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Comparative Perspectives on the Application of TRIZ in Computer Maintenance Workshops and Other Domains such as Education

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ABSTRACT:
The Theory of Inventive Problem Solving (TRIZ) has been widely adopted as a structured methodology for resolving complex problems and contradictions in technical and organizational systems. While its use in engineering and manufacturing is well documented, its application in service contexts—such as computer maintenance workshops—and in non-technical fields like education remains comparatively less explored. This paper provides a comparative analysis of TRIZ implementation in computer maintenance workshops versus other domains, particularly education and service innovation. The analysis highlights similarities and differences in problem types, implementation strategies, outcome metrics, and sustainability mechanisms. Evidence from previous studies shows that TRIZ can significantly enhance diagnostic accuracy, reduce process time, and improve service quality in maintenance settings, while in education it supports creativity, problem-based learning, and systematic thinking. The paper concludes with implications for practitioners and researchers, emphasizing the potential of TRIZ as a cross-domain framework for innovation and continuous improvement.

Keywords: *TRIZ, service quality, computer maintenance, education, innovation, problem solving.*

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I. INTRODUCTION:

TRIZ (Theory of Inventive Problem Solving) was originally developed by Genrich Altshuller through the analysis of hundreds of thousands of patents to identify recurring patterns of innovationand contradiction resolution.[1] Over time, its application has expanded from engineering design into management, services, and even educational settings.[2,3]

TRIZ (Theory of Inventive Problem Solving) was originally developed by Genrich Altshuller through the analysis of hundreds of thousands of patents to identify recurring patterns of innovation and contradiction resolution.[1] Over time, its application has expanded from engineering design into management, services, and even educational settings.[2,3]

In computer maintenance workshops, TRIZ offers a structured way to tackle operational contradictions such as *speed vs accuracy* in diagnostics, or *cost reduction vs quality improvement*. In parallel, educational institutions and training programs have adopted TRIZ principles to foster creative thinking, systematic problem solving, and innovation skills among learners.[3]

This paper compares how TRIZ is implemented in computer maintenance workshops with how it is used in other domains—especially education and general service innovation. The objective is not only to outline differences in context, but also to show what each domain can learn from the other in terms of methodology, metrics, and sustainability of improvement.

II. TRIZ: Conceptual Background Across Domains:

TRIZ is built on several core concepts: contradictions (technical and physical), the 40 inventive principles, the contradiction matrix, and patterns of technical system evolution.[1,4] These concepts are sufficiently abstract to be transferred fromengineering to services, education, and management.

- In **engineering and manufacturing**, TRIZ is used to redesign products and processes, improve reliability, and reduce defects.[2,4]
- In **services**, TRIZ is applied to process redesign, elimination of bottlenecks, and enhancement of customer experience.[5]
- In **education**, TRIZ supports instructional design, creative thinking workshops, and structured problem-based learning.[3]

This domain-neutral nature of TRIZ explains why the same set of principles can be applied in a computer maintenance workshop and in a classroom, even though the surface problems appear very different.

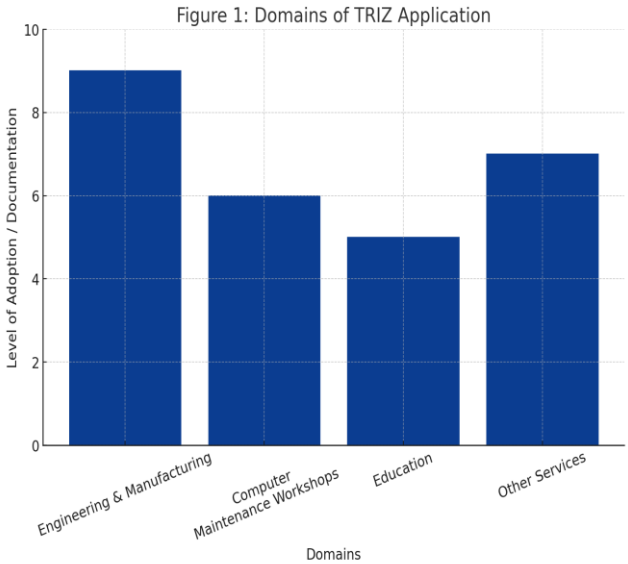


Figure 1: Domains of TRIZ Application

III. TRIZ in Computer Maintenance Workshops:

In computer maintenance environments, service quality and operational performance are closely linked to diagnostic accuracy, maintenance time, repeat-failure rates, and user satisfaction. Studies on ICT maintenance and repair services show that structured approaches can significantly improve cycle time and reliability.[11–13]
When TRIZ is applied in such workshops, typical steps include:

1. Identifying recurring technical and service problems (e.g., long turnaround times, inconsistent diagnosis).
2. Analyzing contradictions such as:
   - “Increase repair speed without reducing diagnostic accuracy.”
   - “Standardize procedures without losing flexibility for complex cases.”
3. Mapping these contradictions onto TRIZ tools (contradiction matrix, inventive principles).

Designing new procedures, checklists, or diagnostic flows based on selected inventive principles.
Evaluating impact using indicators like SERVQUAL scores, mean maintenance time, and repeat-failure rate.[6,8,11]
Empirical evidence from case studies indicates that TRIZ-based redesign can reduce maintenance time, improve perceived service quality, and lower the frequency of repeated faults.[8,11–13]

IV. TRIZ in Other Domains: Education and Service Innovation

4.1 TRIZ in Education:

In educational settings, TRIZ is not used to repair physical systems but to develop **cognitive and creative skills**. TRIZ-based teaching materials and workshops help students:

- Identify and formulate contradictions in real-world problems.
- Use inventive principles to generate alternative solutions.
- Move from trial-and-error thinking to systematic innovation.[3]

Mann (2007) highlights that TRIZ can be integrated into curricula for engineering, business, and management, where students learn to use contradiction analysis and inventive principles to address case-study problems.[3] TRIZ thus functions as a **pedagogical framework** for teaching innovation, rather than as a purely technical method.

4.2 TRIZ in Service Innovation and Other Sectors

Beyond education, TRIZ has been used in healthcare, banking, logistics, and general service design to improve processes and customer experience. Zhang and Chu (2010) showed that TRIZ-based service innovation can streamline service delivery, reduce waiting times, and restructure customer interaction flows.[5]
In such contexts:

- The “system” is a **service process** (e.g., patient journey, customer service workflow).

- Contradictions often involve **customer expectations vs operational constraints**.
- Outcomes are measured by metrics such as customer satisfaction, service time, and perceived value rather than purely technical parameters.[5,9,10]

V. Comparative Analysis: TRIZ in Maintenance Vs Other Domains:

Figure 2: Comparative Framework – TRIZ in Maintenance vs Education

	Maintenance Workshops	Education
Problem Nature	Technical issues, diagnostic faults, workflow delays	Learning difficulties, engagement gaps, curriculum challenges
Key Indicators	Maintenance time, failure rate, service quality scores	Student performance, engagement level, learning outcomes
Typical Activities	Repair procedures, SOP execution, troubleshooting	Classroom activities, curriculum design, assessment
Use of TRIZ	Resolve technical contradictions, streamline processes	Resolve instructional contradictions, redesign learning tasks
Expected Outcomes	Reduced maintenance time, fewer failures, higher service quality	Improved understanding, higher engagement, better learning outcomes

- In **education**, contradictions are **pedagogical**, such as encouraging creativity while maintaining curriculum standards, or promoting independent thinking while ensuring assessment fairness.
- In **service innovation**, contradictions are **customer–organization focused**, such as delivering personalized service at scale.[2,3,5]

Despite these differences, in all domains the core TRIZ logic is the same: formulate contradictions explicitly and resolve them using systematic principles instead of ad-hoc trial and error.[1,4]

5.2 Implementation Strategies

- Maintenance workshops tend to implement TRIZ through process redesign, standard operating procedures, and diagnostic checklists.
- Educational institutions implement TRIZ mainly through curricula, workshops, and classroom activities that teach students how to think in TRIZ terms.[3]
- Other service sectors may implement TRIZ through cross-functional teams, redesign of service blueprints, and innovation projects.[5,9]
- The level of formalization also differs: maintenance settings often embed TRIZ into fixed workflows, whereas education uses TRIZ as a flexible, discussion-based toolkit.

5.3 Outcome Metrics

- In **maintenance**, outcomes are measured quantitatively: maintenance time, repeat-failure rate, service quality scores (e.g., SERVQUAL).[6,8,11–13]
- In **education**, outcomes include student creativity, problem-solving performance, and perceived usefulness of the method—oftenevaluated through qualitative or mixed-method assessments.[3]
- In **services**, metrics may combine customer satisfaction, process time, error rates, and financial indicators.[5,9,10]

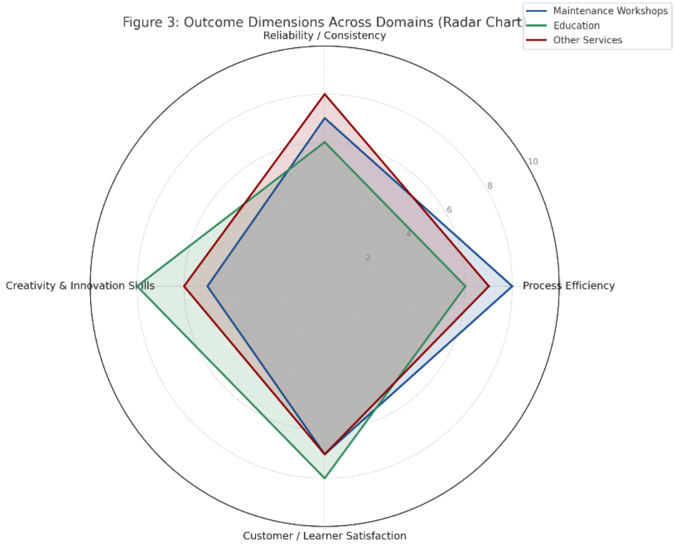


Figure 3: Outcome Dimensions Across Domains

This comparison suggests that TRIZ is **most easily evaluated** in domains with clear numerical performance indicators (e.g., maintenance), but can still add value in more qualitative domains such as education.

5.4 Sustainability and Organizational Learning

Across all domains, TRIZ is most effective when it becomes part of a **continuous improvement cycle** rather than a one-time project. This includes:

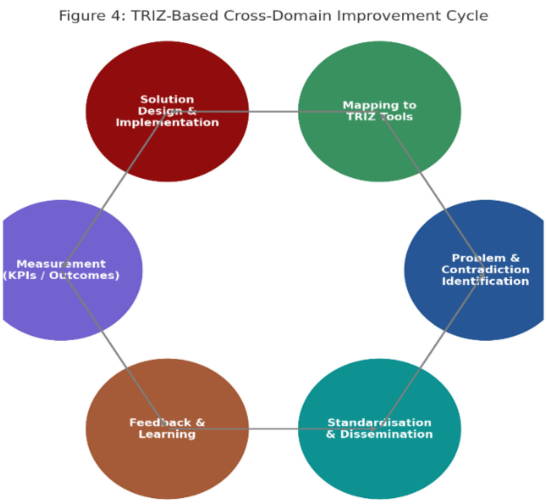
- Regular training and refreshment of TRIZ skills.
- Integration with other frameworks such as SERVQUAL, Lean, or Six Sigma.[2,4,9]
- Feedback loops where lessons learned from each application are used to refine future problem solving.

Maintenance workshops can learn from educational practice in terms of **building TRIZ literacy** among staff, while educational programs can learn from maintenance and services about **using concrete performance metrics** to document impact.

VI. Implications for Practice and Research

6.1 From a practical perspective, the comparison suggests that:

- Computer maintenance workshops can benefit from combining TRIZ with service quality tools (e.g., SERVQUAL) to link technical improvements with customer perceptions.[6,9]
- Educational institutions can use TRIZ not only as a creativity tool but also as a bridge to real-world service and technical problem solving, thus enhancing graduate employability.[3]
- Service organizations in non-technical fields can adopt TRIZ to systematically redesign customer journeys and internal processes.[5]



TRIZ-Based Cross-Domain Improvement Cycle

For researchers, there is an opportunity to:

- Conduct comparative empirical studies across sectors using a common TRIZ-based evaluation framework.
- Explore hybrid models integrating TRIZ with Lean, Six Sigma, and quality management systems.
- Study the long-term sustainability of TRIZ-based interventions in both technical and educational contexts.

VII. Conclusion

TRIZ has evolved from a purely engineering-based methodology into a versatile framework for innovation in multiple domains. In computer maintenance workshops, it directly addresses operational contradictions and leads to measurable improvements in service quality and reliability. In education and other service sectors, it functions as a powerful tool for structured creativity, problem-based learning, and process innovation.

The comparative view presented in this paper shows that, despite contextual differences, the underlying TRIZ logic—identifying and resolving contradictions through systematic principles—remains consistent. Future work should focus on designing integrated models that transfer best practices across domains, especially between technical maintenance environments and educational settings that prepare the next generation of problem solvers.

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