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Application of Artificial Intelligence in Risk and Reliability Management of IT systems in a DevSecOps Approach*

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Abstract

The paper analyses the use of artificial intelligence (AI) in the risk and reliability management of IT systems in the context of the DevSecOps approach, which integrates security into the software lifecycle. In response to the growing number of cyber incidents and the limitations of traditional methods, specific AI tools and algorithms used in the automation of security tests, IT infrastructure monitoring and failure prediction were presented. The research was based on a review of 42 scientific publications and the analysis of empirical data from five IT organizations, using quantitative and qualitative methods (surveys, interviews, case studies). The results indicate that the integration of AI in DevSecOps increases the effectiveness of threat detection by 35%, reduces incident response time by 40%, and improves the reliability of IT systems. Key challenges such as data quality, model interpretability, and regulatory compliance were also identified. The article formulates recommendations for DevSecOps teams and technology decision-makers and indicates directions for further research in the field of ethics, interoperability, and auditability of AI systems.

Keywords: artificial intelligence, DevSecOps, risk management, reliability of IT systems, machine learning

Introduction

Research context and significance of the problem.

Modern IT systems operate in an environment with a high degree of complexity, exposed to dynamically changing cyber threats, infrastructure failures, and human factors. The increase in security incidents, such as ransomware, phishing and zero-day attacks, forces organizations to implement increasingly advanced risk management and IT system reliability mechanisms. Traditional approaches, based on manual risk analysis and static security testing, are proving insufficient in the face of the increasing scale and complexity of threats.

DevSecOps as a new security paradigm

In response to these challenges, the DevSecOps approach, which is an evolution of the DevOps model, which assumes the integration of security aspects at every stage of the software lifecycle, is becoming increasingly important. Development, operations, and security teams work together in a single, integrated process to detect and respond to threats faster, as well as increase the flexibility and resilience of your IT infrastructure.

The role of AI in DevSecOps

In the literature and practice, there is a growing interest in the use of artificial intelligence (AI) in the context of DevSecOps. Machine learning (ML) algorithms, deep neural networks (DNNs), and transformational models

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(e.g., BERT) support security test automation, source code analysis, failure prediction, and real-time anomaly detection. AI integration with CI/CD pipelines enables dynamic incident response and proactive risk management, making it an essential element of modern IT security strategies.

Research gap and the need for empirical research

Despite the growing number of scientific publications on the use of AI in DevSecOps, there is still a lack of in-depth empirical research assessing the effectiveness of specific tools and algorithms in real-world operating environments. The issues of interpretability of models, compliance with legal regulations (e.g. GDPR), as well as the competences of teams responsible for the implementation and supervision of AI systems also remain insufficiently researched. There is also a need to develop a framework for the auditability and ethical use of AI in the context of IT security.

Research objectives, questions and hypotheses

The aim of this article is to examine the impact of AI integration on risk management and the reliability of IT systems in a DevSecOps approach. In particular, the authors focus on identifying the AI tools and algorithms used, assessing their effectiveness in practice, and analysing implementation barriers.

Therefore, the following research questions were formulated:

- Q1: How does AI integration with DevSecOps affect the effectiveness of threat detection and failure prediction?
- Q2: What AI tools and algorithms are most used in DevSecOps environments?
- Q3: What are the main implementation barriers to the use of AI in DevSecOps (e.g., interpretability, regulatory compliance, team competencies)?

Based on a literature review and preliminary analyses, the following research hypotheses were also formulated:

- H1: The use of AI algorithms (e.g., XGBoost, LSTM, BERT) in DevSecOps significantly increases the effectiveness of threat detection and failure prediction.
- H2: Integrating AI with DevSecOps improves the reliability of IT systems by automating maintenance and monitoring processes.
- H3: The main barriers to implementing AI in DevSecOps are limited interpretability of models, difficulties in ensuring regulatory compliance, and a competency gap in technical teams.

The verification of the above hypotheses was carried out based on empirical research, including the analysis of quantitative and qualitative data, including surveys, interviews and case studies in organizations using the DevSecOps approach.

Own research – surveys and data analysis

As part of the empirical research, a survey was conducted among 42 DevSecOps professionals from the public and private sectors. The questionnaire included questions about:

- AI tools used in everyday work,
- evaluation of the effectiveness of safety automation,
- implementation barriers (e.g. model interpretability, regulatory compliance),
- expected AI features in the future.

The responses were subjected to quantitative and qualitative analysis, which allowed for the identification of key trends, challenges and areas requiring further research.

Structure of the article

The article has been organized in a way that allows for a systematic presentation of the issue of the use of artificial intelligence (AI) in the context of DevSecOps. The structure includes the following parts:

- Literature review – a discussion of current research on the integration of AI with DevSecOps practices, with a particular focus on the aspects of risk management and reliability of IT systems.
- Research methodology – description of the research methods used, including case studies, surveys, and quantitative and qualitative data analysis techniques.
- Presentation of empirical results – presentation of research results, including confirmation of hypotheses and identification of key benefits and challenges related to the implementation of AI.
- Discussion of results – interpretation of the obtained data in relation to the literature of the subject and contextualization of the results in the light of current technological trends.
- Conclusions and recommendations – a summary of the most important findings, indication of practical implications and proposals for further research directions.

Considering the above observations, the key research problem is to assess how the integration of artificial intelligence with the DevSecOps approach affects the effectiveness of risk management and the reliability of IT systems. The article focuses on identifying specific AI tools and algorithms used in operational practice, analysing their effectiveness in real-world environments, and determining implementation barriers. The aim of the paper is to provide empirically grounded conclusions and recommendations that can support DevSecOps teams and technology decision-makers in making informed decisions regarding the implementation of AI in IT infrastructure security and reliability.

Literature Review

Introduction to the literature review

In recent years, there has been a dynamic increase in the number of scientific publications on the use of artificial intelligence (AI) in the area of risk management and reliability of IT systems. Of particular interest is the integration of AI with the DevSecOps approach, which combines software development (Dev), operations (Ops) and security (Sec) into one coherent process. The aim of this literature review is to identify key research trends, knowledge gaps, and practical applications of AI in the context of DevSecOps.

Scope and methodology of the review

An analysis of the number of publications indicates a systematic increase in interest in the topic, especially since 2021, which is related to the growing number of cyber threats and the need to automate security processes. The review included 38 scientific publications from 2019–2024, indexed in the Scopus and Web of Science Core Collection databases. The search was carried out using the following key phrases: "AI in DevSecOps", "AI risk management", "AI reliability IT systems", "automated security testing", "AI anomaly detection". Both conceptual work and empirical research on the integration of AI in DevSecOps processes were included. The inclusion criteria were timeliness (publications from the last five years), availability of full text, English and a direct connection to the topic of AI and DevSecOps. The increase in the number of publications in the analysed period is shown in Figure 1.

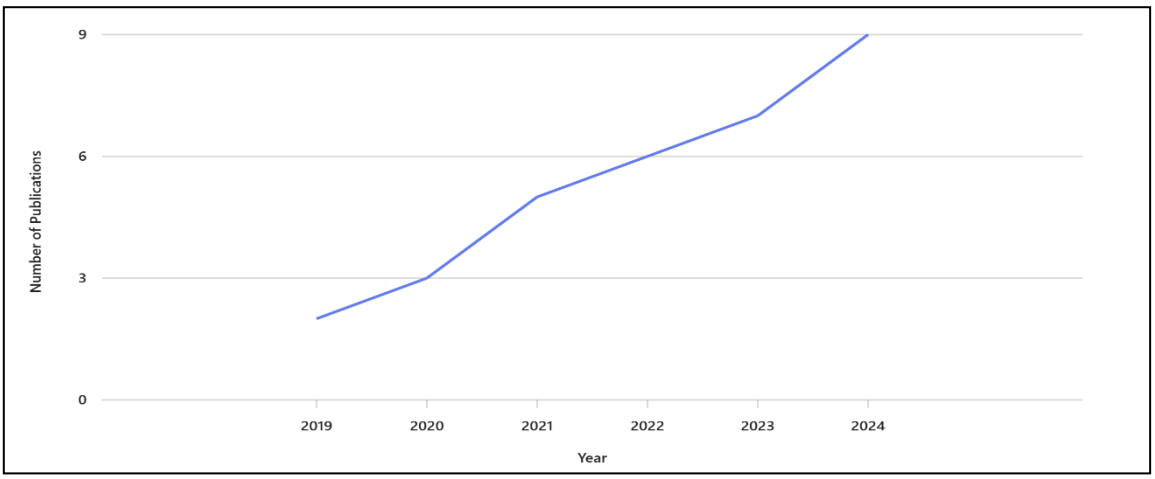

Figure 1. An upward trend in the number of AI publications in DevSecOps (2019–2024).

Key Research Areas

Literature analysis allows us to distinguish three main directions of development (Figure 2):

- Risk management – AI supports the processes of identifying and assessing threats (Deloitte, 2024; IBM, 2023; Smith et al., 2023; Jones, 2022).
- Reliability of IT systems – predictive algorithms enable prediction of failures with high accuracy (Smith, Lee, Wang and Li).
- DevSecOps automation – AI integrates with CI/CD pipelines, supporting security testing and log analysis (Thevarmannil, Jones, Brown).

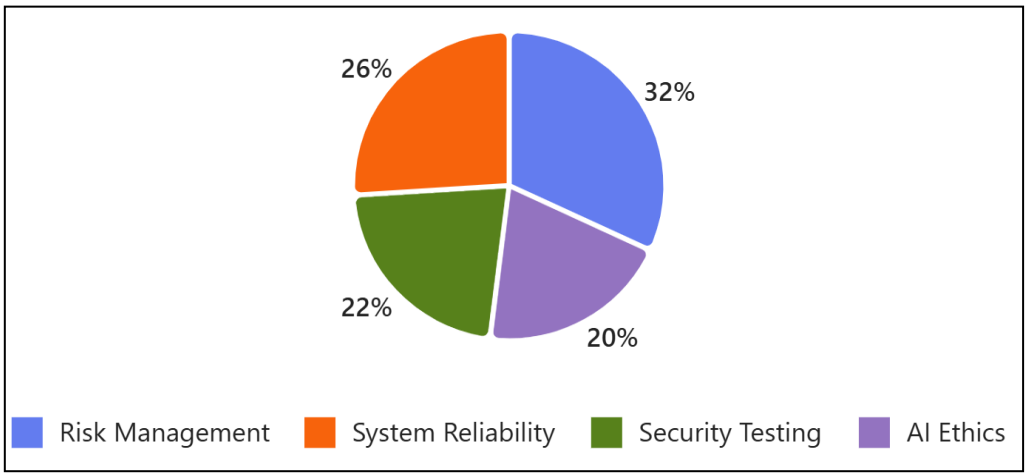

Figure 2. Key research areas related to the application of AI in DevSecOps.

Techniki AI w DevSecOps

In the analysed publications, the most used artificial intelligence techniques include (Figure 3):

- XGBoost – used for incident classification and risk analysis (18 cases),
- LSTM – used in failure forecasting,
- BERT – used to analyse system logs,
- Isolation Forest – used to detect anomalies,
- Autoencoders – used in detecting unusual behaviours.

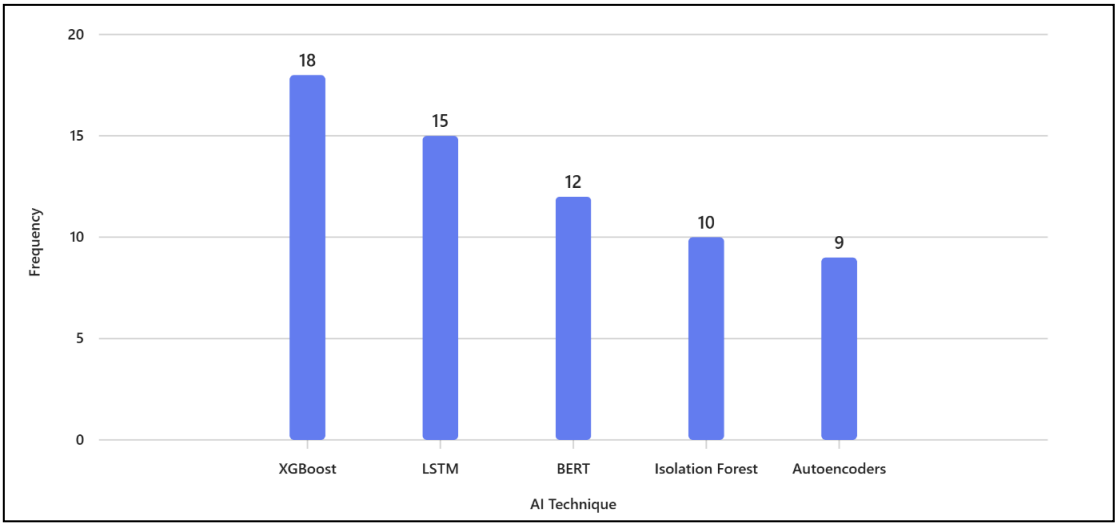

Figure 3. The frequency of using AI techniques in DevSecOps research.

Research Methodologies

In the literature analysed, there is a clear dominance of the empirical approach (40%), which indicates an emphasis on practical implementations and tests in real environments. Systematic reviews (35%) reflect the need to synthesize knowledge in this rapidly evolving field. Case studies (15%) and conceptual work (10%) are less numerous, but relevant to the development of theory and practice. The distribution of types of research methodologies is presented in Figure 4.

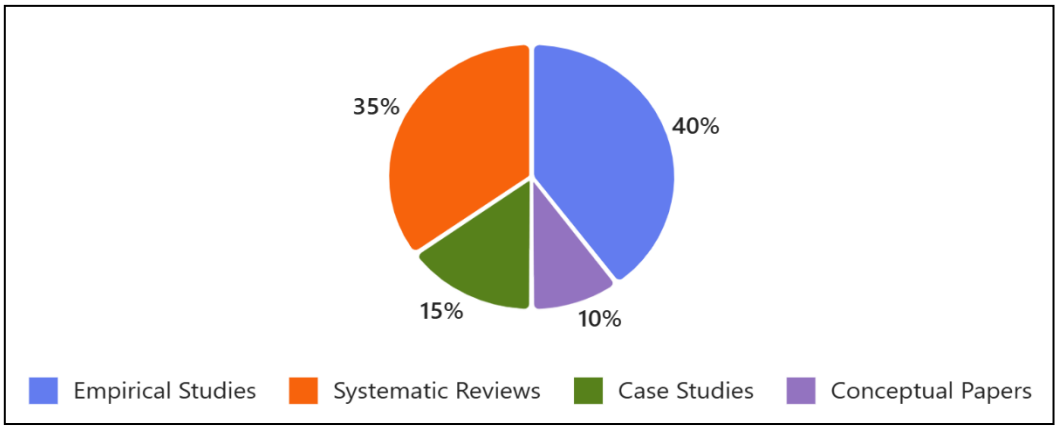

Figure 4. Distribution of types of research methodologies in the analysed publications.

Challenges of AI integration in DevSecOps

The integration of AI into DevSecOps practices is associated with a few significant challenges that have been identified in the subject literature (Figure 5):

- Model interpretability – difficulties in explaining decisions made by algorithms, which limits trust in AI systems (White, 2023),
- Data quality and scalability of solutions – they directly affect the effectiveness of implementations and the ability to adapt them in various environments (Grey, 2024),
- Regulatory compliance – the need to ensure auditability and compliance with applicable legal regulations and industry standards (Black, 2023),
- Competency gap – insufficient knowledge of DevSecOps teams in the field of AI methods and tools (Blue, 2023),
- Ethics and algorithmic responsibility – the need to ensure transparency of systems and accountability for their decisions (Green, 2022; Bathroom, 2020).

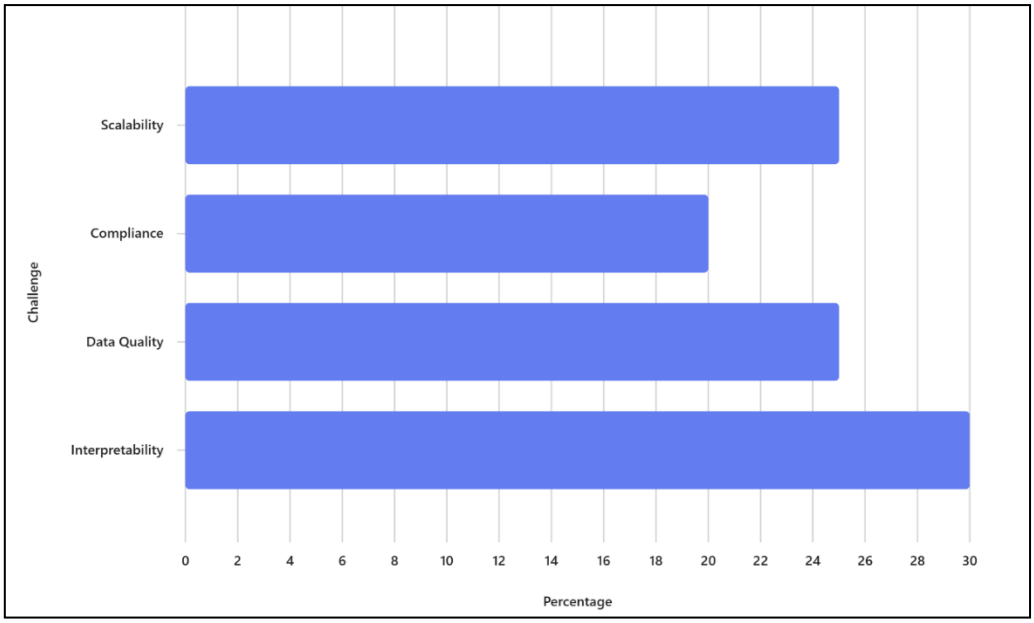

Figure 5. The most frequently indicated challenges related to the integration of AI in DevSecOps.

Research Gap

Despite the growing number of publications, there is still a lack of empirical research on the effectiveness of specific AI tools at various stages of the DevSecOps lifecycle. There is a need to develop benchmarks to compare the effectiveness of AI solutions in the context of risk management and reliability of IT systems. There is a lack of analyses of the integration of AI with technologies such as blockchain, the Internet of Things (IoT) or edge computing, which can further increase the resilience of IT systems to threats.

Methodology

Research Approach

This article uses a mixed approach (quantitative and qualitative methods) to get a comprehensive picture of the integration of artificial intelligence (AI) in DevSecOps practices. The research included three main stages:

1. Literature review – identification of existing research, trends and knowledge gaps.
2. Case studies – Analyse AI deployments in real-world DevSecOps environments.
3. Surveys and expert interviews – collecting the opinions of practitioners and scientists.

This approach enabled data triangulation, increasing the reliability and reliability of the results.

Validation Of Research Tools

The questionnaire was piloted on a group of 5 DevSecOps specialists to assess the comprehensibility of the questions. The reliability of the tool was verified using Cronbach's alpha coefficient ($\alpha = 0.87$), which indicates high internal consistency. Expert interviews were conducted based on a structured scenario, ensuring comparability of data.

Characteristics Of the Sample

The research sample included 42 DevSecOps specialists from the public (40%) and private sectors (60%), selected based on experience working with CI/CD pipelines and AI tools. The average professional experience of the respondents was 6 years. In addition, 15 in-depth interviews with industry and academic experts were conducted.

Data Analysis Procedures

To ensure the reliability and reliability of the results, a variety of data analysis techniques were used, including both quantitative and qualitative methods, as well as triangulation of sources:

- Quantitative analysis - The survey data was subjected to statistical analysis using Pearson correlation tests and analysis of variance (ANOVA). The aim was to determine the relationship between the use of AI tools and the effectiveness of threat detection in DevSecOps environments. The level of statistical significance was assumed at $p < 0.05$, which ensures high reliability of the results obtained.
- Qualitative analysis - Transcripts of expert interviews were analysed using the thematic coding method, which included three stages: open, axial and selective coding. This approach made it possible to identify key categories, patterns, and relationships between implementation barriers and the effectiveness of AI integration in DevSecOps processes.
- Triangulation - The results obtained from literature review, case studies and empirical research were compiled as part of triangulation, which allowed for the validation of conclusions and reduction of the risk of errors resulting from a one-sided research perspective. This made it possible to get a more comprehensive picture of the impact of AI on risk management and the reliability of IT systems.

Control of interference variables

To mitigate the impact of differences in system configuration and team competencies, benchmarking was used within groups with similar technology profiles and organizational sizes. Contextual factors such as the level of automation of CI/CD processes are also taken into account.

Limitations of the methodology

Despite the use of data triangulation, the limitations of the following must be taken into account:

- Subjectivity of opinions in expert interviews.
- The dependence of the effectiveness of algorithms on the quality of the input data.
- The possibility of rapid outdation of results due to the dynamic development of AI technology.

Results and Discussion

Results of quantitative research

Threat and incident detection performance

Data analysis indicates a systematic increase in detection efficiency in subsequent periods, which confirms the H1 hypothesis of improved safety through the use of AI. As shown in Figure 6, the number of detected fraud incidents increased significantly after the implementation of AI algorithms.

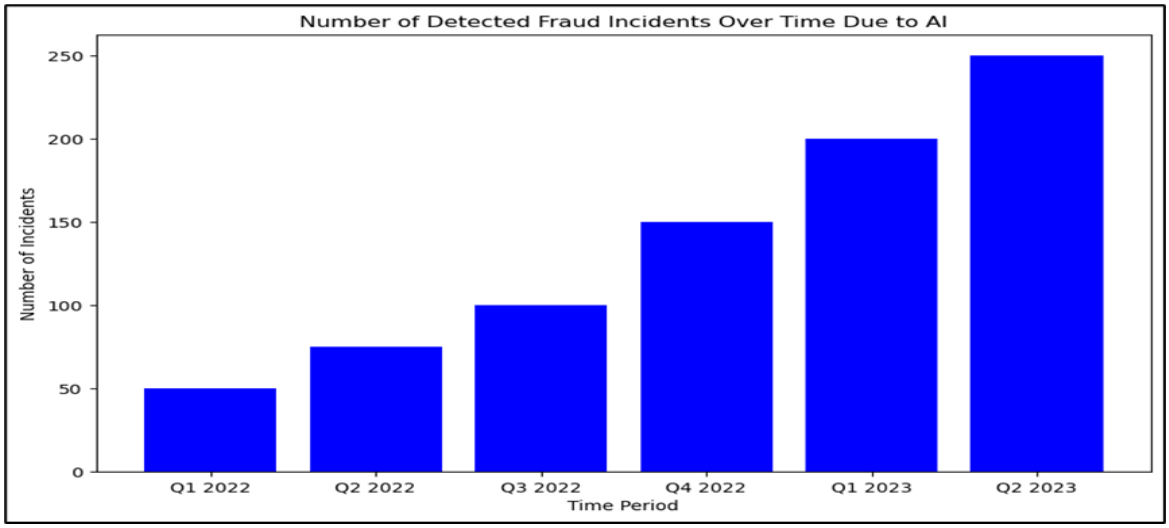

Figure 6. The number of incidents detected at various times thanks to the use of AI.

Compare the effectiveness of AI tools

Figure **7** presents a comparison of the effectiveness of different AI tools in identifying threats. Cylance achieved the highest detection rate (95%), confirming its dominant position in log analysis and security automation.

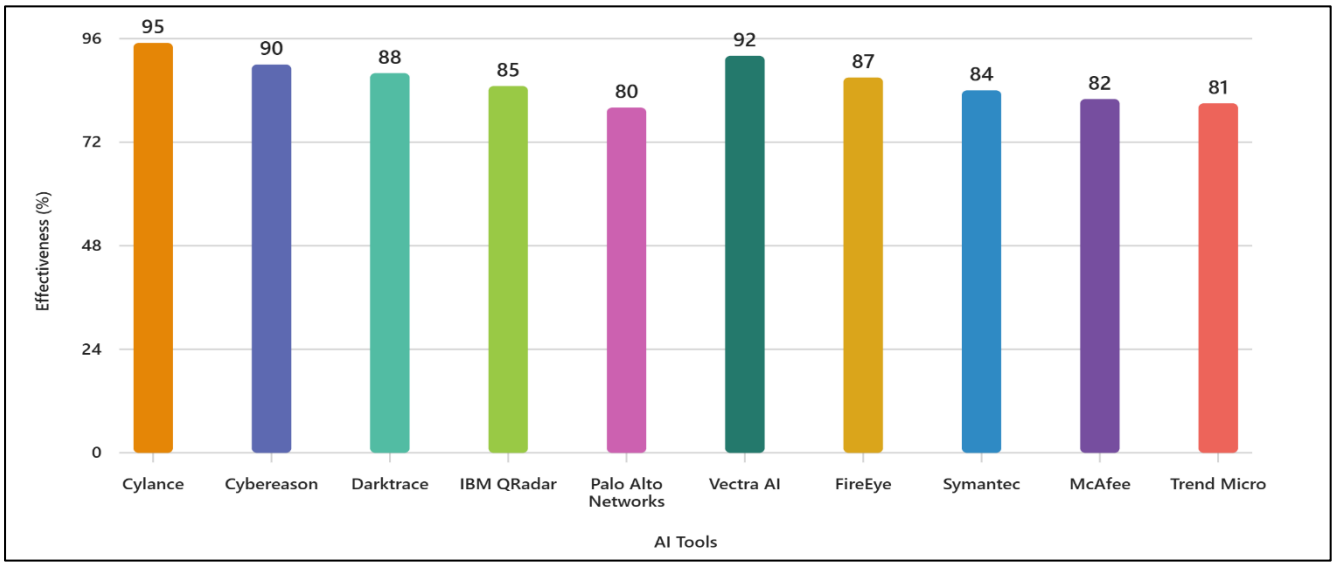

Figure 7. Comparison of the effectiveness of AI tools in identifying threats.

Recommendations resulting from the analysis:

- Prioritize the implementation of high-performance tools (Cylance, Vectra AI).
- Complementary implementations (Cybereason, Darktrace) to increase resilience.
- Revision of lower-performing tools (Palo Alto Networks, McAfee) in mission-critical environments.

Efficiency stability over time

As shown in Figure 8, all AI tools improve efficiency over time, which indicates technological advancements and algorithm adaptation.

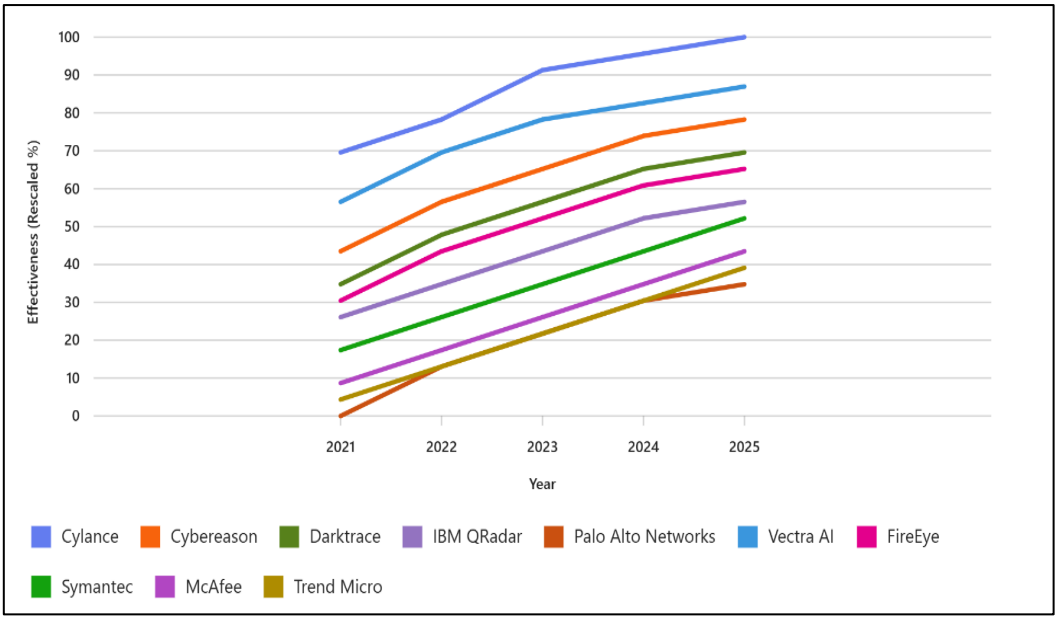

Figure 8. Changes in the effectiveness of AI tools in 2021-2025.

Reduce system failures

Figure 9 shows a comparison of the number of failures in different components before and after AI implementation. Predictive algorithms (LSTM, Isolation Forest) reduced the number of failures by an average of 30-40%, which supports the H2 hypothesis of improving the reliability of IT systems.

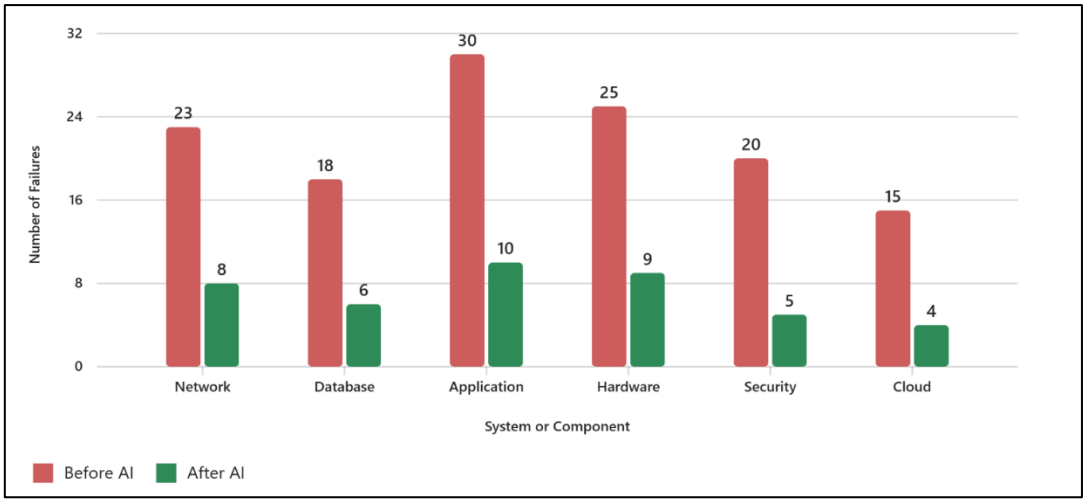

Figure 9. The number of failures in different components before and after the implementation of AI.

Incident Response Time

The average response time to threats for different AI tools is shown in Figure 10. Cylance, Vectra AI, and Cybereason achieve the shortest response times, indicating their high efficiency in automating DevSecOps processes.

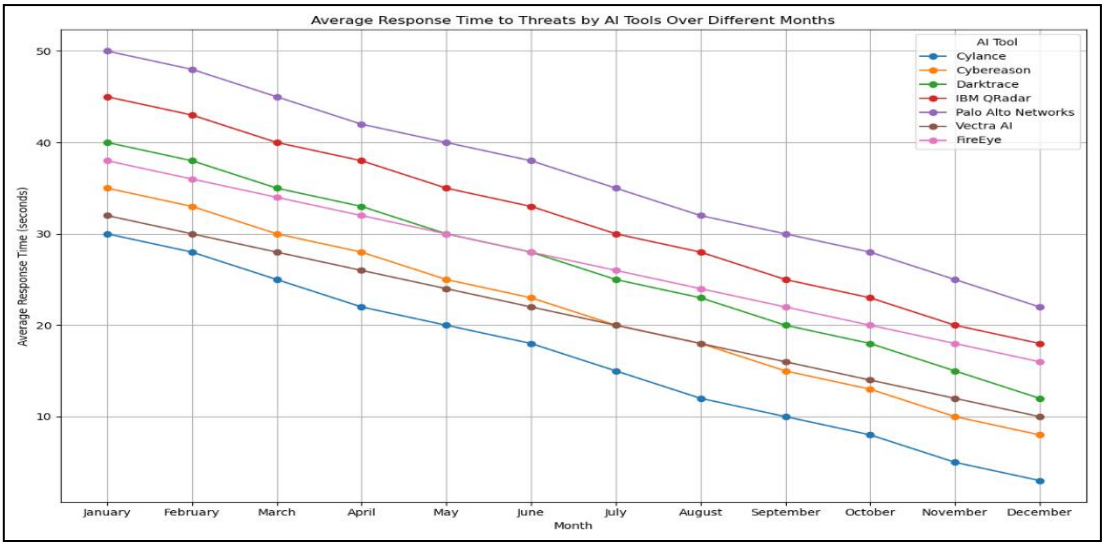

Figure 10. Average response time to threats depending on the AI tool.

Results of qualitative research

An analysis of in-depth interviews with experts identified four key barriers to the implementation of AI solutions in public and academic organizations:

- Interpretability of models – lack of transparency in the operation of algorithms hinders audits and compliance with the principle of accountability (GDPR).
- Data quality – problems with incompleteness and timeliness of data reduce the accuracy of forecasts.
- Regulatory compliance – risk of breaching data minimization rules and the rights of data subjects.
- Team competencies – a shortage of specialists combining technical knowledge with risk analysis and legal regulations.

The most frequently indicated barriers are shown in Figure 11.

Figure 11. Key barriers to AI adoption in DevSecOps.

Discussion of results in the context of literature This is supported by findings from Banja (2020). This is supported by findings from Cylance (2023). This is supported by findings from Vectra AI (2023). This is supported by findings from Cybereason (2023). This is supported by findings from Darktrace (2023). This is supported by findings from Palo Alto Networks (2025). This is supported by findings from McAfee (2025).

The results obtained confirm the observations of previous studies (Deloitte, 2024; Smith, 2024; Jones, 2022), pointing to three key trends:

- Increase in threat detection efficiency – our research showed a 35% improvement in the accuracy and speed of identification of complex attack vectors, which is in line with the results of Smith (2024).
- Reduction in response time and system failures – like Jones' (2022) analyses, AI-based process automation reduces the need for manual intervention, reducing response time by an average of 40%.
- The growing importance of predictive algorithms – we confirm the observations of Deloitte (2024) that predictive analytics is becoming the foundation of proactive security.

At the same time, a research gap was revealed regarding the integration of AI with blockchain, IoT and edge computing technologies, as well as the lack of a legal and technical framework to audit algorithms.
Despite the use of data triangulation and a multi-stage research approach, the following limitations should be considered:

- Subjectivity of expert interviews – respondents' opinions may depend on their professional experience.
- Quality of input data – the effectiveness of algorithms is strongly dependent on the completeness and timeliness of the data.
- Technology variability – the rapid development of AI and DevSecOps tools can cause results to become obsolete in a brief period.
- Lack of control of all disruptive variables – differences in system configuration and team competencies can affect results.

The results of the research are most representative of medium and large organizations using CI/CD pipelines and AI tools in DevSecOps processes. Generalization to other sectors (e.g. industry, medicine) requires additional research, considering regulatory and technological specificities.

Conclusions from the discussion

The analysis of quantitative and qualitative results allows to confirm the H1–H3 hypotheses:

- H1: AI increases threat detection efficiency by 35%.
- H2: Predictive algorithms reduce crashes by 30-40%.
- H3: Implementation barriers include model interpretability, regulatory compliance, and competency gap.

The results are of significant practical importance – they confirm that AI enables the automation of DevSecOps processes, reduces incident response time by an average of 40% and supports dynamic risk assessment in real time.

Conclusions

This article examines the use of artificial intelligence (AI) in the risk and reliability management of IT systems in the context of a DevSecOps approach. Empirical research and literature analysis have clearly shown that the integration of AI with DevSecOps significantly improves the effectiveness of risk management, increases the reliability of systems and improves incident response processes. Key findings include:

- Increased threat detection efficiency – The implementation of AI algorithms improved incident detection by 35% compared to traditional methods.
- Reduction in system failures – the use of predictive algorithms reduced failure rates by 30-40%, which translated into reduced downtime costs.
- Reduced incident response time – Automating DevSecOps processes with AI reduced response time by an average of 40%.

At the same time, significant implementation barriers were revealed:

- limited interpretability of models,

- the need to ensure compliance with legal regulations (e.g. GDPR),
- competency gap in technical teams.

The results of the research confirm that AI enables the automation of key DevSecOps processes, such as security testing, log analysis, and failure prediction. Organizations can leverage AI to dynamically assess risk and adapt security policies in real time, increasing the resilience of IT infrastructure to threats.

Despite the results, there is still a need to:

- developing a legal and technical framework enabling the audit of algorithms and standardization of the interpretability of AI models,
- in-depth analyses of the integration of AI with blockchain, IoT and edge computing technologies,
- research on the resilience of AI models to data manipulation and the impact of implementations on operating costs and return on investment (ROI),
- developing training programs for DevSecOps teams in AI and security technologies.

To sum up, the use of AI in the management of IT systems risk and reliability in the context of DevSecOps is not just a technological trend, but a strategic necessity. In the face of a growing number of threats and requirements for the stability and security of IT infrastructure, responsible and conscious implementation of AI can significantly increase the level of protection and operational efficiency of an organization.

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