International Journal of Computer (IJC)
ISSN 2307-4523 (Print & Online)
https://ijcjournal.org/index.php/InternationalJournalOfComputer/index

Application of International Standards to Improve Competitiveness in the Gaming Industry

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Abstract

This review article explores the importance of international standards in optimizing processes and enhancing the competitiveness of companies in the rapidly growing market for video games. The author delves into the existing standards created by renowned organizations such as the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Institute of Electrical and Electronics Engineers (IEEE). Among the standards examined are ISO/IEC 25010, which covers systems and software quality models, ISO/IEC 33020, which assesses process capability, ISO/IEC 29110, which outlines lifecycle profiles for small businesses, IEEE 2861 for evaluating and optimizing mobile gaming performance, and ISO/IEC/IEEE 29119 for software testing. The article highlights the key features of these standards and explains how they contribute to process optimization, quality improvement, and enhanced user experience (UX). It also addresses the risks associated with implementing these standards and suggests strategies to minimize or eliminate them.

Keywords: gaming industry; international standards; ISO / IEC 25010; ISO/IEC 33020; ISO / IEC 29110; IEEE 2861; ISO/IEC/IEEE 29119; competitiveness improvement; processes; risk management.

1. Introduction

The dynamics of today's video game market are characterized not only by continuous growth, but also by increasing competition for audience attention, high technology requirements, and significant capital expenditures. Game companies are faced with the need not only to improve their products but also to adapt to technological innovations, such as the introduction of virtual reality (VR), augmented reality (AR), artificial intelligence (AI), machine learning (ML), and cloud technologies [1, 2]. Relying only on intuitive or customized approaches to game development is not enough to maintain competitiveness in this environment.

Received: 10/25/2024
Accepted: 12/25/2024
Published: 1/3/2025

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Companies are encouraged to focus on standardized methods that have the potential to efficiently manage complex projects, reduce costs, and improve the quality of the final product. The best solution in this context may be the use of international standards. Standards developed by leading standardization organizations such as ISO, IEC, and IEEE are sets of unified and structured rules, guidelines, and methodological tools.These standards are intended to help unify development processes, improve transparency, and predictability, as well as enhance the quality of the final product.The purpose of this paper is to evaluate the role of international standards in improving game development processes and increasing competitiveness in the market, and to formulate recommendations for companies planning to implement them. ISO/IEC standards such as 25010, 33020, 29110 and IEEE 2861, as well as ISO/IEC/IEEE standard 29119, are used as examples. The objectives encompass an examination of the prominent international organizations responsible for developing IT standards, including ISO, IEC, and IEEE; a detailed exposition of the core tenets of relevant standards (ISO/IEC 25010, ISO/IEC 33020, ISO/IEC 29110, IEEE 2861, and ISO/IEC/IEEE 29119) and their potential benefits for game development; the development of robust risk management strategies to mitigate challenges associated with standard implementation; and the formulation of tailored recommendations for standard adoption based on the specific characteristics and resource capacities of different types of game development organizations.

The theoretical significance of the article is to consider the possible positive impact of international standards on user satisfaction, overall game product quality, and the sustainability of game development processes. The standards addressed include capability assessment and key aspects of development. Therefore, the article can contribute to a better understanding of how the standardization of software development processes potentially enhances competitiveness within the gaming industry. The practical relevance of this article lies in its ability to assist companies in predicting and assessing possible risks associated with implementing international standards, while taking into account required costs and resources. This article aims to facilitate successful adaptation and integration of these standards based on the scale and abilities of companies operating within the gaming industry.

2. Materials and methods

This review article employs a qualitative research methodology, specifically a structured literature review, to investigate the application of international standards for enhancing competitiveness within the video game industry. The primary data sources consist of official documentation and publications from internationally recognized standardization bodies, including the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Institute of Electrical and Electronics Engineers (IEEE). Supplementary information is drawn from reputable industry reports and analyses that provide context regarding market trends, technological advancements, and the challenges faced by game developers. This multi-faceted approach allows for a comprehensive understanding of the interplay between standardization, technological innovation, and market dynamics within the gaming sector.

The analysis focuses on a selection of key standards pertaining to software development and quality assurance, including ISO/IEC 25010 (systems and software quality models), ISO/IEC 33020 (process capability assessment), ISO 29110 (lifecycle profiles for small businesses), IEEE 2861 (mobile gaming performance

evaluation), and IEEE/ISO/IEC 2919 (software testing). The examination of these standards involves a detailed exploration of their core components, prescribed methodologies, and potential benefits when applied to the specific context of game development. This includes an assessment of how these standards can contribute to process optimization, quality enhancement, and improved user experience.

Furthermore, the research acknowledges the potential challenges and risks associated with the implementation of these standards within the gaming industry. These include considerations of financial implications, resource allocation, technological compatibility, and potential resistance to change within organizations. The analysis incorporates risk management strategies and mitigation techniques to address these challenges and promote successful standard adoption. These strategies include phased implementation, return on investment analysis, staff training, and the adaptation of standards to accommodate the unique characteristics of different game development projects and company sizes.

Finally, the research culminates in the formulation of tailored recommendations for the application of international standards based on organizational typology. This involves categorizing game development entities into small, medium, and large organizations based on their resource capacity and operational scale. Specific standards and implementation strategies are then suggested for each category, taking into account their individual constraints and opportunities. This differentiated approach aims to provide practical guidance for game developers seeking to leverage international standards for competitive advantage.

3. Results

3.1. International organizations developing standards applicable to the IT industry

International standards organizations play a key role in shaping common approaches to quality and security in the IT industry. They contribute to the standardization of various aspects of software and hardware development. These standards help to unify processes, improve their predictability, and ensure high quality end products. This article will discuss three leading organizations that are actively developing standards for the IT industry: ISO, IEC, and IEEE. Each of these organizations has its own area of expertise and approach to standards development, which has a significant impact on IT processes. The following is a description of these organizations.

3.1.1.ISO (International Organization for Standardization)

The International Organization for Standardization (ISO) is one of the largest and most authoritative international standardization organizations, uniting the national bodies of more than 160 countries. It develops standards by consensus among its members, which makes its norms universal and recognized worldwide. ISO standards cover a wide range of industries, including information technology, and help unify processes, improve product quality and reduce risk. In IT, ISO standards provide uniform approaches to software design, development and quality assessment, which make them indispensable for companies striving for a high level of quality and competitiveness [3].

3.1.2.IEC (International Electrotechnical Commission)

The International Electrotechnical Commission (IEC) is the leading global standards development organization for the electrical and electronics industries. It works to create standards that promote safe, sustainable, and innovative technologies. IEC has more than 170 member countries, and publishes thousands of international standards that are used to assess the quality, safety, and reliability of products. IEC's standards help developers integrate modern technologies, such as electronics and telecommunications, into their development processes, ensuring that products meet safety requirements and high-quality standards [4].

3.1.3.IEEE (Institute of Electrical and Electronics Engineers)

The Institute of Electrical and Electronics Engineers (IEEE) is the world's largest professional association of engineers specializing in the development of standards in electronics, computing, telecommunications, and other high-tech fields. The organization has more than 400,000 members from over 160 countries and plays an important role in creating standards for advanced technologies such as AI, VR, AR, and mobile systems. IEEE standards are actively used in the development of software and hardware, which helps to improve their quality, performance, and safety [5].

3.2. International standards and their potential benefits for the gaming industry

We outline the essence of several key standards relevant to the gaming industry, and outline their application and potential benefits.

3.2.1.ISO/IEC 25010

ISO/IEC 25010 is an international standard that provides a framework for assessing the quality of software systems and software, including games. It is part of the ISO/IEC 25000 series, also known as SQuaRE, which helps manage the quality of software products at all stages of their life cycle.

The standard includes two quality models:

- A product quality model covering eight key attributes: functional suitability, reliability, performance, Usability, compatibility, security, portability and maintainability
- Usability quality model that aims to ensure efficiency, safety and user satisfaction when users interact with the product [6]

ISO/IEC 25010 can be useful to game developers in evaluating parameters such as server performance, response time in networked games, user data security and user interface (UI) usability. One of the main advantages of the standard is the ability to adapt the evaluation criteria to the specifics of the game genre and target audience. For example, for mobile games such as Angry Birds and Rush Royale, the simplicity and usability of the UI is critical, while for games with VR elements, such as Surgeon Simulator: VR and Half-Life: Alyx, smooth and realistic interaction with the game world plays a key role. ISO/IEC 25010 thus offers game development

companies practical solutions to improve the quality of game products.

3.2.2.ISO/IEC 33020

ISO/IEC 33020 is an international standard that is part of the ISO/IEC 33000 family of standards and provides a methodology for measuring and assessing the maturity of software development processes.

The main elements of ISO/IEC 33020 include:

- Process Maturity Assessment - the standard provides a system for assessing the maturity and effectiveness of the processes used in a company. It uses a 6-level scale: Incomplete Process (Level 0), Performing Process (Level 1), Managed Process (Level 2), Established Process (Level 3), Predictable Process (Level 4), and Optimizable (Level 5). This allows companies to track their improvements and identify areas for further optimization
- Process Performance Measurement - The standard focuses on key process characteristics such as productivity, efficiency, flexibility and manageability. This helps game studios accurately assess how well their processes are meeting established requirements and goals, as well as identify weaknesses;
- Supporting process improvement - the standard offers recommendations for improving development processes to improve their products. Implementing these recommendations helps minimize risks, increase efficiency, and improve the quality of games developed;
- Adaptability to different scales of projects - the standard allows assessment for both small studios and large game companies. This makes it a universal tool for different types of organizations working in the game industry, helping them to improve the quality of management of development processes [7].

The application of ISO/IEC 33020 to the games industry can contribute to structured evaluation and improvement of game development processes, which will help companies systematically track their progress, minimize errors and risks, create better products and ultimately have a positive impact on user satisfaction and competitiveness of games on the market.

This standard plays an important role in game studios where the sustainability of development processes is key to creating competitive and reliable games.

3.2.3.ISO/IEC 29110

ISO/IEC 29110 is a series of international standards designed for small organizations of up to 25 people. It takes into account resource and personnel constraints, making it particularly useful for small game studios that make up a significant part of the games industry and want to develop high quality products. The standards offer practical guidance on software lifecycle management, enabling studios to optimize their development processes.

ISO/IEC 29110 includes:

- Simplified project management: helps with task planning, resource allocation and progress tracking,

allowing studios to focus on game development by avoiding complex and overwhelming processes

- Structured development: identifies key steps in all phases of development, from design to testing, reducing the likelihood of errors and missing important milestones
- Quality Control: offers testing methodologies that ensure the game is compliant and free of critical bugs
- Minimize bureaucracy: provides templates for documentation, which reduces administrative burdens and simplifies management processes
- Post-release support: includes recommendations for updates and bug fixes based on user feedback and analytics data [8]

ISO/IEC 29110 can help game studios to improve project management and game quality, even with limited resources. Implementing this series of standards opens up new opportunities to participate in major projects and partner with global leaders, ensuring competitive and efficient development.

3.2.4.EEE 2861

IEEE 2861 is an international standard aimed at evaluating and optimizing the performance of mobile games. It is designed to improve UX by addressing the high demands of game applications and the limited resources of mobile devices. With the growing popularity of mobile games and the increasing performance of their graphics, this standard offers mechanisms that help to cope with problems arising from insufficient device power.

The standard addresses several key challenges:

- Mobile device resource management. The standard provides methods to optimize the use of the central processing unit (CPU), graphics processing unit (GPU), and memory. This enables efficient resource allocation to ensure stable game performance, avoiding overheating and frame rate (FPS) degradation
- Two-way communication between the game and the device. The standard introduces protocols that enable communication between the mobile game and the device. This allows the game to adapt to the real-time state of the device, such as reducing CPU load or changing graphics settings when overheating or low battery life occurs
- Game performance evaluation. The standard defines criteria for evaluating the smoothness of gameplay, such as FPS and latency. This helps developers monitor how efficiently a game is utilizing device resources and make changes to improve application performance
- Optimization of key game scenes. Important gameplay moments, such as massive battles or scenes with high detail, require more performance. The standard offers mechanisms for game adaptation, keeping stable performance even under peak loads
- Cross-platform optimization. The use of standardized protocols allows developers to more easily adapt games for different device models, ensuring the same high quality on platforms of different manufacturers [9]

The IEEE 2861 standard was designed specifically for the gaming industry. Its implementation helps minimize

technical issues related to overheating, performance degradation, and other hardware limitations. This ultimately improves user satisfaction and the competitiveness of mobile games on the market.

3.2.5.ISO/IEC/IEEE 29119

ISO/IEC/IEEE 29119 is a series of international standards designed to regulate software testing processes. This series covers all aspects of testing, from planning and organization to execution and reporting of test results. The main objective of the standard is to provide a universal set of guidelines and methodologies for testing that can be applied to any industry, including the gaming industry.

ISO/IEC/IEEE 29119 includes the following main components:

- Testing terminology: introduces and unifies the terms that are used to describe various aspects of software testing, which is important for understanding and communication between professionals
- Testing Processes: describes a set of processes that help companies structure their testing approaches. These processes include test management, test script development, test execution, and test results analysis and reporting
- Test documentation: the standard calls for the creation of detailed documentation for each stage of testing. This includes test plans, test specifications, test reports and incident analysis. These documents help to organize testing and make the testing process transparent and repeatable [10].

The application of ISO/IEC/IEEE 29119 in the games industry can help game developers provide a systematic approach to testing, which will improve product quality and reduce errors at the final stages of development. Potential benefits of applying these standards include the ability for game companies to significantly improve the quality of their released games by identifying problems and minimizing risks during development. Developers will be able to conduct high-quality functional testing and load testing as well as pay attention to aspects such as usability and compatibility with different platforms. This is especially important for cross-platform games, which require compatibility with various devices and operating systems. Thus, ISO/IEC/IEEE 29119 can become an indispensable tool for the gaming industry, facilitating structured and reliable product testing. Its use can increase testing productivity, reducing the likelihood of bugs in releases and ultimately improving UX.

3.3. Development of risk management strategies when implementing international standards

The application of international standards in the gaming industry, despite the potential benefits, also has risks that can make it impossible or significantly slow down the implementation process and reduce its effectiveness. These risks are caused by both specific features of the industry itself and technical and organizational aspects. Table 1 identifies the main risks and suggests possible strategies to minimize or eliminate them.

Table 1: Identified risks and strategies

Risk	Possible strategies
Risk 1. Implementation of standards such as ISO/IEC 25010 or ISO/IEC/IEEE 29119 may require significant financial and time resources for employee training, customization, documentation, and certification of processes.	**Phased implementation.** Breaking the implementation of standards down into several phases, starting with prioritized and the most applicable processes, will gradually distribute financial costs and reduce the burden on companies.
	Return on Investment (ROI) assessment. Before implementing a standard, evaluate potential long-term benefits, such as improved product quality, reduced error correction costs and improved user experience. This will help justify the investment.
	Seeking external funding. Attracting grants or subsidies for standard implementation from government programs or innovation support organizations can help reduce the financial burden.
	Use of free resources. Some standards provide free guides and templates for implementation. Companies can start by using these resources before moving on to full certification.
	Applying innovation. By integrating AI technologies and data analytics into various processes, it is not only possible to optimize them, but also to reduce documentation costs.
	Non-certification. Since certification is not mandatory in the gaming industry, standards can be implemented without formal certification, which will reduce costs.
	Avoiding complex standards. Smaller companies should avoid implementing expensive standards and choose alternative methodologies.
Risk 2. Lack of specialists in the company able to work with international standards leads to the need to hire external consultants or train employees at a cost.	**Staff training.** Organization of training programs for employees using internal and external resources, such as online courses, webinars, and standards certification programs, will help develop internal competencies and reduce the dependence on external consultants.
	Hire standardization experts. For critical projects, consultants with experience in standards implementation can be temporarily hired to focus on transferring knowledge to the existing team, so that the company can maintain the processes on its own later.

	Cooperation with educational institutions. Entering into agreements with universities and training centers to provide student internships, or engaging specialists on a project basis, can reduce the costs of hiring highly qualified standardization specialists.
Risk 3. The company's technological infrastructure may not meet the requirements of standards. This could lead to significant costs in adapting or upgrading software and hardware systems.	**Standards compatibility analysis.** Before implementing a standard, conduct a detailed analysis of the compliance of existing technologies with the requirements of the standard. This will help to determine the need for improvements and reduce the cost of non-compliant hardware or software.
	Adapting standards to existing processes. Implementation can be adapted to existing systems, avoiding unnecessary changes.
	Partial implementation. If full implementation of the standard is not possible, it is possible to focus on selected elements that provide the greatest benefit and require minimal changes to technology.
	Leveraging the cloud. Moving to cloud-based solutions can reduce infrastructure costs and allow for easier adaptation to new standards, especially in terms of security, reliability and interoperability.
Risk 4. International standards may be too rigid for small companies or flexible projects that require rapid changes and adaptations.	**Standards adaptation to specific needs.** Customize standards implementation to fit the company's unique processes, tailor requirements and methods to real-world needs and capabilities, while maintaining flexibility in development.
	Limited application by element. Highlight critical elements of standards that can be integrated into current processes without completely redesigning them. For example, introduce quality-related elements while leaving the more creative aspects of development unchanged.
	Limited application by stage. Implement standards only at critical process steps, such as testing or project management, while maintaining flexibility in the rest of the development process.
Risk 5. Implementation of standards is often perceived as a threat to established work processes, which causes resistance among employees.	**Explaining the benefits of standards.** Conduct internal training activities to explain the importance of implementing standards in order to improve product quality, competitiveness, and performance. It is essential to demonstrate how standards will simplify the achievement of tasks.
	Pilot projects. Implement standards on small projects or

	individual company departments to demonstrate the success and benefits of these changes. A successful pilot can serve as an example for the rest of the staff.
	Employee involvement in the implementation process. Employees need to feel that their opinions are taken into account. An inclusive approach can help reduce resistance to change. For example, working groups can be set up to discuss and implement standards with representatives from different departments.
Risk 6. The gaming industry is rapidly changing, and implementing strict standards can slow the development process down or significantly reduce flexibility.	**Rapid adaptation and regular revisions of standards.** With technology and market demands changing rapidly, standards and processes need to be regularly revised to ensure they do not become obsolete. For example, agile approaches can be used to implement standards, allowing flexibility to respond to change.
	Using hybrid approaches. Combining standardized and agile development methodologies, such as Scrum or Kanban, can help ensure quality control while maintaining agility in development.

3.4. Recommendations on the application of international standards depending on the type of organization

In order to formulate recommendations for the application of international standards in the gaming industry, all organizations can be roughly divided into three categories based on their size or level of resources:

- Small studios (~under 25 people / limited resource level)
- Medium-sized companies (~under 100 people / moderate level of resources)
- Large companies (~from 100 people / significant level of resources)

For each category, we will determine the appropriateness of different international standards.

3.4.1.Small studios

Small studios, often facing limited resources and a lack of skilled professionals, are encouraged to consider applying the ISO/IEC 29110 standard series. These standards were specifically designed for small and medium-sized organizations to simplify project management, testing, and documentation processes, while minimizing bureaucratic burdens. ISO/IEC 33020 can also be used by small companies due to its flexibility. In the context of mobile game development with demanding performance requirements, the IEEE 2861 standard can assist in partial optimization, although its implementation requires substantial technical expertise and resources, limiting its primary use for small studios. Implementing more complex standards, such as ISO/IEC 25010 and ISO/IEC / IEEE 29119, is often beyond small studios' capacity due to the high resource demands and technical complexity associated with these standards.

3.4.2.Medium-sized companies

Medium-sized companies can implement ISO/IEC 29110 standards in individual departments if necessary and use the ISO/IEC 33020 universal standard. With potentially more resources, medium-sized companies can use comprehensive standards such as ISO/IEC 25010 and ISO/IEC/IEEE 29119, but successful implementation may require adapting existing processes. In the case of mobile game development, it is recommended to also look at the IEEE 2861 standard for performance optimization if the company has the necessary resources.

3.4.3.Large companies

Large companies in the games industry are encouraged to implement international standards, including ISO/IEC 25010, ISO/IEC/IEEE 29119, and ISO/IEC 29110. They can also partially apply ISO/IEC 29110 to optimize processes in smaller teams. ISO/IEC 33020 and IEEE 2861 are highly recommended for assessing maturity and improving internal processes in large companies engaged in mobile game development. With their significant resources, these companies have the ability to deeply integrate these standards by hiring skilled professionals and consultants.

3.4.4.Final recommendations

Table 2 summarizes the resulting recommendations regarding the application of international standards to different categories of companies in the gaming industry.

Table 2: Recommendations for the application of international standards depending on the type of company

Standard	Small studios	Medium-sized companies	Large companies
ISO/IEC 25010	Not recommended: high risks and complexity of implementation	Recommended: for risk mitigation and adaptation to company / project specifics	Recommended: when mitigating risks and accepting risks and adapting to company and project specifics
ISO/IEC 33020	Recommended: when adapting to company specifics, it is designed for companies of all sizes	Recommended: when adapting to company specifics, it is designed for companies of all sizes	Recommended: when adapting to company specifics, it is designed for companies of all sizes
ISO/IEC 29110	Recommended: when adapting to the specifics	Partially recommended: when adapting to the	Partially recommended: when adapting to the

	of projects, designed specifically for small companies	specifics of projects, it is suitable for small units within the structure	specifics of a project, it is suitable for small departments or individual studios within the structure
IEEE 2861	Partially recommended: if risks are excluded, it is useful for studios focusing on mobile games	Recommended: for risk mitigation, useful for mobile gaming-oriented companies	Recommended: when mitigating risks and accepting risks and adapting to the company's specific needs
ISO/IEC/IEEE 29119	Not recommended: high risks and complexity of implementation	Recommended: for risk mitigation and adaptation to company / project specifics	Recommended: when mitigating risks and accepting them, and adapting to the company/project's specific needs

Thus, the assessment shows that the choice of standards should be based on the size of the company and its resource capabilities. Small studios can benefit from implementing ISO/IEC 29110, whereas medium and large companies are recommended to implement more complex standards, such as ISO/IEC 25010 or ISO/IEC/IEEE 29119. Large companies have the greatest potential to implement all the standards discussed above, which allows them to significantly improve the quality and efficiency of their processes.

4.Conclusion

The introduction of international standards in the gaming industry can be an important step towards increasing product quality, improving development processes and strengthening the competitive position of companies in the global market. ISO, IEC and IEEE standards provide a structured and systematic approach to project management, testing and quality assessment of software products, which is especially relevant in the context of rapid growth and change in the industry. Nevertheless, standards implementation comes with certain risks associated with high costs, lack of qualified personnel, and technical limitations. The article offers strategies to minimize these risks and recommendations for small, medium and large companies to implement standards. Thus, the successful integration of international standards into the game development process can help companies achieve sustained growth, improve product quality, and strengthen their international competitiveness.

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