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Literature Review Benefits and Proposed Implementation of New Seven QC Tools in Testing Laboratories

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Abstrak

Menjaga kompetensi dan kinerja laboratorium pengujian merupakan faktor penting yang selalu diperhatikan dan perlunya melakukan perbaikan dengan tepat jika terdapat ketidaksesuaian yang terjadi. Penelitian ini mengkaji manfaat dan usulan penerapan metode *New Seven QC Tools* dari berbagai jenis industri menggunakan metode *literature review*. Artikel dipilih menggunakan pendekatan *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) dengan sumber *database* online seperti *Google Scholar, ResearchGate, Crossref, Semantic Scholar* dan *Scopus* serta berfokus pada artikel yang terbit pada rentang tahun 2013 hingga 2024. Sebanyak 30 artikel terpilih kemudian dianalisa dari segi demografi (tujuan penelitian, hasil penelitian, asal negara, tahun publikasi, banyak alat terpakai, dan urutan penggunaan alat pada setiap langkah) dan manfaat serta usulan penggunaanya untuk laboratorium pengujian. Hasil analisa artikel menunjukkan bahwa penerapan metode *New Seven QC Tools* dapat diterapkan untuk mengidentifikasi dan memberikan usulan perbaikan terhadap masalah yang ada pada laboratorium pengujian, sehingga pada akhirnya dapat meningkatkan kualitas hasil pengujian.

Kata kunci: Kualitas; Laboratorium Pengujian; *Literature Review*; PRISMA; *New Seven QC Tools.*

Abstract

Monitoring laboratory testing competence and performance is a critical factor that requires constant attention. Timely corrective actions must be taken whenever non-conformities arise. This research investigates the benefits and proposed application of the New Seven QC Tools across various industries through a literature review. The articles were selected using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach from online databases such as Google Scholar, ResearchGate, Crossref, Semantic Scholar, and Scopus, focusing on publications between 2013 to 2024. 30 selected articles were analysed in terms of demographics (research objectives, results, country of origin, publication year, number of tools used, and sequence of tool usage at each step) and the benefits and proposed applications for testing laboratories. The analysis results indicate that the implementation of the New Seven QC Tools can be applied to identify and propose improvements for existing problems in testing laboratories, ultimately leading to enhanced test result quality.

Keywords: *Quality; Testing Laboratory; Literature Review; PRISMA; New Seven QC Tools.*

INTRODUCTION

As a critical component of the Conformity Assessment Institution (LPK), the Testing Laboratory (LP) significantly enhances Indonesia's export product competitiveness by

facilitating test result recognition (KAN, 2019). It is imperative to consistently uphold the competence and performance of testing laboratory in compliance with the SNI ISO/IEC 17025 Laboratory Management System (BSN, 2018). All nonconformities arising form testing laboratory activities require immediate attention and action to ensure the quality of test outcomes (Faridah et al., 2018).

The New Seven QC Tools, developed by the Union of Japanese Scientists and Engineers (JUSE) in 1972, are a valuable tool for systematically identifying and analysing nonconformities within a system such as a testing laboratory. These tools are particularly effective at middle and upper management levels, aiding in decision-making and fostering effective team communication to address identified challenges (Mizuno, 2020). The New Seven QC Tools primarily focus on verbal data analysis, idea generation, and strategic formulation (Prashanth & M, 2020). The New Seven QC Tools consist of the Affinity Diagram, Interrelationship Diagram, Tree Diagram, Matrix Diagram, Matrix Data Analysis, Activity Network Diagram, and Process Decision Program Chart (PDPC) (Charantimath, 2011).

An extensive body of literature review has emerged exploring the implementation of various quality tools, including Total Productive Maintenance (Setiawan & Purba, 2021), Lean Six Sigma (Tampubolon & Purba, 2021), Seven QC Tools (Sutrisno, 2022), Statistical Process Control (Hadiyanto & Sitepu, 2023) and Failure Mode Effect Analysis (Wu et al., 2021). However, a notable gap exists in the literature review regarding the application of the New Seven QC Tools. This research gap underscores the need for further investigation into implementation of these tools across diverse industries.

This study aims to comprehensively analyse the implementation of the New Seven QC Tools in different industrial sectors to ascertain their potential benefits and propose their application in an Indonesian testing laboratory context. A literature review of published articles was conducted to provide stakeholders with a resource for implementing the New Seven QC Tools in testing laboratories.

RESEARCH METHODOLOGY

This study employed a systematic literature review methodology adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMSA) guidelines for articles selection. This approach allows readers to assess the appropriateness of the methods used and ultimately creates confidence in the findings (Page et al., 2021).

The first stage entails establishing article eligibility criteria. The desired articles pertain to the application of New Seven QC Tools within various industries and manufacturing contexts, with publication years ranging from 2024 to 2014. The second stage involved identifying relevant information sources within extensive online academic databases such as Google Scholar, ResearchGate, Crossref, Semantic Scholar, and Scopus. A comprehensive keywords search was employed to ensure data alignment with research objectives. Additionally, Harzing's Publish or Perish software was utilized to refine the search by inputting the term "New Seven QC Tools" to the available keyword bar. The third stages involve selecting and collecting articles that exclusively focus on the implementation of the New Seven QC Tools, without incorporating other quality tools. This stage entails more in-depth examination of titles, abstracts, keywords, and a full or partial review of articles that advanced from the previous stage. The fourth stage involves extracting the following information from the selected articles: 1) research objective, 2) New Seven QC Tools employed, 3) research findings, 4) industry sector, and 5) country of origin. The fifth stage involved selecting data from the chosen articles. This data encompassed articles demographics (study distribution related to the implementation of New Seven QC Tools,

country origin, publication year, and tool usage) and the benefits and proposed applications of the New Seven QC Tools in testing laboratories. All the stages are shown in Figure 1 as follows.

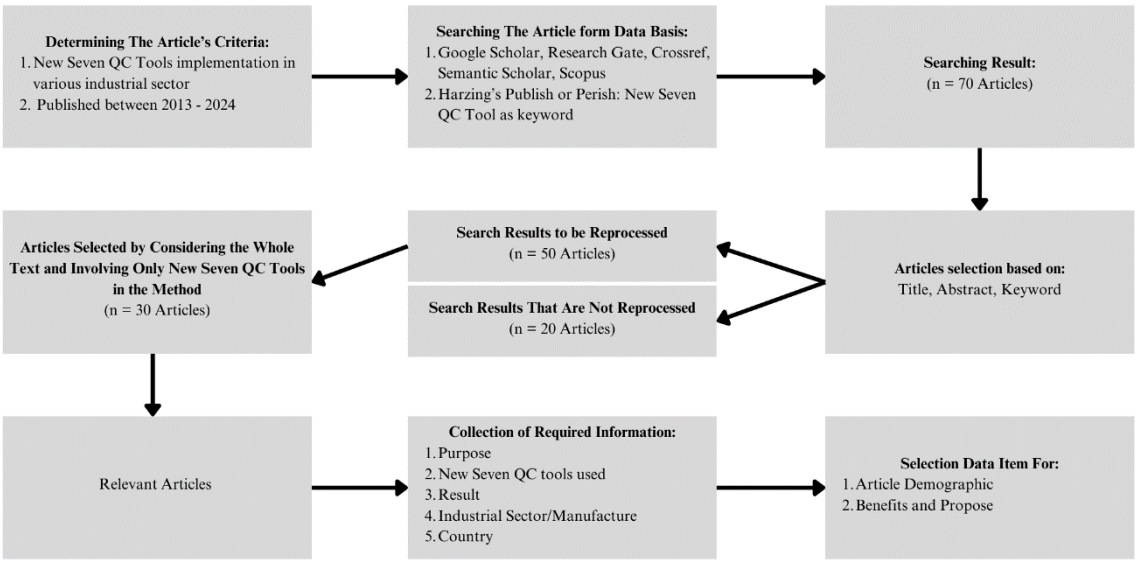

Figure 1. Research steps

RESULT AND DISCUSSION

The article selection process yielded 30 articles published between 2023 and 2024 that focused on the implementation of the New Seven QC Tools. Table 1 presents a summary of the selected articles including key details, research objectives, and findings.

Tabel 1. 30 Selected and Relevant Articles

No	Identity	Objective	Result	Used Tools						
1	(Andrássyová et al., 2013)	This study addressed customer complaints lodged against Automobile Bench.	Analysis revealed that work instructions, quality control processes, and methods contributed to nonconformities, prompting the creation of improvement plans.	●	●	●	●	●	●	●
2	(Liwang, 2016)	Minimizing bread defects through the use of New Seven Tools at Toko Roti Glory Surabaya.	Effective quality control requires attention to four factors, with training being a fundamental component.	●		●	●		●	●
3	(Rachmadina & WP, 2016)	Analyze the factors contributing to manufacturing flaws and implement quality initiatives to decrease defective output.	Material thickness, process parameters, machine state, and operator skill can introduce defects. Improvement initiatives are targeted based on these defect origins.	●	●	●	●	●	●	●
4	(Silviadara & Budiawan, 2016)	Address customer complaint management issues.	Customer complaints were analyzed to identify underlying issues, which were then rectified.	●	●	●	●	●	●	●

No	Identity	Objective	Result	Used Tools						
5	(Chandra devi & Puspitasa ri, 2016)	Understanding the company's quality control procedures, particularly for its 500ml X bottle product.	Quality control focuses on optimizing personnel, materials, machinery, workspace, and methodologies to identify and implement corrective actions.	●	●	●	●	●	●	●
6	(Rahayun ingtyas & Sriyanto, 2018)	Acquiring knowledge about the company's quality control practices, specifically for Ibu Pudji's baxo tofu.	Meatball quality is influenced by operators, materials, machines, environment and methods. Improvements are made by paying attention to these factors.	●	●	●	●	●		
7	(Tsironis, 2018)	Implement data mining techniques for quality improvement, develop data mining based on the New 7 Quality Tools, discover hidden knowledge in data, propose solutions for quality improvement, and create automated applications based on data mining results.	The root cause of most defects can be traced back to operator mistakes during machine operation. To address this, we propose developing QTs that examine raw data from the initial stages of data mining.	●	●	●	●		●	●
8	(Pramon o et al., 2018)	Identify factors that cause Triocid strips to become damaged.	Aluminum, process, machine and operator conditions are factors that cause defects. The improvement formulation is set based on these factors.	●	●	●	●	●	●	●
9	(Himawa n et al., 2019)	Quality control of Swallow's Nest at CV LVS Probolinggo uses the New Seven Tools to minimize defects that occur.	Quality is controlled by considering the factors of awareness, skill, and stability of raw material quality. Based on this, 5 improvement proposals were determined.	●	●	●	●	●	●	●
10	(Ferastra & Puspitasa ri, 2019)	Discover the causes of delays in ASTINet installation services by identifying the entire process of ASTINet installation.	The labour factor has the greatest effect on the delay in the ASTINet installation process. Improvement plan were successfully formulated.	●	●	●	●	●	●	●
11	(Aziza & Setiaji, 2020)	Identify factors and propose solutions to reduce the percentage of product defects.	Lack of ability and accuracy of operators to master the machine. SOP training and periodic maintenance are required.	●	●	●	●	●	●	●
12	(Zakariya et al., 2020)	Obtained a quality improvement process quality through the implementation of the new seven tools.	The main factors are in the dimensions of machine, man and method. Proposed improvements are determined from these factors.	●		●			●	●

No	Identity	Objective	Result	Used Tools						
13	(Yusnita & Puspita, 2020)	Find out the results of analyzing each stage of the new seven tools.	Defects in products come from people, machines, methods, materials and the environment. Improvements to the causes are established.	●	●	●	●		●	●
14	(Ginting & Fattah, 2020)	Find causes and provide improvement alternatives to reduce delivery delays.	Delays are caused by human, materials, processes, machines, systems and work environment factors. There are 3 improvement proposals determined.	●	●	●	●	●	●	●
15	(Ginting & Wibowo, 2020)	Find the root cause and suggest improvements related to quality issues in wheat flour.	The main causes of quality problems in wheat flour come from man, raw materials, machine, work methods and work environment so that the required improvements have been established.	●	●	●	●	●	●	●
16	(Ngatilah et al., 2021)	Analyzing the quality of sugar grains produced at PT "X".	There are material, operator and machine factors as the main causes of quality problems. This resulted in the required improvements.	●	●	●	●	●	●	●
17	(Putra & Prakoso, 2021)	Knowing the causes of defects that occur and providing recommendations for improvement in bubble window production at PT X.	Causes of defects come from the environment, people, machines, methods, and materials. Improvement recommendations are established.	●	●	●	●	●	●	●
18	(Al Faritsy & Prasetiyo , 2022)	Quality improvement on 5kg gallon paint.	Various root causes were identified along the dimensions of man, material, machine and method. There are 10 proposed improvement recommendations.	●	●	●	●	●	●	●
19	(Umami & Donoriya nto, 2022)	Determine the quality of refractory stone, factors causing defects and their impact, and quality improvement proposals.	Human error, old machine, undeveloped work methods, and poor-quality raw materials. The proposed improvements are adjusted to these factors.	●	●	●	●	●	●	●
20	(Amartya & Mahbuba h, 2022)	Evaluate the quality along the carton box production line flow based on the new seven tools approach.	The causes of quality problems were found to be SOPs, employee fatigue, conditions, and environment. Proposed 9 improvements needed.	●	●	●	●	●	●	●
21	(Febryan syah et al., 2022)	Discover the factors that cause damage to local fruits.	Local fruit damage is caused by factors such as fruit, display conditions, work methods and	●	●	●	●	●	●	●

No	Identity	Objective	Result	Used Tools						
			employees. Improvements were formulated related to these factors.							
22	(Wibowo & Handayani, 2022)	Applying the new 7QC tools in controlling the quality of robusta coffee beans in government-owned plantation companies.	Focused tasks on individual employees to improve performance, better environmental and material conditioning, improved methods, and optimized use of machinery.	●	●	●	●	●	●	●
23	(McDermott et al., 2023)	Investigate the 7 new quality control or new 7 management tools and their use in manufacturing organizations.	10% of participants agreed that the new 7 QC tools can solve 80% of organizational problems, Tree Diagram is the most widely used method in manufacturing organizations, The general benefit of using the new 7 QC tools in the manufacturing sector is to help define, measure, and analyze the problem area or priority level and provide a problem-solving model.							
24	(Kistianto & Prakoso, 2023)	Reduce the number of defective products.	Operator error during machining, poor material quality, and lack of quality inspection. Improvements are proposed as per these factors.	●	●	●	●	●	●	●
25	(Arera & Suseno, 2023)	Reduce the number of defects Giboult products.	There were 13 contributing factors to product defects and 7 improvements were formulated related to machines, people, methods, and environment.	●	●	●	●	●	●	●
26	(Lafeniya & Suseno, 2023)	Knowing the factors that cause defects and knowing the types of defects that are the highest.	Factors causing defects come from people, machines, methods, materials, and the environment. Five proposed improvements were produced.	●	●	●	●	●	●	●
27	(Aini et al., 2023)	Improve the quality and minimize the defects of 600 ml Hanaang brand bottled water products.	Quality improvement is carried out on factors that cause defects such as human, machine, and environmental factors. Proposed improvements consist of scheduling, training and supplying storage tools.	●	●	●	●	●	●	●
28	(Setiawan &	Controlling the quality of 19L gallon	It was found that human, technical, material and environmental factors	●	●	●	●	●	●	●

No	Identity	Objective	Result	Used Tools						
	Nuryanto , 2023)	products of PT Sariguna Primatirta	affect product quality. Improvement proposals were successfully established.							
29	(Aziz & Winursito, 2024)	Find out the influencing factors and proposals to solve the problem of remaining cable material.	It was found that the lack of accuracy of staff and field workers in determining material requirements to material processing.	●	●	●	●	●	●	●
30	(Faturohman, 2024)	Identify various variables that affect the production of defective products and solutions to reduce defective products with New Seven QC Tools.	The causes of manhole defects were caused by workers, raw materials, machine maintenance, working methods and room temperature. Suitable improvements were successfully established according to the existing causes.	●	●	●	●	●	●	●

Note: Affinity Diagram (AD), Interrelationship Diagram (ID), Tree Diagram (TD), Matrix Diagram (MD), Matrix Data Analysis (MDA), Activity Network Diagram (AND), Process Decision Program Chart (PDPC).

Food Sector: Liwang (2016) employed 5 of the New Seven QC Tools to pinpoint the root causes of bread product defects. Through brainstorming, data was collected and analysed, successfully identifying critical factors and recommending corrective actions. Rahayuningtyas & Sriyanto (2018) identified operator concentration, environmental distractions, and tofu inconsistency as primary contributors to product defects. Their proposed solutions, including performance tracking, workspace optimization, and facility upgrades, were effectively implemented to address these issues. Packaging Sector: Al Faritsy & Prasetiyo (2022) employed all seven tools to pinpoint defect causes in 5kg paint gallons. Their findings indicated that human error, machine malfunctions, and environmental conditions were the primary contributors to product defects. Amartya & Mahbubah (2022)'s study identified sloppy paint and debris as the main causes of carton box defects using the New Seven QC Tools methodology.

Construction Material Sector: Aziza & Setiaji (2020) employed the New Seven QC Tools to identify root causes of Mabel product defects. Their findings indicated that faulty machinery, operator errors, and subpar raw materials contributed to these defects. To address these issues, they proposed improvements such as SOP revision, employee training, machine maintenance, and enhanced raw material storage. Pharmacy Sector: Pramono et al (2018) successfully employed the New Seven QC Tools to pinpoint defects in Triocid strips. Through direct observation and data analysis, the study identified machine conditions as the primary defect cause. Subsequently, the researches developed effective improvement measures to address these root causes.

Airplane Sector: Ginting & Fattah (2020) employed the New Seven QC Tools to pinpoint the root causes of product defects leading to supplier delivery delays. By conducting interviews with managers and operators, as well as through on-site observations and data analysis, they successfully identified the problem and developed effective solutions. Metal Sector: Faturohman (2024) effectively implemented the New Seven QC Tools to manage manhole product quality. The analysis identified poor machine maintenance and low worker concentration as primary contributors to defects. The study proposed improvements including enhanced safety checks, increasing staffing, and additional ventilation equipment.

Automobile sector: Andrássyová et al (2013) successfully employed the New Seven QC Tools to address customer complaints about chipped chrome coating on automobile seats in Slovakia. The root cause was identified as a combination of employee and blower factors. Data Mining Sector: Tsironis (2018) employed the New Seven QC Tools and data mining techniques to identify patterns in machine breakdown data. This approach easier pattern recognition for all stakeholders. Internet Sector: Ferastra & Puspitasari (2019) successfully enhanced a 14-day repair service through the application of the New Seven QC Tools. By pinpointing root causes, including employee proficiency and tool wear, the study effectively identified and addressed service shortcomings.

Fabric Sector: Lafeniya & Suseno (2023)'s study applied the New Seven QC Tools to identify quality issues in gray fabric production. Their findings that non-standard quality stemmed from unclear work procedures, equipment malfunctions, and suboptimal working conditions. Based on these results, they successfully developed improvement recommendations. Manufacturing Sector: McDermott et al (2023)'s Irish study on Nes Seven QC Tools implementation in manufacturing revealed that manufacturers require adequate preparation to overcome related challenges. Drinking Sector: Zakariya et al (2020)'s study identified specific defects in bottled drinking water, pinpointing their root causes. The researchers subsequently proposed process enhancements to address these issues.

Outdoor Equipment Sector: Kistianto & Prakoso (2023) employed the New Seven QC Tools to analyse fishing rod defects, identifying eight defect types. Their research pinpointed three primary causes: operator error, subpar raw materials, and inadequate quality inspection. Restaurant Sector: Silviadara & Budiawan (2016) investigated the low visitor count at a restaurant, identifying key contributing factors. The study culminated in the development of solutions to address these issues.

Shipping Sector: Aziz & Winursito (2024) investigated the significant amount of remaining cable material and identified a critical need for a solution. Their research demonstrated the effectiveness of the New Seven QC Tools in pinpointing root causes and developing improvement strategies for these issues.

An analysis of the research objectives from the selected articles yielded 5 categories, detailed in Table 2.

Table 2. Categorization of Articles Based on Research Objectives

Research Objective	N	Article No.
Quality Improvement/Control	15	1, 2, 3, 4, 5, 6, 8, 9, 10, 13, 18, 19, 21, 25, 27
Determination of Defect Factors	15	5, 6, 8, 10, 11, 12, 14, 15, 20, 22, 23, 24, 26, 28, 30
Customer Complaints	2	7, 16
Benefits to Organization	1	17
Production Process Improvement	1	22, 30

Table 2 reveals a diverse range of objectives among studies utilizing the New Seven QC Tools, with 15 articles explicitly targeting quality enhancement, control, and root cause identification of product or service defects. This data underscores the enduring relevance and versality of the method in organizational contexts. By demonstrating its applicability across a spectrum of quality-related challenges, these findings reinforce the New Seven QC Tools as a robust framework for problem-solving and continuous improvement. Furthermore, the alignment of these results with McDarmott et al (2023) assertions about the method's efficacy in problem definition, measurement, analysis, and resolution strengthens its credibility as multifaced quality issues, as evidenced by the varied objectives

of the analysed studies, positions it as an indispensable asset for organizations seeking to optimize their process and products.

Figure 2 provides a visual representation of the article distribution across publication years. This graphical depiction offers insights into the temporal spread of research focused on the New Seven QC Tools, allowing for an analysis of research trends and potential gaps over time.

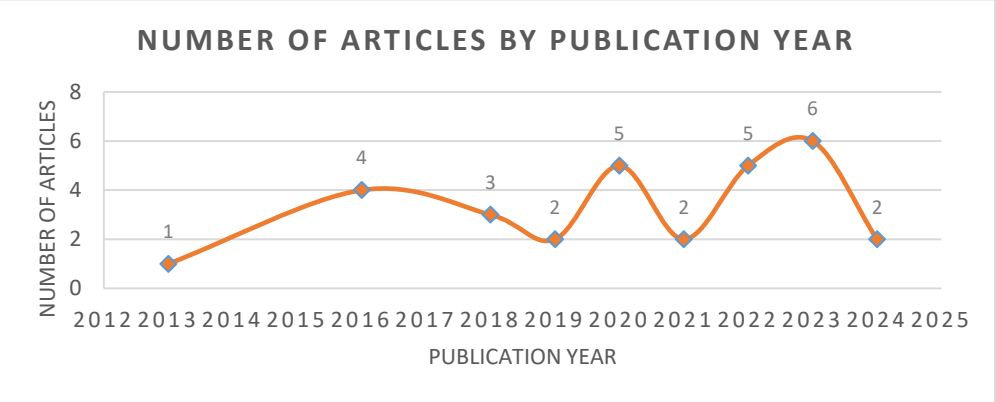

Figure 2. Number of articles by publication year

Figure 2 presents a compelling Figure 2 presents a compelling narrative of the New Seven QC Tools' enduring relevance in contemporary research. The steady stream of publications employing this methodology over the past five years is a testament to its sustained utility. Moreover, the sharp uptick in research activity from 2021 to 2023 is indicative of a burgeoning interest in the tool's potential to address emerging quality challenges. This escalating adoption across diverse industries is a strong indicator of the method's broad applicability and its capacity to deliver tangible benefits. The ability to translate theoretical concepts into practical solutions, as evidenced by its widespread use, positions the New Seven QC Tools as a cornerstone of effective quality management strategies. It is plausible to infer that the method's adaptability, coupled with its proven efficacy, has contributed significantly to its sustained popularity. As industries continue to evolve and face new quality imperatives, the New Seven QC Tools appears poised to remain a valuable asset for researchers and practitioners alike (Mizuno, 2020).

Figure 3 categorizes the selected articles by industry type and author’s country of origin.

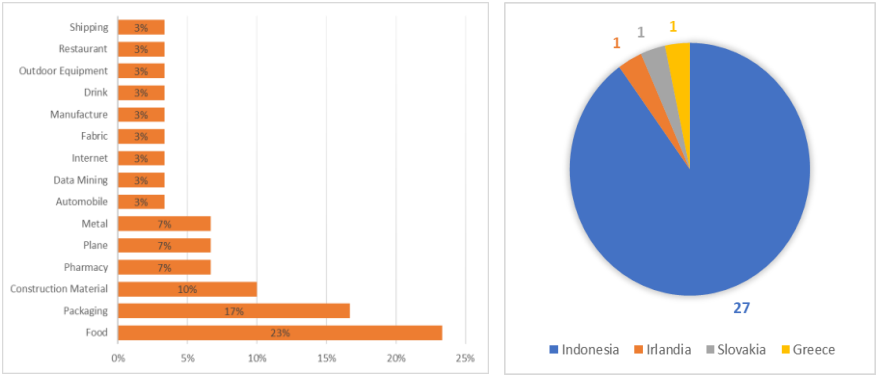

Figure 3. Article distribution based on: a). Type of industry (Left), b). Author’s country origin (Right)

Figure 3a provides a sectoral overview of the New Seven QC Tools application, with the food industry leading the pack at 27%, followed by packaging and construction materials at 17% and 10%, respectively. The dataset encompasses a diverse range of 15 industries. Notably, Figure 3b reveals a strong national concentration, with Indonesia accounting for a substantial 90% of the analysed articles. This overrepresentation of Indonesian studies underscores the method's significant adoption within the domestic industrial landscape. It suggests a heightened awareness of quality improvement initiatives and a proactive approach to problem-solving among Indonesian organizations. The prevalence of the New Seven QC Tools in such a concentrated geographical area also presents an opportunity for in-depth comparative analysis and the identification of best practices specific to the Indonesian context.

Figure 4 illustrates the frequency of the New Seven Tool usage in the selected articles.

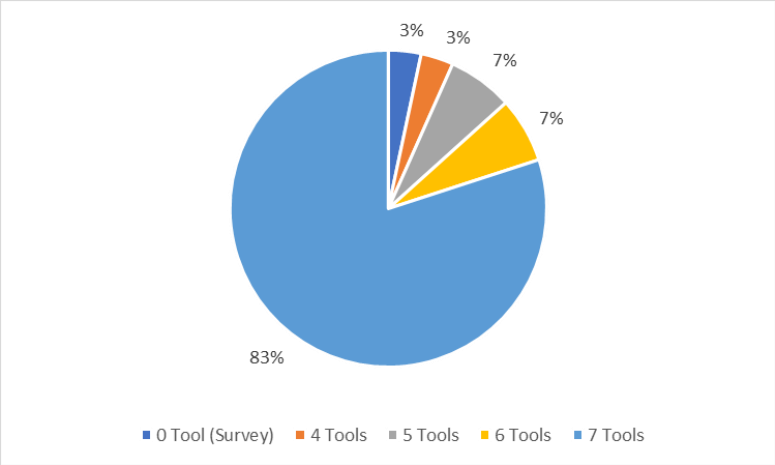

Figure 4. Number of tools used

Figure 4 shows that the application of the New Seven QC Tools within the studied articles was not uniformly exhaustive. While some studies utilized all seven tools, others effectively achieved their research objectives with a subset of four or five. This variability in tool usage offers intriguing insights. It suggests that the efficacy of individual tools might be contingent upon the specific problem domain. Additionally, it challenges the notion of a one-size-fits-all approach to quality control, implying that a tailored selection of tools may be more appropriate in certain contexts. This finding underscores the potential for further research to delve deeper into the comparative effectiveness of different tool combinations and their suitability for various problem types. By examining these patterns, researchers can develop more nuanced recommendations for tool selection and application in future studies, as Markulik et al. (2022) did in their research about application of quality tools to solve production problems.

There are differences in using the sequence of steps from the New Seven QC Tools. The results of using each step are presented in Figure 5. The analysis of tool utilization across 28 out of 30 articles provides a nuanced understanding of how researchers approach problem-solving within the New Seven QC Tools framework. The sequential application of these tools, as depicted in the data, offers valuable insights into their perceived utility at different stages of the research process. Affinity Diagram's prevalence as an initial step suggests its effectiveness in capturing and organizing raw data. This aligns with its core function of grouping related ideas into categories. The subsequent shift towards

Interrelationship Diagram and Tree Diagram indicates a progression from data organization to identifying relationships and hierarchies, respectively.

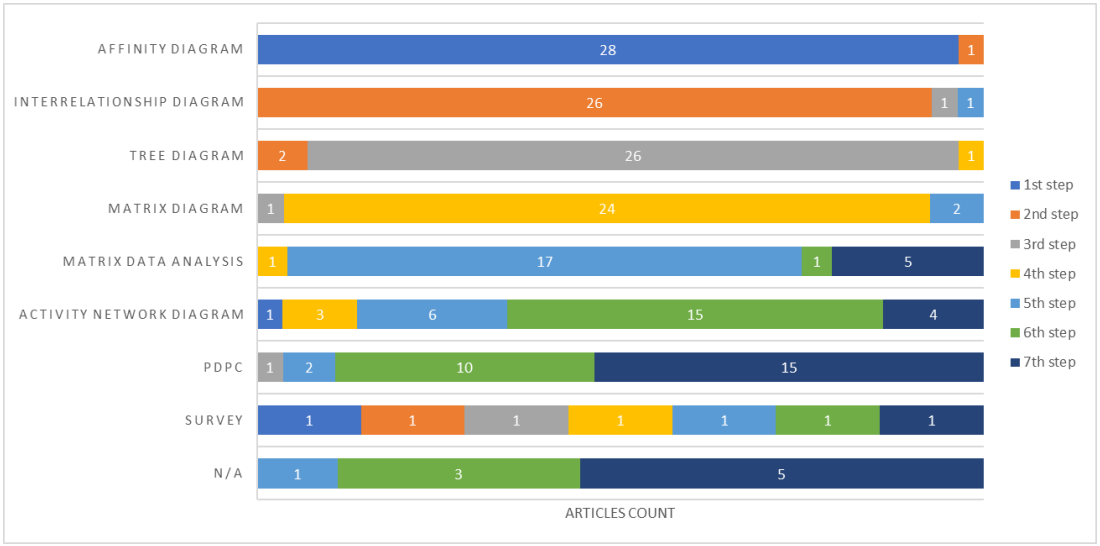

Figure 5. Tool usage at each step

These tools are crucial for establishing cause-and-effect linkages and understanding problem structures. The dominance of Matrix Diagram in the fourth step highlights its role in analysing complex relationships between multiple variables. This is followed by Matrix Data Analysis, suggesting a quantitative approach to identifying patterns and trends within the collected data. The increased use of Activity Network Diagram in the subsequent stages emphasizes the importance of process optimization and resource allocation. Finally, PDPC's prominence in the final step underscores its determining process for needed implementation. This sequential pattern implies a systematic approach to problem-solving, moving from data collection and organization to analysis, evaluation, and solution development. However, the variability in tool usage across different steps also indicates that researchers adapt their methodology based on specific research questions and challenges, as Dawadi et al. (2021) in their research about research methods. This flexibility is essential for effective problem-solving. To fully leverage the potential of the New Seven QC Tools, future studies should explore the synergistic effects of different tool combinations in addressing specific problem types, examining how existing tools can be modified or combined to fit unique research contexts, and developing rigorous methods for assessing the effectiveness and efficiency of different tools.

Previous research has consistently demonstrated the efficacy of the New Seven QC Tools in optimizing efficiency and quality within a broad spectrum of industrial domains. The laboratory setting, characterized by its intricate processes, demanding quality standards, complex regulatory frameworks, and ceaseless drive for improvement (Martínez-Perales et al., 2021), presents a unique yet ideal environment for the application of these tools. By aligning the principles of the New Seven QC Tools with the specific challenges and objectives of laboratory operations, significant advancements can be achieved. These potential gains encompass not only enhanced accuracy in test results but also accelerated turnaround times, optimized resource utilization, and a fortified foundation for continuous improvement. This strategic alignment between tool and environment offers a promising avenue for laboratories to elevate their performance and contribute more effectively to broader organizational goals.

CLOSING

Conclusion

A review of 30 selected articles confirms the New Seven QC Tools effectiveness in addressing laboratory quality issue. This method identifies benefits and proposes solutions, demonstrating its value for improving laboratory performance. This study isolates the New Seven QC Tools, neglecting other quality frameworks. Future research should compare these tools and explore their combined potential. While most studies identify problems and propose solutions, quantifying the impact of these tools remains scarce. To address this, future research must measure outcomes.

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