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THE USE OF “BOW TIE” ANALYSIS TO RISK IDENTIFICATION IN ORGANIZATION

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Abstract: The article presents the use of "bow tie" analysis to identify risk in an organization. Risk identification is one of the initial stages of the risk management process and can be carried out using a variety of methods or techniques. The choice of method depends on the specifics of the organization, available resources, as well as spatiotemporal criteria. The paper presents practical examples of the use of "bow tie" analysis as an alternative to more popular methods, such as: "what if?" scenario analysis, fault tree, or Haddon matrix (less popular, but detailed). The versatility of the "bow tie" analysis allows it to be implemented in organizations with various business profiles. The aim of the study was to demonstrate that the "bow tie" method effectively exhausts the issue of risk identification (especially for complex risks), and thus allows for the implementation of subsequent stages of the risk management process. The potential of this method allows for continuous improvement of the organization's processes and minimization of the risks that occur. Thus, it fits into the idea of broadly understood security, which is topical in the current socio-economic conditions of the organization's environment.
Keywords: risk identification, risk management “bow tie”, causes, effects.

1. INTRODUCTION

Contemporary organizations operate in an environment characterized by increasing uncertainty, regulatory pressure, and rapid technological development, which makes risk an inherent element of managerial and decision-making processes (Knop, 2020; Silva, et al., 2025). Globalization, digital transformation, process automation, and the growing complexity of organizational systems contribute to the emergence of new types of risks and the intensification of existing ones (Potjanajaruwit, et al, 2025; Ingaldi & Ulewicz, 2025). As a result, risk management is no longer perceived solely as a reactive function but as a fundamental component of modern management, supporting organizational resilience, operational continuity, and the achievement of strategic objectives.

According to the approach presented in ISO 31000 (ISO/IEC 31010:2019), effective risk management requires a structured and systematic process that includes establishing the organizational context, risk identification, risk analysis and evaluation, followed by the planning and implementation of appropriate risk response measures. Among these stages, risk identification plays a particularly critical role, as it determines the quality and

effectiveness of subsequent risk management activities. Inadequate or incomplete identification of risk sources, their causes, and potential consequences may lead to flawed managerial decisions and a reduced level of organizational safety. Therefore, both the academic literature and managerial practice emphasize the need for methods that enable a comprehensive and transparent identification of risks, taking into account not only their origins but also their possible outcomes.

The aim of the paper was, firstly, to discuss and apply in practical examples the "bow tie" analysis in the field of risk management in an organization, and secondly, to demonstrate that this method effectively exhausts the issue of risk identification in the entire risk management process. The motive for the author's research was the growing emphasis on risk management, which has an impact on ensuring broadly understood security in an organization. Thus, it requires the use of effective risk management methods at every stage of the process. One of the interesting proposals for the use of the method due to its universality, practicality and ease of implementation is the "bow tie" method. This method is not new, but it can provide a lot of interesting data for identifying risks and combining them (as in the Haddon Matrix (Korzeniowski, 2012)) with control mechanisms, which gives greater effectiveness in the implementation of the entire process. In addition, the "bow tie", through its construction, forces the risk owner to constantly monitor the identified risks with reducing or minimizing actions, which is in line with the idea of continuous improvement of the organization's processes, and thus contributes to the development of management science. Taking into account the assumptions for this paper and a review of the literature on the subject, it is noted that the "bow tie" method is not classified as appropriate for risk identification, but only for the assessment of the consequentiality, probability and level of risk (ISO/IEC 31010:2019), which, according to the author of this paper, is a research gap. Therefore, by clearly linking the results of the research with specific gaps in the literature, the author indicates the legitimacy of the presented study and the presentation of "bow tie" as one of the methods of identifying risk in the organization. As mentioned earlier, the analysis of "bow tie" is not a new phenomenon, it has extensive application in various fields of business science and practice, including safety systems (Kobaszyńska-Twardowska & Gill, 2013), including aviation (Krzyżanowski, et al., 2014), accident analysis in maritime shipping (Yang et al. 2025), medicine (Abdi, et al., 2016, Dimova, et al., 2014), including the identification of the causes and effects of the global corona pandemic in 2021 (Brown, et al., 2021), management, including the management of innovative projects (Pitblado & Wijand, 2014; Orellano & Gourc, 2025) or in the retail sector (Barros, et al., 2021).

The whole risk management process consists of several stages, such as: establishing the context of the organization (or indicating the objectives for which we identify risks), risk identification, risk analysis, risk assessment, risk response with communication and control (Jastrzębska, et al., 2014, PN-ISO 31000:2018). These stages are accompanied by the implementation of specific tasks in this area (Kaczmarek, 2020). Risk identification consists in determining the risk factors along with its causes and effects. The type of risk is also often formulated according to a given category. By defining these two parameters, control mechanisms can be established, among others: milimalizing, eliminating or preventive actions. This is then the stage of risk response, which also includes a plan of action with risk (setting a deadline for the implementation of activities, persons responsible for them, costs, etc.). (Woźniak & Wereda, 2023).

Thanks to the wide range of available scientific and practical methods, each stage of the risk management process has a number of methods, analyses and techniques that can be used to implement it (Czajkowska, 2017). According to: ISO/IEC 31010:2019 Risk Management – Risk Assessment Techniques, the methods that will work best at the identification stage include: brainstorming, structured or semi structured interviews, delphi method, checklist, preliminary hazard analysis, hazard and operability study, hazard analysis and critical control points, structured „what if?" technique, failure mode and effects analysis, event tree analysis, cause and consequence analysis, cause and effect analysis and decision tree analysis etc. According to the author of this study, the "bow tie" method is also a helpful tool for risk identification, which was demonstrated in the research part of the study.

"Bow tie" owes its name to the male bow tie, which is associated with the construction of the diagram being created (wolterskluwer.com). This method is a relatively simple and schematic way of describing and analysing the paths of development of a given risk from the cause of the risk to its effects (Jasińska, 2016, Wróblewski, 2015). It has two basic functions: it analyses possible scenarios of events that make up the risk and identifies control measures. These functions are inspired by the following methods: the fault tree (left side) and the event tree (the right side of the diagram) (wolterskluwer.com). "Bow tie" is used to illustrate the risks along with the range of possible causes and causes that can be constructed during brainstorming. On the other hand, potential control mechanisms in response to the consequences of risk can be determined using other creative methods, including, for example, the Disney's method (Krwawicz, 2020). Causes and effects are important due to the fact that when determining actions to minimize or eliminate risks (control mechanisms), it is possible to act specifically on causes or effects with these mechanisms, so that the risk is at an acceptable level (Kobaszyńska & Gill, 2013). Creating a "bow tie" diagram starts with defining a given risk (the central point on the diagram). On the left side there is a path showing the tree of the events that led to the risk (cause). They are accompanied by control mechanisms that eliminate or minimize the causes. On the left, there are the effects of risks along with control mechanisms that reduce or reduce the level of consequences of the analyzed risk. The "bow tie" effect is a diagram presenting the main risk pathways and barriers that are to prevent or mitigate the effects of risk (Wróblewski, 2015). Bow-tie analysis exhausts the implementation of the two stages of risk management: risk identification and risk response, but it does not evaluate risk and does not determine its level. The advantage of "bow tie" is undoubtedly the ease of understanding and the transparent form of risk analysis from causes to consequences, as well as a fairly high level of detail. Moreover, it clearly indicates which control activities are assigned to which factors, which allows for their level of effectiveness in relation to a given cause or consequence in the long term. However, when constructing a "bow tie" diagram, it is important to take into account the fact that there is a balance when determining causes and effects, so that they are not too specific (difficult to find effects) or too general (too many effects).

2. METHODOLOGY OF RESEARCH

This study presents the results of the "bow tie" analysis for the risk occurring in a selected company from the automotive industry. This work is a methodological development of the risk identification stage for the article on the implementation of the overall risk management process (Wojtyto, et al., 2025). In order to identify control mechanisms, the

Disney's method was used, which, through creative thinking, allowed for the development of optimal preventive actions, eliminating or reducing the effects and causes of selected risks. Moreover, the paper uses such research methods and techniques as: review of subject literature, comparative analysis, analysis of collected data and brainstorming technique, synthesis and analysis.

3. RESULTS

The results of the "bow tie" analysis in the form of a diagram and a table are presented for an example of the risk occurring in the examined manufacturing company. Figure 1 presents a schematic 'bow tie' analysis in the form of a diagram for production continuity risk, while Table 2 presents a description of this analysis. The diagram shows the potential causes of the risk (left side) with control mechanisms and the consequences of the risk (right side) with control mechanisms. The middle of the diagram represents the risk being studied.

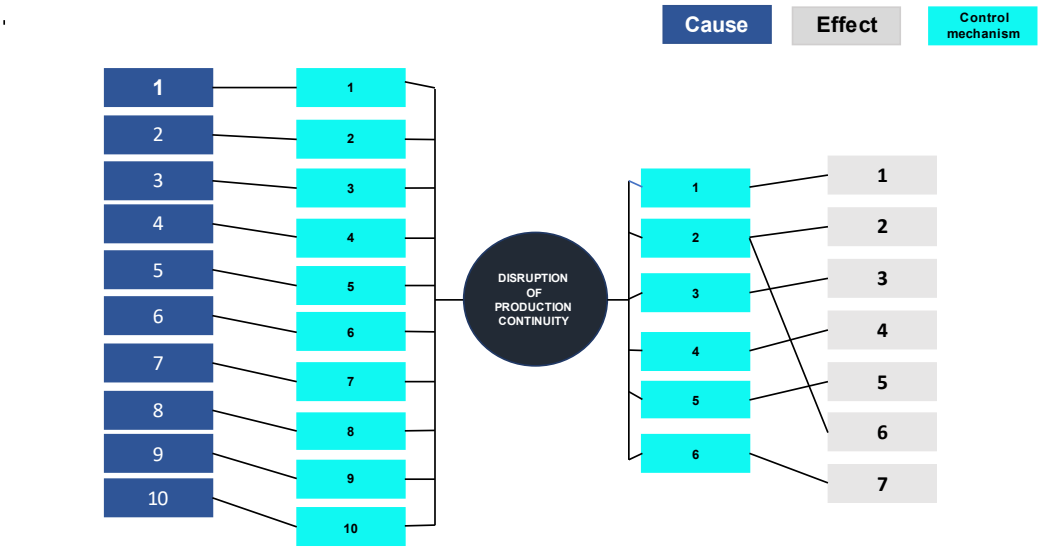

Fig. 1. "Bow-tie" analysis for risk: production continuity disruptions
Source: own elaboration

Table 1.
Identified causes and effects in the "bow tie" analysis for risk: production continuity disruptions

Causes	Control mechanisms	Effects	Control mechanisms
1-Incorrect organization and planning of production	1-Implementation of an integrated management system taking into account the planning, organization and optimization of production/intelligent systems	1-Untimely deliveries to customers	1-Increased optimization activities (delivery time), proper planning and organization of deliveries (production volume), policy aimed at optimal reserves

			and inventories and a balance between demand, and supply
2-Quality control that does not meet the highest standards	2-Moving away from sampling methods, inspecting products at every stage of the process	2-Low product quality	2- Product quality control at every stage of the process, implementation of appropriate quality control methodology
3- Lack / problem with the availability of raw materials/ materials for production	3-Raw material reserves	3-Loss of customers and increased competition	3-Business diversification, price and product competitiveness, benchmarking, outsourcing, intensified marketing activities (planning marketing strategies), reliable market analysis and adaptation of the offer to the specific needs of the most important customers, favorable sales conditions, good relations with customers.
4- Fluctuations in raw material prices, instability in the supply chain.	4-Negotiation policy with suppliers, long-term contracts	4-Decline in the company's reputation	4- Intensified, very active marketing activities based on different strategies
5- Downtime due to human mistakes	5-Employee training, analysis of the causes and effects of possible errors, employee control	5-Financial problems (lack of financial liquidity, contractual penalties)	5-Insurance, negotiating payment terms with creditors
6-Downtime due to machine and equipment failure	6-Continuous program of systematic repairs and maintenance	6-High complaint rate	2- Product quality control at every stage of the process, implementation of appropriate quality control methodology
7-Downtime due to lack of power	7-Alternative energy sources	7-Lack of production efficiency	7-Production optimization, implementation of a management system supporting the production

			process, use of modern technologies based on AI, IoT
8-Employee absenteeism, lack of qualified staff	8-Training of employees in various positions, optimization of employment		
9-Other macroeconomic measures	9-Strategic planning (including macroeconomic analyses), financial reserves		
10-Insufficient production technology – lack of state-of-the-art solutions based on robotization, automation, digitization, computerization	10- Phased implementation of modern technologies based on automation and computerization of production		

Source: own elaboration

As shown in Figure 1 and Table 1, for the risk of production continuity disruption, the “bow tie” analysis identified 10 potential causes fitted for individual control solutions. Similarly, 7 potential effects were identified for the effects of this risk, for which 6 control mechanisms were adjusted. One of them (product quality control at each stage of the process, implementation of appropriate quality control methodology) was implemented for two different effects, such as: a high complaint rate and low product quality.

3. CONCLUSION

To summarize the considerations regarding the use of “bow tie” analysis at the stage of risk identification in an organization, the following conclusions can be presented:

- The "bow tie" analysis is a universal tool, which is confirmed by a literature review. It refers to various risks, combines many aspects of the organization's operations, is simple to use, and its structure is legible and clear. Simplicity in preparation and inference is an advantage of its use.
- "Bow tie" can take any extension of the method. It can be a diagram of the causes of risk and its consequences, with control mechanisms tailored to these factors, but it is also recommended to expand it with consequences regarding the human, environmental, economic, physical (property, equipment) aspects, etc. You can also classify causes according to the adopted taxonomy, e.g. human, external, technical causes, etc. A similar concept is used by the Haddon Matrix, which is also a method used to identify risks and respond to them. In addition, for better functioning of the method, especially in the context of risk response, and thus the application of control mechanisms, it is possible to determine in this method who is responsible for the implementation of individual actions within the control mechanisms (owners), as well as to indicate the exact place where the risk occurs.

- Despite the fact that in the literature on the subject there are mentions that "bow tie" does not fit into risk identification, according to the author of this work, it is quite the opposite. In its construction, "Bow tie" takes into account causes and effects, which is in line with the definition of risk identification, which recognizes risks by determining their causes and potential effects. Subsequently, causes and effects can be evaluated, for example, using the scale of probability and effects, or significance for risk (impact).
- Bow tie analysis can be used in both risk identification and risk response, as it adjusts control mechanisms to both cause and effect, thus acting on the entire risk without its value. This gives them a greater chance of effectiveness of control mechanisms, as actions are taken "immediately".
- "Bow tie" necessitates the need for detailed cooperation and high involvement of the employees who are affected by the risks or who are in possession of the necessary information. That is why it is so important that when determining the causes of a given risk, they are not too detailed, because then a lot of control mechanisms would have to be implemented, and their too fragmentation may cause a problem with taking responsibility and effective implementation of risk owners. Causes that are too specific are also difficulties in determining the effects. Too general causes cause too many effects to be generated.
- By using "bow tie", you can support yourself with many other methods or techniques that are proposed by the literature on the subject. To identify risk, all kinds of brainstorming or the Haddon Matrix will be helpful, which identifies the causes of risk in detail and responds to them with specific actions. On the other hand, in order to determine the control mechanisms that will be the optimal solution for the causes and effects determined in the 'bow tie' diagram, the Disney method is proposed, which allows for creating actions taking into account optimistic, realistic and pessimistic variants.

Despite its advantages, the use of the “bow tie” method is subject to certain limitations. First, the effectiveness of the analysis largely depends on the knowledge, experience, and engagement of participants, which may introduce subjectivity into the identification of causes, consequences, and control mechanisms. Additionally, an improper level of detail, either too granular or too general, may reduce the clarity of the diagram and limit its practical usefulness. Therefore, future research should focus on developing guidelines for the optimal level of detail in “bow tie” construction, as well as on empirical validation of the method across different organizational contexts and industries, including its integration with quantitative risk assessment techniques.

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