| Paper's structure | |
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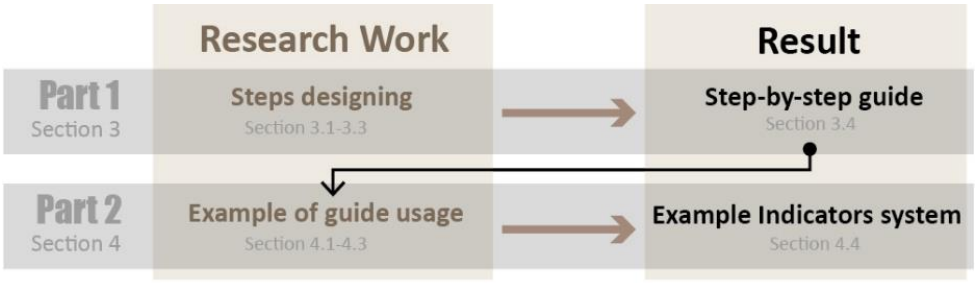
| **Comment** | why does it need a guide design? Why can we not develop criteria from key factors directly? Again, the audience will be more convinced if the paper has an example.<br><br>One possible solution is that the authors do not have to propose a small example for each section (such as lines 132-145) but use a big example to include all the steps shown in the framework, and then echo back which part is associated to which step. This could help avoid the body text looking tedious and repetitive, and instead make it clear and concise. |
| **Reply** | The structure of this paper is unclear due to the step of "step designing". We suggest combining sections for "key factors identification" and "step designing". Thus, the designed steps, for the "Criteria & Indicators" setting and data analysis, could be presented directly with the identification of key factors (Criteria, indicators, and data). In the new version, the result of section 3 is therefore the development of a guide for building indicator systems. Section 4 shows then a big example for demonstrating the use of the developed guide. |
| **Revision 1**<br><br>**Section 2: Research Methodology and Structure** | **2 Research Methodology and Structure**<br><br>To achieve the objectives of this study, … Therefore, criteria, indicators and data are the indispensable contents of an indicators system. For building an indicator system, the setting of Criteria & Indicators (C&I), and the collection of data are considered basic. This research could start with a presentation of the three basic key factors (criterion, indicator and data). Then, the main research work is designing the steps for C&I setting and data collection (Fig.2). Moreover, for these steps to be better operational in practice, the steps designed in this guide should be clearly described and preferably with the support of schematic diagrams.<br><br>  <br>**Fig. 2. Methodology and structure of the present study.**<br><br>In the second part, this study applies the designed steps to a French critical infrastructure to build an indicator system that can assess resilience during urban flooding (Fig.2). The example focuses on the Nantes Ring Road (NRR) network, the investigation of which was assisted by a local management organisation, Direction interdépartementale des routes Ouest (DIRO) that is in charge of the road networks of Nantes City in France. This example involves 62 676 traffic flow data from DIRO, and over 15 000 road infrastructure data from French National Geographic Institute (IGN).<br><br>The present paper is divided into several sections. Section 3 will (Fig.2) develop a step-by-step guide that enables CIs managers building indicator systems for their particular studied cases. Section 4 (Fig.2) will illustrate how to use this developed guide to build an indicators system through an example focusing on Nantes Ring Road. Section 5 discusses the contributions, and limitations of this guide, and shows an assessment process (including resilience and indicator assessment phases in Fig.1) in using the built indicator system in Section 4. |

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| **Revision 2**<br><br>**paper's structure** | 1 Introduction<br>2 Research Methodology and Structure<br>3 Part 1: Guide's Steps Designing<br>3.1 Specific criteria setting<br>3.1.1 Direct and indirect damages<br>3.1.2 Effectiveness and efforts of actions<br>3.2 Indicators setting and references definition<br>3.3 Verification of available data<br>3.4 Result of part 1: Step-by-step guide<br>4 Part 2: Example of Guide Usage<br>4.1 Criteria setting<br>Initial scenario<br>Continuous scenarios<br>4.2 Possible Indicators setting<br>4.3 Available data analysis<br>4.4. an indicator system for studied example case<br>5. Discussion<br>5.1 A practical and operational guide<br>5.2 Assessment demonstration<br>5.2.1 Criteria & Indicators weighting<br>5.2.2 Assessment methods and results<br>5.3 Limitation<br>6 Conclusion |

| **Use of some similar terms** | |
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| **Comment** | The word "operationalizing" may not be the most appropriate term. The authors may want to consider using "application" or "implementation". However, without a clear and compelling illustrative example, it becomes challenging to substantiate the novelty of this paper as the authors proposed. This underscores the importance of revising and improving the argumentation to ensure clarity |
| **Reply** | The study is confusing in its use of 'operationalisation', 'application' and 'implementation'. This paper wants to discuss two topics: the application of indicators-based assessment for critical infrastructure resilience; and the implementable actions identified through the Behind the Barriers model. However, the initial paper did not well distinguish these terms. This problem has been resolved in the new version. Since the focus of the paper is on indicator systems built by a developed guide, one discussion refers to the contribution of developed guide and indicator systems to the application of CIs resilience assessment. |
| **Revision 1**<br><br>**Abstract** | **Abstract**<br><br>Criteria and indicators are frequently used for assessing the resilience of Critical Infrastructures (CIs). Moreover, to generate precise information on conditions, the assessment designed for CIs resilience could rely on indicator systems. However, few practical tools exist for guiding CIs managers to build specific indicator systems in considering local realities. Therefore, the main objective of this study is to develop a step-by-step guide that contains guidance on operational steps and required resources for Criteria & Indicators setting, references definition, and data |

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| | collection. This guide enables CIs managers to build systems of indicators adapted to different realities. This guide could assist CIs managers in their decision-making process, as it is structured based on a multi-criteria framework that takes into account the cost-benefits and side effects of implementable actions. This guide could furthermore advance the application of indicator-based CIs resilience assessment in practical management. In addition, this study provides an example to demonstrate how to use this guide. This example is based on a given scenario for the Nantes Ring Road (NRR) network: when the ring road is flooded and closed, the road network manager suggests alternative roads to the public. An indicator system, consisting of 4 criteria, 7 sub-criteria and 11 indicators, could be built for this scenario through the developed guide. This example relates to criteria and indicators in technical, social, and environmental dimensions, and involves 62 676 data. |
| **Revision 2**<br><br>**Section 5: discussion** | **5. Discussion**<br><br>**5.1 A practical and operational guide**<br><br>The developed guide requires a multi-criteria analysis, a setting of numerous indicators and an investigation of available data. The built indicator systems may be considered complex with a large number of contents, and it may increase the application complexity of indicator systems to a certain extent. Nevertheless, there is no doubt that CIs resilience is a complex object, but not a complicated one. A complicated object, i.e. one with a certain amount of disorder, can be simplified, whereas a complex object should not be simplified. “Complexity varies according to a number of parameters, including the multiple uses to which it is put, the number of participants involved, its geographical dispersion, and the spatial and temporal scales considered” (Barroca et al., 2016). Since CIs resilience is a complex object, complex indicator systems seems inevitable for CIs resilience assessment. The more complex an indicators system, the more it requires detailed knowledge of local realities in diverse dimensions (geographies, socio-economic, environmental, technic, etc.). At the same time, the higher the need to increase the autonomy of local managers, which the developed guide in this study provides.<br><br>A consideration of the local realities of each case may be one key for advancing CIs resilience application. The realities bring the uniqueness of each case that could be realised by the specificity of sub-criteria and indicators. Just as teaching a man to fish, rather than simply giving him fish. Rather than predefining sub-criteria or indicators for all potential resilience scenarios of CIs resilience, the guide for building indicator systems developed in this study enables CIs to set specific sub-criteria and indicators based on concrete situations. This guide is a tool flexible, adapting itself to different case studies and different kinds of CIs. The developed guide provides a wide margin of autonomy for CIs managers or stakeholders who need support and guidance to build indicator systems. The autonomy also brings the possibility of continuous updating or optimising of building indicator systems. Changes in the external environment may lead to changes in the setting and weighting of criteria, and indicators. For example, the sub-criteria of “Environmental damage” and the indicator of “Additional CO2 emission” has become important in recent years because of the development of environmental concern. In addition, the criteria and indicators relating to implementable actions are another key for advancing the application of CIs resilience assessment. Even though many existing theories or models for CIs resilience assessment are valuable, the discussion about the effects of implementable actions is not sufficient in current studies. The present study insists that, for advancing CIs resilience application, it is necessary to consider the cost-effectiveness and side effects of implementable actions.<br><br>Meanwhile, the autonomy of this guide can also be interpreted as a weakness. Managers' experience or knowledge may be so limited that they overlook invisible factors. From a holistic |

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| | perspective, a collaborative exchange between different stakeholders can reduce this shortcoming. The examples in this study demonstrate exactly the kind of cooperation between local operators, university scientists, and local researchers. Whereas a significant investment in human resources at the same time may reduce the cost-benefit of collaborative management. Research in the field of management is therefore needed for better use of built indicator systems.<br><br>In addition, the developed guide that promotes the practical use of resilience indicators could further contribute to the application of CIs resilience. The current studies of the CIs resilience aim to develop more effective and sustainable infrastructure management strategies for CIs through the concept of "resilience". In other words, one of the desired developments in resilience research is to put resilience-based theories, tools, and models into practice. Thus, CIs resilience studies need to consider the application of the concept of "resilience" in practical risk management. According to Cambridge Dictionary, an application is a way in which something can be used for a particular purpose. A practical application of CIs resilience is therefore a way in which CIs resilience can be used for real risk management. Although CIs resilience has gained considerable attention in the research literature during the last decade, there remain relatively few resilience studies with application in real-life infrastructure (Hosseini; 2016; Meerow et al., 2016; Hernantes et al., 2019; Heinzlef et al., 2022; Esmalian et al., 2022; de Magalhães et al., 2022; Barroca et al, 2023; Rød, 2020). The obstacle to applying the CIs resilience concerns two major limitations: 1) the absence of applied tools; 2) the lack of an organisational aspect (Weichselgartner and Kelman, 2015; Hernantes et al., 2019 ;Heinzlef et al., 2022; Rød et al., 2020; Yang et al., 2023, b). The guide developed in the present study is firstly a practical tool that can be applied in concrete scenarios, as demonstrated by the example case presented. The fact that the criteria setting is based on organisational perspectives has been also emphasised. The developed guide could contribute to transforming the concept of "resilience" into an object of practical value, in the broader sense of 'use'. |
| **Revision3**<br><br>**Section 6: Conclusion** | **6. Conclusion**<br>Focusing on the indicators-based assessment of critical infrastructures resilience, this study develops a step-by-step guide for building indicator systems. The developed guide considers both the positive and negative effects of implementable actions. Three key phases (Fig.9) have been presented in detail for building indicators systems: criteria setting, indicators setting with references definition, and verification of data availability. In addition, this study provides an example to demonstrate how to use this guide. This example is based on a given scenario for the Nantes Ring Road (NRR) network: when the ring road is flooded and closed, the road network manager suggests alternative roads to the public. The results show that this guide enables to building of specific indicator systems adapted to local realities. Built indicator systems could furthermore assist CIs managers in their decision-making process as they involve the various interests of stakeholders. |