

27th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES 2023)

Best Practices for Knowledge and Quality Management in IT Projects

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Abstract

With the ever-increasing demand for development and innovation, organizations must prioritize quality management aspects to ensure the quality of their online products and services. This includes implementing effective test management strategies to identify and resolve issues before they impact end users. The aim of this research is to underscore the need for a robust test management plan to ensure stable and trustworthy web services. As such, it proposes best practice solutions for organizations in the field of quality control and testing, which have a high impact on improving knowledge management. This study used an observational approach to assess the importance of quality assurance in IT projects and its impact on knowledge management. The findings presented in this paper highlight the critical role that quality control and testing procedures play in promoting effective knowledge management. Furthermore the outcomes of the study show that in order to deliver world-class software and services, organizations must prioritize effective test management and continuous quality assurance.

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Peer-review under responsibility of the scientific committee of the 27th International Conference on Knowledge Based and Intelligent Information and Engineering Systems

Keywords: knowledge management practices; web quality assurance; testing procedures

1. Introduction

In the early days of software testing, test scenarios were transferred onto paper and the tests were based on calculations of algorithms, the flow of control, and data processing, all of which were done using the paper-based method. However, the general examination of the software program only occurred at the end of the project plan [1]. In the early 1990s, with the advent of the World Wide Web and the development of web browsers, software testing faced new hurdles. Because the sequence in which criteria might be retrieved was practically random, the arrival of

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web-based applications necessitated a fresh approach to test design [1], [2]. It should be emphasized that due to the continuously progressing technology and software development, testing strategies and methodologies must constantly adapt and improve to meet the ever-changing demands. Incorporating good practices of knowledge management within organizations can aid in this effort. The software development teams need to stay up to date with the current developing trends and best practices in software testing and knowledge management to be able to make their products high quality and meet the demands and expectations of their consumers.

The main aim of this research is to present the need of having robust test management plan in order to provide reliable and trustworthy online services. As such the paper recommends best practices in the field of quality control and testing, which have a significant influence on enhancing knowledge management. To achieve this goal the following research question is identified. What role does knowledge management play in successful quality control and testing? The main input of this research is to present the efficient solutions for businesses in the areas of quality assurance and testing, as well as their impact on knowledge management. This solutions will ensure high-quality of online products and services, increase the customer satisfaction, and improve company performance.

After the introduction the paper presents the theoretical section with a review of the literature focusing on quality assurance as a best practice in knowledge management. Next section will describe the research methodology applied in this study. In the subsequent chapters, a case study will be presented based on the analysis of test management processes in an online organization. Finally, the article will present the conclusive findings regarding the impact of test management on knowledge management.

2. Quality Assurance as a best practice in knowledge management

In the course of their careers, every IT professional develops an intuitive understanding of software quality definition [3]. The formal definition of software quality, as expressed in DIN ISO 9126:1991, is as follows: "Software quality is the totality of features and characteristics of a software product that bear on its ability to satisfy stated or implied needs." This definition demonstrates that software quality is a multidimensional construct that is made apparent through the characteristics of the software, which must be operationalized further into software quality measures [4].

The quality characteristics of software are explicitly captured in various standards, including the collection of standards. According to software standards the following software quality characteristics are listed: functionality, reliability, usability, efficiency, maintainability, and portability. ISO/IEC 9126 [5]. The impact of quality characteristics on knowledge management best practices within an organization was analyzed and is presented in Table 1.

Table 1. Software quality Characteristics and their Impact on Knowledge Management.¹

Quality Characteristics	Definition	Impact on Knowledge Management
Functionality	The ability of a product to deliver the functions of the software and meet the specified requirements.	Ensures that software meets user needs and supports the organization's goals. This can lead to increased user satisfaction and better business outcomes.
Reliability	A summary of properties relating to the reliability of the software (stable conditions over a fixed period).	Helps ensure that software operates consistently and meets user expectations. This can lead to increased trust in the software and the organization that developed it.
Usability	The ability of a software product to operate, be learned and be used by the user.	Enhances user satisfaction and adoption of the software, which can lead to increased productivity and better business outcomes.
Efficiency	The efficiency of software is measured by the powerful functionalities contained in relation to the resources expended.	Helps ensure that software operates efficiently and does not unnecessarily consume resources. This can lead to reduced costs and improved system performance.
Maintainability	The ease of correcting and extending a	Allows for easier maintenance and updating of

¹ Own elaboration based on [6]

	software product.	software, reducing downtime and costs associated with fixing errors or adding new features.
Portability	The ability of a product to be transferred from an independent software environment or hardware environment.	Enables software to be used in different contexts, increasing its potential user base and usefulness. This can lead to increased value and return on investment for the organization.

The above characteristics affect both the development and testing phases of software products. Adopting these quality characteristics as best practices in knowledge management can result in enhanced outcomes and overall success within the organization [7].

2.1. Software Testing

Testing is a crucial practice in knowledge management as it ensures that the software product meets the required specifications and operates correctly. The process involves a range of activities such as test planning, preparation, control, and evaluation of the tests to achieve the objectives mentioned above. The use of various methods during testing, including dynamic testing with computer support, and static reviews without computer support, helps to eliminate errors and detect defects in software components, leading to improved outcomes and overall success within the organization [8].

The relationship between software testing and knowledge management is vital for continuous improvement in organizations. Software testing plays a crucial role in uncovering defects, errors, and potential issues during the software development process. Through rigorous examinations and diverse tests, valuable insights and data are generated, which contribute to the advancement of knowledge management practices, see Figure 1 [16].

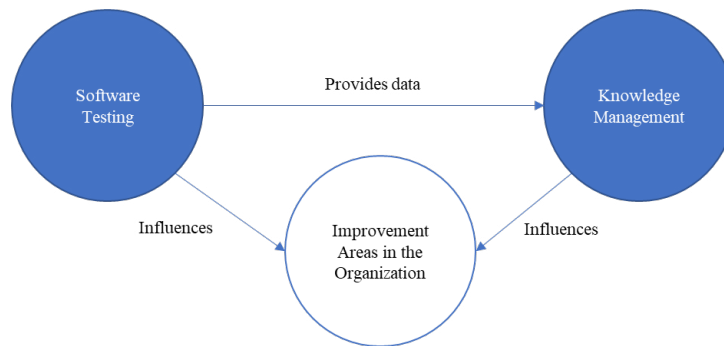


Figure 2: The Correlation between Software Testing and Knowledge Management[‡]

By pinpointing recurring issues or patterns in software defects, testing teams help identify areas that need improvement and highlight potential knowledge gaps in knowledge management processes. This feedback empowers knowledge management teams to strengthen documentation, create targeted training materials, and promote knowledge sharing. Software testing also provides organizations with valuable data to evaluate the effectiveness of their knowledge management practices. Analyzing the success rates of different testing methodologies, tools, and practices allows organizations to refine their knowledge management systems and incorporate the most efficient approaches [17]. This iterative process of improvement is fueled by real-world testing experiences. Documentation and reporting within software testing create a valuable repository of information. Test reports, defect records, and test outcomes become a well of knowledge that can be referenced, used for training purposes, and facilitate continuous learning.

Software testing itself is a process that encompasses multiple (test) procedures aimed at achieving the coverage

[‡] Own elaboration based on [16]

of clean actual states and meeting the required specifications. Testing itself involves various activities, such as test planning, preparation, control, and evaluation, that lead to the above-mentioned objectives. A test is performed using specific methods that should eliminate errors. This can be accomplished through static reviews (testing the test object without the use of computers) or dynamic testing methods (testing the test object with computer support) to ensure the correct functionality of the software (e.g., performance of the software components), while attempting to detect defects as accurately as possible [8].

The explicit test phases are characterized by predefined test objectives, general investigation procedures, and test tools. Each phase must be started only after termination of the previous test objects, and no parallel execution of the specifically to be tested stages is possible [9].

To cover the testing approach at all test stages, it is necessary that the basic principles are well defined in the work, which will ensure the effectiveness of the testing process. The basic principles could be defined as follows; ideally, the principles should be applicable in each of the four test stages: component testing, integration testing, system testing, and acceptance testing [10]. The four stages of software testing play a significant role in ensuring software quality and meeting the desired specifications. Each stage has specific test goals, examination procedures, and test tools and must be carried out sequentially without parallel execution. The impact of the four stages of software testing on knowledge management practices within an organization is notable. In addition to ensuring software quality and meeting desired specifications, these stages influence knowledge management. The factors listed below serve to illustrate this influence:

- Testing processes presented in a structured manner improve knowledge management by organizing and planning testing activities, leading to more efficient and effective testing. This structured approach also ensures that knowledge about software requirements, design, and testing processes is readily accessible to all stakeholders.
- Repeatability of tests is necessary to ensure consistent and reliable test results, which reduces the likelihood of errors and enhances software quality. This allows developers and testers to share knowledge about the testing process and results, improving software development and testing practices.
- Documenting and archiving the testing process and results ensures knowledge about the software is preserved and available for future use, supporting knowledge management.
- Transparency for third parties and traceability enhance accountability and ensure all stakeholders have a clear understanding of software requirements, design, and testing processes, essential for effective knowledge management.
- The testing process must be efficient and time-oriented, reducing the likelihood of costly errors and software failures and effectively managing knowledge about software development and testing processes.

2.2. Test phases

The testing process is a critical aspect of software development that aims to ensure software quality and reliability. The process comprises several phases that must be meticulously executed to achieve the desired results. In the context of knowledge management, each testing process also consists of crucial phases such as planning, analysis and design, test execution, and test evaluation. It is imperative to follow these phases diligently to identify and address any issues before software release to avoid potential risks that may impact software performance and reputation [11]. The phases of testing in the context of knowledge management will be presented below:

■ Phase 1 – Test planning

Test planning involves defining the overall direction and purpose of the test in order to introduce the test as simply as possible, including specifics such as why, when, with what resources, and where to test. In the planning phase, the team establishes standards and guidelines for creating "test suites" [11]. Taking into account what needs to be tested, it is planned in which environment the tests should be set up. Typically, these questions are determined through the documentation of the necessary software configurations. During this phase, the adaptation time is preliminarily estimated.

▪ Phase 2 – Test analysis and test design

Test analysis and design involves defining concrete test cases that are later broken down into detailed test steps. These steps can then be either manually executed or designed and developed through automated test scripts. For certain test teams, this information is captured in a test management tool [11]. By documenting and sharing this information in a centralized tool, team members can easily access and reference it, leading to better knowledge sharing and transfer. This can ultimately improve the efficiency and effectiveness of the testing process, making it easier to identify and address any issues that may arise

▪ Phase 3 – Test execution

Test management must effectively manage the pre-implemented tests' executability. It is decided which employee with the most suitable knowledge should execute the manually-operable test. Tasks should be assigned according to experience and responsibility. In another case of the test process, such as dealing with more complex test criteria, semi-automated test scenarios are used. The final branches of the provided test types are automated tests, which execute the test steps in a constantly ordered sequence without the tester's influence [11].

During the execution phase, logical sentences are formed from the test cases, which are typically referred to as a test suite. In this phase, the "test suites" (against a known configuration of the software) are executed, and a distinction is made between manual, semi-automated, and automated tests. Test execution should be aligned with the schedule [13]. Three methods are offered to execute a test suite:

- Manual test execution: This is done by getting pre-formulated steps from the test leader and applying the test suite to a part of the software in use. Manual testing also includes intuitive tests, in which the software functionality is checked based on personal experience
- Semi-automated test execution: In this phase, both the automated method and the competence of the testing team to produce valid results are introduced. It is a combination of a manual test and automated methods.
- Automated test execution: To execute the automated tests, an adequate testing tool is required, and it is important to select the right tool configuration for correct execution. Finished implemented scripts must be brought into an environment to give the test procedure a start command.

It is essential to record the configuration for the purpose of new tests at a later point in time (save configurations). Additionally, after each procedure, an evaluation of the test ending should be communicated to avoid failed steps or negative results in the next test proc

▪ Phase 4 – Test evaluation

Test evaluation is an essential aspect of the software testing process. Test management tools are used to record the test results, which are then displayed and summarized through a dashboard or test metrics tool. The primary objective of such tools is to determine the current status of the project examination accurately. Precise test reports are helpful in graphical software test evaluations. The continuous improvement of the testing process remains at the forefront of the company's objectives [11].

Tracking is a necessity in the testing process because quality metrics are required to effectively monitor how the testing effort and the quality of the system or application are measured. When a test management application is used to track the reporting of the testing process, project dashboards are usually added. Test reporting allows for the assessment and communication of information about the overall quality of the application. For instance, test results may be shared with other stakeholders [11].

Furthermore, knowledge management is an integral part of the test evaluation process. Test results and feedback provide valuable insights into the performance of the software and can help identify areas for improvement. The ability to capture and store this information in a knowledge management system ensures that it can be used in future testing processes. The knowledge management system should include mechanisms for storing and retrieving relevant information, such as test cases, test results, and quality metrics. The knowledge management system can also provide access to historical data, which can be used to identify trends and patterns in the testing process, leading to continuous improvement.

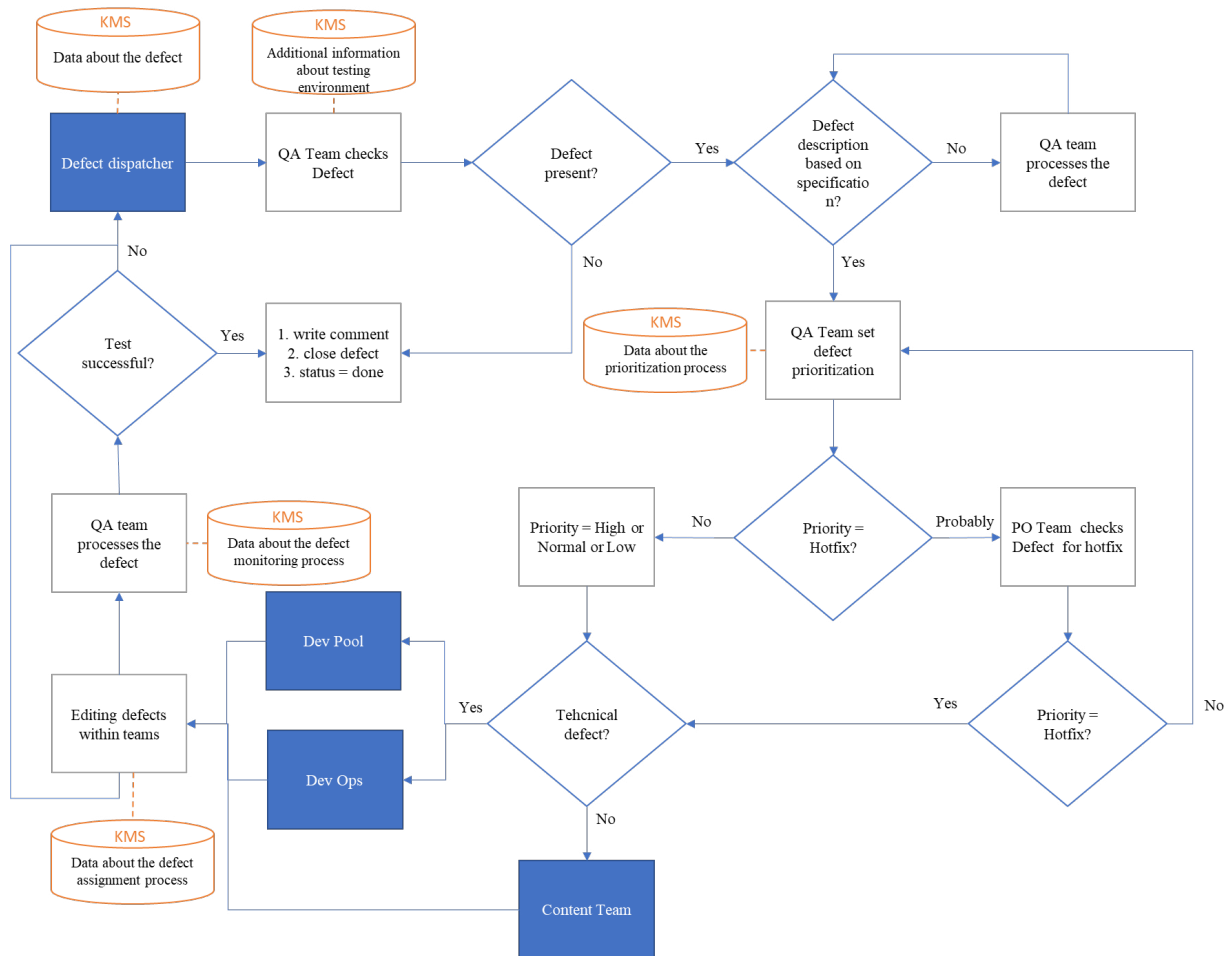
3. Research methodology

In the first part of the study, the aim is to identify and evaluate the key components of test management in relation to knowledge management. The study will use an observational approach [14] and examine project documentation, with a case study of an online tourism business. The organization selected for the study through intentional sampling [15] is a medium-sized company that has a structured test management system and follows an agile methodology approach. Observations will focus on the knowledge management practices employed during the development of the online product, and a descriptive analysis will be carried out based on the gathered information. The observations will provide insights into the specific practices associated with test management and its impact on knowledge management. The team will be observed at the company's headquarters, providing an opportunity for detailed workplace surveillance. The goal is to understand how test management works in the context of knowledge management in online businesses.

4. Quality and knowledge management within Online Organization: A Case Study Approach

In the process of software testing and quality assurance in the online touristic company, effective knowledge management is of paramount importance. The use of various testing methods allows for the determination of whether quality requirements are met, with each area of the website having its own specific requirements. The requirement specification captures outcome-oriented requirements and aims to identify measures that can be taken to counteract project failure. It is essential that the specification is objective and comprehensive, particularly with regards to the conditions for conducting tests, to ensure that all requirements are fully met. Early detection of errors is an advantage in reducing costly rework expenses. Effective knowledge management is therefore essential to ensure that errors are detected and reported as quickly as possible, allowing for prompt corrective action. The testing group must possess the necessary knowledge and skills to use different testing methods and tools effectively, thus ensuring the software is thoroughly tested and the quality is assured.

The online company faced various software-related issues that affected its overall functionality and legal conformity. These issues included minor software bugs and critical errors that violated legal regulations and caused stability problems. For instance, the Cascading Style Sheets failure caused significant disruptions. To report these issues promptly, the testing group needed to take specific quality assurance measures. There were two methods of reporting defects: reporting them in person to the Dev/Ops pool or using a web management application such as "Jira" to create a ticket and manage it with the help of the quality assurance team. The error handling process involved just-in-time procedures and required developers to work on error correction measures as soon as possible. A detailed workflow diagram was used to manage and prioritize these issues, see Figure 2.

Figure 2: Test and knowledge management within an online organization[§]

The process flow described above outlines the quality control procedures for identifying and resolving defects in a system. This process has a significant impact on knowledge management, leveraging the data collected in the knowledge management system (KMS) to enhance overall system performance and problem-solving capabilities. This process begins by collecting information about the defect through a ticket system, which includes detailed instructions on how to reproduce the issue. This information is crucial in accurately diagnosing and resolving the problem and contributes to knowledge management by capturing valuable data and instructions for future reference and issue resolution. During the testing phase, additional information such as the testing environment, browser, operating system used, and the area of the website where the error occurred is collected. This information helps isolate the problem and identify potential causes. It enriches the knowledge base by providing specific details about the system's context and conditions, enhancing the ability to identify patterns and improve overall system performance. Next, the prioritization process occurs, where the severity of the defect is considered, and a course of action is determined accordingly. This step requires a good understanding of the system and its components, as well as knowledge of the potential impact of the defect on the system's overall performance. By considering the impact on knowledge management, this process helps in making informed decisions and allocating appropriate resources

[§] Own elaboration

for resolving the issue, optimizing the resolution process, and contributing to overall knowledge management efforts. Assigning the ticket to a specific department requires knowledge of the department's area of expertise and the types of problems they are equipped to handle. This step ensures that the defect is addressed by the appropriate team, leveraging their knowledge and experience. It enhances knowledge management by aligning the issue with the team's expertise, leading to efficient problem-solving, knowledge sharing, and improved overall knowledge management within the department. Finally, the quality control team assigns a ticket status that provides an overview of the defect's status and the progress made towards resolving it. This information is essential for tracking the defect's lifecycle and ensuring that it is resolved in a timely and efficient manner. It facilitates effective knowledge management by monitoring the efficiency of the resolution process, identifying areas for improvement, and promoting a continuous learning and improvement cycle within the organization.

The process flow described above, from collecting information through a ticket system to assigning ticket status, contributes to knowledge management by capturing valuable data, providing context, optimizing resource allocation, aligning expertise, and facilitating efficient defect resolution. These actions collectively enhance knowledge management practices, improve system performance, and contribute to the overall effectiveness of quality control procedures.

5. Conclusion

The paper discussed the importance of quality management and test management to ensure high-quality products and services, where the aspect of knowledge management plays an important role. Complex processes can be simplified to increase their effectiveness and efficiency through the use of knowledge management systems. To ensure that issues are resolved efficiently and effectively, quality control and test methods must be well organized, with clear and direct communication between departments and customers.

The study underscores the importance of a structured testing approach for efficient knowledge management, with a readily accessible repository of knowledge about software requirements, design, and testing processes. Repeatable tests ensure consistent and reliable results, allowing for sharing of testing knowledge and practices. Documentation and archiving support knowledge preservation, and transparency and traceability promote accountability and stakeholder understanding of software processes. An efficient and time-oriented testing process is critical for managing knowledge and minimizing costly errors.

Effective test management and constant quality assurance are necessary to ensure that the software and services offered by the company meet the highest standards. Quality characteristics such as functionality, reliability, usability, efficiency, portability, and maintainability have a relevant impact on knowledge management in organizations.

Finally, the answer to the research question highlights the significant role of knowledge management in quality control and testing. Knowledge management plays a crucial role in various aspects of quality control and testing processes, encompassing the capturing of valuable data, providing context for effective problem-solving, facilitating informed decision-making, aligning expertise, and promoting continuous improvement. These contributions collectively lead to efficient defect resolution, improved system performance, and enhanced overall effectiveness of quality control procedures.

References

- [1] Muir P., Li S. and Lou S. (2016) The real cost of sequencing: scaling computation to keep pace with data generation. *Genome Biology*. <https://doi.org/10.1186/s13059-016-0917-0>
- [2] Dernbach C. (2010) "Mit 165 Wörtern in die Zukunft" in: *stern.de*. <https://www.stern.de/digital/online/die-erste-webseite-wird-20-mit-165-woertern-in-die-zukunft-3037904.html>
- [3] Hoffmann D. W. (2013) "Software-Qualität" Berlin Heidelberg, Springer-Verlag: 5-6.
- [4] Herzwurm G. M. (2018) "Software-Qualitätsmanagement" *Enzyklopädie der Wirtschaftsinformatik*.
- [5] Glinz M. (2011) "Software-Qualität" Universität Zürich, Institut für Informatik.
- [6] Liggesmeyer P. (2009) "Software-Qualität: Testen, Analysieren und Verifizieren von Software" Heidelberg, Spektrum.
- [7] Kleuker S. (2013) "Qualitätssicherung durch Softwaretests Vorgehensweisen und Werkzeuge zum Test von Java-Programmen" Wiesbaden, Springer: 20-21

- [8] Hooda I. and Singh Chhillar R. (2015) “Software Test Process, Testing Types and Techniques. *International Journal of Computer Applications*” 111:10–14. <https://doi.org/10.5120/19597-1433>
- [9] Stok L. (2013) “Developing Parallel EDA Tools [The Last Byte]. “ *IEEE Design & Test* 30:65–66. <https://doi.org/10.1109/mdat.2012.2237140>
- [10] Vivenzio A. (2013) “Testmanagement bei SAP-Projekten: Erfolgreich Planen, Steuern, Reporten bei Einführung von SAP-Banking“ Wiesbaden, Springer.
- [11] Spillner A. (2008) “Praxiswissen Softwaretest- Testmanagement“ Heidelberg, Dpunkt.Verlag: 14-28
- [12] Borba P. (2010) “Testing Techniques in Software Engineering“ Berlin Heidelberg: Springer: 24-28
- [13] Mahmud J., Cypher A., Haber E. and Lau T. (2012) “Design and industrial evaluation of a tool supporting semi-automated website testing. *Software Testing, Verification and Reliability*“ 24:61–82. <https://doi.org/10.1002/stvr.1484>
- [14] Kostka-Bochenek A. and Lisiecka K. (2009). “Case study research jako metoda badań naukowych” *Przegląd Organizacji* 10(837): 25–29
- [15] Czakon W. (2006) “Łabędzie Poppera – case studies w badaniach nauk o zarządzaniu“ *Przegląd Organizacji* 9 (80): 9–12.
- [16] Abbas, J. (2020). Impact of total quality management on corporate sustainability through the mediating effect of knowledge management. *Journal of Cleaner Production* volume 220. doi:<https://doi.org/10.1016/j.jclepro.2019.118806>
- [17] Honarpour A., Jusoh A. and Nor K. M. (2018) Total quality management, knowledge management, and innovation: an empirical study in R&D units, *Total Quality Management & Business Excellence*, 29:7-8. 798-816, DOI: 10.1080/14783363.2016.1238760