Proceedings of the 35th European Safety and Reliability & the 33rd Society for Risk Analysis Europe Conference
Edited by Eirik Bjorheim Abrahamsen, Terje Aven, Frederic Bouder, Roger Flage, Marja Ylönen
 Published by Research Publishing, Singapore.
doi: 10.3850/978-981-94-3281-3_ESREL-SRA-E2025-P9858-cd

Balancing risk and protection: Exploring the interactions between the preventive and reactive systems in Swedish land use planning

Mattias Svanström

Division of Risk Management and Societal Safety, Lund University, Sweden. E-mail: mattias.svanstrom@risk.lth.se

As society evolves, so do the risks we face. Emerging challenges like sustainable development and climate change adaptation intensify these risks within an interconnected, complex environment with conflicting objectives. Effective risk management in this context requires balancing risk and protection by integrating preventive land use planning with reactive emergency response systems. Integrating systems requires mutual feedback between the actors to enhance understanding and broaden perspectives in risk assessments, thereby contributing to a more holistic approach. This study explores the prevalence of risk-related feedback among Swedish land use planners, rescue services, and crisis management professionals through a questionnaire survey. The findings reveal imbalances in feedback, risk-related knowledge, and perceived gaps between the preventive and reactive systems. Despite these challenges, incentives exist for more uniform collaboration. Enhanced coordination, communication, and awareness of the benefits of a holistic approach could strengthen the practical utility of risk analyses and improve preparedness for societal changes.

Keywords: risk analysis, risk management, survey, land use planning, crisis management, fire and rescue service

1. Introduction

Society cannot develop without risk. Put differently, the price of development is accidents (Aven 2022). Thus, the essential role of risk management is to find a balance between development and risk. This paper focuses on how the balance is managed in practice in the context of land use planning.

Today's rapid changes in society due to transformative events such as the ongoing climate crisis and shifts in the general security landscape mean increased challenges for risk management. There are many challenges in land use planning, but urgent changes can amplify conflicting objectives. One example is the potential conflicts between densification and the green transition, where densification implies shorter distances, and the green transition may introduce new risk sources, such as more extensive use of hydrogen in urban settings or the switching of refrigerants to substances with a lower carbon footprint but with the potential for more severe consequences to humans in the case of accidental release. Conflicting objectives result in introducing risk-mitigating measures to a certain level while accepting risks considered *de minimis* (Peterson 2002). However, this will result in a residual risk, leading to incrementally increased cumulative risk levels in society, an example of what Hills (2005) calls "creeping dependencies". Assuming this increased risk is recognized, society now has a choice either to accept the somewhat diffuse risk increase or to balance with increased capability to *manage* the threats if the risks materialize; in other words, the *preventive* system should be balanced with the *reactive* system. This view aligns with the new risk perspective, focusing on resilience and robustness (Aven and Thekdi 2021).

However, the perfectly weighted balance maintains a theoretical ideal. Imbalances rather than balances have been recognized, such as a greater emphasis on emergency planning instead of prevention (Chmutina, Ganor, and Bosher 2014; Sapountzaki et al. 2011). Various factors can hinder the holistic approach and desired balance. For example, different risk perceptions (Slovic 1987), biases (Thekdi and Aven 2024), bounded rationalities (Meadows 2009), and different decision horizons (Toda 1976) among decision-makers may complicate achieving balance from an individual perspective.

At the organizational level, besides the problem with different organizational goals (Ruane, Swapan, and Babb 2020), fragmentation between actors poses challenges (Britton and Lindsay 1995; King et al. 2016). This may result from variations in administrative systems, legal frameworks, regulations, and policies (Roslan et al. 2021). Young (2002) describes a "problem of interplay", which arises from a lack of coordination between actors and is prevalent when actors are regarded as individual entities rather than part of a more comprehensive network with interactions between organizations vertically and horizontally. However, it has

been noted that collaboration may be facilitated by standardizing risk communication, which aids in risk aggregation and comparisons between different actors (Tehler et al. 2019); furthermore, Greiving et al. (2012) has suggested ensuring structured communication to lessen fragmentation.

Thus, with structured feedback and information flow (IF) between the involved actors, it is reasonable to assume that the possibility of making more informed decisions about the balance increases. To gain insight into whether this balance exists, the initial step should involve exploring the occurrence and nature of this feedback. However, to the author's knowledge, empirical research in this field is limited, which provides the rationale for the present study. By exploring the interactions between the preventive and reactive systems, this study aims to deepen the understanding of how the balance between risk and protection (BRP) is perceived among practitioners.

This paper will contribute to risk science by deepening the understanding of the opportunities and challenges practitioners encounter when sharing risk-related information with other actors. After all, actors in a municipality operate in the same area, and many risk sources they have to deal with are shared. Leveraging the synergies between the risk analyses, which requires interactions while continuing to recognize their distinct purposes and adopting a holistic perspective to balance risk and protection, creates an opportunity for more informed decision-making and constitutes a low-hanging fruit for fostering robust and sustainable societal development.

2. Method

The present study was carried out in a Swedish context where the main actors are land use planners (LUP), operational fire and rescue services (FRS), and crisis management (CM). LUP primarily focuses on prevention, while FRS/CM centers on reactive strategies. Nonetheless, this distinction isn't absolute; LUP can implement resilience-building actions, and FRS/CM can also engage in prevention efforts. The focus was on these actors' strategic documents at the municipal level. In guidance documents from Swedish authorities, it is stated that information should be shared between these three risk analyses. Considering LUP, that document is the comprehensive plan (CP), encompassing the municipality's overall land and water use. It is the municipality's strategic guidance and includes many relevant aspects where risk issues from a broad perspective are essential. For FRS, the document in focus is their mandatory action program (AP), which is used to dimension the capacity of the operative and the preventive parts of FRS in the municipality and shall be based on a risk analysis. Finally, the strategic document for CM is the municipal risk- and vulnerabilities analysis (RVA). This document focuses on risks threatening the functioning of society in case of crisis or war.

2.1 *Research and survey design*

The study aims to collect consistent data from various actors across a geographically distributed but nationally contained context. Therefore, a questionnaire survey was used for data collection. However, dependence on fixed questions can impose limitations; conversely, qualitative data collection methods may not generate an equivalent amount of data or facilitate participant comparisons. Since this paper is expected to serve as a foundation for further research, the quantitative focus was considered appropriate.

The initial data collection strategy focused on achieving an even nationwide distribution of municipalities, considering both location and size. The survey was distributed to large, mid-sized, and small municipalities in all 21 counties[a] of Sweden ($n = 183$). An invitation to participate in the survey was sent to the contact person of each actor, retrieved from the actor's website or to the municipalities' general inboxes in case a specific contact person was missing. The invitation had clear guidelines on which individuals were invited to respond to the survey. However, due to a low response rate at the initial deadline, the mailing was extended to the remaining FRSs in Sweden and their corresponding municipalities. The FRS was the limiting factor because rescue services are often organized in associations covering several municipalities, resulting in the survey being sent to 127 FRS, 149 LUP offices, and 151 CM offices.

The survey was conducted through a web-based questionnaire[b] consisting of 80 questions on the topic and seven questions on the respondent. The survey was made in three versions with adapted wording to fit the context of each actor, but the question content was the same in all three

[a] With except for Gotland County, which only consists of one municipality.

[b] The platform Webropol was used.

versions. The questions were in Swedish, but the questions and answers were translated into English in this paper. However, of the 80 questions, 28 were intended for this study, and the remaining 52 were for a coming study. The study included questions regarding IF and BRP. Of these 28 questions, 17 were designed to provide a nominal scale response, eight were on a unipolar ordinal scale (Likert), and three were open.

The questions were carefully processed to be clear, not leading, and avoid unanswerable double questions (Walliman 2017). All questions were non-compulsory, and the respondents could answer "Do not know" in every question and "Other" by completing free-text fields when relevant. A pilot test was performed with seven participants representing the different actors (Wenemark 2023). The pilot group was asked about the questions, further improving the questionnaire.

Data from the three surveys was aggregated in IBM SPSS, version 29.0.2. Relevant data were subjected to statistical tests to reveal significant differences between the answers of different actors. For nominal questions, χ^2-tests were applied. However, Fisher's exact test was used in some follow-up questions, where fewer responses were obtained (Cunningham and Wallraven 2012). The Independent-Samples Kruskal-Wallis Test was applied to the ordinal scale questions due to the presence of three independent variables (Cunningham and Wallraven 2012).

2.2 *Response rate and characteristics*

Of the 21 Swedish counties, 17 were represented by at least one actor, meaning a broad geographical spread of respondents. The 17 represented counties comprise 90 municipalities with responses from 35 LUP offices, 29 FRS offices, and 26 CM offices. 14% of the municipalities are categorized as "*Metropolitan and peri-metropolitan municipalities*", 34% as "*Larger cities and municipalities near major cities*", and 51% "*Small towns/urban and rural municipalities*" (SKR 2022). The national proportion of this categorization is 16/37/46%, indicating that the represented categories of municipalities reflect the national proportions, albeit with a slight predominance of medium-sized municipalities.

Respondents were asked about professional titles and work experience. Case officers dominate LUP and CM respondents, and managers dominate FRS respondents. Most respondents representing LUP were dominated by one to five or > 10 years of experience, while FRS was dominated by respondents with > 10 years of experience. In contrast, CM was dominated, with respondents reporting one to five years of experience and relatively few reporting > 10 years of experience. Respondents were also asked to self-assess their level of knowledge regarding the survey questions. In general, LUP indicated the most significant level of uncertainty, FRS shows the least, and CM falls somewhere in between. This order of precedence is reflected in many of the following questions.

3. Results

This section presents the survey results. The responses to the core questions are presented in tables with all relevant data, while the running text describes the follow-up questions.

3.1 *Information flow (IF)*

IF refers to how risk-related information flows between the three actors. Respondents were asked whether information is typically provided to the other actors and, if so, what it contains. If information was not provided, respondents were asked why. The same type of questions was asked about the collection of risk-related information. Respondents were also asked how the risk-related information is used.

The question of providing risk-related information was formulated: *"Do you or your immediate colleagues provide input to NN's*[c] *documents on risk-related issues?"*. The results are displayed in Table 1 below. The most distinctive among the results was that the most active actor providing risk-related information was FRS and, to the slightest part, LUP. The highest percentage of the answer "yes" and lowest "no" was from FRS to LUP, in addition to low uncertainty. The corresponding lowest percentage of the answer "yes" and highest "no" were from the opposite flow: LUP to FRS, although there was a high percentage of unsure respondents. The highest percentage of unsure respondents overall was found among LUP and the lowest among FRS. Most respondents confirmed that they provide information, but the proportion of unsure respondents is noteworthy. The differences in answers between actors were significant.

[c] NN was labeled LUP/FRS/CM depending on which actor was asked.

Table 1. Actors' providing of information to other actors' documents. Y = Yes, N = No, U = Unsure, n = count. The arrows represent the direction of IF.

	Y	N	U	n
LUP→RS	9%	35%	56%	34
LUP→CM	37%	34%	29%	35
RS→LUP	83%	7%	10%	29
RS→CM	61%	25%	14%	28
CM→LUP	42%	23%	35%	26
CM→RS	39%	23%	39%	26
Total	44%	25%	31%	178

$\chi^2 = 42.34$
$df = 10$
$p < 0.001$

The two follow-up questions were given as multi-choice questions with a list of proposals and the ability to include free-text answers. First, when asked what type of comments actors provide, the results reveal that of 78 responses, most (26%) provided info about identified risks, followed by a consequence impact assessment (20%). An almost equal proportion (19%) of the comments concerns the ability to influence spatial planning and thus the risk picture (LUP) and the capability to manage incidents (FRS+CM). Very few respondents indicated uncertainty ("Do not know" with 0.4%), suggesting a high level of awareness regarding what their feedback contains. Second, when asked *why* the respondent's organization does not provided comments on the other actor's document, of 45 responses, the most common reason (63%) was that it "has not been requested". Then, there was a jump down to five respondents (8%) who reported "Other"; however, these were comments or clarifications without interrelationships. Finally, 7% reported they "had not thought about it", and the same percentage reported confidentiality issues.

The following question about collecting risk-related information was formulated: "*Does your organization collect information from NN²:s risk analysis in the preparation of your own*". The results are shown in Table 2.

Table 2. The actor collects information from other actors' documents. Y = Yes, N = No, U = Unsure, n = count. The arrows represent the direction of IF.

	Y	N	U	n
LUP←FRS	40%	29%	31%	35
LUP←CM	51%	23%	26%	35
FRS←LUP	69%	24%	7%	29
FRS←CM	64%	36%	0%	28
CM←LUP	27%	46%	27%	26
CM←FRS	65%	15%	19%	26
Total	53%	29%	19%	178

$\chi^2 = 24.95$
$df = 10$
$p = 0.005$

Again, FRS was the most active actor. CM was divided into a high fraction collecting information from FRS and a low fraction from LUP. The fraction of unsure answers was high by both LUP and CM but low among FRS. The differences in answers between actors were significant.

The follow-up questions were given and reported as previously described. Of 94 responses, the most common type of collected information (24%) was on identified risks and, after that, identified vulnerabilities (18%), followed by an assessment of the consequences of risks (16%). Further, the majority of 51 responses (34%) stated that they did not collect information from the other actors because they had not "considered it". Many (18%) gave "other" answers, which may indicate that the question was difficult to answer with a questionnaire. However, though the field "other" allowed free text answers, no clear trend emerged: comments were like that LUP did not know that FRS has an action program with risk analysis, and it was difficult to see the couplings between RVA and FRS risk analysis. The final follow-up question was about how information from the other actor is used in the respective actor's risk analysis work. Of 94 responses, the most frequent answers were "to identify risks" (24%), "to identify vulnerabilities" (18%), "to assess the consequences of risks" (15%), "to facilitate the valuation of risks" (13%) and "to assess the probabilities of risks" (12%). 34% reported "other", and 1% were unsure.

Lastly, respondents were asked to assess the extent to which sharing risk-related information with the other actors can help make their document a better basis for decision-making (Table 3).

Table 3. Respondents' assessment of the extent to which sharing risk-related information with the other actors can help make their document a better decision-making basis. 3 = Fully and completely, 2 = For the most part, 1 = To some extent, 0 = Not at all, U = Do not know, n = count.

	3	2	1	0	U	n
LUP	23%	37%	34%	0%	6%	35
FRS	10%	41%	41%	3%	3%	29
CM	8%	42%	35%	0%	15%	26
Total	14%	40%	37%	1%	8%	90

*Kruskal-Wallis Test = 2.24, $df = 2$, $p = 0.327$

Compared to other questions, uncertainty was, in this case, relatively low. Most respondents answered "for the most part" and "to some extent". Very few indicated that information sharing was

irrelevant. LUP has answered positively to a higher proportion than the others. Also, in this case, CM reports the highest percentage of uncertainty. However, the differences were insignificant.

3.2 *The balance between risk and protection (BRP)*

Several questions considered BRP. First, LUP was asked if their organization actively informs the municipality's emergency response organizations about risks they have assessed as severe in the CP and if it may be possible to reduce them through changes in capabilities. The results are presented in Table 4 below. The uncertainty among respondents was noteworthy. Among those who have been able to provide an answer, more have answered "yes" than "no". However, the differences were not significant. No clear trend emerged when asked in free text which specific risks were relevant. Some examples of the answer were "risk concerning civil preparedness" and "flooding".

Correspondingly, FRS and CM were asked if their organization actively informs LUP about risks that they have assessed as severe in their risk analysis and may be possible to reduce them through physical planning. The results are shown in Table 4. The uncertainty among the respondents was notably lower; overall, the "yes" percentage was higher but insignificant. In free text, respondents explained the certain risks involved, such as road accidents in particular places, dangerous goods routes, and risk distance to industries.

Table 4. IF regarding the balance of risk and protection. The arrows represent the direction of IF. Y_1 = Yes for all types of risks, Y_2 = Yes for certain types of risks, N = No, never, U = Unsure, n = count.

Does your organization actively inform …					
… CM or FRS about risks that you have assessed as severe in the CP and may be possible to reduce through changes in capabilities?	Y_1	Y_2	N	U	n
LUP→FRS*	14%	17%	23%	46%	35
LUP→CM*	3%	26%	17%	54%	35
Total	9%	21%	20%	50%	70
… LUP about risks you have assessed as severe in your risk analysis and that it may be possible to reduce them through physical planning?					
FRS→LUP**	28%	48%	14%	10%	29
CM→LUP**	19%	35%	12%	35%	26
Total	24%	42%	13%	22%	55

* Fishers' exact test = 3.65, $p = 0.302$,
** Fisher's exact test = 4.70, $p = 0.205$

Respondents were also asked to describe their views on BRP by responding to various statements. Those statements and responses are shown in Table 5 below. The first statement concerned if a higher level of preparedness regarding CM can compensate for an increased risk in society due to physical development. The most frequent answer was "to some extent", and only a few answered "not at all" but the uncertainty was notable, especially among LUP. CM agreed more with the statement than the others. However, the differences between the actors' responses were not significant. A follow-up question revealed how the actors considered this compensation taking place today. The percentage agreements were lower in this case, but most notably, the uncertainty was higher, especially among LUP. Again, CM agreed more than the others. However, these differences were not significant.

Table 5. Respondents' statements on BRP. 3 = Fully and completely, 2 = For the most part, 1 = To some extent, 0 = Not at all, U = Do not know, n = count.

If the physical development of society leads to higher risk in society…						
… to what extent can this be compensated by a higher level of preparedness regarding CM?*	3	2	1	0	U	n
LUP	9%	12%	44%	9%	27%	34
FRS	7%	17%	48%	10%	17%	29
CM	4%	27%	58%	0%	12%	26
Total	7%	18%	49%	7%	19%	89
… to what extent does such compensation take place today regarding CM?**						
LUP	3%	18%	12%	9%	59%	34
FRS	7%	3%	45%	14%	31%	29
CM	4%	15%	46%	8%	27%	26
Total	5%	12%	33%	10%	40%	89
… to what extent can this be compensated by a higher level of preparedness regarding FRS?***						
LUP	6%	9%	44%	6%	35%	34
FRS	10%	21%	69%	0%	0%	29
CM	8%	27%	42%	4%	19%	26
Total	8%	18%	52%	3%	19%	89
… to what extent does such compensation take place today regarding FRS?****						
LUP	3%	6%	15%	15%	62%	34
FRS	7%	10%	55%	21%	7%	29
CM	4%	15%	39%	4%	39%	26
Total	5%	10%	35%	14%	37%	89

* Kruskal-Wallis Test = 2.64, $df = 2$, $p = 0.267$
** Kruskal-Wallis Test = 4.64, $df = 2$, $p = 0.098$
*** Kruskal-Wallis Test = 16.30, $df = 2$, $p < 0.001$
**** Kruskal-Wallis Test, = 10.59, $df = 2$, $p < 0.005$

The corresponding statements regarding FRS, also shown in Table 5, revealed a similar pattern. The

emphasis of the responses was on "to some extent", and the percentage of uncertain respondents was relatively high. Just as CM considered that its preparedness could balance increased risk, FRS assessed it similarly. However, the overall difference between the answers was significant in this case. The pattern in the follow-up question's answers was similar to the previous question: fewer respondents generally agreed, and the uncertainty was higher. However, in this case, while FRS generally agreed with the statement, the percentage of respondents who answered "not at all" was highest compared to the other actors; thus, their answers seemed more polarized. The uncertainty concerning these statements among FRS was low. The differences between the actors were significant.

Next, all actors were asked if they consider the operative capability when assessing the impact of risks in the work in their "own" risk analysis. The results are shown in Table 6 below. Most respondents did not consider operative capabilities when assessing risks or were uncertain. There were higher percentages of "yes" among CM and FRS than among LUP. Of those respondents who answered "yes", LUP considered FRS capability in their risk impact assessment (in total 34%) more frequently than the capability of CM (in total 25%), but the proportion of unsure was high. Similarly, a total of 65% of CM considered the capability of FRS but 50% of FRS considered the capability of CM. The actor with the highest proportion of "no" was FRS. The differences were significant. When respondents were asked in a free-text follow-up question to indicate what risks are relevant, the risks mentioned were broad, covering natural disasters like fires and floods, civil preparedness issues (e.g., drinking water supply), and critical infrastructure risks.

Lastly, FRS and CM were asked if they consider the impact of future changes in physical planning on the municipality's risk profile and if they are planning their preparedness, as shown in Table 6. Most respondents answered "yes", and the proportion of unsure respondents was lower than in the previous question. CM was more unsure than FRS. However, these differences were not significant. Among the respondents who answered "yes", FRS and CM consider the impact of future changes in spatial planning to a high degree, particularly FRS (in total 75%, while in total 58% of CM answered yes).

Table 6. Consideration of BRP in the actors' risk analysis. The arrows represent which actor is considered. Y_1 = Yes for all types of risks, Y_2 = Yes for certain types of risks, N = No, never, U = Unsure, n = count.

Do you consider the operative capability when assessing the impact of risks in the work on your risk analysis?*	Y_1	Y_2	N	U	n
LUP→FRS	20%	14%	31%	34%	35
LUP→CM	11%	14%	31%	43%	35
CM→FRS	23%	42%	12%	23%	26
FRS→CM	36%	14%	39%	11%	28
Total	22%	20%	29%	29%	124
Do you consider the impact of future changes in spatial planning on the municipality's risk profile when planning your preparedness?**					
FRS←LUP	36%	39%	14%	11%	28
CM←LUP	12%	46%	12%	31%	26
Total	24%	43%	13%	20%	54

* $\chi^2 = 22.38$, $df = 9$, $p = 0.008$
** Fisher's exact test = 6.06, $p = 0.104$

4. Discussion

This study uncovers asymmetries in the IFs between actors, such as the frequent flow from FRS to LUP while the reverse flow was low. Although the cause of this asymmetry is beyond the scope of the study, some possible explanations should be addressed. First, LUP has reported high uncertainty, meaning their actual IF cannot be excluded from being higher than reported. Second, the study does not comprehend the actor's perceived or actual responsibility nor the perceived need for the risk-related IF. Thus, it cannot be ruled out that the asymmetries may have well-considered and entrenched reasons or that the actual asymmetries are less significant than reported.

However, the reported uncertainty *per se* reveals asymmetries in knowledge and reported activity among the practitioners, with FRS and LUP representing opposing poles with CM in between. FRS conveys greater confidence and a proactive stance on risk-related information, whereas LUP expresses uncertainty and a more passive approach. The fact that risk issues are only a *sub-issue* to LUP in its development focus and the *main issue* for FRS (King et al. 2016; Ruane, Swapan, and Babb 2020) may be an explanatory factor. As LUP is considered a well-suited platform for risk management (Farinós-Dasí et al. 2024; Sapountzaki et al. 2011), the survey reveals challenges to that approach. However, the respondent's role and experience may also affect the answers, where FRS were represented by a high proportion of managers

(likely holding a comprehensive view of all IFs) and a high proportion of respondents with work-life experience > 10 years, compared to LUP.

The most common type of information provided and collected relates to identified risks and assessing their consequences. Månsson et al. (2015) revealed that *uncommon categorization* is prevalent and widespread within Swedish (disaster) risk management systems, meaning that differences in interpreting, coding, and categorizing similar terms and information hinder inter-actor communication and collaborative understanding. However, avoiding discussing probabilities and focusing on the less diffuse risk identification and impact assessment may result from uncommon categorization.

Regarding the balance of risk and protection, the prevailing view is that preparedness may offset increased risk, and the respondents gave similar answers about whether it concerns the CMs' or the FRSs' preparedness. However, the current effectiveness of this compensation is viewed with significant uncertainty, indicating a need for better assessment or communication on the impact of preparedness efforts. The results further indicate the presence of an IF concerning the specific risk/protection balance, which was not directly addressed in the comments on the specific documents (CP/AP/RVA). Instead, this information seems to be conveyed through alternative forms that were not explicitly revealed by the survey questions. When LUP was asked if they would inform FRS about risks that they have assessed as severe in the CP and that may be possible to reduce through changes in capabilities, 31% agreed (Table 4). In contrast, when asked if LUP provides input to the specific document AP, only 9% agreed (Table 1).

The survey also revealed that most respondents were uncertain about or opposed to considering operational capability in risk assessment. However, actors with preparedness capability also consider it to a greater extent. Overall, the capability of FRS was regarded with greater significance than CM's. Further, CM and FRS seem more used to discussing the relationship between preventive and reactive measures, as they report less uncertainty about this question than LUP. Most of these respondents were also more optimistic about thinking in terms of *balance* than LUP. The literature discussed in the Introduction reports imbalances focusing on preparedness. Nevertheless, this was not evidenced by the survey: the preparedness actors consider physical planning aspects and vice versa.

While this paper argues that sharing information is necessary to find BRP, it should be stressed that this should not imply that each actor's risk perception must be adjusted with the others. The challenging problems risk management entails means that different actors with potentially different views on risk should deliberate the conflicts, facilitating risk management capability by using their contrasting interpretations of risk (Lodge 2009). Since there is no universally correct view of risk, assessing various risks can be challenging; therefore, gathering and combining multiple perspectives is essential (Bowonder and Linstone 1987). In addition, feedback *per se* may motivate the actors to produce information, knowing that the information is helpful to others (Månsson 2018). This motivator could mean that the feedback becomes self-reinforcing and gives rise to even more feedback, leading to an increased overall view and improved quality. Furthermore, it should be noted that a modern risk management system aims not only to facilitate decision-making for an isolated actor but also to act as a supply chain of risk information, serving multiple actors (Tehler et al. 2019).

Although the survey does not reveal individual biases that challenge interaction, it indicates that the actors do not act in completely siloed manners. Due to perceived utility, the willingness and motivation for information-sharing feedback emerge in explicit questions and free-text answers. However, a large fraction reported not commenting on other actors' documents because they were not requested, suggesting that improving formal communication channels and increased coordination between actors might help increase collaboration and reduce the problem of interplay.

Finally, some remarks on the response rate are in order. Although the final response rate was close to 20%, the spatial distribution of the results within Sweden, the diversity of the actors involved, and the proportional representation of community sizes that align with national proportions suggest that the results reflect Swedish conditions. Similar studies should be conducted in different countries to deepen the understanding of these issues and further explore their generalizability.

5. Conclusion

The results highlight asymmetries in information flows, risk-related knowledge, and activity, particularly between FRS and LUP. In addition, a lack of balance between risk and protection was revealed.

Still, there are also reasons to strive for more consistent cooperation. Better coordination, communication, and awareness of the benefits of a holistic approach could strengthen the practical utility of risk analyses and improve preparedness for the societal changes we face.

Acknowledgment
The County Administrative Board of Västra Götaland and the Research School for Doctoral Students, established and funded by the Swedish Fire Research Foundation and the Swedish Civil Contingencies Agency, have funded the research in this paper.

References

Aven, Terje. 2022. "On Some Foundational Issues Concerning the Relationship Between Risk and Resilience." *Risk Analysis* 42 (9): 2062–74.

Aven, Terje, and Shital Thekdi. 2021. *Risk Science: An Introduction*. 1st ed. London: Routledge.

Bowonder, B., and H. A. Linstone. 1987. "Notes on the Bhopal Accident: Risk Analysis and Multiple Perspectives." *Technological Forecasting and Social Change* 32 (2): 183–202.

Britton, Niel R., and John Lindsay. 1995. "Integrating City Planning and Emergency Preparedness: Some of the Reasons Why." *International Journal of Mass Emergencies and Disasters.* 13 (1): 83–106.

Chmutina, Ksenia, Tamar Ganor, and Lee Bosher. 2014. "Role of Urban Design and Planning in Disaster Risk Reduction." *Urban Design and Planning* 167 (3): 125–35.

Cunningham, Douglas W., and Christian Wallraven. 2012. *Experimental Design: From User Studies to Psychophysics*. An A K Peters Book. Boca Raton, FL: CRC Press.

Farinós-Dasí, Joaquín, Pablo Pinazo-Dallenbach, Enrique Peiró Sánchez-Manjavacas, and Diana Catalina Rodríguez-Bernal. 2024. "Disaster Risk Management, Climate Change Adaptation and the Role of Spatial and Urban Planning: Evidence from European Case Studies." *Natural Hazards*, March.

Greiving, S., S. Pratzler-Wanczura, K. Sapountzaki, F. Ferri, P. Grifoni, K. Firus, and G. Xanthopoulos. 2012. "Linking the Actors and Policies throughout the Disaster Management Cycle by 'Agreement on Objectives' – a New Output-Oriented Management Approach." *Natural Hazards and Earth System Sciences* 12 (4): 1085–1107.

Hills, Alice. 2005. "Insidious Environments: Creeping Dependencies and Urban Vulnerabilities." *Journal of Contingencies and Crisis Management* 13 (1): 12–20.

King, David, Yetta Gurtner, Agung Firdaus, Sharon Harwood, and Alison Cottrell. 2016. "Land Use Planning for Disaster Risk Reduction and Climate Change Adaptation: Operationalizing Policy and Legislation at Local Levels." *International Journal of Disaster Resilience in the Built Environment* 7 (2): 158–72.

Lodge, Martin. 2009. "The Public Management of Risk: The Case for Deliberating among Worldviews." *Review of Policy Research* 26 (4): 395–408.

Månsson, Peter. 2018. "Indivisible Wholes & Fragmented Realities: On the Aggregation of Disaster Risk Information (Doctoral Dissertion)." Lund: Lund University.

Månsson, Peter, Marcus Abrahamsson, Henrik Hassel, and Henrik Tehler. 2015. "On Common Terms with Shared Risks – Studying the Communication of Risk between Local, Regional and National Authorities in Sweden." *International Journal of Disaster Risk Reduction* 13 (September):441–53.

Meadows, Donella H. 2009. *Thinking in Systems: A Primer*. London: Earthscan.

Peterson, Martin. 2002. "What Is a de Minimis Risk?" *Risk Management* 4 (2): 47–55.

Roslan, Ahmad Farhan, Terrence Fernando, Sara Biscaya, and Noralfishah Sulaiman. 2021. "Transformation towards Risk-Sensitive Urban Development: A Systematic Review of the Issues and Challenges." *Sustainability* 13 (19): 10631.

Ruane, Simone, Mohammad Shahidul Hasan Swapan, and Courtney Babb. 2020. "Disaster Risk Reduction in Bushfire Prone Areas: Challenges for an Integrated Land Use Planning Policy Regime." *Sustainability* 12 (24): 10496.

Sapountzaki, Kalliopi, Sylvia Wanczura, Gabriella Casertano, Stefan Greiving, Gavriil Xanthopoulos, and Floriana F. Ferrara. 2011. "Disconnected Policies and Actors and the Missing Role of Spatial Planning throughout the Risk Management Cycle." *Natural Hazards* 59 (3): 1445–74.

SKR. 2022. "Kommungruppsindelning - Sveriges Kommuner och Regioners kommungruppsindelning 2023."

Slovic, Paul. 1987. "Perception of Risk." *Science* 236 (4799): 280–85.

Tehler, Henrik, Marcus Abrahamsson, Henrik Hassel, and Peter Månsson. 2019. *Standardization of Disaster Risk Management : Challenges and Opportunities*. *Standardization and Risk Governance*. Routledge.

Thekdi, Shital, and Terje Aven. 2024. "Characterization of Biases and Their Impact on the Integrity of a Risk Study." *Safety Science* 170 (February):106376.

Toda, Masanao. 1976. "The Decision Process: A Perspective." *International Journal of General Systems* 3 (2): 79–88.

Walliman, Nicholas. 2017. *Research Methods: The Basics: 2nd Edition*. 2nd ed. London: Routledge.

Wenemark, Marika. 2023. *Enkätmetodik: Att Planera Och Genomföra En Undersökning*. 1st ed. Liber.

Young, Oran R. 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*. The MIT Press.