safety

MDPI

Article

The Effectiveness of the Existing Occupational Safety Risk Assessment Process in the Republic of Croatia: An Empirical Study of the Views of Occupational Safety Experts

Ana Rački Marinković *, Tomislav Katić and Darko Palačić

University of Applied Sciences in Security and Safety, 10000 Zagreb, Croatia; tomislav.katic@vss.hr (T.K.); darko@vss.hr (D.P.)

* Correspondence: ana.racki.marinkovic@vss.hr

Abstract

Risk assessment is a cornerstone of effective occupational health and safety (OHS) management, yet its efficacy often varies in practice. Evaluating legislative frameworks is essential for enhancing the practical application of safety standards. This study examines the state of the risk assessment process in Croatia from the perspective of OHS experts to provide recommendations for improvement and standardization. A digital survey was conducted among registered OHS experts via the national Information System for Occupational Safety (ISZNR). Data from 967 OHS experts were analysed using descriptive and inferential statistics. The hypothesis that current risk assessment processes are insufficiently effective was partially accepted, as a significant portion of the surveyed OHS experts perceive them as having limited functional effectiveness. While 33% of experts view the current prescribed mandatory risk assessment methodology as effective, more than half of respondents (56%) identified that risk assessments are predominantly adjusted to formal requirements rather than to actual work conditions. Statistical analysis showed no significant differences in perceptions of risk assessment effectiveness based on OHS experts' support for mandatory legal frameworks for standardization (Q19; $p = 0.259$) or the active usage of digital tools ($p = 0.984$). However, a statistically significant relationship was observed regarding general attitudes toward quality improvement through standardization (Q17; $p < 0.05$) and the perceived utility of digitalization ($p < 0.001$). The study concludes that the current process requires further improvement and suggests detailed sectoral analyses for future research.

Keywords: risk assessment; occupational health and safety; standardization; Republic of Croatia; occupational health and safety experts

Check for updates

Academic Editor: Raphael Grzebieta

Received: 13 April 2026
Revised: 24 May 2026
Accepted: 3 June 2026
Published: 9 June 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

According to national regulations, all employers in the Republic of Croatia are required to conduct a risk assessment for all workers and persons at work, taking into account the nature of the tasks they perform. There are numerous methodologies, methods, and procedures for risk assessment, since different approaches may be suitable under various circumstances, and new models are being developed continuously [1]. Employed risk assessment methodologies differ worldwide, as regulations in most countries allow competent experts to freely apply various methods and techniques to assess risks at work as they find fit for purpose, rather than prescribing a single, mandatory, legally enforced methodology. In the Republic of Croatia, risk assessment is conducted in accordance with

the Occupational Health and Safety Act [2], the Ordinance on Occupational Health and Safety for Workplaces [3], the Ordinance on Risk Assessment [4], and other relevant laws and regulations. Ordinance on Risk Assessment prescribes the conditions, methods, mandatory content, data sources, and classification of hazards, harms, and efforts. The process is strictly structured, and the analysis and evaluation of the collected data are carried out using a Risk Assessment Matrix based on general risk level criteria: probability and consequence. Risk is categorised as low, medium, or high using a 3×3 matrix. Interactive online tools (OiRA—Online interactive Risk Assessment) developed by EU-OSHA can also be used to assess and document risk assessments for jobs in certain occupations or industries, when these tools are made available for individual jobs via the website of the competent ministry.

Several studies have been performed in the European Union [5–7] regarding the implementation of the risk assessment obligation, which also investigated the effectiveness of risk assessment methodologies applied in European Union Member States. However, the Republic of Croatia was not part of these studies because, at the time when they were conducted, the country was not yet a Member State of the European Union. Yet, these studies provide a valuable comparative baseline for the Croatian context since its position within the "eastern group" of EU Member States aligns it with countries characterised by prescriptive regulatory traditions [7]. Comparative analysis shows a clear divide: Nordic models, such as those in Sweden and Denmark, employ a 'goal-oriented' approach that favours systemic management and functional pragmatism instead of rigid documentation. In contrast, in the Eastern and Latin groups (e.g., Bulgaria and Spain), the heavy reliance on external service providers often transforms risk assessment into a sidelined 'tick-box' exercise [6]. These EU-wide disparities and documented uneven practical risk assessment quality across the EU, as documented [5,6], suggest that the challenges identified in Croatia reflect a broader European tension between prescriptive compliance and the modern need for integrated, flexible safety management.

In the domestic context, OHS risk assessment has been analysed primarily from the perspectives of organizing OHS activities [8] and preparing risk assessments, as well as through the study of existing risk management models [9–11]. Furthermore, it has been reviewed through the lens of compliance with European Union directives [12] and the legal nature of risk assessment [13]; however, there is a lack of in-depth analysis of empirical experiences of OHS experts in carrying out risk assessments in practice. The need for risk assessment research is relevant because it is an integral part of all work activities [14–16].

The ongoing international debate highlights a growing tension between formal compliance and effective risk control. It is argued that the increasing bureaucratisation of safety may become counterproductive to actual safety [17] as it often leads to "safety clutter"—excessive, complex, and sometimes irrelevant paperwork that does not contribute to actual risk reduction [18]. In this context, the effectiveness of risk assessment is frequently undermined when it is treated as a tick-box exercise for legal protection rather than a functional tool for risk reduction and continuous safety improvement. This is further intensified by legacy constraints and practical barriers, which often limit the adaptability and effectiveness of formal risk assessment tools within complex socio-technical systems [19]. Such limitations are particularly evident when a 'one-size-fits-all' regulatory approach is applied, as it often overlooks the requirement for sector-specific methodologies and the operational constraints of different business environments [20]. Furthermore, literature emphasises that effective hazard identification depends on bridging the gap between "Work-as-Imagined", being the idealised tasks captured in formal procedures, and "Work-as-Done", being the actual practice of work on the frontline [21]. In this context, workers' participation and knowledge are essential for providing bottom-up insights necessary to understand how

work is actually performed. Following the Safety-II perspective, risk assessment should aim to integrate this experiential knowledge to strengthen system resilience, while rigid standardised tools like risk matrices often restrict the expert's ability to apply nuanced professional discretion, which is key for identifying emergent hazards that standardised templates do not capture [22]. While standardised tools like risk assessment matrices offer administrative consistency, literature warns that they can oversimplify complex socio-technical risks and create a "false sense of certainty" [23]. From a complexity perspective, such tools often overlook that hazards emerge from systemic interactions rather than from independent components [24]. Empirical research confirms that strict criteria for risk assessment methodologies pose a barrier to successful risk assessment, as they may not be the most appropriate in a given reality [25]. Ultimately, the success of any methodology is contingent upon management commitment and an organisational safety culture that prioritizes functional safety over administrative formality [26]. In practice, however, this commitment is often compromised by competing business pressures, which can lead to safety being sidelined in an organizational structure [27]. Similar dynamics often facilitate a "drift into failure", characterised by a gradual migration toward the boundary of acceptable risk under constant pressures for efficiency and productivity [28]. Such strategic and resource-allocation decisions may create latent conditions consistent with the "organisational accident model" [29]. In this context, it should be emphasised that the ISO 45001 standard and other OHS management systems do not prescribe a specific methodology for preparing a risk assessment, but rather provide guidelines on essential elements that should be included in the preparation, mandating the active leadership and involvement of managers in both the OHS management system and the development of OHS risk assessments. Greater management involvement has been shown to improve organisational culture, break the pro-forma approach to OHS, and better integrate OHS into the core business strategy [30]. Moreover, the transition towards digitalisation and data-driven OSH tools presents both opportunities for real-time monitoring and risks of further distancing safety management from the frontline reality and prioritising "safety on the screen". Research suggests that digital tools, such as AI-driven risk assessment software, are only successful if employees perceive them as beneficial and easy to integrate within daily workflows, rather than as intrusive surveillance mechanisms [31]. This study addresses the central research questions: What is the current state, and what are the problems associated with risk assessment in Croatia from the perspective of OHS experts? The primary aim is to evaluate the effectiveness of the legally prescribed risk assessment methodology within the national regulatory framework as a functional tool for workplace safety. While the literature extensively discusses risk assessment principles, there is a lack of empirical data on how professional experts navigate the tension between regulatory compliance and the practical safety utility of mandated methods and on whether mandated methods in specific regulatory environments truly achieve their intended purpose of risk reduction. Consequently, this research seeks to identify perceived deficiencies in the current approach and determine to what extent it serves as a functional safety tool that facilitates a proactive safety culture rather than a tool for administrative formality that serves as a framework for compliance. Based on these objectives, the following research hypothesis is proposed: the currently prescribed risk assessment methodology is perceived by experts primarily as an administrative requirement whose general effectiveness is diminished by its transition into a formal administrative process rather than an effective tool for practical risk reduction. The results are intended to serve as arguments and a data-driven foundation for policy proposals to improve practical methodological aspects of OHS in Croatia.

2. Materials and Methods

All OHS experts in the Republic of Croatia have a legal obligation to register in a system (ISZNR) maintained by the relevant Ministry. A cross-sectional survey was conducted among registered OHS experts to evaluate the effectiveness of the risk assessment process in the Republic of Croatia and, in particular, the prescribed risk assessment methodology, which standardised the use of a 3×3 matrix. All participants were required to be entered in the national OHS expert register (ISZNR) and have practical experience in conducting risk assessments.

Data were collected via a digital survey (Google Forms) between 21 May and 24 June 2025. The Ministry responsible for administering the ISZNR register sent survey invitations via the ISZNR system to provide a representative, diverse sample across all sectors (construction, manufacturing, healthcare, education, trade, etc.). Invitations to participate in the survey were sent directly to all registered experts who met the participation criteria through ISZNR, on three occasions (an initial call and two reminders). This systematic approach resulted in 968 total responses, of which 967 were validated for final analysis (from the total population of 4885 in the ISZNR register, meaning 19.82% of OHS experts in the Republic of Croatia participated in the survey). One respondent was excluded for not meeting the professional criteria (not an OHS expert). Although the response rate of 19.82% was substantial, the sample should be characterised as indicative. Although the large number of respondents provides a robust overview of professional attitudes and reduces the margin of error, it does not necessarily guarantee statistical representativeness of the demographic structure.

The survey instrument was specifically constructed to investigate OHS experts' perceptions of the effectiveness of the prescribed risk assessment methodology in Croatia by mapping questions to three key areas: regulatory requirements of the national legislative framework (Q11–Q14), the perceived effectiveness and sufficiency of these prescribed tools (Q15–Q16), and theoretical constructs regarding standardization and digitalization (Q17–Q22). The complete questionnaire is provided as Supplementary Data to ensure complete methodological transparency.

As the digital survey required responses to all mandatory fields (except open-ended Q23 and Q24), there was no missing data for the analysed variables. Responses to Q7, Q9, Q11–13, Q15 and Q21 were measured on a 5-point Likert scale (responses were not uniformly phrased, but in all cases 1 = negative, 5 = positive). For analysis, these were treated as ordinal data. For questions where respondents could select multiple options (Q8, Q14 and Q22), data were analysed using multiple response sets, and percentages were calculated based on the number of respondents (n = 967); consequently, totals for these figures may exceed 100%. The categories for these questions were predefined, while Q23 and Q24 were open-ended to provide qualitative context.

Data cleaning was performed in OpenRefine (v. 3.9.3). Prior to statistical analysis, the internal consistency of the measurement scales was analysed by calculating the global Cronbach's α coefficient using the "psych" package (v. 2.5.6) in R [32]. Correlation matrices between individual items were also computed to examine the homogeneity of the construct. The Shapiro–Wilk test indicated that the data were not normally distributed ($p < 0.05$); therefore, non-parametric tests were used. Statistical analysis in R (v. 4.5.1) using descriptive and inferential statistics included Spearman's rank correlation coefficient rho, Mann–Whitney U, Kruskal–Wallis test, and χ^2 (Chi-square) test of independence to examine relationships between expert attitudes and assessment effectiveness.

3. Results

A total of 968 respondents participated in the survey. After reviewing the questionnaires, it was determined that one respondent was not an OHS expert (as he stated when specifying his sector of work); therefore, his responses were excluded from further analysis (n = 967). Hence, a total of 967 valid survey responses from OHS experts were analysed. The global Cronbach's α indicated high internal consistency of the scale (α = 0.8417). Analysis of correlation between items was above 0.14, indicating satisfactory construct homogeneity.

As shown in Table 1, 60% of participants have a graduate degree, either after finishing polytechnic or university studies. In the last year, more than half of the respondents have undergone one or two training sessions in the OHS field (57%). The lowest share of all respondents (only 6%) has undergone more than 5 training sessions in the field, while as many as 20% have not undergone any training in the last year. Almost half of the respondents (46%) have over 10 years of experience in the OHS field. Almost half of respondents (47%) participate in the preparation or review of risk assessments occasionally, while more than a quarter (27%) do so continuously. Notably, 39% of respondents (i.e., OHS experts) believe they lack sufficient knowledge to conduct a risk assessment independently. Among the surveyed experts, the majority work in OHS service providers (23%), the processing industry (20%), professional, scientific, and technical activities (14%), and construction (10%). Detailed demographic data for the total population of 4885 registered OHS experts in Croatia (such as the exact distribution by region, sector, or years of experience) were not publicly available for a precise comparative study. Nevertheless, a breakdown of our sample (Table 1) shows a varied representation across range of sectors and experience levels, suggesting that the results capture a broad spectrum of the OHS expert community in Croatia.

Table 1. Demographic characteristics of OHS experts and primary statistical analysis of factors associated with the perceived effectiveness of risk assessment (n = 967).

Variable	Category	*n* (%)	Primary Statistical Analysis	Result
Education Level	Graduate degree (MA/MSc)	584 (60.4)	-	-
	Other	383 (39.6)		
Professional Experience	>10 years	447 (46.2)	Effectiveness by knowledge (MWU *)	$p > 0.05$
	≤10 years	520 (53.8)		
OHS Certification	Level II Expert	807 (83.5)	-	
	Other	160 (16.5)		
Legislative Framework	1	60 (6.20)	Correlation with effectiveness (Spearman)	ρ = 0.631 **
	2	200 (20.68)		
	3	427 (44.16)		
	4	238 (24.61)		
	5	42 (4.34)		
Management Support	1	98 (10.13)	Correlation with effectiveness (Spearman)	ρ = 0.418 **
	2	211 (21.82)		
	3	319 (32.99)		
	4	224 (23.16)		
	5	115 (11.89)		
Perceived Impact of Standardization on Quality (Q17)	Pro-standardization	552 (57.1)	Effectiveness by attitude (KW)	$p < 0.05$ *
	Neutral/Against	415 (42.9)		
Digital Tools Usage	User	370 (38.3)	Effectiveness by tool use (MWU)	$p > 0.05$
	Non-user	597 (61.7)		

MWU = Mann–Whitney U test; KW = Kruskal–Wallis test; ρ = Spearman's rank correlation coefficient. Statistical significance: * $p < 0.05$; ** $p < 0.001$. For comprehensive statistical indicators, please refer to Table S2 in Supplementary Data.

A comprehensive summary of survey results, including the detailed distribution of responses across all 24 survey questions, is available in Table S1, Supplementary Data. When asked whether the existing risk assessment methodology is effective in practice, almost half of the respondents (44%) take a neutral stance. The rest of the respondents (33%) believe the existing risk assessment methodology is effective in practice, compared with those who perceive it as ineffective (23%). The Kruskal–Wallis test showed a statistically significant difference in perceived efficiency of the risk assessment method among groups with different levels of work experience ($p = 0.007$). This suggests that perceptions of the method's effectiveness vary by respondents' work experience. Post hoc analysis using Dunn's test with Bonferroni correction indicated that participants with less than one year of experience rated the method's effectiveness significantly higher than those with more than 10 years of experience ($p = 0.008$). No other significant differences were found between experience levels after adjustment. Concerning industrial sectors, the Kruskal–Wallis test also showed significant differences in perceived efficiency ($p = 0.009$). However, following the Bonferroni correction for multiple comparisons, no individual comparisons between sectors remained statistically significant. This suggests that while differences across sectors exist, their magnitude is relatively small within the current sample. A comprehensive summary of all inferential statistical analyses is provided in Table S2 of the Supplementary Data.

When asked to what extent the existing legislative framework enables the development of high-quality and practical risk assessments, the majority of respondents were again neutral (44%), while 29% expressed agreement, and 27% of respondents expressed disagreement to some extent with the statement.

In total, 32% of respondents agree that the current risk assessment methodology meets the specific needs of the sector in which they work, while 26% believe the methodology does not meet the needs of their sector. The majority of respondents (42%) again express a neutral attitude towards the claim.

Regarding how accurately the current risk assessment reflects the organisation's actual risks, 43% of respondents agree, while only 22% do not believe that it does.

A third of respondents (33%) take a neutral attitude towards the claim that the management's support and commitment realistically reflect the situation. The ratio between respondents who agree and disagree with this statement is equal (35% and 32%).

When asked what the biggest problems in the application of the existing risk assessment methodology are, 56% of respondents cite more than a single problem. The main issues cited as presented in Figure 1 were an over-generalized approach (46%) and insufficient adaptation to specific sectors (45%).

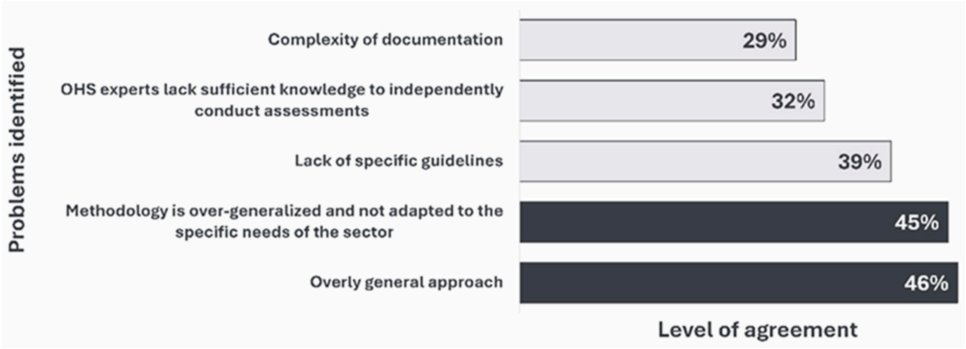


Figure 1. Responses to Q8: "What do you consider to be the biggest problems in the application of the existing risk assessment method?" Note: Percentages exceed 100% due to the multiple-choice format ($n = 967$). Response categories were predominantly predefined.

When asked whether the risk assessment reflects the actual situation in the organization, 43% of respondents confirm that it does. In total, 59% of respondents cite more than one main reason for the risk assessment not reflecting the actual situation in the organization. As presented in Figure 2, more than half of respondents (56%) state that risk assessments are often adjusted to meet formal requirements rather than reflect real workplace conditions. They cited this as the main reason why the risk assessment may not reflect the actual situation. Furthermore, inadequate worker participation in the assessment process (43%) and the lack of a detailed analysis of actual working conditions (42%) are often cited as problems. As many as 58% of respondents believe that management does not actively participate in developing the risk assessments or in implementing their conclusions.



Figure 2. Responses to Q14: "What are the main reasons why a risk assessment might not reflect the actual situation?" Note: Percentages exceed 100% due to the multiple-choice format (n = 967). Response categories were predominantly predefined.

A statistically significant and positively strong correlation was found between the assessment of the legislative framework and the assessment of the effectiveness of the method (Spearman's $\rho = 0.631$; $p < 0.001$), which indicates that participants who assess that the legislative framework enables the development of high-quality and practical risk assessments also believe that the existing risk assessment method is effective in practice.

Between the assessment of the effectiveness of the methodology and the assessment of meeting the specific needs of the sector in which the respondents work, a statistically significant and positively strong correlation was established (Spearman's $\rho = 0.600$; $p < 0.001$), which indicates that participants who assess that the existing methodology of risk assessment is effective in practice also assess that the current method of creating risk assessment meets the specific needs of the industrial sector in which they work.

There is a weak but statistically significant positive correlation (Spearman's $\rho = 0.20$, $p < 0.001$) between the evaluation of the benefits of digitization and the evaluation of the method's effectiveness. This means that respondents who rate digitization as more useful also have a slightly more positive opinion about the method's effectiveness. Although the relationship is weak, the statistical significance indicates that it is not coincidental.

A moderate positive correlation (Spearman's $\rho = 0.42$, $p < 0.001$) between assessments of management support and the method's effectiveness was found. This means that respondents who rate management support more highly also tend to rate the method's effectiveness higher.

The Mann–Whitney U test did not show a statistically significant difference in the evaluation of the method's effectiveness between respondents who think they have sufficient knowledge and those who do not ($p = 0.082$).

The Kruskal–Wallis test showed a statistically significant difference in perceived effectiveness of the risk assessment methodology based on the broader perceived quality benefits of standardization (Q17; $p < 0.05$). Post hoc analysis (Dunn's test with Bonferroni

correction) showed that there is a statistically significant difference in the assessment of the legislative framework between respondents who believe that the quality of risk assessment preparation would be improved by standardization ("Yes") and those who believe that it should not be ("No") ($p = 0.022$). There is a significant difference between "No" and "I don't know" ($p = 0.028$), whereas the difference between "Yes" and "I don't know" is not statistically significant. On the other hand, there are no significant differences in the risk assessment effectiveness found when examining the specific attitude toward legally mandating standardized risk assessments (Q19; $p = 0.259$).

The Mann–Whitney U test showed that there was no statistically significant difference in effectiveness perception between those who utilize digital tools in practice in the assessment and those who do not ($p = 0.984$). However, a weak but statistically significant positive correlation was established between the perceived practical utility of digitalization and the overall evaluation of the methodology's effectiveness (Spearman's $\rho = 0.20$, $p < 0.001$).

In addition, participants have been called to provide their qualitative comments and suggestions for improving the risk assessment process. In Figure 3 are three most frequently cited possibilities for improvement.

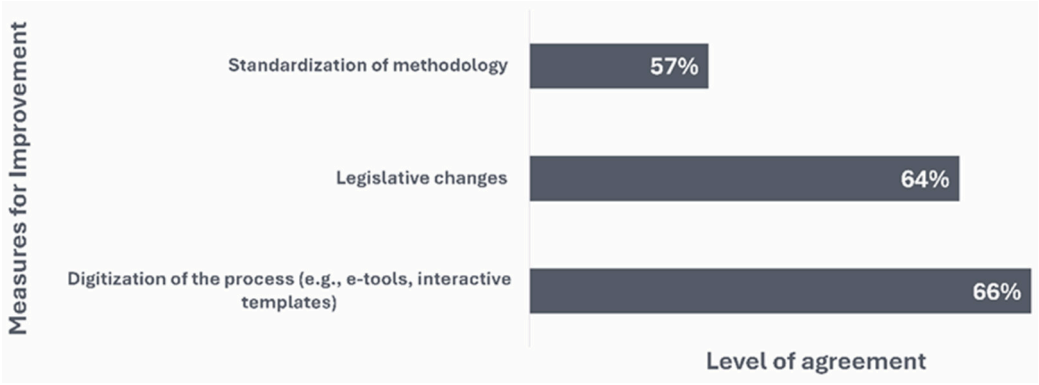


Figure 3. Responses to Q23: "What changes would you suggest to improve the risk assessment process?" Note: Categories were inductively coded from open-ended responses.

4. Discussion

This section analyses the research findings by addressing the epistemic uncertainty of expert knowledge and the gap between formal compliance and actual safety performance. The discussion further explores the critical roles of worker participation, management commitment, and safety culture, while examining the challenges of rigid standardization and regulatory design. Finally, the practical implications of these findings are considered alongside the study's limitations to provide a comprehensive foundation for policy proposals to improve practical methodological aspects of OHS.

4.1. Sample Adequacy and the Epistemic Uncertainty of Knowledge

It is an optimistic fact that as many as 967 people with the status of OHS experts in the Republic of Croatia (19.82%) participated in the research. This substantial response rate reinforces the reliability of the collected data, the practical validity of the results, and the great interest of OHS experts in the topic, providing a highly indicative overview of OHS expert perspectives.

While all the respondents had to be registered in the national ISZNR (meaning they have either passed the national professional examination for OHS experts or have had this status recognized by the Ministry) and almost half of the respondents have more than 10 years of experience in the OHS field, with almost half of them participating

occasionally (47%) and a quarter (27%) continuously, in the preparation and review of risk assessments, 39% of the respondents still believe that they do not have enough knowledge to independently prepare a risk assessment. This is an important and surprising finding that needs to be addressed in subsequent research to be adequately explained. The lack of knowledge about risk assessment preparation introduces significant uncertainty into the accuracy of the risk assessment results. This uncertainty stemming from a lack of knowledge or expertise is conceptually defined as epistemic uncertainty [33], which can be reduced through further learning. Introduced methodological standardisation reduces the influence of professional judgment (good or bad) on the result of risk assessment. However, the results suggest that this methodological standardisation, embodied in the 3 × 3 matrix, is perceived as inadequate. Instead, a higher level of professional judgment is required in preparing a risk assessment to capture the reality of workplace hazards.

The statistical discrepancy between less experienced and senior OHS experts fully supports the argument that more practical insight into complex workplace environments leads to a more critical evaluation of standardised risk assessment tools. The cross-analysis documented in Table S2 (Supplementary Data) reveals that less experienced experts tend to view the current risk assessment method more favourably than more experienced professionals ($p = 0.008$). This difference may suggest that more practical insight into complex workplace hazards leads to a more critical evaluation of standardised risk assessment tools and awareness of the limitations of standard 3 × 3 matrices. The identified dissatisfaction among more experienced OHS experts points to fundamental deficiencies in traditional safety risk assessment tools, such as the prescribed 3 × 3 risk matrices and standardised checklists within the ISZNR system. While these tools guarantee legal compliance, they often fail to capture the complexity of dynamic workplace hazards.

4.2. Formal Compliance Versus Actual Safety Performance

The finding that almost half of the respondents (44%) have a neutral perception of the effectiveness of the existing risk assessment method in practice could potentially suggest that the perspective of this group of respondents is mainly oriented toward the domestic legal framework, potentially due to a lack of direct experience with safety practices of the European Union and globally, leaving them without a comparative baseline. However, it likely reflects deeper systemic issues, signalling an awareness of the inherent limitations of rigid methodologies in capturing dynamic workplace risks. The inherent uncertainty of knowledge in complex socio-technical systems can manifest as uncertainty or ambiguity about the effectiveness of formal tools, leading OHS experts to remain neutral [24]. Furthermore, such responses could signal that experts have become so habituated to formalistic and bureaucratic processes that they no longer critically evaluate their actual effectiveness, a phenomenon described as "normalisation of deviance" [34], leading to its acceptance as the professional norm [35]. Finally, respondents may feel restricted by legacy regulatory structures that value procedural compliance over operational utility [19]. Thus, neutrality likely represents a pragmatic adaptation to the constraints of the existing regulatory system. The rest of the respondents, to a greater extent (33%), believe that the existing risk assessment method is effective in practice compared to those who perceive it as ineffective (23%).

A neutral attitude also dominating the assessment of the effectiveness of the prescribed process and methodology for developing risk assessments, and the suitability of the existing legislative framework for developing high-quality, practical risk assessments, might point to a similar conclusion.

Problems identified with the application of the existing risk assessment methodology are complex, with the main problems highlighted being an overly general approach (46%)

and insufficient adaptation to individual sectors (45%). Since only 32% of respondents agree that the current risk assessment methodology is sector-specific, this indicates that the 'one-size-fits-all' approach inherent in the current legislative framework may unintentionally promote a culture of pro forma compliance. The lack of strong sectoral differences, despite an initial significant result, indicates that the challenges of administrative formalism are likely a systemic issue across the entire OHS profession in Croatia, rather than being confined to specific industries.

The rigid application of the 3 × 3 matrix as mandated by legislation, while ensuring administrative uniformity, is identified by respondents as a key factor in the perceived formalism. This highlights the gap in the conceptual framework between 'Work-as-Imagined' by the legislator and 'Work-as-Done' by the experts, as previously described in literature [21]. Consequently, the fact that more than half of the respondents (56%) believe that risk assessments are often adjusted to formal requirements rather than reflecting the real state of the workplace clearly identifies a significant reality gap, which is a clear empirical manifestation of what is described as the drift toward symbolic compliance. This reality gap confirms that hazards in the Croatian context are often treated as isolated, linear components rather than emergent properties of complex interactions, a perspective central to contemporary safety science [24]. When these outcomes are viewed together, it is apparent that the risk assessment process is commonly perceived and treated as what prior research describes as a bureaucratic necessity [17] rather than an efficient tool for risk mitigation [36]. This is statistically supported by the strong correlation identified between the legislative framework and the perceived effectiveness of the method (Spearman's $\rho = 0.631$; $p < 0.001$), and is additionally reinforced by the previously noted discrepancy in experience levels: more experienced OHS experts (>10 years) are significantly more critical of the method's effectiveness than beginners, highlighting that extensive professional experience in the field exposes the fundamental deficiencies of these traditional, compliance-driven tools.

4.3. Worker Participation

In addition, inadequate worker participation in the assessment process (43%) and the lack of a detailed analysis of actual working conditions (42%) were often cited. In OHS management, worker involvement is a functional necessity for obtaining tacit knowledge and a key to accurate hazard identification [37]. The findings show that despite being a legal requirement, effective worker participation is often overlooked in practice. The high prevalence of these deficiencies suggests that a significant portion of risk assessments in Croatia are performed as 'desk-based' compliance exercises. This lack of empirical grounding explains the previously noted trend toward formalism: when the worker's perspective and the physical reality of the workplace are neglected, risk assessment cannot successfully serve as a proactive safety tool. Ultimately, this situation may be rooted in the current regulatory design, which prioritises the fulfilment of prescriptive administrative forms over goal-oriented safety performance, thus incentivising "paper safety" over proactive risk reduction.

4.4. The Role of Management and Safety Culture

A high rate of perceived management disengagement (58%) serves as a key obstacle to effective risk management. Without the input of decision-makers, who direct organizational resources and workflows, risk assessments lack the managers' safety commitment and the institutional authority to drive actual safety interventions. As highlighted in a recent systematic review, managers' safety commitment has been recognized not only as an important factor for creating the organisation's safety culture but as an independent factor that can influence organisations' safety performance and outcomes [38]. It further helps

contextualize the perceived inadequacy of workplace analysis (42%), since a lack of management commitment can structurally limit the organizational support and resources necessary for conducting risk assessment. The reported lack of management engagement among 58% of participants provides empirical support for the socio-technical framework [27], which identifies that safety outcomes are actively determined by organisational hierarchies and competing commercial pressures. The moderate positive correlation identified in this study between management support and the perceived effectiveness of the methodology ($\rho = 0.\ 418$, $p < 0.001$) further suggests that management support is a major determinant of perceived success of the methodology. In the absence of such engagement, risk assessment tools are often marginalised by competing organisational objectives, confirming that the effectiveness of formal safety tools is intrinsically linked to the wider organisational context. Such a lack of institutional support effectively undermines the methodology's functional utility, reducing it to a peripheral administrative task rather than a proactive safety tool. In the Croatian OHS context, this disengagement may be further compounded by legacy constraints—historical, regulatory, and structural barriers which focus on procedural compliance over operational learning [19]. As suggested by empirical research on safety culture in Croatia [39], risk assessment is embedded in rigid top-down hierarchies, and management's interest and involvement in safety is rated merely "satisfactory", reinforcing a 'pro-forma' safety environment. Consequently, the observed lack of support is likely a symptom of an organisational culture where safety is still perceived as a static legal obligation rather than a value to be integrated into the core business strategy. Given the requirements for management involvement, the wider application of ISO 45001 in Croatian companies would also contribute to greater management engagement and involvement in the development of risk assessments [40].

4.5. Regulatory Design and the Challenges of Rigid Standardisation

A review of respondents' open-ended comments provides deeper insight into the real challenges and suggestions for improving the risk assessment process. Comments clearly confirm the research's quantitative findings and provide an enhanced insight into how legacy risks [19] manifest in daily practice, where systems inherit constraints that limit practical improvements. OHS experts point out the need for greater flexibility of the methodology, standardization of templates, digitalization of processes, and greater involvement of workers and multidisciplinary teams. Their suggestions may indicate the direction of future improvements and function as a valuable basis for developing specific recommendations. In the Croatian OHS context, the use of risk assessment methodology persists not because it is effective, but because it is so prescribed in a legacy regulatory framework that focuses on formal compliance over operational utility and limits the practical improvements that experts clearly advocate.

Although 57% of respondents support mandatory methodological standardisation, this finding should be interpreted with caution. While seeking (further) standardisation is typically intended to ease administrative burdens and ensure consistency, contemporary literature warns that over-standardisation can paradoxically reduce adaptability [27]. Rigid standardized procedures often fail to capture emergent risks across various sectors [24]. Therefore, the call for standardised templates should be viewed as a demand for more efficient administrative frameworks to ensure consistency while allowing for the methodological flexibility required for specific industrial sectors, rather than a preference for a rigid, "one-size-fits-all" safety model.

When correlating survey findings with the employed risk assessment matrix mandated by current regulations, a clear structural deficiency emerges. The research results clearly indicate that from the perspective of the surveyed OHS experts, the current ap-

proach encounters substantial systemic deficiencies, since such a simplified tool often fails to represent the complexity of dynamic work environments. Unlike more advanced international tools [1], which allow for a more subtle understanding of risk controls, the current national framework encourages a "tick-box" approach. The findings of this study provide empirical support for the research hypothesis, showing that experts widely perceive the prescribed methodology as ineffective. This is reflected in the insufficient commitment from management, the concentration on formal compliance instead of practical safety, and the methodology's inability to address the diverse requirements of specific sectors. To address these deficiencies and improve the current process and risk assessment methodology, semi-automated, sector-specific digital templates are suggested with a flexible framework and methodology adaptable to various working conditions. Such improvements should move away from static models toward dynamic, digitalised and participatory assessment tools that would transform risk assessment from a periodic bureaucratic obligation into a proactive safety management instrument.

4.6. Limitations of the Study

Several limitations should be considered to ensure a balanced interpretation of the findings. First, this research uses a perception-based design, relying on self-reported data that reflects subjective attitudes of OHS experts, rather than an objective audit or documentary validation of actual risk assessments. Second, although developed from literature, the survey instrument did not undergo formal statistical validation or pilot testing, which may affect the psychometric depth of the findings. Third, while the 19.82% response rate (n = 967) is substantial, the sample is indicative rather than strictly representative. Probability of response bias (self-selection and non-response) may exist, as experts with stronger opinions on the system's deficiencies might have been more motivated to participate, while the views of the 80.18% who did not respond could differ. However, to reduce this, the survey was conducted anonymously through the official ISZNR registry to ensure broad representation across sectors and experience levels and to promote honest, unbiased feedback. Further, a precise demographic comparison with the total population was limited by the lack of specific data in the ISZNR registry. Fourth, the cross-sectional nature of the study reflects the OHS system at a specific point in time, limiting the ability to draw causal inferences. Finally, while the applicability of the findings is primarily limited to the Croatian regulatory context, they reflect challenges common to many OHS systems. The high internal consistency and broad sectoral representation provide a relevant consensus on the current state of OHS practice in Croatia that transcends the local context. The findings provide valuable insights into the widespread challenges of administrative formalism and the limitations of rigid risk assessment models, making this study highly relevant for international OHS policymaking and the continuing global debate on shifting from safety-as-compliance to safety-as-practice.

5. Conclusions

The findings are built on comprehensive empirical research of the risk assessment process in the Republic of Croatia from the perspective of OHS experts. The results partially confirm the research hypothesis. The study reveals a strong professional consensus that the practical effectiveness of the prescribed risk assessment methodology is significantly undermined by a trend toward formal compliance rather than substantive risk mitigation.

The majority of respondents (56%) cite more than one problem in applying the existing risk assessment method, with a general approach that fails to meet the specific needs of different industrial sectors identified among the biggest problems. The survey results reveal that 56% of OHS experts indicate that risk assessments are frequently adjusted to satisfy

formal legal requirements rather than to reflect actual workplace conditions, suggesting a perceived critical "reality gap". Further findings reveal that the process is further weakened by the lack of active engagement at the management level (58%) and inadequate worker participation (43%).

In view of these challenges, the study discloses a strong consensus among experts on the need for improvement. OHS experts point out the need for greater flexibility of the methodology to more effectively suit specific workplace conditions, while demanding standardised templates and digitalisation of processes to minimize bureaucratic inconsistency. Furthermore, there is a clear call for greater stakeholder engagement to ensure that risk assessments move beyond mere legal compliance toward functional safety.

Recommendations for continuing the research range from the possibility of a more detailed analysis of the data collected, such as analysis by industry, by years of work experience, etc., and comparison of such results with the results of the entire study, testing the statistical significance of the difference, to further research on possible improvements and developing specific recommendations.

The research method applied facilitated the collection of data from a large-scale sample. The approach of using the official national system, ISZNR, demonstrated practical advantages for future research as it enables transparent, fast, and efficient information, and the inclusion of experts from different sectors and regions in the Republic of Croatia.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/safety12030083/s1, Survey Questionnaire; Table S1: Comprehensive summary of survey results—Detailed distribution of responses across all 24 survey questions; Table S2: Summary of inferential statistical analyses conducted on questionnaire responses (n = 967).

Author Contributions: D.P. and T.K. conceived the ideas and created the survey; T.K. collected and analysed the data; D.P. advised on interpretation and reviewed the manuscript; A.R.M. led the writing. All have agreed on the journal to which the article has been submitted and all agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was received formal ethical exemption from the Ethics Committee of the University of Applied Sciences in Security and Safety (CLASS: 602-04/23-03/70; ID NUMBER: 251-376-01-23-306; approved on 14 April 2026). The study was hence conducted in accordance with the COPE guidelines regarding ethics since ethical review and approval were waived for this study by the Ethics Committee of our institution (in accordance with Article 55 of the Croatian Act on Higher Education and Scientific Activity). This exemption was granted because the research involved a completely anonymous online survey of professionals via the national OHS register (ISZNR), ensuring that no personal identifiable data were collected and the study posed no risk to participants.

Informed Consent Statement: All participants provided written informed consent prior to enrolment.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, upon reasonable request.

Acknowledgments: The authors would like to express their sincere gratitude to the Ministry of Labour, Pension System, Family and Social Policy of the Republic of Croatia, specifically the Directorate for Labour and Occupational Safety, for their significant contribution to this research project. Their support was instrumental in facilitating access to the target population through the ISZNR, the official national electronic registry for OHS experts. We particularly acknowledge the Ministry's efforts in coordinating the distribution of survey invitations. This collaboration was essential to the successful execution and high response rate of this study.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. While the Ministry of Labour, Pension System, Family and Social Policy of the Republic of Croatia assisted in the data collection, the Ministry had no role in the study design, the collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the results for publication. The views expressed in this article are strictly those of the authors and do not necessarily reflect the official policy or position of the Ministry.

Abbreviations

The following abbreviations are used in this manuscript:

OHS	Occupational health and safety
ISZNR	Information System for Occupational Safety of the Republic of Croatia

References

1. Kuricová, A.; Hudáková, M.; Kočkár, S.; Hollá, K. An Innovative Approach to Occupational Risk Assessment in OHS: A Case Study on the Verification of the ALrisk Model in Manufacturing Enterprises in Slovakia. *Int. J. Environ. Res. Public Health* **2025**, *22*, 757. [CrossRef]
2. Republic of Croatia. *Zakon o zaštiti na radu [Occupational Health and Safety Act]*; 71/14, 118/14, 94/18, 96/18; Narodne Novine [Official Gazette]: Zagreb, Croatia, 2014.
3. Republic of Croatia. *Pravilnik o zaštiti na radu za mjesta rada [Ordinance on Occupational Health and Safety for Workplaces]*; 105/20; Narodne Novine [Official Gazette]: Zagreb, Croatia, 2020.
4. Republic of Croatia. *Pravilnik o izradi procjene rizika [Ordinance on Risk Assessment]*; 112/14, 129/19; Narodne Novine [Official Gazette]: Zagreb, Croatia, 2014.
5. Cowi A/S. Evaluation of the Practical Implementation of the EU Occupational Safety and Health (OSH) Directives in EU Member States: Synthesis Report. European Commission. 2015. Available online: https://zssszaupnikvzd.si/wp-content/uploads/2017/09/OSH_DIR-SYNTHESIS-REPORT_2_0.pdf (accessed on 10 April 2026).
6. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Practical Implementation of the Provisions of the Health and Safety at Work Directives 89/391 (Framework), 89/654 (Workplaces), 89/655 (Work Equipment), 89/656 (Personal Protective Equipment), 90/269 (Manual Handling of Loads) and 90/270 (Display Screen Equipment). 2004. Available online: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2004:0062:FIN:EN:PDF (accessed on 10 April 2026).
7. Walters, D.; Wadsworth, E. Analysis of the Determinants of Workplace Occupational Safety and Health Practice in a Selection of EU Member States. European Agency for Safety and Health at Work. 2013. Available online: https://osha.europa.eu/sites/default/files/esener-determinants.pdf (accessed on 10 April 2026).
8. Palačić, D. Principles and Philosophy of Occupational Health and Safety Management—Basic Features. *Facta Univ. Ser. Work. Living Environ. Prot.* **2025**, *22*, 77–88. [CrossRef]
9. Katić, T.; Palačić, D. Preparation of occupational health and safety risk assessment in the Republic of Croatia. *Glob. J. Bus. Integr. Secur.* **2023**, *1*, 1–12. Available online: https://www.gbis.ch/index.php/gbis/article/view/146 (accessed on 10 April 2026).
10. Palačić, D. Occupational Health and Safety Risk Management Model. In Proceedings of the 16th International Conference Management and Safety, Online, 18 June 2021; pp. 52–63.
11. Palačić, D.; Lalić, Ž.; Pintarić, L.J.; Kurbanjev, D. Analiza modela procesa upravljanja zaštitom na radu u Republici Hrvatskoj [Analysis of the occupational safety management process model in the Republic of Croatia]. *Sigurnost* **2020**, *62*, 139–150.
12. Šokčević, S. Zakon o zaštiti na radu-prijedlozi de lege ferenda [Occupational Health and Safety Act—De lege ferenda proposals]. *Sigurnost* **2012**, *54*, 11–19.
13. Učur, M.Đ. Procjena rizika (na radu), nomotehničke oznake i pravna narav [Risk assessment (at work), nomotechnical designations and legal nature]. *Sigurnost* **2017**, *59*, 27–36.
14. Alli, B.O. *Fundamental Principles of Occupational Health and Safety*, 2nd ed.; International Labour Organization: Geneva, Switzerland, 2008.
15. Borghesi, A.; Gaudenzi, B. *Risk Management: How to Assess, Transfer and Communicate Critical Risks*; Springer: Milan, Italy, 2013.
16. Hansson, S.O. Managing Risks of the Unknown. In *Risk Analysis of Natural Hazards*; Gardoni, P., Murphy, C., Rowell, A., Eds.; Springer Cham: Heidelberg, Germany, 2016; pp. 155–172.
17. Dekker, S.W. The bureaucratization of safety. *Saf. Sci.* **2014**, *70*, 348–357. [CrossRef]
18. Rae, A.J.; Provan, D.J.; Weber, D.E.; Dekker, S.W.A. Safety Clutter: The accumulation and persistence of 'safety' work that does not contribute to operational safety. *Policy Pract. Health Saf.* **2018**, *16*, 194–211. [CrossRef]

19. Ale, B.J.M.; Hartford, D.N.D.; Slater, D.H. Living with Legacy Risk-The Limits of Practicalities? *Sustainability* **2021**, *13*, 3004. [CrossRef]
20. Hasle, P.; Limborg, H.J. A Review of the Literature on Preventive Occupational Health and Safety Activities in Small Enterprises. *Ind. Health* **2006**, *44*, 6–12. [CrossRef]
21. Hollnagel, E.; Wears, R.L.; Braithwaite, J. *From Safety-I to Safety-II: A White Paper*; Resilient Health Care Net: Middelfart, Denmark, 2015. [CrossRef]
22. Hale, A.; Borys, D. Working to rule, or working safely? Part 1: A state of the art review. *Saf. Sci.* **2013**, *55*, 207–221. [CrossRef]
23. Cox, L.A. What's Wrong with Risk Matrices? *Risk Anal.* **2008**, *28*, 497–512. [CrossRef]
24. Dekker, S.W.; Cilliers, P.; Hofmeyr, J.-H. The complexity of failure: Implications of complexity theory for safety investigations. *Saf. Sci.* **2011**, *49*, 939–945. [CrossRef]
25. Rodrigues, M.A.; Rubio-Romer, J.; Arezes, P.M.; Soriano-Serrano, M. Occupational risk assessment at Olive Oil Mills: Limitations and new perspectives. *DYNA* **2015**, *83*, 21–26. [CrossRef]
26. Zohar, D. Thirty years of safety climate research: Reflections and future directions. *Accid. Anal. Prev.* **2010**, *42*, 1517–1522. [CrossRef] [PubMed]
27. Komljenovic, D.; Loiselle, G.; Kumral, M. Organization: A new focus on mine safety improvement in a complex operational and business environment. *Int. J. Min. Sci. Technol.* **2017**, *27*, 617–625. [CrossRef]
28. Rasmussen, J. Risk management in a dynamic society: A modelling problem. *Saf. Sci.* **1997**, *27*, 183–213. [CrossRef]
29. Reason, J. The Contribution of Latent Human Failures to the Breakdown of Complex Systems. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **1990**, *327*, 475–484. [CrossRef]
30. Friend, M.A.; Kohn, J.P. *Fundamentals of Occupational Safety and Health*, 4th ed.; Government Institutes: Lanham, MA, USA, 2007.
31. Obasi, I.C.; Benson, C. The Impact of Digitalization and Information and Communication Technology on the Nature and Organization of Work and the Emerging Challenges for Occupational Safety and Health. *Int. J. Environ. Res. Public Health* **2025**, *22*, 362. [CrossRef]
32. Revelle, W. *psych: Procedures for Psychological, Psychometric, and Personality Research*; Northwestern University: Evanston, IL, USA, 2025.
33. Möller, N. Analysing safety: Epistemic uncertainty and the limits of objective safety. In *WIT Transactions on The Built Environment-Safety and Security Engineering*; Brebbia, C.A., Bucciarelli, T., Garzia, F., Guarascio, M., Eds.; WIT Press: Southampton, UK, 2005; pp. 63–72. [CrossRef]
34. Vaughan, D. *The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA*; The University of Chicago Press: Chicago, IL, USA, 1996.
35. Hopkins, A. *Safety, Culture and Risk: The Organizational Causes of Disasters*; CCH Australia: Sydney, Australia, 2005.
36. Möller, N. The Concepts of Risk and Safety. In *Handbook of Risk Theory*; Roeser, S., Hillerbrand, R., Sandin, P., Peterson, M., Eds.; Springer: Dordrecht, Germany, 2012; pp. 55–85.
37. Podgórski, D. The use of tacit knowledge in occupational safety and health management systems. *Int. J. Occup. Saf. Ergon.* **2010**, *16*, 283–310. [CrossRef]
38. Levovnik, D.; Aleksić, D.; Gerbec, M. Exploring the research on managers' safety commitment through the prism of leadership. Part 2: A systematic literature review. *J. Loss Prev. Process Ind.* **2024**, *92*, 105460. [CrossRef]
39. Palačić, D. Istraživanje razvoja i utjecaja kulute sigurnosti na sustav upravljanja sigurnošću [Study in the Development and Impact of Safety Culture on Safety Management]. *Sigurnost* **2010**, *52*, 105–112.
40. Palačić, D. ISO 45001:2018—Concept of managing the process of occupational health and safety. *Saf. Eng.* **2019**, *9*, 13–21. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.