Journal on Interactive Systems, 2023, 14:1, doi: 10.5753/jis.2023.3196

Trends and Research in Digital Game Project Management: A Systematic Literature Review

Lucas Pieva [**LESSE/Federal University of Pampa** | ***lucaspieva.aluno@unipampa.edu.br***]
Maicon Bernardino [**LESSE/Federal University of Pampa** | ***bernardino@acm.org***]

Abstract

Given the rapid growth and high demand in the entertainment industry, it is crucial to implement best practices in digital game project management to ensure successful projects within the Triple Constraint of costs, time, and scope. This study aims to provide a valuable empirical reference for game project professionals and researchers by identifying the primary methods, processes, and methodologies used in digital game project management. Using a systematic literature review (SLR) approach, we analyzed 65 primary studies out of an initial pool of 6,658, covering the period from 2010 to 2021. Our results reveal that the most frequently mentioned artifact groups were models (34.1%) and processes (31.7%), and the majority of authors were from Brazil and Indonesia. Overall our findings highlight the prevalence of game projects that do not adopt project management practices, particularly among indie game teams.

Keywords: *Project Management, Digital Game, Indie Game, Software Engineering, SLR, Systematic Literature Review*

1 Introduction

Historically, at a North Atlantic Treaty Organization (NATO) conference in 1968, where proposed Software Engineering (SE). At that time, there was already the challenge of developing software in an organized way since the popularization of modern computer systems made software anything much more generalized within research centers, universities, and companies.

Over time, the processes proposed in the literature for software project management have been continuously created and refined, enabling them to effectively handle an unprecedented range of software projects. However, despite these improvements, challenges persist in adapting these processes to the unique requirements of specialized areas of knowledge when developing complex systems.

One specific field that has seen remarkable growth is the creative industry of digital games. In his study, Amélio (2018) sheds light on various aspects of the Brazilian scenario that may appear to contradict an optimistic outlook, as he notes a decline in investments and profits at the time of his research. Despite these challenges, the author maintains a positive outlook, envisioning various opportunities for reversing this trend.

Conversely, Xavier et al. (2021) emphasizes the importance of SE in supporting independent studios, which can facilitate organized project development and foster better relationships with consumers by creating high-quality artifacts.

Given the diverse range of proposals and challenges, the creative industry has yet to reach a consensus on the standard adopted for SE in game development since SE has not officially addressed this application area. However, academia and the creative industry are working to bridge this gap by generating solutions across various fronts of knowledge relevant to game development.

Hence, the current research study conducted a Systematic Literature Review (SLR) that searched various article digital libraries, yielding and obtaining a total of 3,734 studies related to games. Subsequently, a thorough analysis of the search results allowed the selection of 65 primary studies that met the specific criteria established for this research project.

Building upon the work of Pieva and Bernardino (2022), this study is a translated, extended, and revised version that presents novel research inquiries and outcomes, as well as additional insights into the protocol, potential validation issues, and key takeaways.

To comprehensively elucidate the process entailing the creation, conduction, validation, and results of the systematic literature review (SLR) conducted in this study, we have organized the paper as follows. In Section 2, we introduce the relevant background and previous SLRs already published in the games area. Section 3 explains all the steps that make up the systematic mapping protocol. In Section 4, we outline the findings resulting from the implementation of the review process. In Section 5, we address potential limitations and threats to the validity of the study. Finally, in Section 6, we provide concluding remarks.

2 Related Work

The review carried out by Mizutani et al. (2021) aim to identify studies related to game mechanics development and analyze the relationships between requirement surveys, practices, and limitations.

Trier and Treffers (2021) reveal studies that address the extension of agile project management practices to various areas of the creative industries, including music, cinema, animation, and games.

Similarly, Kummer et al. (2017) investigate studies aimed at understanding the life cycle of games to identify elements that can enhance their longevity and engage players with specific profile traits.

Meanwhile, O'Hagan et al. (2014) propose a systematic review of game development processes to identify adaptations

Aspects	Our SLR	Mizutani	Trier & Treffers	Kummer	O'Hagan
Publication	x2022	2021	2021	2017	2014
Interval	Jan/2010-Set/2021	Abr/2018-Ago/2019	1990-2020	1995-2017*	2004- 2012
Analyzed Studies	65	36	31	26	404
Scope	Project Management	Game Mechanics	Agile Methods Usage	Game Development Life Cycle	Development Process
Contributions	State of the art; Mapping of artifacts and main authors	State of the art; Analysis and comparison of design and its practice	Agile Framework; Applicability Analysis	Identifies lifecycle models and metrics; Engagement measurement	Methodologies used and associated risks in their choices

Legend: * It does not textually present the acquisition period of the studies, based on the results, we observed studies between 1995 and 2017.

Table 1. Related Work in Digital Game.

and improvements that mitigate costs and enhance quality requirements, highlighting changes in agile methods and hybrid methods such as reuse. The overall goal of the review is to ensure the games have a longer useful life.

From our analysis of the reviewed systematic reviews, Table 1 shows that while several SLRs cover various aspects of game production, they fail to systematically investigate the best practices, mainly due to a lack of artifacts that can aid in implementing these practices. It is, therefore, pertinent to evaluate the available practices and their corresponding artifacts to gain a deeper understanding of the most recent developments in game research. This SLR aims to provide an empirical basis for future research by offering insights into contemporary practices in the field.

3 SLR Protocol

We prepared this SLR according to the definitions of systematic reviews of the literature on Software Engineering proposed by Kitchenham and Charters (2007).

3.1 Scope e Objectives

Our aim with this study is to provide an empirical reference for professionals and researchers who seek to manage game projects, identifying the main methods, processes, and methodologies adopted for this purpose existing in the scientific literature. In addition, through this study, we identified artifacts that support digital game projects.

To ensure the quality of the articles, we propose some aspects of the definition of the entry of articles in this SLR: (i) Only studies classified as articles, book chapters, proceedings, or journals; (ii) Studies published in the IEEE, ACM, Engineering Village E, and Scopus SC digital libraries; (iii) Are obtained by using the search term; (iv) Match the selection criteria; (v) Do not match all exclusion criteria.

3.2 Research Questions

To achieve the objectives, let us answer the following Research Question (RQ):

RQ1. What is the current state of game project management studies? We want to find out what methods, techniques, guidelines, and so on are being researched and adopted in the game development industry;

RQ2. What are the artifacts that support these studies? Knowing the types of studies, we need to find out what documents, models, software, and hardware are associated with studies performed.

RQ3. Which phases of the Game Development Life Cycle (GDLC) does the study cover?

RQ4. In which countries are these studies being conducted? In which countries are there active research groups producing studies that are part of this SLR?

3.3 Search Strategy

To identify appropriate search terms and possible synonyms for the current SLR, we first reviewed search terms used in other SLRs in the same field.

Through extensive research, reading, and synthesis of the methods and results obtained, we classified Nishida and Braga (2015), Oliveira and Paula (2021), Jiménez-Hernández et al. (2017) and Souza et al. (2017) as reliable studies that served as a seed for the elaboration of keywords and synonyms, even though they do not have common objectives with our RQs, these studies seek to assess issues related to game development.

Scope	Keywords (Terms in Bold + Synonyms)
Population	**Game** OR Indie OR Gaming OR Gamification
	AND
Intervention	**Methodology** OR Workflow OR Process OR Method OR Guideline, Heuristic OR Engineering OR Management OR Quality OR Requirement
	AND
Comparison	–
	AND
Outcome	"**Game Project**" OR "Game Development" OR "Game Design", "Game Modeling" OR "Game Prototyping" OR "Project Management" OR "Game Design Document" OR GDD OR "Game Management"
	AND
Context	**Project** OR Design OR Development OR Prototype OR Modeling OR Analysis OR Test OR Verification OR Validation

Table 2. Search string based on PICOC Petticrew and Roberts (2008).

We adopted PICOC (Population, Intervention, Comparison, Outcome, Context) Petticrew and Roberts (2008) to structure these verbs to build a search string, presented in Table 2. Defining the domain and expected terms not only clarifies the scope of the studies but also establishes a specific framework that is essential for conducting relevant and compatible research. Merely relying on the domain alone has proved inadequate in delimiting an appropriate research base for this work. Therefore, we chose the digital libraries

ACM, Engineering Village E, IEEE, and Scopus SC for the application of searches for relevant studies based on keywords and defined meanings.

To apply our formulated search string, we used two classification criteria - title and abstract of studies. First, we defined a closed search scope, requiring the terms of the string must have included in both the title and the abstract. Next, we carried out the same search using an open scope, allowing the terms to appear in either the title or the abstract. By running the search strings across multiple digital libraries, we were able to retrieve a total of 6,658 studies. Notably, there was a significant difference in the number of studies obtained between the closed and open scope strings, as shown in Table 3.

Digital Libraries	Closed Scope	Opened Scope
ACM	23 (6,3%)	640 (9,6%)
E ENGINEERING VILLAGE	127 (34,8%)	2.343 (35,2%)
IEEE	50 (13,7%)	690 (10,4%)
SCOPUS	165 (45,2%)	2.985 (44,8%)
Totals	365 (100%)	6.658 (100%)

Table 3. Studies by Digital Libraries.

3.4 Selection Process

This section presents the definition and results of the study selection stage, including the inclusion and exclusion criteria used in selecting each study.

Inclusion Criteria (CI): we aimed to obtain articles that focus on the fundamental aspects of game project development, and included all relevant synonyms. As such, we defined the inclusion criteria as follows: **IC1.** The primary study must propose a workflow, methodology, process, method, guideline, heuristic, engineering, management, or quality framework for a game project.

Exclusion Criteria (EC): To remove studies that are outside the scope of the review, therefore, we defined the following exclusion criteria:

EC1. Duplicate primary studies; **EC2.** Studies that are not in English. The result of searching the digital libraries for other languages represents a small proportion of studies that are in the official language of scientific production, namely English; **EC3.** Studies that do not have full access; **EC4.** Studies that do not meet the inclusion criteria; **EC5.** Secondary or tertiary studies; **EC6.** Studies with less than five pages; **EC7.** Studies with more than ten years of publication.

Selection Result: After reading each of the studies obtained based on the search strings applied and using the exclusion and inclusion criteria defined, we retrieved the results shown in Table 4.

States	Closed Scope	Opened Scope	#Total Studies
RETURNED	365 (5,5%)	6.293 (94,5%)	6.658
DUPLICATED	136 (4,7%)	2.788 (95,3%)	2.924
REMOVED	182 (5,4%)	3.178 (94,6%)	3.360
INCLUDED	47 (12,6%)	327 (87,4%)	374

Table 4. Classified Studies by State.

While we acknowledge that the duplication of studies is an exclusion criterion, we include this information in Table 4 to demonstrate the frequency of articles published across multiple digital libraries. The methodology used to classify the 374 studies selected in the previous stage includes a set of rules and questions designed to identify potential studies that can address the research questions of this work.

Quality Assessment Criteria (QA): We proposed some questions to assess the quality of each study, for which we assign scores, and even minimum requirements for some of the RQs, to identify, through the complete reading of each study, the potential condition to answer one or more RQs of this work.

QA1. Does the study present any workflow, methodology, process, method, guideline, heuristics, engineering, management, or quality for a game project? (Weight 1.5); Possible Answers (PA): Yes (100%), Partially (50%), No (0%). Minimum Requirement (MR): Partially;

QA2. Does the study present the complete development cycle of a game project? (Weight 1.5); PA: Complete (100%), Partially (65%), Little (35%), Not at all (0%). RM: Little;

QA3. Does the study present a practice based on the reality of the creative industry? (Weight 1); PA: Specifically (100%), Superficially (50%), No (0%);

QA4. Does the study present the implementation of the game project management methodology? (Weight 1); PA: Yes (100%), Partially (50%), No (0%).

We used a rating scale from 0 to 5 to assess the relevance of each study to this review. A score of 0 represents the lowest relevance, while a score of 5 corresponds to the highest score, representing 100% of the weight of all quality assessments. We considered relevant those studies that obtained a score greater than 2.0 in the quality assessments and met the minimum requirements of this SLR to address the research questions.

Quality Assessment Result: Among the 327 selected primary studies (Section 3.4), we applied the QAs and delimited this review with an evaluative score greater than 2 points among the assigned weights. The result obtained was 65 primary studies accepted in Table 5[1].

Figure 1 shows the steps of the selection process when searching interactions in opened scope (A) and when searching in closed scope (B). In Step 1, we applied the search string in the digital libraries and eliminated duplicate studies in Step 2. Step 3 was to apply the CIs and ECs to identify potential studies to answer the RQs. In Step 4, we used the quality assessment results to refine these studies and find out if there are studies that could answer the RQs. Finally, in Step 5, we reassessed each study. We uncovered duplicate studies between A and B interactions and subsequently deleted 12 studies. We excluded a study from A interaction that shared significant similarities with other studies authored by the same individual but was comparatively older.

We completed the selection process with 65 studies that could respond to our RQs. We observed that the closed scope, with 24 studies, represents 37% of the total, while the open scope, with 41 studies, represents 63%. However, the accuracy in using the search string in the closed scope represents

[1]Additional information and the complete protocol of this SLR can be found in the open science Zenodo repository available at: `https://doi.org/10.5281/zenodo.7657389`

Figure 1. Steps in Selection Process

only 6.57% of the 365 studies collected, whereas in the open scope, it represents only 0.65% of the initial 6293 studies. This demonstrates that a well-designed search strategy can generate more precise results.

4 Result Analysis

In this section, we present the results of our SLR, answer the RQs, and use graphs and infographics to help interpret the information. The definition of terminology used in the study types and supporting artifacts is specific to the selected studies, as it is a direct transcription of the data and concepts obtained from them.

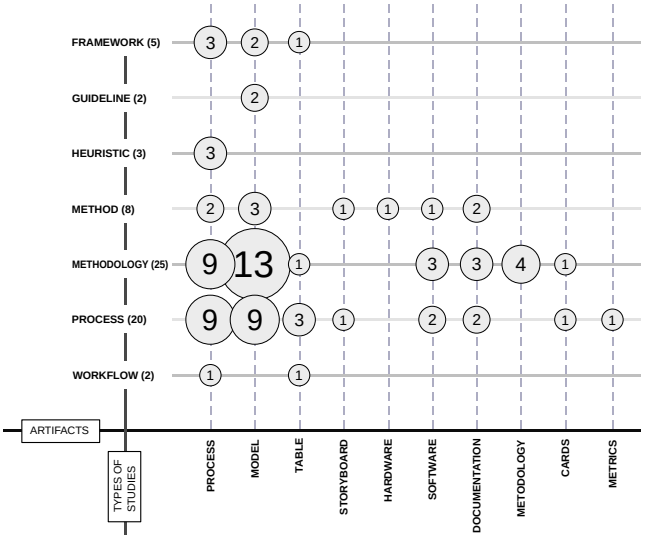

Figure 2. Infographic of the Distribution of the Artifacts vs Study Types.

4.1 RQ1. What is the current state of game project management studies?

Figure 2 identifies different works regarding the practice of management and development of a game. Among the 25 studies that present methods, which is 38.4% of the total number of this SLR, studies Al-azawi et al. (2014) [S05], Kristiadi et al. (2019) [S08], Peres et al. (2011) [S15], Schild et al. (2010) [S24], Maksoud (2020) [S38], Al-Azawi et al. (2014) [S41], Mitre-Hernandez et al. (2016b) [S49], and Glossner et al. (2015) [S50] point to adaptations of the Scrum agile method as a solution. Among the 20 studies that present processes (30.7%), studies Pavapootanont and Prompoon (2015) [S17], Fernandez et al. (2012) [S35], Calderon et al. (2017) [S39], and Calderon and Ruiz (2016) [S52] apply and modify ISO/IEC standards. And studies Guo et al. (2015b) [S04], Zhu et al. (2016) [S22], Guo et al. (2015a) [S33], Fernandez et al. (2012) [S35], and Albaghajati and Hassine (2021) [S45] present model-driven development in the game development process, but they are distributed among different types of studies.

4.1.1 Scrum Results

We can observe that the majority of the articles adapt, apply, and integrate the Scrum methodology with other practices. Below, we present a brief summary of these studies.

Al-azawi et al. (2014) [S05] and Al-Azawi et al. (2014) [S41] propose integrating Agent-Oriented Software Engineering (AOSE) with the Scrum methodology. One of the modifications is replacing the standard Scrum Sprint cycle with the Multi-Agent Systems (MaSE) Engineering Life Cycle while maintaining the Scrum Meetings. The total duration of each Sprint is set to 2 to 4 weeks. Additionally, these studies suggest replacing the Product Backlog with the Game Development Document (GDD) for digital game projects.

The study of Kristiadi et al. (2019) [S08] is supported by other authors in adopting Alpha, Beta, and Completion Sprints (ABC-Sprint), Software Development Project Pattern (sdPP), and Improved Game Design Document (iGDD) to create a customized Scrum approach that aligns with different project stages. However, the study's brief nature limits its effectiveness, as it dedicates only one page to presenting its contributions and conclusions. Moreover, the conclusions lack detailed information about the results obtained.

Peres et al. (2011) [S15] present an experience report on the utilization of the Scrum methodology in a distributed environment for a digital game project. Drawing inspiration from the methodology outlined in the book "Game Development with Scrum", the study explores the project's context, team dynamics, and the adaptation of Scrum principles for game development. It delves into aspects such as methods, process definition, and tools employed throughout the project lifecycle, including conception, project definition, backlog item prioritization, requirement monitoring, and quality assurance.

Schild et al. (2010) [S24] focus on the implementation of Alpha, Beta, and Completion Sprint (ABC-Sprint) within the curriculum of a game design course. The study's findings provide support for the adoption of this Scrum variation, backed by solid comparisons of student outcomes before and after the application of this adaptation. The results demonstrate significant improvements in the quality of games produced during the course disciplines.

Study S38 introduces a framework for teaching Scrum for Games in software engineering disciplines, although it lacks practical applications. The framework involves adapting the Software Development Life Cycle (SDLC) to key software game artifacts such as the Game Design Document (GDD) and Test-Driven Development (TDD). It incorporates prototypes and customized sprints (Alpha, Beta, and Gold Sprint) for the development stage. While each stage of the framework is well-described, the research falls short in terms of application and validation, as there is a lack of results in this regard.

Research [S49] introduces an agile development process

Primary Studies (*ID: + Authors name + (Year) + Title*
S01: Salazar et al. (2012). Proposal of game design document from software engineering requirements perspective.
S02: Pandey et al. (2018). Proposing a Hybrid Methodology for Game Development.
S03: Luhova et al. (2019). The Canvas-Oriented Formalization of the Game Design Processes.
S04: Guo et al. (2015b). A Workflow for Model Driven Game Development.
S05: Al-azawi et al. (2014). Towards Agent-based Agile approach for Game Development Methodology.
S06: Fatima et al. (2018). GDGSE: Game Development with Global Software Engineering.
S07: Ramadan and Widyani (2013). Game development life cycle guidelines.
S08: Kristiadi et al. (2019). Game Development with Scrum methodology.
S09: Desurvire and El-Nasr (2013). Methods for Game User Research: Studying Player Behavior to Enhance Game Design.
S10: de Oliveira et al. (2011). Game modeling using WorkFlow nets.
S11: Hetherinton (2014). SysML requirements for training game design.
S12: Politowski et al. (2016). Are the Old Days Gone? A Survey on Actual Software Engineering Processes in Video Game Industry.
S13: Al-Azawi et al. (2013). A generic framework for evaluation phase in games development methodologies.
S14: Améndola et al. (2015). GLIESE – A Framework for Experimental Game Development.
S15: Peres et al. (2011). Methods and Processes Definitions for Multiplatform Social Network Games Development with Distributed Teams.
S16: Dirgantara et al. (2019). Development of Android-Based Quiz Video Game: Mathventure.
S17: Pavapootanont and Prompoon (2015). Defining usability quality metric for mobile game prototype using software attributes.
S18: Furtado et al. (2011). Improving Digital Game Development with Software Product Lines.
S19: Passos et al. (2011). Turning Real-World Software Development into a Game.
S20: Pizzi et al. (2010). Automatic Generation of Game Level Solutions as Storyboards.
S21: McKenzie et al. (2021). Is Agile Not Agile Enough? A Study on How Agile is Applied and Misapplied in the Video Game Development Industry.
S22: Zhu et al. (2016). Engine Cooperative Game Modeling (ECGM): Bridge Model-Driven Game Development and Game Engine Tool-Chains.
S23: Hernandez and Ortega (2010). Eberos GML2D: A Graphical Domain-Specific Language for Modeling 2D Video Games.
S24: Schild et al. (2010). ABC-Sprints: Adapting Scrum to Academic Game Development Courses.
S25: Winget and Sampson (2011). Game Development Documentation and Institutional Collection Development Policy.
S26: Petrillo and Pimenta (2010). Is Agility out There?' Agile Practices in Game Development.
S27: Mozgovoy and Pyshkin (2018). A Comprehensive Approach to Quality Assurance in a Mobile Game Project.
S28: Desurvire and Wixon (2013). Game Principles: Choice, Change & Creativity: Making Better Games.
S29: Zamora and Villalobos (2019). Integrated Framework for Game Design.
S30: Smith and Graham (2010). Raptor: Sketching Games with a Tabletop Computer.
S31: Arguson and Aldea (2017). Development of Encantasya: War of the Four Kingdoms.
S32: Kriglstein et al. (2014). Workflow patterns as a means to model task succession in games: A preliminary case study.
S33: Guo et al. (2015a). Realcoins: A case study of enhanced model driven development for pervasive games.
S34: Guevara-Villalobos (2011). Cultures of independent game production: Examining the relationship between community and labour.
S35: Fernandez et al. (2012). Integrating usability evaluation into model-driven video game development.
S36: Musil et al. (2010). Improving video game development: Facilitating heterogeneous team collaboration through flexible software processes.
S37: De Macedo and Rodrigues (2011). Experiences with rapid mobile game development using unity engine.
S38: Maksoud (2020). Scrum Based Framework for Teaching Software Engineering for Game Development.
S39: Calderon et al. (2017). Coverage of ISO/IEC 29110 project management process of basic profile by a serious game.
S40: Aslan and Balci (2015). GAMED: Digital educational game development methodology.
S41: Al-Azawi et al. (2014). Multi Agent Software Engineering (MaSE) and agile methodology for game development.
S42: Mitre-Hernandez et al. (2016a). User eXperience Management from Early Stages of Computer Game Development.
S43: Kasurinen et al. (2014). Is requirements engineering useless in game development?
S44: Baharom et al. (2014). Emotional design for games: A framework for player-centric approach in the game design process.
S45: Albaghajati and Hassine (2021). A use case driven approach to game modeling.
S46: de Oliveira et al. (2018). Game design tools for maximum effectiveness.
S47: Marbach et al. (2019). Optimization of Project Management Processes Using the A* Project Management System (AStarPM): A Prototypical Implementation and Evaluation.
S48: Al-Azawi and Ayesli (2015). A simulation based game approach for test drive exam.
S49: Mitre-Hernandez et al. (2016b). Decreasing rework in video games development from a software engineering perspective.
S50: Glossner et al. (2015). Game design and development capstone project assessment using scrum.
S51: Aleem et al. (2016). A Digital Game Maturity Model (DGMM).
S52: Calderon and Ruiz (2016). Coverage of ISO/IEC 12207 software lifecycle process by a simulation-based serious game.
S53: Paschali et al. (2018). Tool-assisted game scenario representation through flow charts.
S54: Pendleton and Okolica (2019). Creating serious games with the game design matrix.
S55: Athavale and Mohan (2018). Understanding game ideation through the lens of creativity model.
S56: Warmelink et al. (2016). Get it right! Introducing a framework for integrating validation in applied game design.
S57: Signoretti et al. (2016). Services & Products Gamified Design (SPGD) a methodology for game thinking design.
S58: Ollsson et al. (2015). Evolution and Evaluation of the Model-View-Controller Architecture in Games.
S59: Braad et al. (2016). Processes and models for serious game design and development.
S60: Atmaja et al. (2016). Game design document format for video games with passive dynamic difficulty adjustment.
S61: Inam et al. (2017). Improving the process for mobile games development.
S62: Ahmad et al. (2017). How to launch a successful video game: A framework.
S63: Mylly et al. (2020). The quest for usable usability heuristics for game developers.
S64: Jónasdóttir and Müller (2020). Theorizing affordance actualization in digital innovation from a socio-technical perspective.
S65: Tap et al. (2021). Creativity Training Model for Game Design.

Table 5. Selected Primary Studies.

that combines Scrum with the software development Project Pattern (sdPP) and an improved Game Design Document (iGDD). In order to define the abstraction levels of the iGDD, the author incorporates a traditional GDD into the MDA framework. The author establishes an association between the sdPP workflow and the iGDD product flow, adapting, adding, and eliminating certain Scrum tasks to create their customized process. While the description of the process steps is concise, the study provides references to other articles by the same authors and includes sections dedicated to results, discussion, conclusion, and future works, indicating the rigorous nature of the research.

Study [S50] examines the process and outcomes of replacing the traditional waterfall methodology with Scrum in a senior game design and development course. The study presents results that would benefit from further investigation due to the limited number of students from project management disciplines who participated in the application of Scrum.

Pavapootanont and Prompoon (2015) [S17] present an approach to establish an internal usability quality metric specifically for mobile game prototypes during the design phase. The proposed metric is derived from the general usability metric category recommended in the ISO/IEC 9126-3 stan-

dard and follows the principles of the Goal Question Metrics (GQM) method. The structure and elements of the metric description are based on the ISO/IEC 15939 standard.

To conduct the quality metric assessment, a process is outlined based on evaluating the objectives of Content, Device, and Gameplay. Each of these assessment elements is further categorized into five attributes: Understandability, Learnability, Operability, Attractiveness, and Compliance. For each attribute, relevant questions are formulated to gauge the prototype's satisfaction in achieving its objectives. The evaluation is carried out using the proposed metric, and a process based on activities outlined in the ISO/IEC 15939 standard guides the execution of the evaluation. However, the study falls short in concluding without presenting practical results obtained through the application of the metric in a real-world environment.

4.1.2 ISO/IEC Results

The articles that mention the utilization of ISO/IEC standards, excluding S39 and S52, authored by the same authors, present distinct approaches as they employ different standards for their proposed solutions.

Pavapootanont and Prompoon (2015) [S17] utilize the ISO/IEC 9126-3 standard to develop a metric for assessing the usability of mobile game prototypes. Additionally, the ISO/IEC 15939 standard is employed to establish the stages of the evaluation process.

Study S35 focuses on integrating usability evaluation into model-driven video game development. The authors put forth a usability inspection method that utilizes a Usability Model aligned with the ISO/IEC 25010 standard. This method enables the evaluation of video game usability within a model-driven development process. By detecting and addressing usability issues at the model level, the method facilitates the automation of common usability evaluation tasks. However, the authors acknowledge the necessity of further comparison with users' perceptions of video game usability obtained through a model-driven development approach. In summary, the study emphasizes the significance of considering usability in video game development and proposes an effective method to accomplish this.

Studies S39 and S52 are similar articles that share some sections and figures. However, study S39 focuses on demonstrating the application of the ISO/IEC 29110 standard for project management in the development of a serious game called ProDe. On the other hand, study S52 showcases the utilization of the ISO/IEC 12207 standard, which outlines the life cycle processes for software development, in the same game project. Although the articles overlap in certain aspects, they provide distinct insights into the application of different standards in the context of the ProDe game project.

We can demonstrate our concern because studies Pavapootanont and Prompoon (2015) [S17] and Fernandez et al. (2012) [S35] do not demonstrate the practical implementation of the proposed work, and their conclusions are overly simplified, lacking empirical evidence.

4.1.3 Model-Driven Development Results

The purpose of study Luhova et al. (2019) [S03] is to explore the feasibility of utilizing Domain Specific Modeling (DSM) in conventional computer game development to enhance software quality and reduce costs. The study introduces a workflow for DSM-based game development and assesses its effectiveness through a case study. The findings indicate that the DSM-based workflow has the potential to enhance software quality and decrease development costs, but it necessitates a substantial initial investment in time and resources.

Zhu et al. (2016) [S22] propose a hybrid approach called Engine-Cooperative Game Modeling (ECGM), which integrates Model-Driven Game Development (MDGD) with game engine tool-chains to streamline and enhance game development. The study presents a case study where ECGM is employed to develop a 2D platformer game and assesses the effectiveness of the approach. The results indicate that ECGM can significantly reduce development time and effort, improve game quality, and enhance collaboration between game designers and developers. Overall, the study suggests that ECGM holds great potential for enhancing the efficiency and effectiveness of game development.

This study proposes a framework for enhanced Model-Driven Development (MDD) in game development, encompassing domain analysis, Domain-Specific Modeling (DSM) definition, and code generation. The authors present a case study of a pervasive game called RealCoins to showcase the effectiveness of their framework. The study identifies three key challenges in employing MDD and DSM in game development and offers solutions to address these challenges. The results demonstrate that the proposed framework can substantially decrease development time and enhance the overall quality of the resulting game.

Study S45 presents the use of the UML use case diagram to guide the organization of stages and tasks associated with digital game projects. For this purpose, it introduces its own UML extension and a modeling software called GUCM tools to integrate with this new specification. The study provides several examples of its application and conducts an experiment with 29 participants to validate their work. It is worth mentioning that study S35, which has its results based on the practice of ISO/IEC 25010, has already been presented in the previous section.

Summary of RQ1.
From the pool of 65 studies identified through the SLR, we categorized them into 17 distinct types, each contributing insights relevant to our RQ1. Each study was assigned to a single category, with the majority falling into the following classifications: 25 as Methodologies, 20 as Processes, 8 as Methods, 5 as Frameworks, 3 as Heuristics, 2 as Guidelines, and 2 as Workflows.
For a more focused presentation of our findings, we emphasize eight studies on Scrum adaptations, four studies exploring alternative applications of ISO/IEC standards, and an additional four studies investigating model-driven development within game projects.

4.2 RQ2. What are the artifacts that support these studies?

Based on Figure 1, we identified 29 studies (44.6%) that are based on models. Notably, studies Pandey et al. (2018) [S02], Ramadan and Widyani (2013) [S07], and Dirgantara et al. (2019) [S16] utilize the Game Development Life Cycle (GDLC) as their software life cycle model. Furthermore, we identified 27 studies (41.5%) that incorporate one or more processes to support their proposals. Noteworthy examples include Politowski et al. (2016) [S12] and Kriglstein et al. (2014) [S32], which employ the Business Process Model and Notation (BPMN) for process modeling. Additionally, studies Zamora and Villalobos (2019) [S29], Pendleton and Okolica (2019) [S54], and Signoretti et al. (2016) [S57] align with the Mechanics, Dynamics, and Esthetics (MDA) framework in their process descriptions. It is worth emphasizing that the Game Design Document (GDD) is the focal point of studies Salazar et al. (2012) [S01], Winget and Sampson (2011) [S25], Mitre-Hernandez et al. (2016a) [S42], de Oliveira et al. (2018) [S46], Atmaja et al. (2016) [S60], and Tap et al. (2021) [S65], while it is referenced in numerous other studies as well.

4.2.1 GDLC Results

Pandey et al. (2018) [S02] present a hybrid game development methodology that combines the benefits of agile and traditional approaches to address the challenges encountered by game developers. This proposed methodology underwent evaluation through a case study involving a game development project. The results of the evaluation demonstrated that the hybrid methodology facilitated the successful delivery of a high-quality game within the specified time and budget limitations.

Ramadan and Widyani (2013) [S07] introduces a novel GDLC model and provides guidelines for delivering high-quality games. This model incorporates various quality criteria at each phase of the game development process. The initial prototype demonstrated that the game is both functional and enjoyable, leading to further development. During the third iteration, the game successfully passed internal quality testing, ensuring it was balanced, functional, and internally complete.

Dirgantara et al. (2019) [S16] provide a brief overview of the game development process guided by the GDLC. As a result, the study demonstrates the progression of the stages, culminating in the creation of a multiplayer quiz game. The game simulates a battle between two wizards, where each question has only true or false answers.

4.2.2 BPMN Results

Politowski et al. (2016) [S12] utilize BPMN processes to analyze 20 postmortem projects in the video game industry, aiming to assess the prevalence of traditional and Agile software engineering processes. The objective was to determine the extent to which the industry has adopted Agile methodologies. The findings revealed that although Agile practices are increasingly prevalent, a significant portion of projects still utilize the waterfall process.

The S32 study is a preliminary case study that investigates the potential use of workflow patterns for modeling task succession in games. The study indicates that workflow patterns hold promise; however, certain limitations currently restrict their application in games, particularly concerning the modeling of winning and losing conditions, as well as time aspects.

4.2.3 MDA Results

Zamora and Villalobos (2019) [S29] introduce a framework that presents eight aesthetics aimed at assisting designers in choosing suitable mechanics to achieve specific desired effects. Additionally, the framework incorporates two new tools: the 5-Part Model for mechanic design and the Risk/Reward Model for difficulty balance. These tools aid designers in developing cohesive products that align with the intended design goals. The study aims to provide valuable insights into the design process of certain games and explores why certain mechanics are effective in specific contexts but may not perform as well in different situations.

S54 introduces initial aspects of analyzing the gamification process with the aim of constructing game dynamics and mechanics aligned with defined learning needs. As a result, the study presents a structured matrix with a step-by-step formula for identifying the Mechanics, Dynamics, and Aesthetics (MDA) oriented towards the learning process.

S59 introduces a methodology that expands upon the Design Thinking Canvas (DTC) and incorporates MDA, Emotions (OCC), Bartle's Types of Players, and Fogg's Behavior Model (FBM). To demonstrate and test this methodology, a card game for game design management was created. The results show that implementing this methodology can foster cohesive collaboration among developers, designers, and evaluators, thereby enhancing the understanding of the necessary steps to create a user experience with a positive emotional response.

4.2.4 GDD Results

Salazar et al. (2012) (S01) seeks to determine the essential characteristics that a Game Design Document (GDD) should possess in order to prevent rework and minimize investment loss during the production stage. The authors conducted a comprehensive literature review and compared their enhanced GDD with a commercial GDD. The findings indicate that a comprehensive GDD should incorporate sections including an overview, game objectives, game justification, initial scope, game balance, user experience, constraints, and assumptions.

The purpose of the Winget and Sampson (2011) [S25] study was to explore the documentation of the creative process in game development. To achieve this, the researchers conducted interviews with game developers and analyzed the collected data to identify recurring patterns. The findings revealed that game development documentation is largely subjective in nature. As a result, the study suggests that future research in this field should prioritize generating support and involvement from the game development community and expanding the sample size to encompass a larger number of participants.

S42 employs the iGDD as documentation to analyze the User eXperience (UX) of games developed using the proposed Game Experience Management (GEM) method in comparison to a conventional approach. The analysis involves 18 junior software engineers divided into six different teams. The results demonstrate that the use of GEM led to an improved UX, combining reduced rework and increased productivity compared to the comparison approach. In conclusion, the study establishes GEM as an effective solution for managing UX in game development.

S46 proposes a method that suggests replacing elements of the GDD with analog prototyping, combining agile development practices and performance analysis (benchmarking). The justification lies in the absence of a single GDD model, as well as the fact that this document often contains ambiguous content. This work presents conclusions that are not very practical, with methodology chapters and succinct and unclear results. Lastly, it reports that using analog materials in definition meetings can provide greater clarity in understanding the objectives of the sprints.

The purpose of the S60 study was to adapt the format of the Game Design Document (GDD) to better accommodate the development of video games with a passive Dynamic Difficulty Adjustment (DDA) mechanism. The modified format was tested by five developers and 30 anonymous players. The results indicated that the modified format improved the overall development process and led to higher-rated educational video games. However, there was no significant difference in scores between the games created using the old format and those developed using the modified format.

Study S65 aims to identify and validate the creativity components of game design and develop a Creativity Training Model for Game Design (LK2RBPD Model) that is verified through the prototype of the Game Design Document Tool (GDD Tool). Both the model and the tool were developed and evaluated using a mixed-method design approach. The study found that the LK2RBPD model can be effectively used to train creativity in game design, and the GDD tool prototype was effective in implementing the model.

Summary of RQ2.
To align with the type of study for RQ1, we have identified a total of 10 distinct supporting artifacts. These include 29 models, 27 processes, 6 tables, 2 storyboards, 6 software implementations, 7 documentation sets, 4 methodologies, 2 cards, 1 metric, and 1 hardware component. In order to underscore our key findings, we spotlight 3 studies that employ the Game Development Life Cycle, 2 that leverage BPMN processes, 3 studies that utilize Model-Driven Architecture (MDA), and 6 studies that are underpinned by the Game Development Document (GDD) framework.

4.3 RQ3. Which steps of the GDLC does the study cover?

Among the steps of the GDLC presented in Table 6, it is noticeable that most of the studies focus on solutions for requirements analysis, development, or game design. Only studies Peres et al. (2011) [S15], Schild et al. (2010) [S24], Musil et al. (2010) [S36], Mitre-Hernandez et al. (2016b) [S49], and Aleem et al. (2016) [S51] address all the main steps in the cycle. Additionally, study Ahmad et al. (2017) [S62] stands out as the only selected study that specifically addresses the game launch phase by proposing a dedicated framework for this stage.

4.3.1 Featured Studies in RQ3

The studies Peres et al. (2011) [S15], Schild et al. (2010) [S24] and Mitre-Hernandez et al. (2016b) [S49] were previously presented in Section 4.1, so let's focus on presenting the other articles.

Study S36 proposes a flexible process approach based on Scrum methodology with the aim of enhancing collaboration among diverse disciplines involved in video game software development. Through evaluation, the approach was confirmed as both feasible and valuable for video game development practices. Moreover, the study identifies the need for further research to provide a more comprehensive exploration of the proposed process approach. This includes conducting evaluations in controlled environments and industry settings, which will enable a deeper understanding of its effectiveness and potential improvements.

Study S51 employs the Digital Game Maturity Model (DGMM) to assess the game development processes of two game development organizations. Using a bottom-up approach and questionnaires, the study evaluates the organizations' development practices based on specific dimensions of digital game development. The findings demonstrate that the DGMM is effective in assessing game development processes, enabling organizations to identify gaps and bottlenecks within their current practices. This assessment process assists organizations in building the capability to improve their processes and enhance overall game development efficiency.

Study S62 introduces a comprehensive framework for successful video game development, covering the entire process from conception to launch. The framework is built upon variable assumptions and simulations, emphasizing the significance of having clear direction right from the initial stages of development. The study highlights the importance of both developers and team leaders understanding the complete video game development process in order to effectively produce high-quality video games. By following this framework, game development teams can enhance their chances of delivering successful video game projects.

4.4 RQ4. In which countries are these studies being conducted?

In our analysis of the selected primary studies in this systematic literature review, we observed that researchers from various continents, with the exception of Africa, have made significant contributions to this research field. We determined the origin of the studies based on the nationality of the first author's affiliation. This indicates that the research on this

Primary Study	Game Definition	Documentation	Pre-Production	Requirement Analyze	Development	Testing	Validation	Prototyping	Others
Salazar et al. (2012)	✓	✓							
Pandey et al. (2018)	✓		✓	✓	✓	✓	✓		
Luhova et al. (2019)	✓	✓		✓	✓				
Guo et al. (2015a)	✓		✓	✓	✓	✓	✓		
Al-azawi et al. (2014)				✓					
Fatima et al. (2018)			✓						
Ramadan and Widyani (2013)		✓	✓		✓	✓		✓	
Kristiadi et al. (2019)	✓		✓	✓	✓	✓	✓	✓	
Desurvire and El-Nasr (2013)						✓	✓		✓
de Oliveira et al. (2011)	✓		✓	✓					
Hetherinton (2014)	✓	✓		✓	✓				
Politowski et al. (2016)		✓		✓	✓	✓	✓	✓	
Al-Azawi et al. (2013)						✓	✓		
Améndola et al. (2015)				✓	✓	✓	✓		
Peres et al. (2011)	✓	✓	✓	✓	✓	✓	✓	✓	
Dirgantara et al. (2019)	✓		✓	✓		✓	✓		✓
Pavapootanont and Prompoon (2015)					✓	✓	✓	✓	
Furtado et al. (2011)		✓		✓	✓	✓	✓	✓	
Passos et al. (2011)					✓				
Pizzi et al. (2010)				✓	✓			✓	✓
McKenzie et al. (2021)		✓	✓		✓	✓		✓	
Zhu et al. (2016)	✓	✓	✓	✓	✓				
Hernandez and Ortega (2010)	✓	✓		✓	✓				
Schild et al. (2010)	✓	✓	✓	✓	✓	✓	✓	✓	
Winget and Sampson (2011)		✓						✓	✓
Petrillo and Pimenta (2010)							✓		
Mozgovoy and Pyshkin (2018)			✓	✓		✓			
Desurvire and Wixon (2013)	✓					✓	✓		✓
Zamora and Villalobos (2019)				✓	✓	✓	✓	✓	
Smith and Graham (2010)						✓		✓	
Arguson and Aldea (2017)	✓		✓	✓	✓	✓		✓	
Kriglstein et al. (2014)	✓		✓	✓			✓	✓	
Guo et al. (2015b)	✓	✓	✓	✓	✓		✓		
Guevara-Villalobos (2011)					✓				
Fernandez et al. (2012)		✓		✓	✓				
Musil et al. (2010)	✓	✓	✓	✓	✓	✓	✓	✓	
De Macedo and Rodrigues (2011)	✓	✓	✓	✓	✓		✓	✓	✓
Maksoud (2020)	✓	✓	✓	✓	✓		✓		
Calderon et al. (2017)	✓		✓	✓					
Aslan and Balci (2015)	✓	✓	✓	✓	✓		✓		✓
Al-Azawi et al. (2014)					✓			✓	
Mitre-Hernandez et al. (2016a)						✓	✓	✓	✓
Kasurinen et al. (2014)	✓		✓	✓		✓	✓		
Baharom et al. (2014)	✓			✓					
Albaghajati and Hassine (2021)	✓	✓		✓	✓				
de Oliveira et al. (2018)	✓			✓					
Marbach et al. (2019)					✓				
Al-Azawi and Ayesli (2015)	✓	✓		✓	✓		✓	✓	
Mitre-Hernandez et al. (2016a)	✓	✓	✓	✓	✓	✓	✓	✓	
Glossner et al. (2015)	✓			✓					
Aleem et al. (2016)	✓	✓	✓	✓	✓	✓	✓	✓	
Calderon and Ruiz (2016)	✓		✓	✓	✓		✓		
Paschali et al. (2018)	✓	✓		✓		✓			
Pendleton and Okolica (2019)	✓			✓					
Athavale and Mohan (2018)	✓								
Warmelink et al. (2016)							✓		
Signoretti et al. (2016)		✓		✓		✓	✓	✓	
Ollsson et al. (2015)					✓				
Braad et al. (2016)	✓			✓	✓	✓	✓	✓	
Atmaja et al. (2016)	✓	✓		✓					
Inam et al. (2017)			✓						
Ahmad et al. (2017)									✓
Mylly et al. (2020)							✓		
Jónasdóttir and Müller (2020)						✓		✓	
Tap et al. (2021)	✓		✓	✓	✓		✓		

Table 6. Primary Studies by Steps of the GDLC.

Summary of RQ3.
We have identified a total of 9 distinct steps within the digital game development life cycle across the 65 studies. These steps encompass various aspects, with 36 studies addressing the game definition, 25 focusing on documentation, 26 on pre-production, 42 on requirements analysis, 36 on documentation (reiterated), 28 on testing, 32 on validation, and 24 on prototyping. For the remaining 9 steps, we have combined their classifications due to their limited representation.
To emphasize our key findings, we have referenced the 6 studies that encompass multiple phases. Furthermore, we have provided more detailed insights from 3 studies that were not previously presented, thereby enhancing the comprehensiveness of our results.

topic has garnered global interest and involvement from researchers across different continents.

In Table 7, we observe that 16 researchers from Brazil demonstrate the relevance of the research area in our country. Soon after, several researchers from Indonesia 10, Germany, Spain, and the United Kingdom 8 and Australia, Canada, United States, Malaysia, Mexico, Norway, and Pakistan 7. Brazil, the United States, and the United Kingdom have each produced four studies, while Canada, China, Spain, Indonesia, Norway, and Oman have produced three. Table 7 reveals that the number of Brazilian researchers involved in the production of the studies is not equal to the total number of studies produced due to collaborations with foreign universities.

Country	Researchers	Studies
flag-argentina Argentina	3 (1.8%)	1 (1.5%)
flag-australia Australia	7 (4.3%)	2 (3.1%)
flag-brazil Brazil	16 (9.8%)	4 (6.2%)
flag-canada Canada	7 (4.3%)	3 (4.6%)
flag-china China	6 (3.7%)	3 (4.6%)
flag-costa-rica Costa Rica	2 (1.2%)	1 (1.5%)
flag-denmark Denmark	1 (0.6%)	1 (1.5%)
flag-finland Finland	3 (1.8%)	1 (1.5%)
flag-germany Germany	8 (4.9%)	3 (4.6%)
flag-greece Greece	5 (3.1%)	2 (3.1%)
flag-india India	3 (1.8%)	2 (3.1%)
flag-indonesia Indonesia	10 (6.1%)	3 (4.6%)
flag-ireland Ireland	1 (0.6%)	1 (1.5%)
flag-japan Japan	2 (1.2%)	1 (1.5%)
flag-malaysia Malaysia	7 (4.3%)	3 (4.6%)
flag-mexico Mexico	7 (4.3%)	2 (3.1%)
flag-netherlands Netherlands	5 (3.1%)	2 (3.1%)
flag-new-zealand New Zealand	5 (3.1%)	2 (3.1%)
flag-norway Norway	7 (4.3%)	3 (4.6%)
flag-oman Oman	6 (3.7%)	3 (4.6%)
flag-pakistan Pakistan	7 (4.3%)	2 (3.1%)
flag-philippines Philippines	2 (1.2%)	1 (1.5%)
flag-portugal Portugal	2 (1.2%)	1 (1.5%)
flag-saudi-arabia Saudi Arabia	2 (1.2%)	1 (1.5%)
flag-slovenia Slovenia	1 (0.6%)	1 (1.5%)
flag-spain Spain	8 (4.9%)	3 (4.6%)
flag-switzerland Switzerland	4 (2.5%)	1 (1.5%)
flag-thailand Thailand	3 (1.8%)	2 (3.1%)
flag-ukraine Ukraine	4 (2.5%)	1 (1.5%)
flag-united-arab-emirates United Arab Emirates	4 (2.5%)	1 (1.5%)
flag-united-states United States	7 (4.3%)	4 (6.2%)
flag-united-kingdom United Kingdom	8 (4.9%)	4 (6.2%)
Total	**163**	**65**

Table 7. Researchers and Studies by Country.

Summary of RQ4.
To address RQ4, our investigation revealed the participation of 32 different countries in contributing studies to our Systematic Literature Review (SLR). This collaborative effort involved a total of 163 researchers hailing from various parts of the world, spanning across almost all continents except Africa.
One notable finding that underscores the global nature of our research is that, despite one of our selection criteria being studies conducted in English, Brazil emerges as the most significant contributor to our SLR. Brazilian researchers have played a substantial role, contributing a total of 16 resources and 4 studies, highlighting the country's notable impact on our research.

5 Threats to Validity

To address potential threats to the validity of this SLR, we considered the main categories outlined by Wohlin et al. (2012):

Construction Validity: which relates to the appropriateness of the research design, is reinforced by using Kitchenham's guidelines Kitchenham and Charters (2007), a well-accepted resource in the software engineering community for conducting SLRs. In addition, we employed the Thoth Marchezan et al. (2019) software tool to facilitate our study selection process and selected search digital libraries that broadly index publications in the area, further strengthening the study's construction validity.

Internal Validity: To minimize potential bias and enhance the process of curating and classifying studies, we conducted the stages of study selection and data extraction in two phases. We began with the most relevant studies in the first phase and then moved on to a range of broader studies in the second phase, training and balancing the selection process.

External Validity: Since our review was based on a well-established and validated protocol as described in Section 3, any other researcher or research group can replicate this study. For a more comprehensive overview of all phases of this SLR, the Zenodo repository is available at `https://doi.org/10.5281/zenodo.7657389`.

Conclusion Validity: To address the subjectivity of study analysis and selection, this SLR utilized objective measures and weight-based quantification for the quality assessment and its answers. For RQ1 and RQ2, we adopted the terminology used in the selected primary studies to avoid any ambiguity in interpreting the study objective or supporting artifacts. In RQ3, we determined the authors' institutions based on the information provided in the studies, which can be easily revised without the need for human judgment regarding their origin.

6 Final Remarks

There are particular challenges when proposing the development of a game whose interdisciplinarity, techniques, and creativity do not directly fit the content proposed in the specific literature of SE. Therefore, this SLR helps to identify studies that present theoretical and practical solutions for the management of game projects.

Following the guideline proposed by Kitchenham, our initial process began with 6,658 studies. After removing duplicate studies, we were left with 3,734 unique studies. Through the application of inclusion, exclusion, and quality selection criteria, we further narrowed down the selection and obtained 65 primary studies that were deemed suitable for addressing our research questions. Analyzing the results, we observed that researchers from various countries have been actively publishing studies to enhance the stages of game project management. Among these countries, Brazil and Indonesia stood out as significant contributors to the field. Their researchers have made notable contributions to the body of knowledge related to game project management, reflecting the global nature of research in this area.

An essential part of these studies proposes adaptations and improvements to the consolidated agile methods, with a focus on the Scrum method. In addition, there are also relevant studies focused on models and applications of some standardized ISO/IEC standards for software management and quality. Among software artifacts intended for project management collaboration, researchers suggest the usage of UML diagrams, models based on GDLC, and processes modeled in BPMN. Among the essential structural documentation, the studies prefer GDD, which is even the target in some of them.

Finally, this SLR represents work that is aware of possible biases or limitations, but several measures and procedures have been taken to mitigate any mistakes. Furthermore, all steps and results can be publicly reviewed and replicated from the Zenodo open data repository mentioned above.

Acknowledgements

The present work was supported by the Federal University of Pampa (Unipampa), Brazil, and FAPERGS Notice 02/2022 - Innovates Technological Clusters.

Building upon the CRediT (Contributor Roles Taxonomy), we classify our contributions to this manuscript as: (i) **Writing – Original Draft**: once this version includes a substantive translation of prior work; (ii) **Data Curation**: we turn available all analysis data and the whole protocol used to conduct our systematic literature review in the open science Zenodo repository; (iii) **Investigation**: we conducted a research and investigation process following a strict methodology proposed by Kitchenham and Charters (2007).

References

Ahmad, N., Barakji, S., Shahada, T., and Anabtawi, Z. (2017). How to launch a successful video game: A framework. *Entertainment Computing*, 23:1–11.

Al-Azawi, R., Ayesh, A., Al-Masruri, K. A., and Kenny, I. (2014). Multi agent software engineering (mase) and agile methodology for game development. In *14th Middle Eastern Simulation and Modelling Multiconference, MESM*, EUROSIS-ETI, pages 116–122, Muscat, Oman.

Al-Azawi, R., Ayesh, A., Kenny, I., and AL-Masruri, K. A. (2013). A generic framework for evaluation phase in games development methodologies. In *Science and Information Conference*, pages 237–243.

Al-azawi, R., Ayesh, A., and Obaidy, M. A. (2014). Towards agent-based agile approach for game development methodology. In *World Congress on Computer Applications and Information Systems (WCCAIS)*, pages 1–6.

Al-Azawi, R. and Ayesli, A. (2015). A simulation based game approach for test drive exam. In *29th Annual European Simulation and Modelling Conference 2015*, pages 346–353, Leicester, United kingdom.

Albaghajati, A. and Hassine, J. (2021). A use case driven

approach to game modeling. *Requirements Engineering*, 27(1):83 – 116.

Aleem, S., Capretz, L. F., and Ahmed, F. (2016). A digital game maturity model (dgmm). *Entertainment Computing*, 17:55–73.

Améndola, F., Fernàndez, M., and Favre, L. (2015). Gliese - a framework for experimental game development. In *12th International Conference on Information Technology - New Generations*, pages 528–533.

Amélio, C. d. O. (2018). A indústria e o mercado de jogos digitais no brasil. In *Proceedings of SBGames 2018*, pages 1497–1506, Foz do Iguaçu, PR. SBC.

Arguson, A. C. and Aldea, W. A. (2017). Development of encantasya: War of the four kingdoms. In *6th International Conference on Software and Computer Applications*, ICSCA'17, page 23–27, New York, NY, USA. ACM.

Aslan, S. and Balci, O. (2015). Gamed: Digital educational game development methodology. *Simulation*, 91(4):307–319.

Athavale, S. and Mohan, A. (2018). Understanding game ideation through the lens of creativity model. In *Proceedings of the Design Society: International Conference on Engineering Design*, Bath, United kingdom.

Atmaja, P., Siahaan, D., and Kuswardayan, D. (2016). Game design document format for video games with passive dynamic difficulty adjustment. *Register: Jurnal Ilmiah Teknologi Sistem Informasi*, 2(2):86 – 97.

Baharom, S. N., Tan, W. H., and Idris, M. Z. (2014). Emotional design for games: A framework for player-centric approach in the game design process. *International Journal of Multimedia and Ubiquitous Engineering*, 9(10):387–398.

Braad, E., Žavcer, G., and Sandovar, A. (2016). *Processes and Models for Serious Game Design and Development*, pages 92–118. Springer International Publishing.

Calderon, A. and Ruiz, M. (2016). Coverage of iso/iec 12207 software lifecycle process by a simulation-based serious game. In *Software Process Improvement and Capability Determination*, volume 609, pages 59–70. Springer International Publishing.

Calderon, A., Ruiz, M., and OConnor, R. V. (2017). Coverage of iso/iec 29110 project management process of basic profile by a serious game. In *Systems, Software and Services Process Improvement*, volume 748, pages 111–122. Springer International Publishing.

De Macedo, D. V. and Rodrigues, M. A. F. (2011). Experiences with rapid mobile game development using unity engine. *Computers in Entertainment*, 9(3).

de Oliveira, G. W., Julia, S., and Soares Passos, L. M. (2011). Game modeling using workflow nets. In *IEEE International Conference on Systems, Man, and Cybernetics*, pages 838–843.

de Oliveira, P. H. R. L., de Miranda, C. A. S., and Boechat Gomide, J. V. (2018). Game design tools for maximum effectiveness. In *IADIS International Conference Game and Entertainment Technologies*, volume 2018-July, pages 363–367, Madrid, Spain.

Desurvire, H. and El-Nasr, M. S. (2013). Methods for Game User Research: Studying Player Behavior to Enhance Game Design. *IEEE Computer Graphics and Applications*, 33(4):82–87.

Desurvire, H. and Wixon, D. (2013). Game principles: Choice, change & creativity: Making better games. In *Extended Abstracts on Human Factors in Computing Systems*, pages 1065–1070, New York, NY, USA. ACM.

Dirgantara, H. B., Prabowo, Y. D., and Jermia, M. M. (2019). Development of android-based quiz video game: Mathventure. In *International Joint Conference on Information, Media and Engineering (IJCIME)*, pages 450–454.

Fatima, A., Rasool, T., and Qamar, U. (2018). Gdgse: Game development with global software engineering. In *IEEE Games, Entertainment, Media Conference (GEM)*, pages 1–9.

Fernandez, A., Insfran, E., Abrahao, S., Carsi, J. a., and Montero, E. (2012). Integrating usability evaluation into model-driven video game development. In *Human-Centered Software Engineering*, volume 7623 LNCS, pages 307–314, Berlin, Heidelberg. Springer Berlin Heidelberg.

Furtado, A. W., Santos, A. L., Ramalho, G. L., and de Almeida, E. S. (2011). Improving digital game development with software product lines. *IEEE Software*, 28:30–37.

Glossner, J., Bertozzi, N., and Stevenson, C. N. (2015). Game design and development capstone project assessment using scrum. In *ASEE Annual Conference and Exposition*, volume 122nd ASEE Annual Conference and Exposition: Making Value for Society, Seattle, Washington. ASEE Conferences.

Guevara-Villalobos, O. (2011). Cultures of independent game production: Examining the relationship between community and labour. In *Proceedings of DiGRA 2011 Conference: Think Design Play*, Utrecht, Netherlands.

Guo, H., Traetteberg, H., Wang, A. I., and Gao, S. (2015a). Realcoins: A case study of enhanced model driven development for pervasive games. *International Journal of Multimedia and Ubiquitous Engineering*, 10(5):395–411.

Guo, H., Trætteberg, H., Wang, A. I., and Gao, S. (2015b). A workflow for model driven game development. In *IEEE 19th International Enterprise Distributed Object Computing Conference*, pages 94–103.

Hernandez, F. E. and Ortega, F. R. (2010). Eberos gml2d: A graphical domain-specific language for modeling 2d video games. In *10th Workshop on Domain-Specific Modeling*, DSM'10, New York, NY, USA. ACM.

Hetherinton, D. (2014). Sysml requirements for training game design. In *17th International IEEE Conference on Intelligent Transportation Systems (ITSC)*, pages 162–167.

Inam, H., Malik, A., Sabahat, N., and Subhani, A. (2017). Improving the process for mobile games development. In *2017 International Conference on Communication Technologies (ComTech)*, page 45 – 49.

Jiménez-Hernández, E. M., Oktaba, H., Piattini, M., and Díaz-Barriga, F. (2017). Serious games when used to learn software processes: An analysis from a pedagogical perspective. In *5th Int. Conf. in Software Engineering Research and Innovation*, pages 194–203.

Jónasdóttir, H. and Müller, S. (2020). Theorizing affordance actualization in digital innovation from a sociotechnical perspective. *Scandinavian Journal of Information Systems*, 32(1):147–180.

Kasurinen, J., Maglyas, A., and Smolander, K. (2014). Is requirements engineering useless in game development?'. In *Requirements Engineering: Foundation for Software Quality*, volume 8396 LNCS, pages 1–16. Springer International Publishing.

Kitchenham, B. and Charters, S. (2007). Guidelines for performing systematic literature reviews in software engineering. Technical Report EBSE 2007-001, Keele University and Durham University Joint Report.

Kriglstein, S., Brown, R., and Wallner, G. (2014). Workflow patterns as a means to model task succession in games: A preliminary case study. In *Entertainment Computing – ICEC 2014*, pages 36–41, Berlin, Heidelberg. Springer Berlin Heidelberg.

Kristiadi, D. P., Sudarto, F., Sugiarto, D., Sambera, R., Warnars, H. L. H. S., and Hashimoto, K. (2019). Game development with scrum methodology. In *International Congress on Applied Information Technology (AIT)*, pages 1–6.

Kummer, L. B. M., Nievola, J. C., and Paraiso, E. C. (2017). Digital game usage lifecycle: a systematic literature review. In *XVI Simpósio Brasileiro de Jogos e Entretenimento Digital (SBGames'17)*, pages 1163–1172, Porto Alegre, RS. SBC.

Luhova, T., Blazhko, O., Troianovska, Y., and Riashchenko, O. (2019). The canvas-oriented formalization of the game design processes. In *IEEE 2nd Ukraine Conference on Electrical and Computer Engineering (UKRCON)*, pages 1254–1259.

Maksoud, S. H. A. E. (2020). Scrum based framework for teaching software engineering for game development. In *2nd International Conference on Video, Signal and Image Processing*, VSIP '20, pages 74–78, New York, NY, USA. ACM.

Marbach, A., Roschke, C., Thomanek, R., Hosel, C., and Ritter, M. (2019). Optimization of project management processes using the a* project management system (astarpm): A prototypical implementation and evaluation. In *HCI International 2019 - Posters*, volume 1032, pages 78–85. Springer International Publishing.

Marchezan, L., Bolfe, G., Rodrigues, E., Bernardino, M., and Basso, F. P. (2019). Thoth: A web-based tool to support systematic reviews. In *ACM/ IEEE Int. Symp. on Empirical Software Engineering and Measurement*, pages 1–6.

McKenzie, T., Morales-Trujillo, M., Lukosch, S., and Hoermann, S. (2021). Is agile not agile enough?' a study on how agile is applied and misapplied in the video game development industry. In *IEEE/ACM Joint 15th International Conference on Software and System Processes (ICSSP) and 16th ACM/IEEE International Conference on Global Software Engineering (ICGSE)*, pages 94–105, 2021.

Mitre-Hernandez, H., Lara-Alvarez, C., Gonzalez-Salazar, M., Mejia-Miranda, J., and Martin, D. (2016a). User experience management from early stages of computer game development. *International Journal of Software Engineering and Knowledge Engineering*, 26(8):1203–1220.

Mitre-Hernandez, H. A., Lara-Alvarez, C., Gonzalez-Salazar, M., and Martin, D. (2016b). Decreasing rework in video games development from a software engineering perspective. In *Trends and Applications in Software Engineering*, volume 405, pages 295–304. Springer International Publishing.

Mizutani, W. K., K. Daros, V., and Kon, F. (2021). Software architecture for digital game mechanics: A systematic literature review. *Entertainment Computing*, 38.

Mozgovoy, M. and Pyshkin, E. (2018). A comprehensive approach to quality assurance in a mobile game project. In *14th Central and Eastern European Software Engineering Conference Russia*, CEE-SECR '18, New York, NY, USA. ACM.

Musil, J., Schweda, A., Winkler, D., and Biffl, S. (2010). Improving video game development: Facilitating heterogeneous team collaboration through flexible software processes. In *Systems, Software and Services Process Improvement*, volume 99 CCIS, pages 83–94, Berlin, Heidelberg. Springer Berlin Heidelberg.

Mylly, S., Rajanen, M., and Iivari, N. (2020). The quest for usable usability heuristics for game developers. In *Advances in Information Systems Development*, volume 39 LNISO, page 164 – 181. Springer International Publishing.

Nishida, A. K. and Braga, J. C. (2015). Systematic review of literature: Educational games about electric energy consumption. In *IEEE Frontiers in Education Conference (FIE)*, pages 1–8.

O'Hagan, A. O., Coleman, G., and O'Connor, R. V. (2014). Software development processes for games: A systematic literature review. In *Systems, Software and Services Process Improvement*, pages 182–193. Springer.

Oliveira, K. W. R. and Paula, M. M. V. (2021). Gamification of Online Surveys: A Systematic Mapping. *IEEE Transactions on Games*, 13(3):300–309.

Ollsson, T., Toll, D., Wingkvist, A., and Ericsson, M. (2015). Evolution and evaluation of the model-view-controller architecture in games. In *2015 IEEE/ACM 4th International Workshop on Games and Software Engineering*, page 8 – 14.

Pandey, J., Singh, A. V., and Alabri, A. A. (2018). Proposing a hybrid methodology for game development. In *7th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, pages 142–146.

Paschali, M.-E., Bafatakis, N., Ampatzoglou, A., Chatzigeorgiou, A., and Stamelos, I. (2018). Tool-assisted game scenario representation through flow charts. In *Proceedings of the 13th International Conference on Evaluation of Novel Approaches to Software Engineering - ENASE*, volume 2018-March of *ENASE'2018*, pages 223–232. INSTICC, SCITEPRESS - Science and Technology Publications, Lda.

Passos, E. B., Medeiros, D. B., Neto, P. A. S., and Clua, E. W. G. (2011). Turning real-world software development into a game. In *Brazilian Symposium on Games and Digital Entertainment*, pages 260–269, 2011.

Pavapootanont, S. and Prompoon, N. (2015). Defining usability quality metric for mobile game prototype using software attributes. In *6th IEEE International Conference on Software Engineering and Service Science (ICSESS)*, pages 730–736.

Pendleton, A. and Okolica, J. (2019). Creating serious games with the game design matrix. In *Games and Learning Alliancex*, volume 11899 LNCS, pages 530–539. Springer International Publishing.

Peres, A. L., Selleri, F., Antunes, J. B., Martins, F., Brito, K. d. S., Wanderley, R. R., Soares, F. S. F., Garcia, V. C., and Meira, S. R. d. L. (2011). Methods and processes definitions for multiplatform social network games development with distributed teams. In *Brazilian Symposium on Games and Digital Entertainment*, pages 189–195.

Petrillo, F. and Pimenta, M. (2010). Is agility out there?' agile practices in game development. In *28th ACM International Conference on Design of Communication*, SIGDOC'10, pages 9–15, New York, NY, USA. ACM.

Petticrew, M. and Roberts, H. (2008). *Systematic Reviews in the Social Sciences: A Practical Guide*. John Wiley & Sons.

Pieva, L. and Bernardino, M. (2022). Tendências e pesquisas em gerenciamento de projetos de jogos digitais: Uma revisão sistemática da literatura (*No Prelo*). In *Anais do XXI Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 1–8, Natal, RN, Brasil. SBC.

Pizzi, D., Lugrin, J.-L., Whittaker, A., and Cavazza, M. (2010). Automatic generation of game level solutions as storyboards. *IEEE Transactions on Computational Intelligence and AI in Games*, 2:149–161.

Politowski, C., Fontoura, L., Petrillo, F., and Guéhéneuc, Y.-G. (2016). Are the old days gone?' a survey on actual software engineering processes in video game industry. In *IEEE/ACM 5th International Workshop on Games and Software Engineering (GAS)*, pages 22–28.

Ramadan, R. and Widyani, Y. (2013). Game development life cycle guidelines. In *International Conference on Advanced Computer Science and Information Systems (ICACSIS)*, pages 95–100.

Salazar, M. G., Mitre, H. A., Olalde, C. L., and Sánchez, J. L. G. (2012). Proposal of game design document from software engineering requirements perspective. In *17th International Conference on Computer Games (CGAMES)*, pages 81–85.

Schild, J., Walter, R., and Masuch, M. (2010). Abc-sprints: Adapting scrum to academic game development courses. In *5th International Conference on the Foundations of Digital Games*, FDG'10, pages 187–194, New York, NY, USA. ACM.

Signoretti, A., Martins, A. I., Rodrigues, M., Campos, A. M., and Teixeira, A. (2016). Services & products gamified design (spgd) a methodology for game thinking design. In *Proceedings of the 7th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-Exclusion*, DSAI 2016, pages 62 – 68, New York, NY, USA. ACM.

Smith, J. D. and Graham, T. C. N. (2010). Raptor: Sketching games with a tabletop computer. In *International Academic Conference on the Future of Game Design and Technology*, pages 191–198, New York, NY, USA. ACM.

Souza, M. R. d. A., Furtini Veado, L., Teles Moreira, R., Magno Lages Figueiredo, E., and Costa, H. A. X. (2017). Games for learning: bridging game-related education methods to software engineering knowledge areas. In *IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track (ICSE-SEET)*, pages 170–179.

Tap, R. M., Zin, N. A. M., Sarim, H. M., and Diah, N. M. (2021). Creativity training model for game design. *International Journal of Advanced Computer Science and Applications*, 12(5):59–66.

Trier, K. K. and Treffers, T. (2021). Agile project management in creative industries: A systematic literature review and future research directions. In *IEEE Technology & Engineering Management Conference - Europe (TEMSCON-EUR)*, pages 1–8.

Warmelink, H., Valente, M., van Tol, R., and Schravenhoff, R. (2016). Get it right! introducing a framework for integrating validation in applied game design. In *Games and Learning Alliance*, volume 9599, pages 461–470. Springer International Publishing.

Winget, M. A. and Sampson, W. W. (2011). Game development documentation and institutional collection development policy. In *11th Annual International ACM/IEEE Joint Conference on Digital Libraries*, JCDL'11, pages 29–38, New York, NY, USA. ACM.

Wohlin, C., Runeson, P., Höst, M., Ohlsson, M. C., Regnell, B., and Wesslén, A. (2012). *Experimentation in Software Engineering*. Springer Berlin.

Xavier, B., Viana, D., and Santos, R. (2021). Modelo de negócio para estúdios independentes em ecossistemas de software de jogos digitais. In *Anais Estendidos do XX Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 903–906, Porto Alegre, RS. SBC.

Zamora, R. M. and Villalobos, E. B. (2019). Integrated framework for game design. In *IX Latin American Conference on Human Computer Interaction*, CLIHC'19, New York, NY, USA. ACM.

Zhu, M., Wang, A. I., and Traetteberg, H. (2016). Engine-cooperative game modeling (ecgm): Bridge model-driven game development and game engine tool-chains. In *13th International Conference on Advances in Computer Entertainment Technology*, ACE'16, 2016. ACM.