Evaluation of an organization's capacity for innovation using the Theory of Inventive Problem Solving (TRIZ) in AI environment

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Abstract. This paper explores the evaluation of an organization's innovative capacity using the Theory of Inventive Problem Solving (TRIZ) as a framework. TRIZ, a systematic approach to problem-solving, provides a structured methodology for identifying innovative solutions. By applying TRIZ principles to assess an organization's innovative potential, we can gain valuable insights into its ability to generate creative ideas and implement them effectively. The paper outlines a methodology for evaluating an organization's innovative capacity, including four issues. Identifying key innovation indicators. These indicators may include factors such as the organization's culture, structure, processes, and resources. Conducting a TRIZ assessment. Applying TRIZ tools and techniques to evaluate the organization's problem-solving skills, creativity, and ability to generate innovative ideas. Analyzing the organization's innovation ecosystem. Examining the factors that support or hinder innovation, such as leadership, teamwork, and knowledge sharing. Developing recommendations for improving innovation capacity. Based on the evaluation findings, proposing strategies to enhance the organization's ability to innovate. By utilizing TRIZ as a framework, organizations can gain a deeper understanding of their innovative potential and take steps to foster a culture of innovation.

Keywords: innovation, TRIZ, organizational innovation, creative problem-solving, innovation assessment.

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INTRODUCTION

Artificial Intelligence (AI) is rapidly transforming our world, offering new possibilities for solving complex problems. Its impact is particularly notable in the field of

innovation, where AI facilitates idea generation, process optimization, and more informed decision-making. This article examines how the theory of inventive problem solving (TRIZ) can be enriched through AI capabilities. We explore how integrating AI into decision-making processes can enhance efficiency, foster new ideas, and help overcome traditional limitations.

However, alongside new opportunities, the use of AI in innovation brings certain challenges, such as data quality, ethical considerations, and the necessity of preserving the human factor. These issues will also be discussed, and we will aim to identify directions for the further development of this field. AI offers a wide range of tools for solving innovative problems, but selecting the optimal method requires a deep understanding of both the problem itself and AI capabilities. Combining expert experience with AI's power opens new horizons for innovation.

TRIZ (Theory of Inventive Problem Solving), developed by Genrikh Altshuller [1], is a powerful tool for systematically solving inventive problems and identifying innovative solutions. At its core, TRIZ is based on principles that help structure the process of discovering and implementing new ideas.

RESEARCH OBJECTIVE

This paper explores the evaluation of an organization's innovative capacity using the Theory of Inventive Problem Solving (TRIZ) as a framework. TRIZ, a systematic approach to problem-solving, provides a structured methodology for identifying innovative solutions. By applying TRIZ principles to assess an organization's innovative potential, we can gain valuable insights into its ability to generate creative ideas and implement them effectively. The paper outlines a methodology for evaluating an organization's innovative capacity, including:

1. Identifying key innovation indicators. These indicators may include factors such as the organization's culture, structure, processes, and resources.
2. Conducting a TRIZ assessment. Applying TRIZ tools and techniques to evaluate the organization's problem-solving skills, creativity, and ability to generate innovative ideas.
3. Analyzing the organization's innovation ecosystem. Examining the factors that support or hinder innovation, such as leadership, teamwork, and knowledge sharing.

Developing recommendations for improving innovation capacity. Based on the evaluation findings, proposing strategies to enhance the organization's ability to innovate.

LITERATURE REVIEW

The capacity for innovation has become a critical determinant of organizational success, particularly in the rapidly evolving field of artificial intelligence (AI). The Theory of Inventive Problem Solving (TRIZ) offers a structured framework for systematically solving problems and fostering creativity. In the context of AI, TRIZ provides a lens for evaluating an organization’s ability to innovate by addressing contradictions, leveraging resources, and adopting inventive principles. This literature review synthesizes current research and insights on using TRIZ as a framework for assessing an organization's creative potential within AI-driven environments.

TRIZ, developed by Genrich Altshuller [1], is a problem-solving methodology that draws upon patterns of innovation and inventive principles derived from a study of global patents. It provides tools such as the contradiction matrix, 40 inventive principles, and patterns of technological evolution, which guide systematic problem-solving and innovation. Studies by [2] emphasize the universal applicability of TRIZ across industries, making it a valuable tool for innovation assessment.

The Intersection of TRIZ and AI

Enhancing Problem-Solving with AI and TRIZ.

The integration of AI with TRIZ methodologies is increasingly explored in academic and industrial research. AI can

enhance TRIZ's capabilities by automating pattern recognition, identifying contradictions, and suggesting inventive solutions.

Researchers in [3] propose that TRIZ can be adapted to evaluate the innovative capacity of AI-focused organizations. Key factors include:

1. Problem-Solving Efficiency. AI tools, combined with TRIZ, can rapidly generate and evaluate solutions;
2. Data Utilization. The ability of an organization to harness data for identifying and resolving contradictions;
3. Patterns of Innovation. Using AI to predict and align with technological evolution patterns identified by TRIZ.

TRIZ-specific metrics for innovation assessment, such as the number of contradictions resolved or the frequency of inventive principle application, have been proposed by Altshuller's successors. In AI environments, these metrics can be supplemented by AI-generated insights, such as the speed of solution generation and the effectiveness of AI-driven predictive analytics in identifying innovative opportunities [4].

The integration of TRIZ with AI presents significant opportunities for assessing and enhancing an organization's capacity for innovation. Current literature highlights the potential of AI to augment TRIZ's systematic approach, while also recognizing the need for adaptations to address the unique challenges posed by AI environments. As AI continues to reshape industries, leveraging TRIZ as a framework for evaluating creative potential will remain a critical area of research and practice [5, 6].

The Theory of Inventive Problem Solving (TRIZ) provides a structured methodology for fostering innovation by analyzing problems and generating creative solutions. Using TRIZ as a framework to assess an organization's capacity for innovation involves evaluating key factors that influence its ability to solve problems inventively and sustain creative potential [7, 8].

Using TRIZ as a framework for assessing creative potential allows organizations to evaluate their systematic problem-solving capabilities, identify gaps, and enhance their innovation strategies [9]. The structured approach ensures that innovation is not left to chance but driven by scientifically-backed principles and practices.

Notable research also analyzes psychological aspects of thinking in AI contexts - sensory-motor thinking for heuristic searches, visual-spatial thinking for planning, and conceptual thinking for logical reasoning. These approaches enhance AI systems and improve their decision-making capabilities in dynamic environments.

RESEARCH METHODOLOGY

The research methodology involves the sequential application of the following steps:

- Analysis of TRIZ principles in the context of AI.
- Identification of the Pareto area of applications.
- Construction of a contradiction matrix for TRIZ principles.
- Assessment of the impact of these principles on managing the sustainable development process.
- Formation of models for creating innovative project chains.
- Development of a system of criteria for selecting chains and creating innovative projects.
- Let's look in detail each of these steps and results (Table 1).

Table 1

Steps of research methodology

N	Step of research methodology	Expected result
1	40 Inventive Principles. How well does the organization use these principles to inspire novel ideas?	Pareto set of utilized principles
2	Does the organization define an ideal solution for its problems?	Ideal Final Result (IFR).
3	Knowledge Base and Resource Utilization	Knowledge Base
4	Does the organization leverage a knowledge database, such as TRIZ patterns of evolution, for innovation?	Systematic Knowledge.
5	Evaluate the ability to identify and utilize internal and external resources creatively (e.g., material, energy, information).	Resources Analysis.
6	Develop Organizational Creativity Metrics	Organizational Creativity Metrics
7	Are interdisciplinary teams formed to bring diverse perspectives to problem-solving?	Diversity of Perspectives
8	Measure the quantity and quality of solutions generated for a given problem.	Solution Generation
9	Assess how effectively the organization implements innovative ideas.	Implementation Rate

CASE STUDY OF IMPLEMENTATION PROPOSED METHODOLOGY

As the case study for application of proposed methodology we concentrate on “Innovation in Artificial intelligence muster program” running in Kyiv National university of construction and architecture.

We will examine TRIZ principles and their application in the process of creating innovative projects for sustainable development and select Pareto set of key principles for certain area of innovation.

As a result of the analysis, the following eight Pareto areas were selected. These are:

1. The principle of division
2. The principle of consolidation
3. The principle of feedback
4. The principle of segmentation
5. The principle of universality
6. The principle of speed
7. The principle of separate execution
8. The principle of excluding people from the process

In the second step of the defined research methodology, a matrix of contradictions of their application in the process of building and implementing innovative projects was constructed. The matrix is given in Table 2.

Table 2

The matrix of contradictions of the principles of the TRVZ

Principle	Contradiction 1	Contradiction 2	Contradiction 3
Principle of division	Too fine-grained division can make management difficult.	Can lead to loss of global vision.	May require additional management resources.
Principle of consolidation	May lead to ignoring details that are important for sustainability.	Excessive consolidation can reduce efficiency.	May make adaptation and flexibility more difficult.
Principle of feedback	Feedback may not be fast enough to respond quickly.	Can cause overload due to constant feedback.	Feedback may not always be accurate or useful.
Principle of segmentation	Segmentation can lead to isolation of parts of the system, which violates integrity.	Excessive segmentation can make integration difficult.	May lead to duplication of effort in certain segments.
Principle of universality	One-size-fits-all solutions may not take into account the specifics of each system.	Difficulty adapting to local conditions.	May limit innovation in specific industries.
Principle of speed	Excessive focus on speed can reduce the quality of solutions.	Speed can lead to errors due to imperfect processes.	Speed of action may lead to ignoring long-term sustainability aspects.
Principle of separate execution	Separation of tasks can lead to a loss of coordination between parts of the system.	Separation can make it difficult to transfer knowledge and experience.	Discrete execution may reduce effectiveness in crisis situations.
Principle of excluding people from the process	Excluding people can lead to a loss of creativity and innovation.	Can create social and psychological problems.	Loss of emotional connection and motivation to the process.

In the third step, the impact assessments of the principles on innovation in managing the sustainable development process were investigated. The quantitative impact assessments generated by the research team are given in Table 3.

Table 3.

Assessment of the impact of the principles on innovation in managing the sustainable development process of complex systems

Principle	Impact on sustainable development management	Explanation
Principle of division	3	Allows detailed analysis of system components,

		but can lead to fragmentation and difficulty in coordination.
Principle of consolidation	4	Provides an overall view of the process and allows for management of more elements, but can lead to loss of detail.
Principle of feedback	5	Key to adapting the system to changes and correction based on results. Important for ensuring sustainable development through process correction.
Principle of segmentation	4	Provides flexibility and efficiency in solving problems, but can complicate integration and synergy between parts of the system.
Principle of universality	3	Allows the use of standardized approaches, but may not take into account the specifics of local conditions and individual needs.
Principle of speed	2	Although speed is important, excessive attention to it can lead to a decrease in quality and omission of important aspects of sustainable development.
Principle of separate execution	3	Improves the efficiency of individual stages of the process, but can lead to a loss of coordination and interconnection between parts of the process.
Principle of excluding people from the process	2	The absence of the human factor can reduce the innovativeness and adaptability of the system, especially when considering the social aspects of sustainable development.

1 — low impact,
5 — high impact.

In the process of studying the selected principles of TRVZ, their application in the artificial intelligence environment was determined (Table 4).

Table 4

How TRVZ principles work in the artificial intelligence environment

Principle	How the Partition Principle Works in an AI Environment
Principle of division	In AI, partitioning can be applied by decomposing complex models into separate parts or modules. For example, a large model can be broken down into smaller submodels for specific tasks (classification, segmentation). This improves accuracy and allows each part to be adapted to a specific task.
Principle of consolidation	In the context of AI, the partition principle can be used to combine individual algorithms into a larger system. For example, each algorithm can process a specific type of data (text, image, sound) and work in a common system, which allows for flexible configuration and integration of new subsystems for large-scale data analysis.
Principle of feedback	The partition principle allows for the creation of separate modules for analyzing and processing feedback. For example, you can divide the system into separate parts, where one part collects feedback, other processes it, and yet another adjusts the model based on this data, ensuring efficient control and adaptation of the AI.
Principle of	In AI, the partition principle can be implemented through the

segmentation	segmentation of data and models. For example, separate specialized models can be used for each data segment. This allows you to adapt approaches for different categories of users or products, increasing the accuracy and efficiency of the system.
Principle of universality	In AI, separation helps to create universal interfaces and components that work independently of the main model. For example, creating separate modules for different languages or data formats allows you to universally adapt the system to specific user needs without changing the general algorithm.
Principle of speed	In the context of AI, the separation principle is used to optimize calculations by parallel data processing. For example, data processing can be divided into subtasks that are performed simultaneously, which speeds up the system. The separation principle also allows you to run less resource-intensive processes to speed up the overall work.
Principle of separate execution	For AI, the separation principle allows you to implement separate execution of individual processes: training, testing and evaluation. For example, training can occur on a separate server, while other processes can run in parallel or independently. This makes it easier to maintain and scale the system.
Principle of excluding people from the process	In AI, separation allows you to automate some tasks without the need for human intervention. For example, dividing tasks between models (such as query processing, automated testing, data collection and analysis) can help remove humans from routine processes. This increases efficiency and reduces the likelihood of human error.

The next step of the research was the formation of chains of creation of innovative projects within the framework of the selected principles of TRVZ. Such chains are formed as presented in Table 5.

Table 5

Chains of creation of values of innovative projects

Principle	Value chain of an innovation project
Principle of division	1. Defining a complex task ➔ 2. Dividing into subtasks (component analysis) ➔ 3. Developing separate solutions for each subtask ➔ 4. Optimizing each component ➔ 5. Integrating into a single system ➔ 6. Testing and agreeing on components ➔ 7. Final optimization and launch.
Principle of consolidation	1. Analyzing all individual components of the system ➔ 2. Combining components with similar functions ➔ 3. Developing a single integrated solution ➔ 4. Creating a platform to support scaling ➔ 5. Agreeing on functions ➔ 6. Checking for consistency ➔ 7. Launching a single, consolidated solution.
Principle of feedback	1. Create a feedback collection system ➔ 2. Identify key performance indicators ➔ 3. Collect and analyze feedback ➔ 4. Identify weaknesses ➔ 5. Modify the model based on the data received ➔ 6. Test the updated model ➔ 7. Continuous cycle of updates and improvements.
Principle of segmentation	1. Identify target market segments or data ➔ 2. Create separate approaches for each segment ➔ 3. Develop specialized models for each

	segment ➔ 4. Test solutions for segments ➔ 5. Agree on the integration of segmented solutions ➔ 6. Release segmented versions of the product.
Principle of universality	1. Identify key features that can be universal ➔ 2. Create modular solutions that are easily adaptable ➔ 3. Optimize universal design ➔ 4. Develop interfaces for integration ➔ 5. Check compatibility with other solutions ➔ 6. Implement a universal platform.
Principle of speed	1. Identify critical points where speed is needed ➔ 2. Distribute tasks for parallel execution ➔ 3. Select high-performance algorithms ➔ 4. Optimize processes for hardware capabilities ➔ 5. Performance testing ➔ 6. Make adjustments ➔ 7. Launch a high-performance solution.
Principle of separate execution	1. Identify tasks that can be performed separately ➔ 2. Decompose processes ➔ 3. Develop specialized tools for each task ➔ 4. Distribute tasks between teams or systems ➔ 5. Parallel execution of tasks ➔ 6. Integrate results ➔ 7. Launch a separate work model.
Principle of excluding people from the process	1. Identifying processes that can be automated ➔ 2. Selecting and configuring appropriate tools ➔ 3. Building automated models ➔ 4. Testing the autonomous operation of the system ➔ 5. Eliminating human actions in certain processes ➔ 6. Controlling automated processes ➔ 7. Launching the autonomous system.

The last step of the proposed methodology defines a system of evaluation criteria for selecting a chain of innovation project creation. This system of criteria is given in Table 6.

Table 6

Criteria for selecting a chain of innovation project creation

Criterion	Description
Project Goal	Identifies what the project is trying to achieve: increase efficiency, automate a process, improve user experience, or create a new product. The goal determines the basic approach and methods that will be involved in the chain.
Project Complexity	A high-complexity project may require breaking it down into smaller parts (the division principle), while a less complex project can be completed using a chain with aggregation or universality.
Technological Requirements	The specific technologies that need to be used (AI, machine learning, automation). This can influence the choice of approach, such as segmentation or automation for AI and machine learning technologies.
Necessary Level of Automation	If the project requires maximum automation, the choice may fall on the principle of excluding people from the process or speed chains.
Time Constraints	If the project needs to be implemented quickly, a speed chain or segmentation will allow for faster execution by processing tasks in parallel.
Resources and Budget	A limited budget may require choosing a chain that provides resource savings, such as dividing it into smaller, less expensive stages.

Level of Integration	Projects that require integration with other systems may require chains that use universal approaches to ensure compatibility between different components.
Flexibility and Adaptability	For projects that require flexibility, a chain that includes feedback to make changes based on user feedback or new data may be suitable.
Target Audience	A chain that includes segmentation may be better for projects with a diverse audience, as it allows you to create personalized solutions for different segments.
Project Scalability	For scalable projects, chains that consider encapsulation and universality are suitable, as they allow you to easily add new modules and scale the system as needs grow.
Quality and Risk Control	If quality is critical, you can choose a chain that includes separate execution for each stage, which allows for thorough testing of individual components, reducing the risk of defects in the final product.

Let's define benchmarks for successful innovation project management.

1. Strategic Agility

Benchmark. Projects must demonstrate the ability to pivot quickly in response to changes in external conditions.

Indicators. Frequency and effectiveness of course corrections, ability to reprioritize goals, and time taken to adapt to disruptions.

2. Robust Risk Management

Benchmark. Proactive identification and management of risks, including brittle points in the system, to prevent catastrophic failures.

Indicators. Implementation of stress-testing protocols, creation of contingency plans, and frequency of scenario planning exercises.

3. Psychological Safety and Team Resilience

Benchmark. Teams should maintain a culture of psychological safety, enabling members to voice concerns, experiment, and learn from failures.

Indicators. Employee satisfaction scores, feedback mechanisms in place, and instances of successful recovery from setbacks.

4. Flexibility in Execution

Benchmark. The ability to adjust project plans in response to nonlinear progress and emerging challenges without losing sight of overarching goals.

Indicators. Percentage of milestones adjusted without significant delays, alignment of new strategies with original objectives, and adaptability of resource allocation.

5. Stakeholder Collaboration and Transparency

Benchmark. Strong, clear, and ongoing communication with stakeholders to ensure alignment and mitigate anxiety.

Indicators. Stakeholder engagement metrics, frequency and clarity of communication updates, and satisfaction with collaboration processes.

6. Speed and Iteration

Benchmark. Projects must prioritize rapid iteration and delivery of minimum viable products (MVPs) to maintain relevance in fast-changing conditions.

Indicators. Time-to-market for MVPs, number of iterative cycles completed, and percentage of features refined through iteration.

7. Data-Driven Decision-Making

Benchmark. Continuous use of real-time data and predictive analytics to guide decisions in incomprehensible and uncertain scenarios.

Indicators. Integration of analytics tools, accuracy of forecasts, and percentage of decisions supported by data insights.

8. Systems Thinking and Interconnectivity

Benchmark. Projects should adopt a systems-thinking approach to understand and manage interdependencies and ripple effects.

Indicators. Mapping of system interdependencies, successful management of cascading effects, and alignment with ecosystem dynamics.

9. Sustainability and Ethical Responsibility

Benchmark. Innovation projects should contribute positively to social, environmental,

and ethical dimensions, even in volatile environments.

Indicators. Sustainability metrics (e.g., carbon footprint reduction), ethical compliance, and long-term impact assessments.

10. Learning and Feedback Loops

Benchmark. A continuous focus on learning through feedback loops to improve project outcomes and organizational knowledge.

Indicators. Number and quality of lessons-learned sessions, frequency of feedback implementation, and improvement in subsequent projects.

CONCLUSIONS

The conclusions of the study indicate the effectiveness of applying the principles of TRIZ in artificial intelligence projects to solve complex problems and improve the management of innovation processes. Pareto analysis helped to identify key principles that have the greatest impact on AI projects, such as division, aggregation, feedback, which allows you to systematize the approach to innovation. The contradiction matrix revealed the main conflicts between the principles that may arise, which will allow them to be resolved at the planning stage. The division principle turned out to be especially important for the flexibility of the AI system, as it helps to break complex models into smaller, easier-to-optimize components.

The development of chains for creating innovative projects based on TRIZ provides a systematic approach to solving problems, and the defined chain selection criteria make it possible to choose the most adaptive solutions depending on the goal and requirements of the project. The use of TRIZ in AI projects opens up opportunities for further research, especially in the context of automation and sustainable development, which can contribute to increasing the efficiency and innovation of management decisions in the AI environment.

DIRECTIONS FOR FURTHER RESEARCH

Further steps may include in-depth study of selected TRIZ principles in various areas of AI, such as automation and adaptive systems, which will allow for a more targeted application of these principles. It is also worth testing the effectiveness of the created contradiction matrix in practical conditions to assess how much it contributes to the elimination of conflicts and optimization of resources in real projects.

The development of a comprehensive methodology for managing innovative projects based on TRIZ can provide additional tools for organizing work, and the integration of TRIZ principles into automation software will help increase efficiency, especially in tasks where the human factor is minimized. Finally, it is advisable to explore the potential of TRIZ in new promising areas of artificial intelligence, such as quantum computing and autonomous systems, which will open up new opportunities for innovation in these areas.

Developing AI-powered TRIZ tools that automate the identification of inventive principles and contradictions.

Tailoring TRIZ methodologies to suit the unique characteristics of AI-driven innovation, such as adaptability and scalability.

Exploring TRIZ's application in interdisciplinary AI projects, such as combining AI with sustainability or social impact initiatives.

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Оцінка спроможності організації до інновацій за допомогою теорії вирішення винахідницьких проблем (ТРИЗ) у середовищі ШІ

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Анотація. У цьому документі досліджується оцінка інноваційного потенціалу організації з використанням теорії вирішення винахідницьких проблем (ТРИЗ) як основи. ТРИЗ, системний підхід до вирішення проблем, забезпечує структуровану методологію для визначення інноваційних рішень. Застосовуючи принципи ТРИЗ для оцінки інноваційного потенціалу організації, ми можемо отримати цінну інформацію про її здатність генерувати творчі ідеї та ефективно їх втілювати. У документі викладено методологію оцінки інноваційного потенціалу організації, включаючи чотири питання. Визначення ключових індикаторів інноваційності. Ці показники можуть включати такі фактори, як культура, структура, процеси та ресурси організації. Проведення ТРИЗ оцінювання. Застосування інструментів і методів ТРИЗ для оцінки навичок вирішення проблем організації, креативності та здатності генерувати інноваційні ідеї. Аналіз інноваційної екосистеми організації. Вивчення факторів, які підтримують або перешкоджають інноваціям, таких як лідерство, командна робота та обмін знаннями. Розробка рекомендацій щодо підвищення інноваційного потенціалу. На підставі результатів оцінювання пропонувати стратегії для підвищення здатності організації до інновацій. Використовуючи ТРИЗ як основу, організації можуть глибше зрозуміти свій інноваційний потенціал і вжити заходів для розвитку культури інновацій.

Ключові слова інновація, ТРИЗ, організаційна інновація, творче вирішення проблем, оцінка інновацій..