

Supporting Game Software Engineering from Business Modeling Towards Building Digital Game Studios

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Abstract. *The growth of the network of actors and solutions in the market has created a scenario in which fast, frequent technological changes as well as high quality level of the products are of utmost importance, affecting game software engineering. In the scenario, digital games stand out for the remarkable presence of leading software distribution platforms while the emergence of platforms dedicated to digital games and the growing network of actors and solutions for specific domains is also a reality. Several difficulties regarding actors' entrance and survival can be pointed out. As such, specific business models to assist in building digital game studios should be considered from the existing solutions reported in the game software engineering literature. This paper aims to report on the definitions and business modeling components applied to digital games research and practice to support game software engineering towards building digital game studios. We extracted data from 40 studies and categorize them into two related subdomains, i.e., definitions and components. Based on the results, we observe that such sector does not appropriate the definitions and components on business modeling, even though several studies mention related concepts. Therefore, this work reinforces the need for exploratory research, mainly empirical studies in real-life solutions throughout the game software life cycle to create and foster game studios.*

Keywords *Game Studios, Business Modeling, Game Software Engineering*

1. Introduction

Games have existed since ancient times and have accompanied technological evolution to remain present in human history. The entrance of games into the digital environment began in the 1950s with the creation of the first computer game and first video game console (Neto et al. 2009). Over the decades, layers in the digital games sector strengthened their relationship with the software market (Murphy-Hill et al. 2014), and have gained a prominent place in the leading distribution platforms in the market, such as Google Play and Apple Store (Xavier et al. 2020; Zendle et al. 2020). The heated demand in this sector has also enabled the emergence of exclusive platforms for games, such as Xbox Live, Playstation Network, Steam, and Nintendo Store (Berg 2015; Fung 2016; Inoue and Tsujimoto 2018; Vervoort 2019).

The exponential growth of the network of players and new solutions in the digital games sector has awakened the need to adapt to rapid technological changes and the high level of quality demanded by consumers (De Prato et al. 2012; Machado et al. 2018). Digital game studios that act or think about starting in the sector need a fast, simple, and clear solution to organize their operation. In other words, the problem is that digital game companies need to appropriate the business models' concepts and solutions, aiming to adapt or develop innovative ways to create, deliver, and capture value for their customers (De Prato et al. 2012; Berg 2015).

In this context, this paper reports on the definitions and business modeling components applied to digital games research and practice to support game software engineering towards building digital game studios. To do so, we performed a systematic mapping study (SMS) (Kitchenham et al. 2015; Petersen et al. 2015). We extracted data from 40 studies and categorize them into two related subdomains, i.e., definitions and components. As such, this work presents as main contributions (1) definitions of business modeling to build studios in the context of game software engineering, and (2) details of components used in business modeling, besides conceptual models, taxonomies, design methods and tools, change methodologies, evaluation models, and adoption factors. This paper is organized as follows: Section 2 presents research method; Section 3 describes results; Section 4 refers to the discussion and limitations; finally, Section 5 concludes the paper.

2. Research Method

This work followed empirical software engineering guidelines (Kitchenham et al. 2015; Petersen et al. 2015). The definition of a protocol is relevant to strengthen the scientific character, besides forming an action guide for research planning and execution. Moreover, the systematization assists the evaluation and replication, then being primordial for the maturity of this research. As such, an SMS aims to structure a research area, while systematic literature reviews are focused on evidence collection and synthesis (Petersen et al. 2015). As such, an SMS aims to provide an overview of a research area by classifying and listing contributions about the categories of that classification.

2.1. Research questions

The research question were defined through the PICOC (Population, Intervention, Comparison, Outcomes, and Context) structure (Kitchenham and Charters 2007). For this work, the criteria for comparison do not apply, since the aim is not to compare aspects of the mapping results with other studies or to measure the results obtained (Petersen et al. 2008; Petersen et al. 2015; Kitchenham et al. 2015), but to identify definitions and business modeling solutions in digital game research and practice. The structure and synonyms are: (1) Population - Business modeling for digital games; (2) Intervention - Definitions, solutions, approaches, techniques, artifacts, among others; (3) Comparison - Not applicable; (4) Outcomes - Definitions and artifacts; and (5) Context - Academic studies by practitioners, academics, consultants, or students on a small or large scale.

The PICOC criteria assist in formulating the research question (RQ): *How is business modeling performed in order to building digital game studios?* Some sub-questions emerged to help understand the objective of this work: RQ1 - "Which definitions the digital games use to describe and explain business modeling?", and RQ2 - "Which components the digital games sector use for business modeling?".

2.2. Search strategy

The search strategy consists of selecting the academic search bases and the search terms to be applied. The bases selected in this work were: (1) Scopus¹, (2) Springer Link², (3) IEEE Xplore³, (4) ACM Digital Library⁴, and (5) Science Direct⁵. Although Scopus indexes other bases chosen in this search, such as IEEE Xplore, ACM Digital Library, Science Direct, and Springer Link (Kitchenham et al. 2015), the indexation may not have all the contents of the other bases. Another reason was that the research themes involved are in a maturation stage in the academic literature (Zott et al. 2011), and repeating databases guarantees retrieval of more research that has not disseminated in all databases.

Therefore, we only use the population's short terms to maintain the search scope, since intervention's, context's and outcomes' terms could limit the results. As a result, the main research string is: **“(digital game* OR game*) AND (business model)”**. The search strings were then elaborated according to each search base's parameters, as exposed in Table 1. The searches ran the string in fields 'title', 'abstract', and 'keyword', and the results were extracted in a spreadsheet to start the filtering process. Only Springer Link has no search filter for these fields.

2.3. Study selection and analysis procedures

The quality criteria in (Kitchenham et al. 2015) were not used for this study, since the academic rigor of the work obtained does not influence the SMS objective. After the execution of the search strings in the academic research bases, the selection stage starts with the inclusion (IC) and exclusion criteria (EC) definitions, as in Table 2. This SMS was conducted by three researchers who performed the selection of studies until the extraction of data. Figure 1 illustrates the consolidation of results. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow was observed to organize the study selection (Liberati et al. 2009) and data extraction was run based on a spreadsheet.

To organize the selected studies, this work applied the framework presented in (Pateli 2003; Pateli and Giaglis 2004), which proposes a set of eight subdomains to categorize studies on business modeling. The framework was identified in the studies' full-text reading and was used after the study selection process to organize the presentation of the results. The framework presents overview perspective on business model related research and is considered the work that presents the most important findings for the business modeling area (Wirtz 2020) as well as as one of the most famous research frameworks (Musulin and Strahonja 2018). In order to answer RQ1 and RQ2, only the first two subdomains are addressed in the scope of this work, considering the size constraints.

¹<https://www.scopus.com/>

²<https://link.springer.com/>

³<https://ieeexplore.ieee.org/>

⁴<https://dl.acm.org/>

⁵<https://www.sciencedirect.com/>

Table 1. Specific search strings

Base	Search String
Scopus	TITLE-ABS-KEY (“digital game” OR game) AND (“business model”)
IEEE Xplore	((“Document Title”:“digital game” OR game AND “business model”) OR “Abstract”:“digital game” OR game AND “business model”) OR “Author Keywords”:“digital game” OR game AND “business model”
ACM Digital Library	acmdlTitle:(“digital game” OR game) AND “business model”) OR acmdlAbstract:(“digital game” OR game) AND “business model”) OR keywords.author.keyword:(“digital game” OR game) AND “business model”
Springer Link	(“digital game” or game) and “business model”
Science Direct	Title, abstract, keywords: (“digital game” OR game) AND “business model”

Table 2. Inclusion and exclusion criteria

Criteria	ID
Study on business modeling approaches for digital games.	IC1
Study does not deal with a business model, i.e., it addresses other stages of the business.	EC1
Study deals with board games or card games (no digital games).	EC2
Study is not openly available for download and the institutional IP of the researchers does not provide access.	EC3
Similar study (duplicate, update, replication or clear reduction of some other work).	EC4
Preface, book, editorial, summary, poster, panel, lecture, round table, workshop or demonstration.	EC5

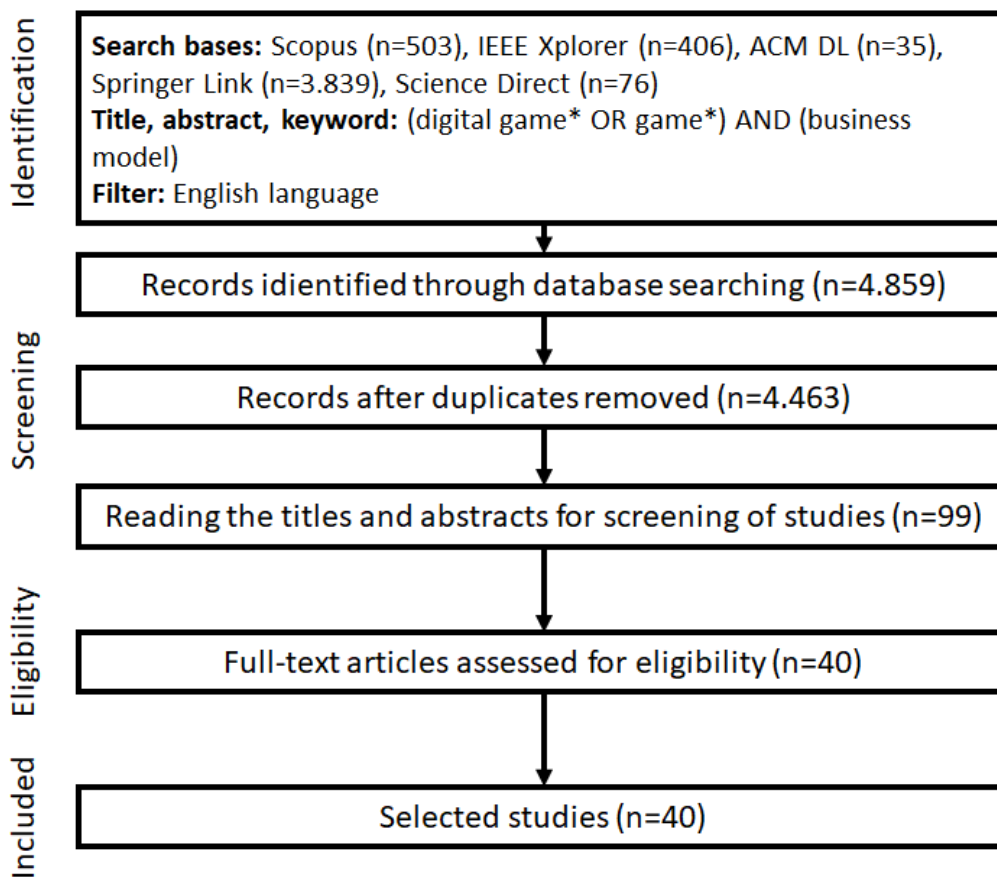


Figure 1. Selection process applied in this SMS

The subdomains analyzed in this work are: (1) Definitions - refers to objective, scope, and primary elements; and (2) Components - decomposes business modeling definitions into a set of fundamental components. Others are described next but support a future work: (3) Conceptual models - explores the relationship between the constituent elements of a business model; (4) Taxonomies - refers to categorizations and typologies of business models; (5) Design methods and tools - consists of instruments or visual representations of the components of a business model and their interrelationships; (6) Change methodologies - includes formulation of guidelines, description of steps and specification of actions to be taken to change business models; (7) Evaluation models - refers to evaluation criteria or best practices in implementing a business model; and (8) Adoption factors - involves factors that affect adoption in business environments.

3. Results

Supplementary material is available at Zenodo⁶ and includes the list of selected studies considered in the data extraction step, identifying search base, year of publication, work title, and identification (ID with Ax , where A refers to ‘article’ and x refers to ‘number on the list’). Moreover, quotes identified in the selected studies were included to allow traceability. In the analysis, the studies related to business modeling were categorized in

⁶<https://zenodo.org/doi/10.5281/zenodo.11456403>

the framework in (Pateli 2003), as detailed in Table 3. The following subsections detail the findings by the sub-domains.

Table 3. Selected studies on business models categorized according to the framework in (Pateli 2003)

Reference	Sub-domains							
	1	2	3	4	5	6	7	8
(Afuah and Tucci 2003)	✓	✓	-	✓	-	✓	✓	-
(Al-Debei et al. 2008)	✓	✓	-	-	-	-	-	-
(Al-Debei and Avison 2010)	✓	✓	-	-	-	-	-	-
(Alt and Zimmermann 2001)	-	✓	-	-	-	-	-	-
(Amit and Zott 2001)	✓	✓	-	-	-	-	-	-
(Baden-Fuller and Morgan 2010)	✓	-	-	-	-	-	-	-
(Bartelt and Lamersdorf 2001)	-	-	-	✓	-	-	-	-
(Björkdahl 2009)	✓	-	-	-	-	-	-	-
(Bouwman et al. 2008)	✓	✓	✓	-	-	✓	-	-
(Casadesus-Masanell and Ricart 2010)	✓	-	-	-	-	-	-	-
(Cavalcante et al. 2010)	✓	-	-	-	-	✓	-	-
(Chesbrough and Rosenbloom 2002)	✓	✓	-	-	-	-	-	-
(Chesbrough 2007)	✓	✓	-	-	-	✓	-	-
(Dubosson-Torbay et al. 2002)	✓	✓	-	-	-	-	✓	-
(George and Bock 2011)	✓	✓	-	-	-	-	-	-
(Akkermans and Gordijn 2003)	-	✓	✓	-	✓	✓	✓	-
(Gordijn et al. 2005)	-	-	-	-	-	-	-	-
(Johnson et al. 2008)	✓	✓	-	-	-	-	✓	-
(Kortmann and Piller 2016)	-	-	-	✓	-	-	-	-
(Linder and Cantrell 2000)	✓	✓	-	✓	-	✓	-	-
(Lindgardt et al. 2015)	-	✓	-	-	-	-	-	-
(MacInnes 2005)	-	-	-	✓	-	✓	-	-
(Magretta 2002)	✓	-	-	-	-	-	-	-
(Mahadevan 2000)	-	✓	-	-	-	-	-	-
(Morris et al. 2005)	✓	✓	-	-	-	✓	-	-
(Morris et al. 2006)	✓	✓	-	✓	-	-	-	-
(Osterwalder and Pigneur 2002)	✓	✓	-	-	-	-	-	-
(Osterwalder 2004)	✓	✓	✓	-	✓	-	-	-
(Osterwalder and Pigneur 2004)	✓	✓	✓	-	-	-	-	-
(Osterwalder et al. 2005)	✓	✓	-	-	-	-	-	-
(Osterwalder and Pigneur 2010)	✓	✓	-	✓	✓	✓	✓	-
(Pateli 2003)	-	-	-	-	-	-	-	-
(Pateli and Giaglis 2004)	-	-	-	-	-	-	-	-
(Petrovic et al. 2001)	✓	✓	-	-	-	-	-	-
(Rappa 2001)	✓	-	-	✓	-	-	-	-
(Stewart and Zhao 2000)	✓	-	-	-	-	-	-	-
(Tece 2010)	✓	-	-	-	-	-	-	-
(Timmers 1998)	✓	-	-	✓	-	-	-	-
(Malone et al. 2006)	-	-	-	✓	-	-	✓	-
(Wirtz et al. 2010)	✓	✓	-	✓	-	-	-	-

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Table 3. Selected studies on business models categorized according to the framework in (Pateli 2003) (continued)

Reference	Sub-domains							
	1	2	3	4	5	6	7	8
(Zott and Amit 2010)	✓	✓	-	-	-	-	-	-
(Zott et al. 2011)	✓	-	-	-	-	-	-	-
(Nae et al. 2011)	-	-	-	-	-	-	-	-
(Nahar et al. 2012)	✓	-	-	-	-	-	-	-
(Yamakami 2015)	-	✓	-	-	-	-	-	-
(MacInnes 2006)	✓	-	-	-	-	-	-	-

3.1. Which definitions the digital games use to describe and explain business modeling?

Table 4 consolidates the definition quotes identified in selected studies, sorted by the sum of the citations referring to a specific definition. In the first line, the same citation belongs to five different references, being these references located in eight studies. The first highlight refers to the definition in (Timmers 1998) as the oldest work identified in this mapping. Other works in the business modeling literature also point out the study (Timmers 1998) as the first academic initiative to define the term (Osterwalder et al. 2005; Zott and Amit 2010). The second highlight goes to the authors Osterwalder and Pigneur, who had several studies identified and used the same snippet to define the term.

Table 4. Definitions of business modeling for digital games studios

ID	Definition	Study (A: article)
1	“(…) is nothing else than a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams.” (Dubosson-Torbay et al. 2002; Osterwalder and Pigneur 2002; Osterwalder 2004; Osterwalder and Pigneur 2004; Osterwalder et al. 2005)	A12, A17, A20, A24, A25, A27, A28
2	“An architecture for the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; and a description of the sources of revenues.” (Timmers 1998)	A2, A12, A17, A21, A36, A38
3	“(…) business model as a new unit of analysis, offering a systemic perspective on how to “do business,” encompassing boundary-spanning activities (performed by a focal firm or others), and focusing on value creation as well as value capture.” (Zott et al. 2011)	A23, A25, A28, A29, A40
4	“(…) depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities.” (Amit and Zott 2001; Zott and Amit 2010)	A22, A25, A28, A38
5	“(…) refers to the logic of the firm, the way it operates and how it creates value for its stakeholders.” (Casadesus-Masanell and Ricart 2010)	A23, A25, A40

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Table 4. Definitions of business modeling for digital games studios (continued)

ID	Definition	Study (A: article)
6	“(…) is a statement of how a firm will make money and sustain its profit stream over time.” (Stewart and Zhao 2000)	A17, A28, A29
7	“(…) is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well as all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its strategic goals and objectives.” (Al-Debei et al. 2008; Al-Debei and Avison 2010)	A13, A25
8	“(…) is the method by which a firm builds and uses its resources to offer its customers better value than its competitors and to make money doing so. It details how a firm makes money now and how it plans to do so in the long term.” (Afuah and Tucci 2003)	A12, A40
9	“(…) is the method of doing business by which a company can sustain itself – that is, generate revenue. The business model spells out how a company makes money by specifying where it is positioned in the value chain.” (Rappa 2001)	A12, A17
10	“A business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers.” (Teece 2010)	A25, A28
11	“(…) is thus conceived as a focusing device that mediates between technology development and economic value creation.” (Chesbrough and Rosenbloom 2002)	A18, A21
12	“(…) is the organization’s core logic for creating value.” (Linder and Cantrell 2000)	A17, A12
13	“(…) have a multivalent character as models. They can be found as exemplar role models that might be copied, or presented as nutshell descriptions of a business organization: simplified, short-hand descriptions equivalent to scale models.” (Baden-Fuller and Morgan 2010)	A24
14	“(…) is defined as the logic and the activities that create and appropriate economic value, and the link between them.” (Björkdahl 2009)	A36
15	“(…) an abstraction of the principles supporting the development of the core repeated standard processes necessary for a company to perform its business.” (Cavalcante et al. 2010)	A18
16	“(…) a blueprint for a service to be delivered, describing the service definition and the intended value for the target group, the sources of revenue, and providing an architecture for the service delivery, including a description of the resources required, and the organizational and financial arrangements between the involved business actors, including a description of their roles and the division of costs and revenues over the business actors.” (Bouwman et al. 2008)	A21
17	“(…) performs two important functions: value creation and value capture.” (Chesbrough 2007)	A36
18	“(…) is the design of organizational structures to enact a commercial opportunity.” (George and Bock 2011)	A24

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Table 4. Definitions of business modeling for digital games studios (continued)

ID	Definition	Study (A: article)
19	“(…) business model consists of set of elements and their relationships and expresses the business logic of firms.” (Gordijn et al. 2005)	A12
20	“(…) consists of four interlocking elements that, taken together, create and deliver value.” (Johnson et al. 2008)	A40
21	“(…) we define business model as a dynamic process that encompasses a company’s activities that would allow it to capitalize from the value it provides to customers which include technical efficiencies, environmental considerations, revenue streams, and innovation over time.” (MacInnes 2006)	A6
22	“They are, at heart, stories – stories that explain how enterprises work.” (Magretta 2002)	A21
23	“(…) is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.” (Morris et al. 2005)	A36
24	“(…) is used to describe a company’s unique value proposition (the business concept), how the firm uses its sustainable competitive advantage to perform better than its rivals over time (strategy), and whether, as well as how, the firm can make money now and in the future (revenue model).” (Morris et al. 2006)	A24
25	“(…) as the way how a company creates, delivers and extracts value and generate revenue.” (Nahar et al. 2012)	A20
26	“(…) describes the rationale of how an organization creates, delivers, and captures value.” (Osterwalder and Pigneur 2010)	A20
27	“(…) is not a description of a complex social system itself with all its actors, relations and processes. Rather, it describes the logic of a ‘business system’ for creating value that lies behind the actual processes.” (Petrovic et al. 2001)	A17
28	“(…) reflects the operational and output system of a company, and as such captures the way the firm functions and creates value.” (Wirtz et al. 2010)	A25

Among the other definitions identified, it is worth highlighting some aspects. The definition of the study (Björkdahl 2009) is based on that one of the studies (Chesbrough and Rosenbloom 2002) and (Slywotzky 1997). In the study (Nahar et al. 2012), several definitions are also considered, among them the definition in (Chesbrough 2007). Although there is no literal passage in the studies (Chesbrough and Rosenbloom 2002) and (Chesbrough 2007), these studies have terms about the creation and capture of value as a characteristic in common. Even though the study (Osterwalder and Pigneur 2010) uses a different definition concerning other works with the same authors (Dubosson-Torbay et al. 2002; Osterwalder and Pigneur 2002; Osterwalder 2004; Osterwalder and Pigneur 2004; Gordijn et al. 2005; Osterwalder et al. 2005), the authors’ definition can be considered an evolution or final description of the authors about the term. In turn, in (Gordijn et al. 2005), a comparison is made between the ontologies of other works identified in this SMS (Akkermans and Gordijn 2003; Osterwalder 2004), so there is a repetition of passages.

Finally, although the studies (Morris et al. 2005; Morris et al. 2006) have sections to characterize the business modeling, we observe a centrality in the terms business concept, strategy, and revenue model to define the business modeling. The last highlight goes to the study (George and Bock 2011), which elaborate a definition for the term based on the analysis of an opinion survey with 151 respondents with a management profile.

3.2. Which components the digital games sector use for business modeling?

In Table 5, some propositions have a hierarchical structure to group the components. The numbering between relatives in the columns “Groups” and “Components” is responsible for describing this hierarchical structure. We notice that the terms “groups” and “components” were used to consolidate the findings in the component sub-domain. The first structure highlighted is the Business Model Canvas. It is possible to observe that in the works of Osterwalder (Dubosson-Torbay et al. 2002; Osterwalder and Pigneur 2002; Osterwalder 2004; Osterwalder and Pigneur 2004; Osterwalder et al. 2005; Osterwalder and Pigneur 2010), there is a evolutionary sequence on the business modeling components. Therefore, the study (Osterwalder and Pigneur 2010), which proposes four pillars and nine building blocks, has been highlighted in Table 5. Such structure aims to address innovation in business models, providing a shared language that can easily describe business models and methods for change and evolution.

Table 5. Components of business models for digital game studios

ID	Name	Groups	Components	Reference	A:Article	
1	Business Model Canvas	(1) Product innovation (2) Customer relationship (3) Infrastructure management (4) Financial aspects	(1.1) Value proposition (2.1) Customer segment (2.2) Channels (2.3) Customer relationship (3.1) Key resources	(3.2) Key activities (3.3) Key partnership (4.1) Cost structure (4.2) Revenue streams	(Dubosson-Torbay et al. 2002; Osterwalder and Pigneur 2002; Osterwalder 2004; Osterwalder and Pigneur 2004; Gordijn et al. 2005; Osterwalder et al. 2005; Osterwalder and Pigneur 2010)	A10, A12, A14, A20, A24, A31, A34, A35, A36
2	N/A	N/A	(1) Value proposition (2) Target market (3) Value chain	(4) Revenue mechanism (5) Value network (6) Competitive strategy	(Chesbrough and Rosenbloom 2002; Chesbrough 2007)	A11, A12, A13, A24, A31
3	Activity System Design Framework	(1) Design themes (2) Design elements	(1.1) Efficiency (1.2) Complementarities (1.3) Lock-in (1.4) Novelty	(2.1) Content (2.2) Structure (2.3) Governance	(Amit and Zott 2001; Zott and Amit 2010)	A22, A35, A36, A40
4	N/A	N/A	(1) Profit site (2) Customer value (3) Scope (4) Price (5) Revenue sources	(6) Connected activities (7) Implementation (8) Capabilities (9) Sustainability (10) Cost structure	(Afuah and Tucci 2003)	A24, A31
5	V4 Framework	N/A	(1) Value proposition (2) Value network	(3) Value architecture (4) Value finance	(Al-Debei et al. 2008; Al-Debei and Avison 2010)	A32, A35
6	MSA Framework	N/A	(1) Offering (2) Market (3) Internal capability	(4) Competitive strategy (5) Economic (6) Personal/Investor	(Morris et al. 2005; Morris et al. 2006)	A34, A36
7	N/A	N/A	(1) Value stream (2) Revenue stream	(3) Logistical stream	(Mahadevan 2000)	A10
8	N/A	N/A	(1) Mission (2) Structure (3) Processes	(4) Revenues (5) Legal issues (6) Technology	(Alt and Zimmermann 2001)	A10
9	N/A	N/A	(1) Value model (2) Resource model (3) Production model (4) Customer relations model	(5) Revenue model (6) Capital model (7) Market model	(Petrovic et al. 2001)	A10
10	E3-value	N/A	(1) Actor (2) Value object (3) Value port (4) Value offering (5) Value interface	(6) Value exchange (7) Market segment (8) Composite actor (9) Value activity	(Akkermans and Gordijn 2003; Gordijn et al. 2005)	A31
11	N/A	(1) Value proposition (2) Operating model	(1.1) Target segment (1.2) Product or service offering (1.3) Revenue model	(2.1) Value chain (2.2) Cost model (2.3) Organization	(Lindgardt et al. 2015)	A32

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Table 5. Components of business models for digital game studios (continued)

ID	Name	Groups	Components	Reference	A:Article	
12	N/A	(1) Customer value proposition (2) Profit formula (3) Key resources (4) Key Processes	(1.1) Target customer (1.2) Job to be done (1.3) Offering (2.1) Revenue model (2.2) Cost structure (2.3) Margin model (2.4) Resource velocity (3.1) People (3.2) Technology and products	(3.3) Equipment (3.4) Information (3.5) Channels (3.6) Partnerships and alliances (3.7) Brand (4.1) Processes (4.2) Rules and metrics (4.3) Norms	(Johnson et al. 2008)	A24
13	N/A	N/A	(1) Resource structure (2) Transactive structure	(3) Value structure	(George and Bock 2011)	A24
14	STOF model	(1) Service (2) Technology (3) Finance (4) Organization	(1.1) Intended value (1.2) Delivered value (1.3) Expected value (1.4) Perceived value (1.5) Customer or end-user (1.6) Context (1.7) Tariff and effort (1.8) Bundling (2.1) Technical architecture (2.2) Backbone infrastructure (2.3) Access networks (2.4) Service platforms (2.5) Devices (2.6) Applications (2.7) Data (2.8) Technical functionality (3.1) Investment sources	(3.2) Cost sources (3.3) Performance indicators (3.4) Revenue sources (3.5) Risk sources (3.6) Pricing (3.7) Financial arrangements (4.1) Actors (4.2) Value network (4.3) Interactions and relations (4.4) Strategies and goals (4.5) Organizational arrangements (4.6) Value activities (4.7) Resources and capabilities	(Bouwman et al. 2008)	A13
15	4 Factors Model	(1) Social network (2) Interaction orientation (3) Customization and personalization (4) User-added value	(1.1) Social identity (1.2) Social trust (1.3) Virtual word of mouth (1.4) Increasing consumer power (2.1) Customer centricity (2.2) Interaction configuration (2.3) Customer response (2.4) Cooperative value generation	(3.1) Personal customization (3.2) Group customization (3.3) Social customization (4.1) User-generated content (4.2) User-generated creativity (4.3) User-generated innovation (4.4) Sources of revenue	(Wirtz et al. 2010)	A35

The study (Gordijn et al. 2005) refers to a comparison made between two ontologies about business modeling, being one of these ontologies of the study (Osterwalder 2004). In turn, the study (Akkermans and Gordijn 2003) proposes the E³-value, an interdisciplinary approach with nine concepts to explore e-commerce. The work claims to explore requirements engineering, employing concepts and terminology from business science, marketing and axiology. Similar to the study (Osterwalder and Pigneur 2010), the study (Lindgardt et al. 2015) also focus on innovation criteria in business modeling. The work addresses the concept of Business Model Innovation (BMI) clearly and shows its relevance to the business environment, besides describing circumstances in which BMI can contribute to companies' competitive capacity. The business model in (Lindgardt et al. 2015) has two elements and seven dimensions. In this case, the dimensions are the smallest hierarchical level elements. The study (Lindgardt et al. 2015) used the same questioning approach to achieve an understanding of the components used in (Afuah and Tucci 2003; Morris et al. 2005; Morris et al. 2006).

As mentioned before, the studies (Morris et al. 2005; Morris et al. 2006) used a series of questions to identify key aspects of business modeling. The six component structure proposed in (Morris et al. 2005; Morris et al. 2006) is called MSA Framework, in allusion to the authors' names (Morris, Schindehutte, and Allen). It has the purpose of allowing its user to conceive, describe, categorize, criticize, and analyze a business model for any company. In the study (Morris et al. 2005), the MSA Framework is detailed, while a study is made with the same framework in (Morris et al. 2006), but with a methodology to measure the business model applied to a random sample of companies. The study (Afuah and Tucci 2003) develops a work supported on strategic manage-

ment and technology management to develop a framework focused on the performance of Internet-related business models. The framework is divided into nine components and has a collaborative approach, where each component has a set of questions, and the actors involved must interact to achieve/improve the business model definitions. Similar to the study (Osterwalder and Pigneur 2010), the study (Afuah and Tucci 2003) also suggests a series of tools and methods to support its component structure.

The study (Chesbrough and Rosenbloom 2002) proposes a structure composed of six attributes, exploring the role of the business model in capturing the value of early-stage technologies. The proposed attributes focus on ensuring that the technological core of business innovation adds value to customers, as this is a challenge identified in the emergence of new technologies. It is worth mentioning that the study (Chesbrough 2007) is an interview in white paper format that addresses the previous study (Chesbrough and Rosenbloom 2002). The study (Amit and Zott 2001) explores the theoretical underpinnings of value creation in e-business, examining 59 American and European e-business companies that have become publicly traded corporations. Based on the data and casework analyses, the proposed framework focuses on Value Creation sources in e-business. The first work (Amit and Zott 2001) created the components subordinated to the “Design Themes” group, which describes the sources of value creation of the activity system. The new components (content, structure, and governance) called “Design Elements”, presented in (Zott and Amit 2010), describe the architecture of an activity system. It is important to notice that the term “sources” refers to the components and the term “level” to the groups in (Amit and Zott 2001; Zott and Amit 2010).

The study (Al-Debei et al. 2008) investigates the area of business modeling for digital companies, more specifically for cellular and telecommunications network operators, and have developed a 4-pillar framework called V4 Framework. The main objective was to identify the four main concepts and values of the business model. In another work (Al-Debei and Avison 2010), highlighted in Table 5, an extension of the four pillars ontological structure previously proposed in (Al-Debei et al. 2008) is made. Considering these two works (Al-Debei and Avison 2010; Al-Debei et al. 2008), there were two citations along with the works of this SMS. The study (Alt and Zimmermann 2001) proposes a set of six generic elements based on analyses from various sources, such as electronic databases, conference proceedings on business modeling. The main objective of this study consists of developing sustainable business models for an eMarket environment.

In turn, the study (Wirtz et al. 2010) rely on the “4C” typology to perform changes in Internet business models focused on the Web 2.0 phenomenon. The study (Petrovic et al. 2001) extended the model in (Wirtz et al. 2010) and adopted characteristics of the framework proposed in (Alt and Zimmermann 2001). In the end, seven sub-models were elaborated that compose a business model for e-business. The study (Petrovic et al. 2001) states that their model should handle complex systems, provide a form of experience without risk, and be practically applicable. The work proposes an evolutionary model based on systems theory and combines aspects of the system dynamics and action research.

In (Bouwman et al. 2008), the Service, Technology, Finance and Organization Model, or just STOF Model, was developed and aims to design business models for mobile internet services. The analysis of other works on business models results in a

four-dimensional and thirty-concept tool that explores in detail the functioning and relationships of these concepts. Focusing on determining when a company should change its business model, the study (Johnson et al. 2008) developed a methodology with four components and seventeen aspects. The main difficulty refers to solve is the inclusion of innovation criteria. For this purpose, a three steps structure emerged: the first consists of realizing that success is related to the opportunity to satisfy a real customer who needs a job done; the second step refers to build a plan that establishes how the company will satisfy that need with profit, from which a new model emerged; finally, the third step focuses on comparing the model with the previous one to see how much modification is needed to capture the opportunity.

The study (Mahadevan 2000) elaborates on a simplified view of business modeling through three critical streams. The goal was to provide a means to understand how to design business models for organizations on the Internet. In turn, the study (George and Bock 2011), with an opportunity-centric and entrepreneurial perspective, formulated a three-dimensional business model based on inductive work data that captured the perceptions of 151 incumbent managers.

4. Discussion

The number of work retrieved from the research string shows a growth in the business model term related to digital game studios. However, after applying inclusion and exclusion criteria, it is possible to observe that the term's use is made superficially and, above all, without the proper bibliographic reference to support or contextualize its use. Among the 40 studies selected for the final extraction, only 24 (60%) used bibliographical references to support the statements. To respond to RQ1 and to understand how the digital games sector defines business modeling, it was possible to identify some prominent studies. At the full-text reading stage (stage 5 described in Section 2), we noticed that part of the works used the business model term through a punctual perspective as isolated aspects, e.g., resale or monetization. This approach, combined with the use of the term "business model" to aid argumentation or introduction, resulted in works without the proper theoretical reference and without a clear and grounded definition.

Among the works that used references to support the use of the term, it was possible to observe that the definitions in (Timmers 1998) and (Osterwalder et al. 2005) were the most used in the context of digital games. Although the study (Zott et al. 2011) received an emphasis on citation count, the passages used in the selected works do not provide a common sense on the business modeling definition. More broadly, business modeling is associated with a description of the logic of how a business creates value for its customers. This definition emerged from an analysis of the most frequent terms extracted from the definitions identified in this SMS (Table 4). We noticed that the definition snippets have been kept in the original language and used as a data source. Figure 2 was generated using the *Word Cloud Generator*⁷ tool, which defines the size of the words according to the frequency with which they occur in the text excerpt entered as data input.

With a focus on identifying business models solutions used by digital game, the answer to RQ2 emerged. This SMS identified 33 studies that deal with business models artifacts (e.g., tools, frameworks, models, methods and others) out of the 40 se-

⁷<https://www.jasondavies.com/wordcloud/>

lected studies. Among the various artifacts, the Business Model Canvas, proposed in (Osterwalder and Pigneur 2010), gained prominence due to the framing in almost all sub-domains of the framework in (Pateli 2003). Another work that called attention due to framing sub-domains is that reported in (Afuah and Tucci 2003).

In the Components sub-domain, some works have components with similar objectives. The most prominent component is the Value Proposition. This component reinforces the emphasis given to the term “value creation” extracted from the definition sections’ analysis. Other components that deserve to be highlighted due to the fact of being identified in several studies are the Revenue Model and Customer Segment. In Figure 3, we show the distribution of business modeling studies used in digital games by year and subdomain of the framework in (Pateli 2003).

This study’s validity may be affected by several factors, such as the researchers’ partiality, inaccuracy during the data extraction and synthesis process, and the high amount of work returned in the consultations. There may be relevant works that have not been recovered, for reasons such as non-indexing of events and journals important to the areas involved in the chosen research bases, affecting the research’s completeness.

This study also obtained numerous results due to the search string’s scope and the limitation of one of the chosen digital bases. In the Springer Link search base, there is no way to limit the search in the title, abstract, and keyword fields. Such limitation resulted in a massive return and high occurrence rate by the exclusion criteria. The number of results may negatively affect researchers’ analysis and synthesis, impacting the study’s quality and even validity. However, the researchers relied on the detailed documentation of the findings, which made it possible to revisit the data extraction processes for validation, increasing the study’s degree of assertiveness. The volume of results may lead to the exclusion of potentially relevant research work due to exhaustion and the lack of attention during the process of complete reading for selection and extraction.

The limitation of access from the institutional credentials resulted in the non-access of some works. Researchers did not have access to some works due to their cost. To mitigate access problems and bring quality to the results, the researchers chose to make an in-depth analysis of the works obtained in the selection. The analysis of the results dipped into the works’ references identified to extract the content presented in Section 3.

There may be a bias of researchers during the selection process of works. A shared spreadsheet with assessments of inclusion and exclusion criteria and extracts from the works that answered each study’s research questions helped reduce bias. Another action that helped to mitigate bias was the observation of the framework in (Pateli 2003) to aid in the characterization of the studies. The study protocol was also discussed among researchers to ensure a common understanding of the selection process.

Finally, it is possible to cite the low occurrence of empirical studies on business modeling for the digital games sector, impacting on data collection and research representativeness. As such, we highlight that the results reported in this SMS were not necessarily implemented – they were only referenced most times.



Figure 2. Word count form definitions quotes, based on Table 4 and generated from Word Cloud Generator

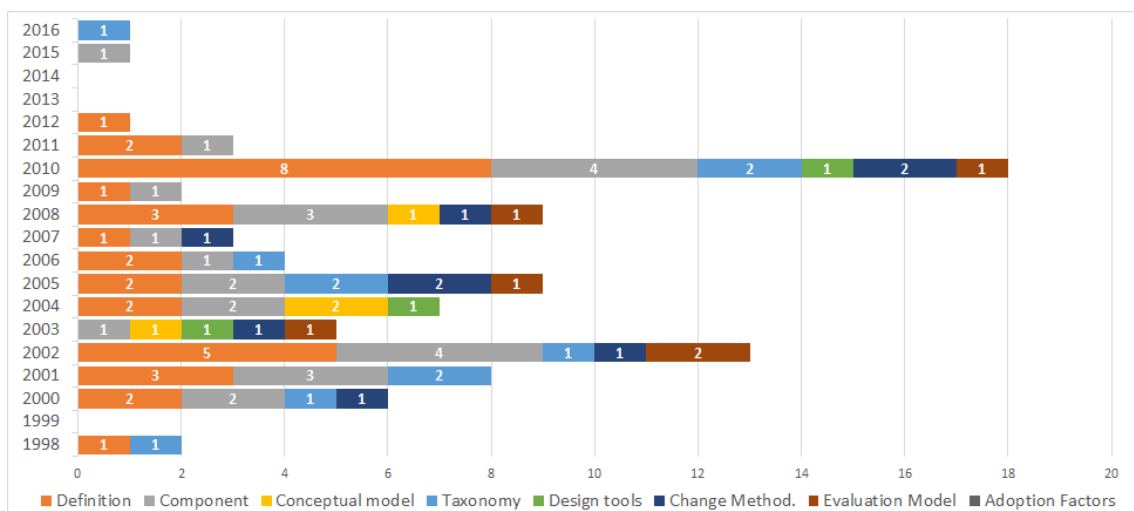


Figure 3. Business modeling works found in digital games studio studies, consolidated by year and subdomains

5. Conclusion

This SMS identified 40 studies on the definitions and business modeling components applied to digital games research and practice to support game software engineering towards building digital game studios. We extracted data from these studies and categorize them into two related subdomains, i.e., definitions and components, given the size constraints. Other subdomains of the framework in (Pateli 2003) have been addressed to support a future work. Among those studies, we extract 28 definitions, 15 components, 3 conceptual models, 11 taxonomies, 3 design methods and tools, 9 change methodologies, and 6 evaluation models on business modeling. No adoption factors were identified from the selected studies.

To answer this work's RQ, **How is business modeling performed in order to building digital game studios?**, it was necessary to conceptualize the term "business model" and identify the business modeling components for digital game studios in the context of game software engineering. For the conceptualization, a set of terms was identified and drawn from stretches of definitions identified in this SMS, which assisted in the understanding and response to RQ1. In general, business modeling is associated with the business logic description of creating value for its customers. As presented in studies related to definitions, the highlights go to the studies (Timmers 1998) and (Osterwalder et al. 2005). For the components (RQ2), it was possible to identify a common sense among some components of the proposed models, such as Value Proposition, Revenue Model, and Customer Segment. As general components, the studies (Osterwalder and Pigneur 2010) and (Afuah and Tucci 2003) reinforce the match to the subdomains in (Pateli 2003).

Business modeling is a concept present in digital-based companies, and the digital games sector needs to appropriate of this conceptualization (definitions and components). Both business modeling and digital games are terms on the rise in academia and the market, especially with the challenges of the game software engineering towards building digital game studios (Xavier et al. 2023). Besides reporting on the analysis and discussion of further results regarding the other six subdomains of the framework in (Pateli 2003), some future work can be pointed out: (1) update this SMS, due to the fact that the themes are growing in academia and industry, (2) refine or develop business models that consider directly the definitions and components presented in this paper, as well as other sub-domains, and (3) plan and execute exploratory studies applying business modeling components in real-life solutions throughout the game software ecosystems (Xavier et al. 2024) to create and foster game studios.

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