IES 2023 - Statistical Methods for Evaluation and Quality: Techniques, Technologies and Trends (T^3)

BOOK OF SHORT PAPERS

Editors: Andrea Bucci, Alfredo Cartone, Adelia Evangelista and Andrea Marletta

Book of Short papers
11th International Conference **IES 2023**
Statistical Methods for Evaluation and Quality: Techniques, Technologies and Trends (T^3)

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ISBN 979-12-803-3369-8
DOI 10.60984/978-88-94593-36-5-IES2023
https://doi.org/10.60984/978-88-94593-36-5-IES2023

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Risk Management and Future Scenarios. A proposal based on a mixed-method approach

Gestione del rischio e scenari futuri? Una proposta basata su un approccio quali-quantitativo

Simone Di Zio, Mario Bolzan, Marco Marozzi and Manuela Scioni

Abstract The rapid changes in society and the risks related to disastrous and unexpected events increasingly represent a challenge to scientists. The aim of this paper is to provide a comprehensive framework to effectively manage emerging and future risks by incorporating the strategic foresight approach, which starts from a future scenario planning method and includes quali-quantitative tools, in a consequential chain of techniques, where the output of one step is the input of the next. The framework is based on a six-step future risk management process, including assessment (comprising identification, analysis and evaluation), treatment and communication. A research project on future scenarios for contemporary families will serve as a representative example of this framework.

Abstract *I rapidi cambiamenti a cui la società è soggetta e i rischi legati ad eventi inattesi e disastrosi rappresentano una sfida crescente per gli scienziati. Lo scopo di questo lavoro è quello di fornire un quadro metodologico per la gestione dei rischi emergenti e futuri, il cui punto di partenza è un metodo di pianificazione degli scenari futuri e che include strumenti quali-quantitativi organizzati in una successione. L'intero processo di gestione è suddiviso in sei fasi che comprendono la gestione (identificazione, analisi e valutazione), il trattamento e la comunicazione dei rischi.*

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Un progetto di ricerca sugli scenari futuri per le famiglie contemporanee viene utilizzato come esempio rappresentativo della metodologia proposta.

Key words: Risk Analysis, Risk Assessment, Mixed Methods, Futures Scenarios, Family

1 Introduction

The evident and rapid changes in society and the risks of disastrous events that manifest themselves in unforeseen and unexpected ways increasingly represent a challenge to scientists who intend to continue to be credible when advancing hypotheses in response to the needs of contemporary society. The example of the pandemic produced by Covid-19 - like the events related to climate change - is still in everyone's eyes and it represents the event that has caught the governments of nations as well as the scientific community unprepared. It then raises the spontaneous question: are traditional research approaches still convincing and exhaustive to face risks?

Often, when a new approach that goes off the beaten track of science is proposed, it is viewed with suspicion and, sometimes, with hostility. We do not want to say that everything new is better than the old, but this is what happened to a dear colleague of ours, who unfortunately passed away. More than 20 years ago, Antonio Pacinelli began to propose the themes of futures studies and scenarios, with the intention of offering advanced scientific solutions to complex problems, encountering doubts and perplexities in the scientific community of statisticians. Today, this scientific area is spreading more and more, and the skepticism of many has turned - at least - into curiosity. The contribution of this paper fits into this groove traced by Pacinelli and which we, and other statisticians, are starting to follow, with great enthusiasm and enormous gratitude to dear Antonio. With his tenacity, he taught many the courage of commitment to the service of the best research.

The advancement of new and not always tested proposals is required also to address interactions between cognitive problems of different epistemological natures, whether qualitative or quantitative. We propose a proactive and forward-looking approach to risk management, which can be defined as future risk management.

The aim of this paper is to provide a comprehensive framework to effectively manage emerging and future risks by incorporating the strategic foresight approach, which starts from a future scenario planning method and includes quali-quantitative tools like Delphi surveys and focus groups, composite indicators, fuzzy clustering, cross-impact analysis and multi-criteria methods, in a consequential chain of techniques, where the output of one step is the input of the next. The framework is based on a six-step future risk management process, including assessment (which in turn can be decomposable in three phases: identification, analysis and evaluation), treatment and communication of emerging and future risks.

A research project on future scenarios for contemporary families will serve as a representative example of this framework [1, 2].

2 A new approach to risk management using Delphi-based scenario planning

Since the 1970s, studies of risk have become a very large and active interdisciplinary field of research and, in recent years, also embraced statistics and Futures Studies [3, 4]. Regardless of how it is defined and/or measured, risk is a characteristic of the future. Indeed, according to Fischhoff et al. [5], the most significant aspect of risk is the attribution of consequences to future events.
An important step in understanding the problem of risk analysis, risk evaluation, and decision-making is the distinction between risk assessment and risk management. The first regards the qualitative and/or quantitative estimation of risk, while the second (at a macro level) includes plans, actions, strategies or policies set to reduce the probability and/or impact of risks [6].
Scenarios can be defined in various ways and are used in different disciplines. In the methodological corpus of Futures Studies (FS), and in its application counterpart - known as Strategic Foresight - scenarios are recognized as "a set of hypothetical events set in the future constructed to clarify a possible chain of causal events as well as their decision points" [7]. They do not intend to predict a static future but are "hypothetical sequences of events constructed in order to focus attention on causal processes and decision points" [7] useful to reduce risk. According to the International Organization for Standardization [8], scenarios are strongly applicable in the steps of risk identification and risk analysis. Since we propose a complete future risk management process, starting from a specific scenario planning approach called Delphi-based Scenario, what we are presenting in this paper is entirely distinct.
As already mentioned, an emerging and future risk management process includes different steps that aim at identifying, analyzing, evaluating, treating and communicating potential risks that may arise from new or mutating sources.
As we will see in the following we propose a matching between the phases of future scenario planning following the approach proposed by [9] and the phases of the risk management process suggested by the ISO [8]. Within each of these phases, we propose one or more techniques for risk framing, risk assessment and risk treatment. In particular, we suggest a combination of techniques organized in a specific sequence [2] in an overall approach that fully falls within the logic of mixed methods [10].
In the following, we describe the phases of this approach and to this end, the title of each paragraph contains the risk management phase alongside the corresponding scenario planning phase.

1. Scope and context - Framing.
According to the ISO, the purpose and scope of the risk assessment should be established, with a clear description of what is included, and what is excluded. The framing phase of Delphi-based scenario also involves developing a set of questions/hypotheses that the scenarios will seek to answer, and this is important in helping to ensure that the developed scenarios are relevant and helpful for the intended purpose.

2. Risk identification - Scanning.
Identifying risk enables explicitly taking into account uncertainty, by considering all its possible sources and identifying and describing risks. This step can involve different techniques, such as brainstorming sessions, focus groups, surveys, Delphi with stakeholders or a literature review. Most recently, new techniques are also being used, among which we mention text analytics, an approach that uses natural language processing (NLP) to transform free unstructured text into structured data [11], and so it turns out to be very useful in the rapid scanning of large quantities of documents for identifying potential and emerging risks.

3. Risk analysis - Forecasting.
Risk analysis allows an understanding of the nature of risk and to assess consequences, risk likelihood, as well as interactions and dependencies between risks, in order to evaluate the possible impacts. According to ISO, in this phase, it is important to analyze the type, magnitude and timing of consequences and the importance of the changing of consequences over time, so the time variable must be taken into account. The Delphi technique is particularly suited in this step.

4. Risk evaluation – Visioning.
Risk evaluation requires comparing the outputs of the risk analysis with the established risk criteria to move towards the next phase which requires concrete actions [8].
In the Visioning phase of scenario planning the experts and/or stakeholders are asked to consider the implications of the various scenarios that were developed in the preceding forecasting phase and asked to evaluate how different scenarios would impact the context under study and the long-term consequences of each scenario. Among the many techniques, Cross Impact Analysis [12] - a semi-quantitative method suitable for short/medium time horizons - is very useful in this stage to evaluate changes in the probability of the occurrence of a given set of events consequent on the actual occurrence of other events/scenarios.

5. Risk treatment – Planning & Acting.
The aim of this phase is to select concrete actions for the mitigation of the impact of emerging and future risks, the definition of preventative care and/or contingency plans, based on the evaluation made in the previous steps. The Planning phase of the Delphi-based scenario planning may be fully suited to achieve the same purposes because consists of developing a plan of action starting from the developed scenarios. This implies identifying specific strategies, policies, and resources that will be needed to implement the plan. In the Acting phase, actions to give concreteness to the previous planning phase must be defined. About the techniques usable in this phase, we find Multi-Criteria Analysis (MCA), a family of techniques for comparing options in a way that makes trade-offs explicit. In particular, we suggest the Analytic Hierarchy Process - AHP [13] - which does not require particular starting data, can be used for any time horizon.

3 The "Tomorrow in the family" Project

The "Tomorrow in the family" project is a four-year research project carried out to figure out the possible dynamics that will affect family life in the near future [1], with a time horizon of ten years and reference to the North East of Italy. The main idea underlying this project was to build some plausible scenarios to stimulate the reflection on which risks the family will have to face in the near future.
Framing & Scanning: Scope and Context & Risk Identification. Through a series of focus groups, a set of 41 items including the key elements have been identified as fundamental in the future development of the family system. Each item can lead to the identification of both risks and opportunities.
Forecasting: Risk Analysis. The next step was to apply a Delphi Survey with a panel of 32 experts. In order to investigate the future development of each item, the experts were asked to provide two assessments using an ordinal scale of 0-100, the first concerning Evolution, that is the spread of the phenomenon indicated in the item, and the second regarding Relevance (or importance). Both evaluations were merged by proposing a robust method to combine experts' opinions [2].
Visioning: Risk Evaluation. The Delphi and the robust ranking procedure produced four scenarios, whose titles are: 1. Parents and society: even more for the family; 2. At home to feel like a family; 3. There is no family without... the internet; 4. Politics and volunteering meet the family. We refer to [2] for the complete description of the scenarios. These scenarios were submitted for evaluation to a further panel of experts, which evaluated their plausibility and consistency. In the project, an application of the Cross-Impact analysis [12] is in progress, as well. It is about assessing the impact that certain policy actions can have on the four scenarios. Policies tested are: a) Increase the accessibility and availability of family counselling services in situations of family difficulties of different types; b) Improve public welfare (e.g., availability of services to the person, the elderly, children); c) Promote a cultural change in family members through training actions (to promote awareness of shared responsibilities); d) Improve corporate welfare to support workers with dependent children and elderly.
Planning and Acting: Risk Treatment. Eight intervention proposals to support the family members, particularly women, in the context of one scenario (concerning, in particular, the future of the mother and her role within the family) were compared according to two different criteria: "Feasibility" and "Efficacy", using the Analytic Hierarchy Process (AHP).

4 Conclusions

The proposal of this paper starts from the re-reading of the risk management process as described by the International Standard [8] combined with the contribution of the futures studies approach conducted, in particular, by using the Delphi-based scenario development.

In our proposal, we tried to highlight the possibility of building a matching between the two approaches, in order to achieve new and useful synergies, both from a methodological and epistemological point of view.
At the conclusion of the work, some indications or proposals emerge which seek to go beyond the classic dichotomous approach "quantitative or qualitative", trying instead to follow a proactive approach based on the so-called mixed methods approach.
The research conducted on the "Tomorrow in the family" project represents a specific application in the process of evaluating actions in support of a specific scenario, in order to support public decisions to mitigate and/or prevent the effects of the risks that have emerged from that scenario.

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