, p. 16). As a process, evaluation includes observation of all exercise activities, their assessment in light of the exercise objectives and identification of strengths and weaknesses (World Health Organization, 2017, p. 6). Its purpose is to produce feedback to players in order to support reflection and learning but it can also be used to improve the exercise process itself (Gralla et al., 2015). Having reviewed exercise evaluation research, Beerens and Tehler notice that various methods were used for data collection, such as observation, questionnaires, debriefings and interviews (2016, pp. 418–419). These evaluation methods also allow for generating rich empirical data for research on policy-making (see, e.g., De Caluwé et al., 2012). Self-reflection of the participants (such as oral or written debriefings) is an important part of exercise evaluation, but observation and data collection is also commonly done by external experts or observers (Borodzicz & Van Haperen, 2002; Van Niekerk et al., 2015). Drawing on the debriefing sessions and reports from the observers, the lead facilitator and evaluators make an exercise report that is shared with the participants. This written report could include an overview of the exercise and present the identified achievements, challenges and recommendations. (WHO, 2017, p. 26; also UNDRR, 2017, p. 7; 19)

2.5. Design drivers and criteria for success

We summarize the implications of past research for the design of simulation exercises as follows. First, the exercise needs to be adequately *realistic and credible* for the participants (Section 2.4.1). Second, and in tension with the first principle, the exercise should embrace *inconceivable surprises* that threaten the institutional position of the players (Sections 2.3; 2.4.1). Third, the exercise should have a *clear structure* yet incorporate technical-physical and social-political *complexities* (Sections 2.1; 2.4.1). Fourth, the exercise should enhance the motivation and commitment of the players to *organizational change* (Section 2.2). Fifth, the exercise should be *difficult* for the players yet enable them to meet their objectives (Section 2.4.1). Sixth, the exercise should be a low-risk *learning experience* for the players and place them in the dual position of enacting their role and reflecting on it – in other words, the exercise should function as a platform that enables the players to consider both the utilitarian and emancipatory aspects of their work (Section 2.2). Seventh, the design and implementation of the exercise should be based on *broad participation* (Sections 2.4; 2.4.1). And eighth, the exercise should be *evaluated* carefully and include debriefing with the participants (Section 2.4.2).

In what follows, we use the eight summary points of the literature review for two purposes. First, they provide the design drivers for the POR exercise, that is, guidelines for incorporating vital components in the exercise (Section 3.2). Second, they provide an important set of criteria for evaluating the success of the exercise (Section 4.2).

3. Policy operations room

3.1. Research context

The POR exercise is designed and executed in the six-year multidisciplinary research consortium WISE, comprising six research teams from five different universities and research institutions. WISE studies and develops creative adaptation to wicked socio-ecological disruptions in the Finnish context through three main tasks: 1) identify important socio-ecological disruptions at the organizational, municipal, and national levels, 2) identify potential resilience gaps in the Finnish society vis-à-vis the disruptions, and 3) design and run a research instrument that taps into urgent decision-making with long-term implications and can later be developed into a decision-making tool. The particular focus areas of WISE are the dynamics between crisis decision-making and long-term path dependencies as well as the use of scientific knowledge in decision-making. The simulation exercise studied in this paper drew on the research tasks 1 and 2, in which a considerable qualitative data set of recorded and transcribed interviews and publicly available documents was formed and analyzed.

3.2. Design process

The design of the POR exercise for the City of Helsinki was based on the design drivers identified in Section 2. The first task was to

convince the practitioners that the exercise would be *relevant* from their perspective. After presenting our initial concept of the POR, the city's safety and preparedness team believed the exercise provided a good opportunity to explore how the mayor-led decision-making system, into which they had recently transferred from an officials-led system, would function in a crisis situation. Through an exchange of ideas, the POR concept was developed further, matching our research interests with the safety and preparedness team's interests in exploring and improving the functioning of the city's crisis decision-making and future anticipation practices. Both parties were keen to learn how the city's crisis decision-making balances between short-term and long-term considerations and how the decision-making could be improved through expert and science-based assessment of future path dependencies. A key moment in securing the participants' *commitment* to the exercise and building initial *motivation* for organizational learning occurred when the city mayor approved the exercise, and sent personal email invitations to the other participants more than six months before the event. For us this was a promising start: the mayor enacted his role in the exercise, calling together a (fictitious) crisis meeting. Another option would have been us researchers inviting the participants to *our* exercise – or the preparedness team to theirs – which would not have had the same initial appeal. The participants of the exercise – 14, in addition to the researchers (9) and the organizers from the city (3) – were chosen based on who would take part in a real crisis situation: the mayor (1), the deputy mayors (4), and the leaders of the largest parties in the city council (5 were invited, 2 of whom participated). The preparedness team also invited senior experts from the city (7) in related fields (environment, energy, land use, transportation, governance and finance).

Drawing on multidisciplinary studies, we aimed at a scenario design that would appear highly *realistic* and *credible* for the participants. Of all the potentially important socio-ecological disruptions identified in the WISE research consortium, we focused on climate change, because it constitutes a well-established and significant dimension in the city's policymaking (Helsinki has a goal of net carbon neutrality by 2035) and it is, at the same time, ridden with deep uncertainties and political complexities. For years, the city has been struggling with high climate emissions, particularly from burning coal for heating and electricity generation. Achieving radical climate emission reductions while attaining other social and economic goals poses a genuinely wicked challenge for the city (Vadén et al., 2019). It is also known that at the latitude of Helsinki, climate warms approximately double the rate of average global warming, requiring an urgent consideration of climate adaptation measures. In the Helsinki capital area, heat waves are expected to become more common during the summer and snow cover duration will decrease in the winter. Flooding is expected to increase. Helsinki will also have to adapt to the indirect effects of changing climatic conditions globally, for instance food shortages and increased migrations (Kankaanpää, 2017; Mäkelä et al., 2016). Thus, the backbone of the exercise scenario was formed by recent natural and social scientific studies on climate change (direct and indirect effects on Helsinki and Finland in the next two to three decades), broadened and deepened by multidisciplinary understanding of the cultural, economic, political and technological changes related to lowering emissions radically while preparing for the effects of climate change and other environmental disruptions.

According to the design drivers we identified, the exercise should *challenge* the participants but should allow them to *meet their objectives*. We decided to focus on long-term paths that would be, to a large extent but not fully, under the city's control. This meant focusing on likely rather than catastrophic climate change scenarios – or creeping catastrophes rather than sudden ones. We also excluded game-over scenarios, such as war, pandemic, total defeat of the political system, global electricity blackout, or collapse of the international financial system. Enough wickedness is built into the established ecological-political-economic order: a radical decrease in climate emissions without giving up on existing social and economic goals is extremely challenging without any other system shocks. In the words of Wackernagel and Rees (1998), "the politically acceptable is ecologically disastrous while the ecologically necessary is politically impossible." Also, in our internal dry runs we quickly noticed that we did not want to run the scenario in such a dramatic situation that the politicians would resort to the city's emergency preparedness protocols, which detail crisis procedures and seek to diminish the role of political interests during crisis. If the politicians started to follow the preparedness instructions, they would effectively dodge responsibility and let the officials make the difficult decisions.

To build a *clear structure*, we chose a rigid exercise design that would proceed pre-planned, with pre-formulated decision options and scenario snapshots following each other in a tree-like composition. As designers, we would know where a certain decision would lead, but the players would get to know the decision path, and only the decision path they would take, retrospectively. We also chose to keep the audiovisual design of the exercise within our research consortium to ensure that external audiovisual sensitivities would not influence the exercise in unwanted and unexpected ways. For instance, explicit Hollywood-style imagery that easily comes to mind from references to crisis decision-making would not fit our idea of creeping rather than sudden catastrophes. Keeping the audiovisual design to ourselves also gave room for flexibility and iterative learning during the design process.

To further improve *clarity*, we focused on the nexus of energy (electricity and heating) and transportation. As we will discuss later, the exclusion of other linked topics led to some criticism from the participants. The nexus of energy and transportation is highly relevant in terms of decreasing climate emissions and adapting to the effects of climate change. Together they constitute almost all of the climate emissions formally attributed to the city of Helsinki (notably, the accounting excludes products consumed in Helsinki but produced elsewhere). They are important politically and economically (see Vadén et al., 2019), and tangible in terms of everyday life in the city. They also have deeper cultural dimensions, as explored by the burgeoning field of energy humanities, and captured in the question "what is energy for" (Shove & Walker, 2014). All in all, policymaking related to energy and transportation is complex even without potential political games that have to do with gaining and staying in power.

To incorporate *technical-physical and social-political complexities* in the exercise and to acknowledge the actual wickedness of policymaking, we decided that the exercise would not hold "correct answers", no solutions that would let the policymakers off the hook (see, e.g., Edzén, 2014; Noori et al., 2017). The consequences of each decision option were constructed autonomously from the perspective of the option in question; the consequences were not pre-designed to raise certain issues or promote certain views. By doing so, we sought to avoid any research bias. It also enabled us to approach the scenario design as a learning opportunity, to explore where certain initial conditions or paths could lead into. In shaping the outcomes of the decisions, we drew on natural and social sciences but

also speculated more freely what could plausibly happen. For example, we speculated on possible outcomes if a strongly automated electrified city transportation system encountered surprisingly harsh winter conditions – a rare but possible event during winters that are typically milder than now due to climate warming.

Two design drivers we found difficult to balance were *credibility* and *inconceivability*. Our assumption was that the biggest risk in designing the exercise would be lack of *credibility*: that the players would not play if they were not convinced by the scenario they were offered (Boin et al., 2004, p. 389) We were thus very careful in depicting the technical, economic, and institutional realities, especially with respect to district heating, which we have previously researched and which has triggered one of the most heated debates in the city politics in many years (Vadén et al., 2019). In addition to scenario design, the carefulness also defined the design of the strategic decision options the players would be asked to choose from. In both tasks, we got help from the city officials, who validated our designs and suggested (rather minor) improvements.

We were convinced that the exercise would also need an element of *inconceivability*. We aimed to create a situation in which the policymakers would be taken out from their comfort zones, from the cognitive space they have learned to master during their political careers. In the WISE research consortium, we were interested in the practices and knowledge resources the policymakers would draw on individually and collectively to make sense of an unclear or new situation. Through inconceivability, we also aimed to arouse the participants' curiosity, to make them affectively invested in the exercise (see Anderson, 2010, 786). In addition to lack of credibility, lack of attraction could also hinder active and honest participation (Aronson, 2012). In the end, we reasoned that the ways in which the scenarios would play out over two decades would in themselves provide enough surprise vis-à-vis everyday policymaking. Examples of scenario events that would be inconceivable from the standpoint of today's ordinary policymaking were the effects of intensified climate change in the form of extreme weather events and increased migration to the city. We did not add abrupt interventions or injects into the basic structure of the exercise, which is a common way for incorporating surprising elements into exercises (see, e.g., European Centre for Disease Prevention & Control, 2014, p. 28). We thought that the pre-formulated decision options and scenario snapshots would together suffice to attract the participants and spark lively discussions. This approach was confirmed by the city's safety and preparedness team.

The design and implementation of the exercise should also involve *broad participation*. We engaged in relatively open and intensive communication with the city's safety and preparedness team, our co-organizers. We were, however, unable to control the involvement of city officials as experts in the exercise and its design. At one point, the safety and preparedness team invited experts from different parts of the city organization to take a look at the script of the exercise. We were relieved, assuming this would ensure the credibility and "match" of the scenario from the policymakers' and experts' viewpoints. Together with our co-organizers we decided to invite a selection of senior experts to take part in the actual exercise, which solved the challenge of how to bring along "live" expert knowledge to the exercise. What turned out to be an important issue was that the safety and preparedness team effectively held us back from communicating directly with the experts during the design process. We did not set the terms for collaborating with the experts, nor were we able to probe in advance more freely what they considered to be the most serious climate challenges in terms of urgent and long-term policymaking (we turn to this issue in Section 4).

We aimed to create a *low-risk learning experience* for the participants with carefully formulated spoken instructions at the beginning of the exercise. We emphasized that the exercise is not a test – rather it is an opportunity to explore strategic options and simulate living through the long-terms paths formed by the decisions in connection with socio-ecological disruptions. Importantly, we also made sure there was enough space for the participants to *reflect* on their experience in the debriefing immediately after the exercise and later in post-exercise interviews. This was key in enabling double-loop learning for the participants and in opening up a dialogue between the *utilitarian* and *emancipatory* approaches identified in futures studies.

Throughout the development, we tested different versions of the exercise in our research consortium four times, each leading to significant changes. Learnings from the dry runs fed into the review discussions with the city's safety and preparedness team, and vice versa. With all the main elements ready, we ran the exercise with two different university student groups, and were convinced that the design was good enough: no more could be done without first seeing how the exercise went with the intended participants. We anticipated that the actual exercise event would differ quite much from the student runs, with the experts and policymakers having years of experience to draw on.

3.3. Implementation of the exercise

The exercise took place in the city hall's meeting room in which also an actual crisis meeting would likely take place. The tables, chairs and meeting technology such as microphones were arranged in a U-shape format with a projection surface and speakers in front. Behind the U-formation there were chairs and tables for assisting personnel, in this case for the observing research team and the city's safety and preparedness team.

While the participants – the politicians and the experts – were coming in, the leader of the research project had a short orienting discussion with the mayor who would chair the crisis meetings in the exercise. All other invited participants came (14 out of 17), except three of the five leaders of the largest parties in the city council. The event was opened by the chief of the city's safety and preparedness team, followed by an introduction by the leader of the research project. The exercise was kicked off by a snapshot of the year 2022, followed by sets of strategic decision options and further snapshots, in a sequence depicted in Fig. 1. The snapshots depicted situations that involved a series of socio-ecological disruptions in connection to decisions made earlier in Helsinki and demanded urgent strategic decisions from the city leaders. The strategic decision options focused on the nexus of energy and transportation, and involved different means to pursue significant climate emission reductions with different social, technological, economic and political consequences.

After the snapshot of 2022, three pre-formulated strategic decision options were given to the politicians. The first round of decision
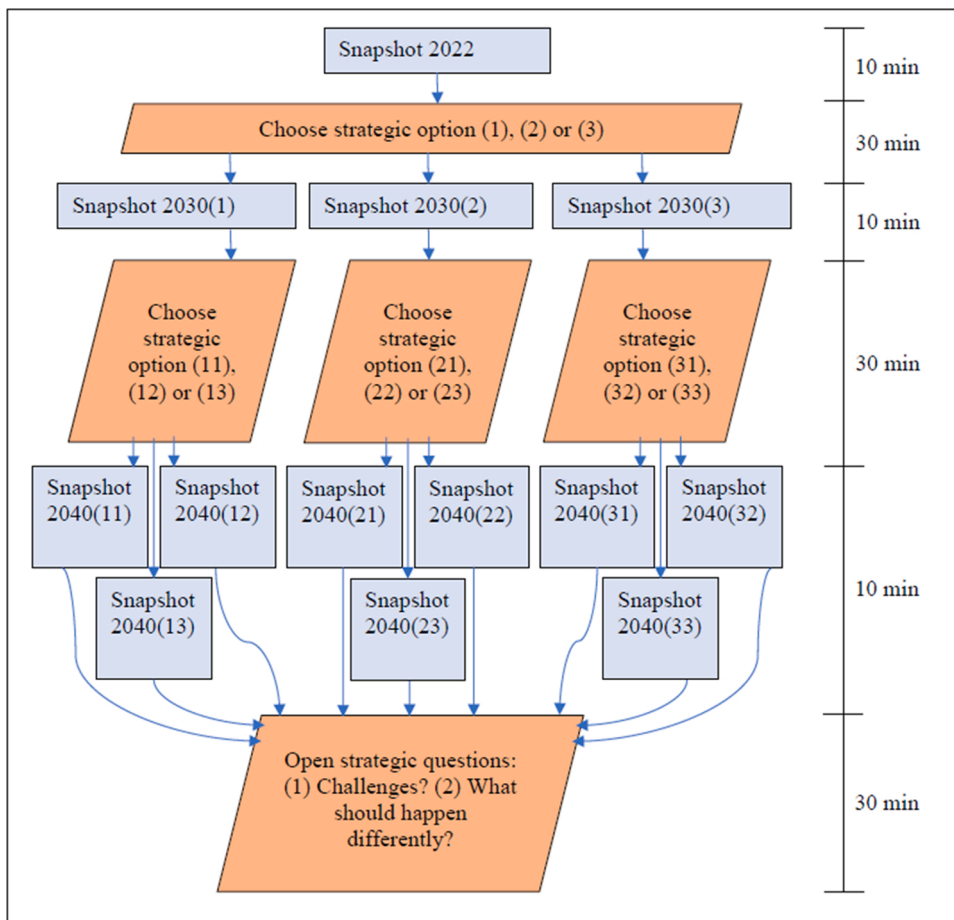
Fig. 1. The flow of the POR exercise with an approximate timeline (excluding the introductions, coffee break, and debriefing discussion).

options contrasted between strategic focuses on 1) developing the conditions for *economic competition* in the energy and city transportation sectors, 2) setting *tighter restrictions and higher sanctions* for high-emission energy use and city transportation, and 3) *investing* in the innovation and implementation of low-carbon energy and city transportation solutions. The strategic decision options were delivered to the participants by the undersecretary of the city, one of the participating experts, playing himself in the exercise. In the world of the exercise, the idea was that the strategic alternatives were crafted by the city officials (in reality they were crafted mainly by the researchers, with help from a few key experts in the city), and the politicians would make the final calls. The politicians were asked to discuss how they saw the options and to finally choose one, which they could modify to some extent if they so wished. The experts taking part in the exercise were there to deliver expert knowledge if demanded by the politicians. In the introduction, we had encouraged the experts to take an active role in the exercise.

Based on the decision in 2022, a consequent snapshot of 2030 was presented. The choices the politicians made in 2022 affected the city's social, technological, economic and political setting in 2030, on the basis of which they would need to encounter the socio-ecological disruptions happening in the city and beyond. Again in 2030 the politicians were given a set of three choices, linked to what they chose in 2022. The second round of decision options gave the policymakers the chance to diverge or stick to their previous focus. Finally, based on the decision in 2030, they were given a consequent snapshot of Helsinki and the world in 2040. This time, there were no pre-formulated decision options but open questions: 1) What do the participants see as the main challenges in the world in 2040 they ended up in, from their own viewpoints? 2) What should happen differently during the period of 2020–2040 to avoid or alleviate the challenges?

The audio-video snapshots of the future were narrated by a serious, calm, male voice. The main information given in the narration was summarized as text in the snapshots. The first snapshot, year 2022, displayed video clips of a sunny climate march day in Helsinki in 2019. The second snapshot, year 2030, displayed video clips of construction sites and alike – scenes of in-between, with nothing much happening. The third snapshot, year 2040, displayed video clips of Helsinki when the president of Russia, Vladimir Putin, visited the city, and the city was very much in a state of alert, with empty streets, barred public access to central places, and police and military forces on street corners and the main square. It was not made clear to the participants what the videos were of; no direct clues of president Putin were visible, for instance. The point of the visualization was to situate the participants in familiar Helsinki but not to focus attention on current affairs or something that has already happened, mix ordinary with the extraordinary, give space for taking in

the narrated information, let the mind wander in Helsinki but not any specific time frame.

We had designed the exercise to last 4 h (with two 10 min breaks in between). The mayor was able to squeeze it into 2 ½ h (discussion times were shortened quite evenly in each part of the exercise, and only one 10 min break was held). He kept the rhythm rather intensive all along, so the participants actually accomplished quite a lot in that compact time. In our internal runs and in the student runs the deliberation was much more laid back. The actual exercise did not lack deliberation, but the mayor encouraged compact argumentation. In general, the participants played along actively – some participated more intensively than others, but no-one voiced doubts about the scenario or withdrew from being a player in the exercise. The debriefing immediately after the exercise lasted a little over 20 min, and we let the participants know that we would contact them soon after and conduct post-exercise interviews, where they could continue sharing their thoughts about the exercise. The debriefing and the interviews were arranged so that the participants could reflect on the exercise and their performance, and the researchers could get feedback and gain a deeper understanding of the backgrounds, thoughts and language of the policymakers and experts.

Audio from the whole exercise was recorded and transcribed. Six researchers observed and took notes of extra-lingual communication. Eight out of 14 participants and all three co-organizers from the city were interviewed individually or in small groups shortly after the exercise. The interview questions were related to the participants' professional backgrounds, their past experiences of comparable exercises, the match between their expectations of the POR and how the POR unfolded in reality, similarities and differences between the POR and a real crisis situation, expert–policymaker interaction in the POR, and what they learned in the POR. The interviews were recorded and transcribed.

4. Discussion

4.1. Research process

The overall research process related to the design and implementation of the POR exercise can be summarized in the following phases: 1. multidisciplinary assessment of socio-ecological disruptions and resilience gaps, 2. literature review of simulation and gaming research, 3. co-design of the simulation exercise, 4. implementation of the simulation exercise, 5. post-exercise interviews, 6. research analysis (Table 1). To develop the POR exercise not just as a utilitarian procedure for far-sighted policymaking but also as an arena for critical reflection of the conditions under which such policymaking is possible, we discuss the following two issues: Was the exercise successful? What are the implications for future design and research of exercises such as this? We also offer tentative remarks for using the POR as a decision-making instrument in real-life settings.

4.2. Was the exercise successful?

We evaluate the success of the exercise as a *simulation of policymaking to facilitate learning* by policymakers (in other words, how well the exercise incorporated the design drivers identified in Section 2.5); and as a *futures research investigation* (whether the exercise produced good empirical material for studying the dynamics between long-term developments and urgent decision-making).

What came out in the debriefing and the post-exercise interviews was that the background scenario, or the way the social-political-economic-environmental dynamics would play out globally between 2022 and 2040, was considered *well-researched* and *convincing* by the participants. The local political setting in the exercise – the pre-formulated strategic options, the participants' role in the exercise, and the decisions' relation to future events – was seen as less convincing, or at least *less engaging*. The strategic options given to the politicians were considered *too narrow*, dealing specifically with heating and transport only, and *too cautious*, not pushing the city and

Table 1
Phases of the research process.

1. Multidisciplinary assessment of socio-ecological disruptions and resilience gaps	2. Literature review of simulation and gaming; design drivers and success criteria for the POR	3. Co-design of the POR	4. Half-day simulation exercise with the city's top politicians and a group of senior experts	5. Post-exercise interviews	6. Research analysis (to be done in subsequent research papers based on the POR exercise)
Identified disruptions included populist nationalism, economic inequality and instability, rapid technological change, climate change, ecosystem loss, and various other environmental hazards Identified resilience gaps included lack of acknowledgment of system shifts in economic models, lack of understanding of long-term path dependencies, gaps in crisis communication, and lack of overlapping knowledge, resources and power in crisis situations	1) Realistic, credible scenario 2) Surprises that threaten institutional positions 3) Clear structure; yet incorporation of technical-physical and social-political complexities 4) Motivation to organizational change 5) Difficult but achievable objectives 6) Low-risk learning space; deliberation and reflection 7) Design and implementation based on broad participation 8) Evaluation (incl. debriefing with the participants)	Co-design with the preparedness team of the City of Helsinki Commitment to participate from the city's top policymakers Engaging the city's senior experts (environment, energy, land use, transportation, governance, finance)	Pre-crafted scenarios, presented as audio-video snapshots A sequence of urgent strategic decisions in years 2022, 2030 and 2040, with a focus on the nexus of climate, energy and transport Politicians arguing for their preferred choices, with the possibility to ask for expert advice Debriefing discussion about the participants' performance and the exercise as a whole	Questions about the participants' professional background, past exercise experiences, expectations of POR vis-à-vis realized exercise, POR vis-à-vis real crisis situation, expert–policymaker interaction in POR, learnings from POR	Professional report co-written with the co-organizers from the city Academic papers with different foci; the general research questions including: what do policymakers draw on in urgent decision-making; how are long-term path dependencies present in urgent decision-making, how could the use of multidisciplinary expert knowledge be improved in urgent decision-making

the decision-makers far enough into a certain direction. The politicians also mentioned that they could play the game '*too easily*', without having to worry about their usual stakeholders, party alliances, media representation or re-election. The level of difficulty and uneasiness could have been raised through abrupt, dramatic interventions into the basic exercise structure, such as simulated newspaper articles, Tweets or radioclips (see, e.g., European Centre for Disease Prevention & Control, 2014, p. 28), or by introducing more social-political complexity, which we discuss next.

Mayer (2009) emphasizes two faces of *complexity* in policymaking: technical-physical and social-political. In designing the exercise, we were very careful to take on board the technical-physical complexity of heating and transportation that the city of Helsinki needs to deal with. We also took on board the unique social aspects related to, for instance, different forms of transportation and heating in Helsinki. What we more or less left out, however, was the political complexity (Mayer, 2009) or institutional crises, such as loss of legitimacy (Boin et al., 2004). This was the type of complexity that the participants yearned for in the debriefing. The clearly defined and somewhat technical nature of the strategic options was a design choice, based on the reasoning that this way we would avoid broad-brush, routine-like, party-ideological discussions that have little to do with concrete changes in the city. The caution built into the options was also based on our goal for the exercise to seem highly convincing. In the design phase, our approach was affirmed by the city's safety and preparedness team: we were under the impression that the strategic options we crafted were reasonable but brave, going somewhat further than the usual political debates, but remaining in the same ballpark.

Behind our choice to focus on technical-physical rather than social-political complexity was our assumption that the participants would bring with them the political urgencies, power plays, and passions that drive complexity in policymaking. We reasoned that the participants would not narrow down their discussions to the elements of the exercise materials, that they would make argumentative bridges from heating and transport to whatever they felt important, be it the economy, immigration, sports or culture. This was realized to a rather limited extent. As we understood from the post-exercise interviews, the participating politicians pride themselves in being professional leaders. They have a tendency to downplay political conflicts and focus on efficient management within shared political-economic boundaries. The politicians indicated to us that they would have preferred more political challenges and conflicts in the exercise design (scenarios and decision options), which they then could have dealt with in a professional, orderly manner.

Even in hindsight, it is difficult to assess whether our reasoning on these issues was correct or not, but we can tentatively agree with the literature on simulation and gaming which suggests that the chances of the exercise being highly meaningful for the participants can be increased by adding political complexity to the exercise design. Under different circumstances, however, the discussion starting off and unfolding differently, the elements in the exercise might have played out closer to our expectations. We cannot do repeats: this was a tailor-made exercise for specific participants in a specific context. The exercise can still be played by others, but they will not be the actual decision-makers that they play in the game, so their approaches and experiences will not be meaningfully comparable.

Let us return to the exercise as a dual process of *representation* and *deliberation* to assess how the exercise encouraged learning among the participants (Parson, 1997). Representing themselves as decision-makers and experts, and being reflective about their performance while doing it, what kind of a learning space (Lee et al., 2009) did the participants co-create, given the set-up of the exercise? In our analysis, the participants got well into the spirit of the exercise but were not pushed very far into any direction. Thus, the learning space created was not that of deep dialogue, aimed at enhancing collective understanding at the expense of admitting one's own lack of knowledge, nor that of intense political debate, aimed at fighting for one's own approach. Rather, the space allowed *friendly, well-articulated discussion* of the strategic options they were given. In this space, *representation was mixed with deliberation with ease*. The participants could learn from each other as well as from the scenario they played through. All this was *somewhat removed from the everyday organizational routines*, which enabled new types of learning to occur. Plenty of learning potential was used, but not all. We estimate that with more politically engaging and challenging scenarios and strategic options, the performance of the participants would become more intense, pushing thinking and discussions further and producing deeper material for the participants' deliberation.

Also in terms of integrating the *utilitarian* and *emancipatory* dimensions in futures studies, the exercise fared well but missed some emancipatory potential. The utilitarian dimension worked as planned: the politicians and experts got to explore how the city might plausibly co-evolve with and react to a series of future socio-ecological disruptions. The utilitarian dimension was realized in a dialectical relationship with the emancipatory dimension. In terms of the latter, we observed that the participants drew strongly on professional management practices that focused on the city's economy and dominated the participants' performance. These practices did not allow critical deliberation to flourish, although the policymakers did raise some concerns whether the political-economic assumptions they typically rely on are suitable for tackling the interrelated socio-ecological challenges they faced during the exercise. For example, one participant noticed and voiced a conflict in the city's attempts to decrease climate emissions in the exercise: the players initially managed to get the emissions down significantly but with great economic cost, which also became a great social cost. In addition, any further decreases in emissions became very difficult to achieve due to a lack of innovation and investment capacity. The participant acknowledged that the city might need to reconsider the dynamics between economic growth and climate emissions. This sentiment was affirmed by some of the other participants but the discussion was not taken further. We conclude that even stronger enforcement of an alternative learning space would be needed for a fuller emancipatory discourse, but we acknowledge that this might run the risk of inconceivability and irrelevance.

In the debriefing immediately after the exercise and in the interviews some weeks later, the participants generally praised the *opportunity to simulate living through a well-thought-out future scenario*. What came out clear in the responses was that many of the participants had participated in simulation exercises before, and practically all of the exercises had taken them into scenarios that were so extreme that they could make only limited use of their past experience as decision-makers or of the normal resources of their organizations. They were, thus, used to exercises being very difficult to play, and entertaining, in the sense of the scenarios being totally overwhelming. The POR was different in these regards, which *surprised* the participants. After thinking it through, the participants

seemed to acknowledge the importance of such "blander" future exercises. Non-extreme exercises relate more tightly to the everyday, highlighting aspects that can be *developed in normal organizational practices*.

The systematic assessment of *future path dependencies* created by decisions made now is an important aspect brought forward by the POR. The structure of the exercise, with snapshots of the world and the city progressing in relation to the strategic decisions made by the participants during a long time period, served this purpose well. One key aspect of the future paths was that they were based on *multidisciplinary scientific assessment*. The scenarios in the exercise provided scientific knowledge to the participants in a way that enabled and supported social and experiential learning. Another key aspect of the path dependencies was that the participants got to live through and reflect on one of the plausible paths that their decisions created in relation to a web of other socio-ecological conditions and drivers. They participated in a simulation of the future outcomes of strategic city-level decisions. The feedback from the exercise participants and co-organizers was very positive in this regard. According to the interviews, the city could significantly benefit from a regular use of long-term path assessments in connection with major decisions. Currently, future path assessments are not done systematically, and there is much room for methodological development. In this sense, the POR served as a significant benchmark and *motivator for organizational change* for the city. Of course, such assessment requires the input of many types of expertise, from different sectors and disciplines, which can be a great challenge for contemporary city organizations.

In relation to the design driver of *broad participation*, a clear design mistake in the Helsinki-POR was the *inadequate involvement of experts* in designing the exercise and in the exercise itself. Our communication with the city experts was strongly mediated by the city's safety and preparedness team. First, through deeper and more direct engagement with the experts, we could have co-created even more contextualized and nuanced scenarios and snapshots. Such local, rich, and unique elements could have produced more affective attachment and get the participants even deeper engaged in the exercise. Second, by getting to know the experts' insights and positions within the city politics, we could have designed their roles in the exercise in a more detailed manner. This would have enabled more intentionally shaped expert–politician relationships, or science–policy interaction. A significant difference between the POR and ordinary policymaking in the City of Helsinki is that in the POR, the experts stayed in the room also during the political debates and the actual decision-making moment. Normally, the experts first lay out information or introduce a case and then leave the room. It is only after the experts have left that the dense political deliberation begins, and the experts are rarely called back. The convention is also that the experts speak only when called to do so. In the POR exercise, we could observe and interpret how the expert–politician relationships play out in the city organization but could not really design interventions into them. Such interventions would have shaken up ordinary policymaking even more, potentially enabling new ideas and processes to emerge. As it were, the experts in the exercise did not take a proactive approach but largely assumed their conventional roles. The economic and energy experts were frequently called for by the politicians, whereas the environmental experts stayed much more silent.

The fact that our communication with the experts was strongly mediated by the safety and preparedness team also had an impact on what and how the experts could learn from the exercise. Much of the experts' learning had to do with seeing and hearing up close the top politicians discuss at length issues relevant to their fields. In the interviews, many experts said it was interesting to witness in a new way how different types of expert knowledge gets used in political discussions. Not all expert knowledge, for example economic and environmental, has equal status, and the POR added to their understanding of what the status might be.

Where we did rely quite much on the experts' advice was in crafting the strategic options. Together we decided that the options needed to be realistic and doable within the mandates of the city. Although we designed an opening up of the mandates into the scenario, in hindsight we felt that the options we provided did not push the participants far enough in their thinking and discussions. To improve exercise design, researchers would benefit from taking advantage of their outsider position and introduce brave alternatives to the routines, traditions and sensibilities of the policymaking system at hand.

Finally, in evaluating the success of the exercise, we were interested in whether the POR produced *rich empirical material* for studying the dynamics between long-term paths and urgent decision-making. In this respect, the exercise succeeded very well. The exercise, in conjunction with the material from the co-design process and the post-exercise interviews, opened a door to rare materials that combine group-level decision-making performance with the decision-makers' own reflection on the performance. The mix of representation and deliberation within a realistic but still speculative future scenario produced insights that went beyond everyday dialogue between expert knowledge and policy and, at the same time, remained policy-relevant, due to the pressures of political representation constantly at work in the exercise. One example of this kind of insight is the earlier mentioned conflict between economic growth and climate emissions reductions. The empirical materials will be analyzed from different theoretical perspectives in subsequent research papers in the WISE research consortium.

4.3. Remarks for using the POR as a decision-making instrument

One of the motivations for developing the POR exercise in the WISE research consortium is that it could potentially be used also as a novel decision-making platform, and not just a learning and research instrument. It would let policymakers and experts try out living through science-based future scenarios and decisions with long-term path dependencies. This idea was in the beginning also shared with the city's safety and preparedness team, and we agreed together that it would make sense to model the exercise based on how such decision-making could actually happen if the city was faced with similar wicked disruptions. The modeling was, to a certain degree, speculative, because the city's new politically led decision-making system had not gone through such a situation before. For the safety and preparedness team, the exercise gave a chance to think the process through – who would take part, how would it be organized – and also to see it in (fictive) action.

A key idea in the POR, when thought of as a potential decision-making instrument, is multidisciplinary science-based assessment of the future path-dependencies that are created by today's decisions. In the POR exercise, the assessment was based on pre-crafted

qualitative scenarios, transmitted through audio-video snapshots. For the purposes of actual decision-making in urgent situations, this method is likely too time-consuming and resource intensive. It also lacks a way of estimating key quantitative parameters vis-à-vis alternative decision paths. At the other end of the spectrum would be a quantitative model that would enable real-time assessment of different outcomes. The downside is that such a model needs to be quite simplified in order to work, which tends to erode its relevance in terms of the real technical-physical and social-political complexities that define future path dependencies. In the WISE research consortium, we are currently developing the next POR exercise based on Bayesian modeling, which we hope to be able to capture enough from both worlds.

5. Conclusion

We describe an experiment in a pragmatic dialogue between utilitarian exploitation of scenarios and simultaneous emancipatory reflection of their usefulness by the exploiters themselves. The experiment was implemented as a simulation exercise, a Policy Operations Room (POR), with high-level policymakers and senior experts in the City of Helsinki. In the simulation exercise, the participants had to make choices among strategic options with decadal-scale disruptive consequences for the city's socio-ecological conditions. The exercise enabled the participants to learn experientially and socially how to steer the city in the midst of future disruptions. The participants also had the opportunity to deliberate on their learning. In organizing the simulation exercise, we in effect created a situation for "triple-loop learning" in the sense that we as researchers also had an opportunity to learn how the participants learned how they themselves learn to make challenging decisions. The POR constitutes a unique way of integrating science-based assessment of future path dependencies into science–policy research and interaction. We hope this paper inspires and instructs further futures research with simulation exercises engaging long-term path-dependencies and socio-ecological disruptions.

Acknowledgments

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