UNIVERSIDADE DE SÃO PAULO
ESCOLA POLITÉCNICA DA UNIVERSIDADE DE SÃO PAULO
PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA DE PRODUÇÃO

MARCELO MAKOTO HIGUCHI

**Digital Games Platforms: a literature review, an empirical assessment of quality and
exclusivity in video-game market and a study on project management**

São Paulo

2018

MARCELO MAKOTO HIGUCHI

Digital Games Platforms: a literature review, an empirical assessment of quality and exclusivity in video-game market and a study on project management

Dissertação apresentada à Escola Politécnica da Universidade de São Paulo para obtenção do título de mestre em ciências.

Área de Concentração: Engenharia de Produção – Engenharia Financeira e Economia da Produção (EPEF)

Orientador: Prof. Dr. Davi Noboru Nakano

São Paulo
2018

MARCELO MAKOTO HIGUCHI

Digital Games Platforms: a literature review, an empirical assessment of quality and exclusivity in video-game market and a study on project management

Dissertation presented at Escola Politécnica da Universidade de São Paulo to obtain the title of Master of Science.

Concentration field: Industrial Engineering – Production Economics and Financial Engineering (EPEF)

Supervisor: Prof. Dr. Davi Noboru Nakano

São Paulo
2018

Este exemplar foi revisado e corrigido em relação à versão original, sob responsabilidade única do autor e com a anuência de seu orientador.

São Paulo, _____ de _____ de _____

Assinatura do autor: _____

Assinatura do orientador: _____

Catálogo-na-publicação

Higuchi, Marcelo Makoto

Digital Games Platforms: a literature review, an empirical assessment of quality and exclusivity in video-game market and a study on project management / M. M. Higuchi -- São Paulo, 2018.

121 p.

Dissertação (Mestrado) - Escola Politécnica da Universidade de São Paulo. Departamento de Engenharia de Produção.

1.Jogos eletrônicos 2.Plataformas de dois-lados 3.Plataformas industriais
4.Administração de projetos 5.Economia criativa I.Universidade de São Paulo.
Escola Politécnica. Departamento de Engenharia de Produção II.t.

DEDICATION

**To my Grandmother Rosa and
Godmother Maria, *in memoriam*.**

**To my mother Gorete.
Always at my side.**

ACKNOWLEDGMENTS

This dissertation was done during difficult and important years in my life. In that period I was always supported by very special people to whom I am deeply grateful and would like to thank for making my dream come true.

First, to Professor Dr. Davi Nakano of the University of São Paulo – Department of Production Engineering. For everything he did as academic advisor – for all the guidance and the example as academic professional and researcher, – and as research partner in the articles of this study. Also, for his trust, caring and friendship through all this years, I am grateful.

To the Polytechnic School of University of São Paulo, an institution of excellence that gave me the opportunity to work on my research.

To all my friends and colleagues at USP. In special Julia and Mariana, who spent long hours with me in our weekly meetings, where we had the opportunity to discuss research on creative industries and many other themes that kept me motivated.

To all my friends, who I declined a lot of social events due to my studies, and despite that, were there when I needed them. In special, to Caio, Murilo, Renatinho, Luis, Amanda, Pri, Isis, Brait, Cabral, Fabio, Robison, Danilo, Fi, Mau, Nelsão and Osmar, with whom I could share all my work and experience trough all these years.

To my beloved family. In special to my mother Gorete, my siblings Bia, Sylvestre and Thiago, my grandmother Rosa, my godparents Maria and Geraldo and my father Marcelo, for always being with me. Thank you for everything.

ABSTRACT

Digital games are part of the creative industries, which is based on value creation through ideas and creativity. This market has gained relevance due to technology development that attracted both new firms and users. The present dissertation aims to explore three themes: (1) video game market as a two-sided market; (2) the effects of characteristics and behavior of game titles on consoles sales; and (3) project management to develop digital games. Those themes were explored through three articles: the first is a literature review and a bibliometric study of the economic concepts on two-sided market, which focused at identifying main topics, research trends and avenues for futures research. The second text is an analysis on the simultaneous influence of games' quality and exclusivity on console sales. The last one is a qualitative, multiple-case study to understand, explore and suggest improvements to game project management in the Brazilian market. Findings include: (1) the main authors and topics, trends and developments, from and avenues for future research; (2) combinations of quality and exclusivity can affect console sales either positively or negatively, (3) quality has a predominant effect on sales over games non-exclusivity; and (4) the use of agile methodologies and Design Thinking are diffused among game developers.

KEYWORDS: two sided-markets, platforms, payment schemes, advertising, bibliometric study, video game market, simultaneous effect, quality, multihoming, game development, Design Thinking, Agile Methodologies, project management

Figure List

Figure 1 – Representativeness of each segment in the total revenue of digital games market in 2017	18
Figure 2 – Video game market interactions.....	21
Figure 3 – Number of publications per year.....	32
Figure 4 – Cited articles and citations per author.....	33
Figure 5 – Articles and citations by journal	34
Figure 6 – Publications by country.....	34
Figure 7 – Association network between journals by period	36
Figure 8 – Association network between journals by geography.....	36
Figure 9 – Association network of keywords by period.....	38
Figure 10 – Association network of keywords by geography	39
Figure 11 – Chronological evolution of the studies on 2SMs	40
Figure 12 – Textual association of the network by period	42
Figure 13 – Textual association of the network by geography.....	43
Figure 14 – Quality and Multihome Effects.....	59
Figure 15 – Overview of exclusive and non-exclusive games	61
Figure 16 – Superstar-Singlehome Games accumulated.....	62
Figure 17 – Superstar-Multihome Games accumulated	62
Figure 18 – Non-superstar-Multihome Games accumulated.....	62
Figure 19 – Non-superstar-Singlehome Games accumulated	62
Figure 20 – Ranges of quality & exclusivity variables	65
Figure 21 – Design Thinking stages	79
Figure 22 – SCRUM stages	82
Figure 23 – Proposed model for game development combining Design Thinking and Agile Methodologies	86
Figure 24 – Proposed methodology - Design Thinking & SCRUM	93

Table list

Table 1 – 2SM business models	28
Table 2 – Consolidation of analyses, segregations, and groupings	44
Table 3 – Estimation Results	66
Table 4 – Robustness test of two consoles	68
Table 5 – SCRUM stages	83
Table 6 – Synergies between Design Thinking and Agile Methodologies	85
Table 7 – Companies’ characteristics	87
Table 8 – Stage and techniques of Design Thinking application	88
Table 9 – Classification of the use of DT techniques	90

Summary

1	INTRODUCTION.....	17
1.1	<i>Contextualization</i>	<i>17</i>
1.2	<i>Video game market as two-sided markets.....</i>	<i>20</i>
1.3	<i>Effects of characteristics and behavior of game titles on consoles sales.....</i>	<i>22</i>
1.4	<i>Project management to develop digital games</i>	<i>23</i>
2	TWO-SIDED MARKETS: A BIBLIOMETRIC STUDY	27
2.1	<i>Introduction.....</i>	<i>28</i>
2.2	<i>2SMs, Network effects, price and revenue generation.....</i>	<i>29</i>
2.3	<i>Methodology.....</i>	<i>31</i>
2.4	<i>Analysis</i>	<i>32</i>
2.4.1	<i>Descriptive analysis</i>	<i>32</i>
2.4.2	<i>Association Analysis</i>	<i>34</i>
2.4.3	<i>A review of the most cited texts</i>	<i>44</i>
2.4.4	<i>Consolidation of analyses</i>	<i>47</i>
2.4.5	<i>Relevant missing points.....</i>	<i>48</i>
2.5	<i>Conclusions</i>	<i>50</i>
3	THE COMBINED EFFECT OF QUALITY AND EXCLUSIVITY IN TWO-SIDED MARKETS: AN EMPIRICAL ASSESSMENT IN THE VIDEO GAME INDUSTRY	53
3.1	<i>Introduction.....</i>	<i>54</i>
3.2	<i>Platforms, Network effects and Video games.....</i>	<i>55</i>
3.3	<i>Quality and Multihoming effects on platform sales</i>	<i>56</i>
3.4	<i>Data: collection and processing</i>	<i>59</i>
3.5	<i>Empirical model definition.....</i>	<i>63</i>
3.5.1	<i>Direct network externality</i>	<i>63</i>
3.5.2	<i>Indirect network externality.....</i>	<i>63</i>
3.6	<i>Results</i>	<i>64</i>
3.7	<i>Robustness.....</i>	<i>67</i>
3.8	<i>Discussion of results.....</i>	<i>69</i>

3.8.1	Implications	69
3.8.2	Limitations and future research	70
4	AGILE DESIGN: A COMBINED MODEL BASED ON DESIGN THINKING AND AGILE METHODOLOGIES FOR DIGITAL GAMES PROJECTS.....	74
4.1	<i>Introduction.....</i>	75
4.2	<i>Literature review.....</i>	76
4.2.1	Design Thinking Approach	76
4.2.2	Agile Methodologies	80
4.2.3	Main focus and characteristics	80
4.2.4	SCRUM	81
4.2.5	Association of game development with software engineering.....	84
4.2.6	Proposal of integrated model: Design Thinking and Agile Methodologies	85
4.3	<i>Methodology: Assessment of DT and AM use by developers.....</i>	87
4.4	<i>Analysis and results discussion.....</i>	89
4.4.1	General vision about the Design Thinking approach	89
4.4.2	Use of DT's techniques	91
4.4.3	General vision about the use of Agile Methodologies	91
4.4.4	Approaches combination DT and AM.....	92
4.4.5	Proposed Model.....	92
4.5	<i>Conclusion.....</i>	95
4.5.1	Limitations.....	96
4.5.2	Futures researches.....	96
5	CONCLUSIONS	98
6	REFERENCES.....	101
	APPENDIX.....	111
6.1	<i>APPENDIX A – Chapter 2</i>	<i>111</i>
6.2	<i>APPENDIX A – Chapter 3</i>	<i>119</i>

1 INTRODUCTION

1.1 Contextualization

The creative economy is defined by the United Nations Conference on Trade and Development (UNCTAD) as a concept that deals with three distinct themes: culture, economics and technology (UNCTAD, Creative Economy, 2017). Creative industries have been defined as a different economic system that is not based on traditional economics of labor and capital, but on value creation through ideas and creativity (Howkins, 2001). It is associated to areas such as arts, cultural goods and services, digital games and research & development (R&D) activities. According to Bendassolli, Júnior, Kirschbaum, & Cunha, (2009) a well known definition of Creative Industries was coined by the British Department for Culture, Media and Sport (DCMS): “those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property” (DCMS, 2001, p.5)

Among creative industries, the digital games industry has grown significantly in the last decades due to technological development. In particular, Personal Computers (PC) and mobile devices technologies have contributed to that growth. The digital game market can be segregated in different groups, for instance, based on the playing platform:

- Console: dedicated devices, developed to play digital games;
- Personal computers: multi-purpose equipment, that can be used for both work and entertainment;
- Mobile devices: tablets and cell phones, multi-purpose equipment like PCs.

Figure 1 illustrates the cited segmentation and shows that the original gaming platform, the console, it is no longer the most used one. In the last decades consoles lost market share to PCs and mobile devices, which together represent 69% of the digital gaming market.

Lemes, Tomaselli and Camarotti (2012) also explore the technology relevance, they stated that Internet evolution and technology convergence have changed how people enjoy leisure and entertainment. Consequently, it become easy to understand why mobiles devices, which evolved in both dimensions, are currently the most used gaming interface.

Figure 1 – Representativeness of each segment in the total revenue of digital games market in 2017

Source: elaborated by the author based on McDonald (2017)

There is also another segregation that is far more recognized among digital game practitioners. It is an eclectic classification, partly based on technology, partly on the skill demand and level of use intensity (Consalvo, 2009; International Game Developers Association, 2009; Kuittinen, Kultima, Niemelä, & Paavilainen, 2007):

- Casual games: played casually, easy to play, simple controls, inclusive (most of them does not present gender preference or age), played for fun and relaxation, requiring less player commitment, low entry barrier and lower production budget for game developers;
- Hardcore games: quite complex to play, sophisticated controls, challenging, exclusive (generally has specific target audience), require commitment and long hours, high entry barrier and higher production budget for game developers.

Casual games are contributing significantly to digital games market, because they expanded the number of players (due to its inclusivity) and game developers, who produce new games (low entry barrier and production budget).

The global digital game market was worth more than US\$ 100 billion in 2017 (McDonald, 2017), above the movie industry revenues. The Brazilian game market has presented continuous growth and now is the 13th largest in the world with estimated sales of US\$ 1.3 billion (Newzoo, 2017). The 11 top selling games in history revenues are worth US\$ 75 billion (adjusted for inflation) and Atari's Space Invaders sales alone are in excess of US\$ 13.9 billions (Weinberger, 2015).

The economic relevance of the game market is a result of various factors, such as the increasing number of players and game developers, mainly associated to the casual games phenomenon. The consumer market has grown by broadening the target audience: some years ago the typical player was “young and male”, which has changed to a very diverse group: children, adults, and elderly from both sexes. There is also a growing number of game developers, both around the world and in the Brazilian market. In Brazil they are mainly small companies dedicated to development of mobile games, which require less investment and resources to be developed (Fleury, Nakano, & Cordeiro, 2014).

The digital game market can also be divided in two large groups, according to the development complexity, which can be associated with the *widening* and *deepening* concepts developed by Malerba and Orsenigo (1997). A *widening* market, which can be associated to the casual games, has the following characteristics: low technology complexity (products of easy elaboration), small companies, large number of new entrants and low asymmetry between companies. On the other hand, the *deepening* market is related to more complex games, generally associated with hardcore games, with has the following characteristics: great technology complexity (products of difficult replicability), large companies and high entry barriers and great asymmetry between the companies.

Thus, this research project aimed at studying three issues associated with the digital games market:

- Video game market as two-sided markets;
- Effects of characteristics and behavior of game titles in consoles sales;
- Digital game development project management.

These issues are explored individually in three articles. The first study is associated with the two-sided market concept. It is a literature review using bibliometry. The main focus is to understand theory evolution and research trends, key authors, main themes and new research avenues.

The second article aimed at analyzing the effect of game quality and exclusivity on console sales. The article evaluates the simultaneous effect of game quality and game exclusivity on console sales through a quantitative study. Such effects have not been previously studied concurrently, which is the theory gap that the paper aims to fill. In addition, this study can be understood as fundamental for the strategy definition in the digital game market, such as acquisition of key developers, creation of franchises and brands, opening of developments, pricing strategies etc.

The last article aims to understand the digital game project management practices through a multiple case study. In addition, in order to help game developers, a new approach to project management for the digital games development is proposed.

1.2 Video game market as two-sided markets

According to Evans (2002) the video game market is a two-sided market, where one side is composed by players (buyer side), and the other side is composed by game developers (seller side). Between those two sides, there is a two-sided platform, represented for instance, by consoles such as Microsoft Xbox 360, Nintendo Wii, Sony PlayStation 3.

Rochet and Tirole (2003) can be considered among the pioneers of the two-sided market concept. For them, almost every market characterized by the presence of network externalities can be considered a two-sided one, composed by two distinct sides that use a common platform to interact, which is responsible for maintaining the transactional continuity between the market sides.

A network externality occurs when the marginal utility of a market participant increases with the entry of a new participant (Katz & Shapiro, 1985). For instance, in social networks the utility of a participant depends on the number of other members that have joined to this network (Katz & Shapiro, 1985). Other example, in the video game market an increase in players' network of a specific platform attracts more game developers to produce games to it – increase the marginal utility for game developers –, and an increase in the number of game titles available turn the platform more attractive to game players – increase the marginal utility for game players (Kim et al., 2014).

There are two kinds of network externalities that are associated with two-sided markets, the direct and indirect ones. In the direct network externality, the presence of a new member on one side influences the utility of other member on the same side. The indirect network externality occurs when the presence of a member in one side of the network influences the utility of consumers in the other side (Katz & Shapiro, 1985). Figure 2 illustrates the participants in the video game market and how they influence each other through networks externalities.

Figure 2 – Video game market interactions¹

Source: elaborated by the author based on Eisenmann (2007) and Rochet and Tirole (2003)

Considering the Figure 2 – Video game market interactions, there are the following influences:

1. Players and players: direct and positive, because an increase in the players' network favors an exchange of information between players, allowing shared matches etc.;
2. Game developers and players: indirect and positive, the greater number of game developers the greater quantity and assortment of game titles for players;
3. Game developers and game developers: direct and negative, an increase in the number of developers increases competition in game developers' market;
4. Players and game developers: indirect and positive influence, a large player network tend to attract more game developers for a platform, since their games have a bigger number of potential players;
5. Players and platforms: players buy consoles and use them to play games supplied by game developers;
6. Game developers and platforms: game developers use software development kits, provided by platforms, to create new games.

Besides network externalities mentioned above, it is worth mentioning that network effects can have positive or negative nature. For example, advertising on television has a

¹ Basic representation of video market iterations, because of that there was not present other actors, such as publishers, retail stores etc.

negative network externality for one side and positive for the other: on the one hand, advertisers look for a large network of potential clients, the viewers, and thus the externality has a positive effect; on the other hand, the greater the number of advertisements, the less is the incentive for viewers to stay on a given platform, a negative network externality (Crampes, Haritchabalet, & Jullien, 2009). In contrast, the example of the video games market, previously illustrated, shows the positive effect of network externalities in which both sides benefit from each other's presence.

One behavior that has been studied in two-sided market theory is the *multihoming*. It occurs when one side of the market may access the other side through more than one platform (Caillaud & Jullien, 2003). Such behavior is widely discussed in articles exploring price equilibrium and competition in two-sided markets, such as Armstrong (2006), Armstrong and Wright (2007); Doganoglu and Wright (2006, 2010), among others.

Finally, it is possible to affirm that the video game market, as well as another two-sided markets has certain peculiarities and complexities, such as: network externalities, competition, strategies, behavior, product qualities, marketing etc. Aiming to better understand the economic concept of two-sided market and its research trends, part of the present study is addressed to a literature review on the dynamics of two-sided markets, research trends and opportunities in the literature.

1.3 *Effects of characteristics and behavior of game titles on consoles sales*

Two-sided market research has considered that indirect network externalities was only associated with its network size (Clements & Ohashi, 2004; Shankar & Bayus, 2003). For example, Gallagher and Wang (2002) evaluated network effects in a software market. They concluded that it behaves as a two-sided market and product network size is important for users' perception.

However, later studies have shown that other factors, such as product features and user behavior, can have a substantial influence on network externality effects, and that they can be more relevant than network size. Choi (2006) studied the competition between two TV transmission systems. One is the *free-to-air*, which is addressed to a general audience and its revenues only comes from advertisement. The other is the *pay media*, which has a specific target audience and has two revenue sources: subscription and advertisement. The authors

concluded that platform's content and platform's audience characteristics influences significantly their networks effects.

There is research that explores other characteristics besides the network size in the video game market. For instance, Kim, Prince, and Qiu (2014) analyzed of one market side characteristics and its influence on indirect network externalities. In particular they studied the influence of games quality in players' utility. They concluded that games quality has a relevant role on indirect network externalities.

Multihoming is one of the most studied behaviors in two-sided markets. This expression refers to the possibility of a user to access the other network side through more than one platform. The use of more than one credit card, e.g. Visa and MasterCard, to pay retailers that accept both is an example of *multihoming* (Doganoglu & Wright, 2006). According to Armstrong (2006) this *multihoming* behavior is one of the most fundamental points for price equilibrium in a two-sided market.

Multihoming (non-exclusivity) effect also was studied in the video game market. For instance, Landsman and Stremersch (2011) analyzed under which conditions a given vendor (game developer) defines his level of *multihoming*. Besides, the authors also investigated *multihoming* level influence on console sales. The results found in this research pointed out that *multihoming* level has a negative impact on console sales, and this effect is more intense in platforms' first years and decreases over time.

In two-sided markets literature there is a small number of empirical analyses, as it was observed by Landsman and Stremersch (2011) and Stremersch, Tellis, Franses and Binken, (2007). In this context there is some research that evaluates the influence of network size, member's behavior and characteristics on network externalities, and each of these points have their specific effects, whether positive or negative.

Additionally, empirical research exploring simultaneously two dimensions (e.g. behavior and characteristic) can be considered scarce. In this context the last research was addressed to fill this literature gap, in this case it was studied in the video market the influence of games' quality and exclusivity on console sales.

1.4 *Project management to develop digital games*

The production of games have both creative and technical activities, that require and produce new technologies, products, services, business models etc. (Fleury et al., 2014).

The game development process has creative and technical activities. The initial phase of the game development process is more characterized by creativity while the following phase has a technical predominance. The creative phase has activities like creation of stories, characters, music, scenario, gameplay etc. In turn, the technical phase involves software, hardware, codes and programs.

The technical aspect is explored by many authors (e.g., Akta & Orcun, 2014; Albino, Souza, & Prado, 2014; Hodgson & Briand, 2013) who consider that game development is a special case of software development. In their research Akta and Orcun (2014) studied relevant processes and methodologies for game development, and they defined computer games as a special type of software for education and entertainment. Albino et al. (2014) and Hodgson and Briand (2013) studied the influence of agile development models for digital games production.

The agile development can be considered an approach to project management, which revolutionized software engineering (Dingsoyr et al., 2012). Agile methods focus is on the efficient and effective software delivery through an iterative development. Agile methodologies follow four foundations pointed out in the Agile Manifesto, which are (Dingsoyr et al., 2012; Agile Alliance, 2001):

- Collaborative development;
- Lean mentality;
- Customers (game players) and stakeholders (software development team) are fundamental to develop product with high quality;
- Uncertainties are parts of software development.

Among the existing agile methodologies, SCRUM is the most popular (Albino et al., 2014). According to Schwaber (2004) SCRUM is a process in which projects advance in iterations, known as *sprints*. One of the hallmarks of SCRUM is its flexibility, in which the work list of a given project can be changed at any time (Cao, Mohan, Xu, & Ramesh, 2009).

Currently the game development market has an increasing number of small companies that typically produces casual games, and in this scenario SCRUM seems to fit well, because it helps to develop games in agile and flexible manner, two important points for small projects. This fact is also observed in the Brazilian market, for example, research on 149 companies – most of them small companies – showed that 60,9% use the SCRUM to project management (Fleury et al., 2014).

Despite the SCRUM fit for game development, this approach typically cover mainly the technical part. Thus, the part that is more characterized by its creativity is uncovered. To fill this gap the paper aimed to combine SCRUM and *Design Thinking*, the first is devoted mainly to cover the technical part and the second to the creative part.

Design Thinking is a creative approach to solve complex problems and it can be considered as an important competitive differential for innovative companies (Brown, 2008; Fleury, Stabile, & Carvalho, 2016; Martin, 2009). In this context the game development can be considered as a complex problem that is analogous to *Design Thinking* problems. Besides, this creative approach has synergies with SCRUM, which reinforce the combination of both approaches to project management for digital games.

Finally, this research explored the game development process through a multiple case study and proposed an all-encompassing approach for game development, which is an association of Design Thinking and SCRUM.

2 TWO-SIDED MARKETS: A BIBLIOMETRIC STUDY

Marcelo Makoto Higuchi

Post-graduate Program in Production Engineering – University of Sao Paulo, Brazil.

Av. Prof. Almeida Prado, 128, 05508-070, São Paulo, SP, Brazil

E-mail: marcelo.higuchi@usp.br

Davi Noboru Nakano

Production Engineering Department – University of Sao Paulo, Brazil.

Av. Prof. Almeida Prado, 128, 05508-070, São Paulo, SP, Brazil

E-mail: dnnakano@usp.br

Manuscript submitted to the Review of Industrial Organization

ABSTRACT

Although recent, the literature about two-sided markets and platforms is broad, as the concept can be applied to several contemporary businesses, such as digital games outlets, online retailers, media companies etc. However, there are still few theory reviews, and none using a quantitative approach. This text performs a bibliometric study on two-sided markets economic literature to identify main texts, trends and developments, research objects and avenues for future research. The quantitative assessment showed that research has grown fast but has already slowed its pace. Three main research themes were identified: economic fundamentals of two-sided markets, studies on payment schemes and on advertising business.

KEYWORDS: two sided-markets, platforms, payment schemes, advertising, bibliometric study

2.1 Introduction

A two-sided market (2SM) is composed of one or more platforms that mediate contact between producers (sellers) and end users (buyers) and charge each party a fee to maintain transactional continuity between them (Rochet & Tirole, 2006).

Research on 2SMs is recent and has expanded since the early 2000s with influential texts such as Rochet and Tirole (2002, 2003 and 2006), Caillaud and Jullien (2003) and Armstrong (2006). The concept has drawn attention, as numerous new businesses, particularly from the mobile ecosystem, are structured as two-sided markets. Companies such as Google, Facebook, and Uber are examples of platforms that offer coordinated interaction between two parties and facilitate their transactions (Rochet & Tirole, 2006; Eisenmann, Parkerand, & Van Alstyne, 2011). Digital games, credit cards, advertising media, and shopping centres are also examples of businesses that operate as 2SMs. In those markets, one side is often favoured by subsidies over the other, which in turn has to bear all transactions costs. Thus, the 2SM price structure are vastly discussed in this literature, as it could be find in Kaiser and Wright (2006), Rysman (2009), among others.

Table 1 below illustrates a number of 2SMs, their business models, participants, and value creation characteristics.

Table 1 – 2SM business models

Business	Product	Loss leader/ break-even segment/ subsidized segment	Profit-making segment/ subsidizing segment
Software	Video games	Consumers (consoles)	Game developers
	Media Streaming	Consumers	Servers
	Browsers	Users	Web servers
	Operating systems (<i>Windows, Palm, Pocket PC</i>)	Application developers (development tools, support, functionality etc.)	Clients
Portals e media	Portals	Visitors	Advertisers
	Newspaper	Readers	Advertisers
	TV networks (free-to-air)	Viewers	Advertisers
Payment systems	Credit and different debt cards (Visa, MasterCard, Amex etc.)	Cardholders	Merchants
	Online debt cards	Merchants	Cardholders

Others	Social gatherings	Celebrities in social happenings	Other participants
	Shopping malls	Consumers	Stores
	Discount coupon books (want advertiser)	Consumers	Merchants
	(Legacy) Internet	Websites	Consumers dial-up
	Real estate	Buyers	Sellers

Source: Elaborated by authors based on (Rochet & Tirole, 2003)

Table 1 shows that many of those platforms have become ubiquitous in everyday life, especially due to technology development. After the contributions from Rochet and Tirole (2002, 2003), Caillaud and Jullien (2003) and Armstrong (2006), research has explored issues such as : the structure of payment schemes (Wright, 2004); platform lifecycle , especially those associated with internet technologies (Muzzelec et al., 2015; Evans & Schmalensee, 2010; Hagiu, 2006); the influence of platform quality in the users' choice (Binken & Stremersch, 2009; Kim et al., 2014); and two-sided platforms strategies (Eisenmann et al., 2011); among others.

Using bibliometric analysis, this paper aims to identify and map main research topics and trends in the economic literature on 2SM, and also to identify avenues for future research. Bibliometry allows robust and comprehensive evaluation of the literature, using key words and co-citation network analysis. This approach distinguishes this paper from previous reviews of 2SM and network economics literature, namely, Roson (2005) and Shy (2011), who used an interpretive approach in their analyses, and contributes to the literature as there are currently no quantitative analyses of that body of literature.

This paper is organised in four sections. The first presents the basic concepts of 2SM, identified in the most frequently cited texts on this theory. The second section describes the method that was used to select articles and describes the final sample used in the analysis. The third section presents the descriptive statistics and bibliometric analyses of the sample. Finally, the last section discusses the findings and offers suggestions for future work.

2.2 2SMs, Network effects, price and revenue generation

According to Rochet and Tirole (2003), most (if not all) markets with network externalities can be modelled as 2SMs. They are characterised by the presence of two sides,

which interact through a common platform that must keep both sides “on board” to be successful.

Network externality (or effect) is one of the main factors to explain two-sided market dynamics. A positive, direct network externality occurs when the marginal utility of one market participant increases as a new participant enters in that market (Katz & Shapiro, 1985). However, it is the indirect network externality that mainly characterizes a 2SM. It represents the benefit to one participant on one side due to the number of individuals on the other side of the platform, and not by the number of individuals on the same side, as in the case of a direct externality (Rochet & Tirole, 2003). For example, video game platforms need to attract players to incentive developers to produce new games. Platforms also need more games to motivate players to buy their consoles (Rochet & Tirole 2006).

The price structure and revenue generation practices are relevant issues in the discussion on 2SM business models. To increase network effects, it is typical for platforms to subsidise one side to attract more participants to the other side who are willing to pay above the marginal cost to gain access to a large network of users (Rochet & Tirole, 2006). For example, free-to-air television channels subsidise viewers, who pay nothing to the platform, while advertisers, eager to reach the largest possible number of viewers, pay above the marginal cost to gain that access (Peitz & Valletti, 2008).

Also because of network effects, as one platform becomes successful, the market tends to consolidate, concentrating on a few platforms. As they usually subsidize one side of the market, some 2SM platforms have faced lawsuits for alleged violations of antitrust laws. Evans (2003) argues the United States government conducted a misguided analysis of the credit card market because only one side, the subsidized one, was analysed. According to the author, the appropriate method should use 2SM competition concepts, in which one side is subsidized and the other pays above the marginal cost, as shown in Table 1.

There are two main pricing strategies in a 2SM, namely, subscription and transaction fees (Rochet & Tirole, 2003). A subscription fee is a single payment that provides access to a platform for a period, such as the monthly payment charged by Internet access providers on users to use the web. A transaction fee is charged for each event between the two sides, as in property transactions, where the seller pays a finder’s fee to the real estate agent, who acts as the platform in this case.

Multihoming has also a relevant role in 2SM competition. The concept expresses platform non-exclusivity of a: an user accesses the other side of the network using more than

one platform (Armstrong, 2006; Rochet & Tirole, 2003). The existence of multihoming strategies alters the pricing levels of two-sided platforms (Rochet & Tirole, 2003). An example is the Microsoft Office suite: to reach the largest number of users, the company had to develop the suite for its operational system, Windows, but also for its competing, the s Mac OS.

Studies on platform strategies in the economic literature have generally revolved around pricing (Armstrong, 2006; Doganoglue & Wright, 2006; Guthrie & Wright, 2007; Rochet & Tirole, 2003; Rysman, 2004). There is also literature on product or service quality and differentiation, as on the envelopment strategy, when a new platform takes over the share of an existing one (Hagiu, 2009; Eisenmann, 2011).

2.3 *Methodology*

Bibliometry was first used by Pritchard (1969), and according to Guerras-Martin, Madhok, and Montoro-Sánchez (2014) it is a quantitative study that objectively analyses the scientific output. In short, it performs statistical analyses on a selected set of papers. It has become popular as it is currently to assemble a large sample of scientific articles is a straightforward task, and there are a number of bibliometric analysis softwares available. Corral et al.'s (2013) present many bibliometry applications, such as in citation analysis and in the assessment of research quality. They also discuss how it can be used to support research decision-making.

To select the sample for analysis, the the Web of ScienceTM database was chosen due to its global scope, its compatibility to many bibliometric analysis software programmes, its large journal portfolio, and the availability of relevant data, such as authors/editors, abstracts, addresses, titles, cited references, languages, number of times accessed, keywords, page counts, etc. In addition to its own catalogue, this database also indexes abstracts from associated catalogues, allowing users to locate articles in them as well.

To locate texts, the keywords used were derivations of the term “two sided markets”, such as “two-sided markets” and “two sided market”. The aim was to focus on the Economics literature, in which the term “market” is prevailing, at the expense of the strategy oriented literature, in which the term “platform” is predominant. . The search using the original expressions, conducted on March 12, 2016, was clearly sufficient, resulting in 245 articles.

The following filters were used: “all years”; research area: “economics and business”; and file type: “articles”.

Article titles and abstracts were read to select only those that addressed 2SMs or related topics as their central theme, and eight texts were excluded from the sample.

A descriptive statistical analysis was performed to analyse the distribution of publications by year, author, country, and number of citations, using the Sitkis software (Schildt, 2002). Co-citation and pattern analyses among countries, authors, words (title and abstracts), articles, and publication sources were also studied, using VOSviewer software (Waltman & Van Eck, 2013).

2.4 Analysis

2.4.1 Descriptive analysis

The first analysis was conducted to identify patterns of production over time, such as growth, decline, or stability in the number of publications. Although the first work addressing the subject dates back to the beginning of the 1990s, the number of publications started to grow in 2002-2003, and Rochet and Tirole (2003) can be considered one of the starting points for recent theory. From 2009, the number of publications has stabilised, and the next section compares two periods, growth and stability, as depicted in Figure 3. The number of cited papers and the main authors' citations are shown in Figure 3.

The number of cited articles and the number of citations per author are shown in Figure 4.

Cited texts are in excess of 4,400 articles, a much larger number than the selected dataset, which contains only 237 articles. The difference is due to cited articles published in business newspapers and magazines not included in the Web of Science™ database, such as Forbes Magazine, as well as from unpublished texts.

The prominent authors and their papers are: Rochet and Tirole (2003, 2006), Caillaud and Jullien (2003, 2006), and Armstrong (2006). Although those studies focus on competition between platforms, they are often cited because they establish basic theoretical constructs, such as platforms, pricing strategies, and indirect network externality influence. In 2006, Rochet and Tirole authored a piece that consolidated existing knowledge on 2SMs. It became one of the major theoretical cornerstones and one of the most cited works on the subject, accounting for over 100 citations in various journals.

The most cited articles are concentrated in a small number of journals, two journals stand out, each with citations in excess of 30, as shown in Figure 5.

As for geographical distribution of authors, two geographic centres can be defined: even though several of the pioneer texts are French, the US accounts for almost half of the texts, followed by Europe – Germany, France, England, and Italy. Similarly to the analysis of publications per year, in the next section we investigate whether there is any distinction between the publications of American origin and the publications from other countries.

Figure 5 – Articles and citations by journal

Figure 6 – Publications by country

2.4.2 Association Analysis

A set of association analyses was performed to determine repeating patterns regarding keywords, citations, sources, and other factors. It shows how texts use common references and how they are related and complement one another. Different analyses were performed concerning the number of citations, co-citations, articles as well as other factors. Three analyses were conducted on content source, keywords used and text co-citation. Each one was

divided into the following two categories: temporal segregation of the sample into two periods and geographic segregation, as follows.

- By period;
 - Growth – sub-sample associated with the period of growth in the number of articles, pre-2008;
 - Stability – sub-sample associated with the period of stability, post-2008.
- By geography;
 - US – sub-sample of the publications whose authors' affiliations are from the US;
 - Other countries – sub-sample of the publications whose authors' affiliations are from countries other than the US.

2.4.2.1 Source analysis

The main sources of scientific content and their most relevant groupings were also analysed. The results of the descriptive statistical analysis indicated two main journals in the field, namely, the Rand Journal of Economics - its website states that its scope covers the “behavior of regulated industries, the economic analysis of organizations, and more generally, applied microeconomics” (RJE, 2016), and the International Journal of Industrial Organization, which “aims at full coverage of theoretical and empirical questions in industrial organization” (IJIO, 2016) and editorial scope thus encompasses microeconomics and industrial organization. Journals' editorial scopes can be grouped into three themes, as identified in Figure 7 and Figure 8.

- Microeconomics: These journals focus on neoclassic microeconomics and discuss competition, pricing, supply, demand, network influence, and other issues associated with 2SMs.
- Regulation, management, and strategy: The texts of journals in this group also have an economic scope, but they discuss issues such as regulation, management, and platform strategy. Antitrust regulation is widely explored by the 2SM literature because, in several cases, there is concentration and platforms charge above marginal cost (Evans, 2003, 2011), which leads to numerous antitrust lawsuits against them.

- Media Advertising: The journals in this group include texts that in addition to economics also address advertising.

Journal network by period

In the analysis by period, we find the same three groups are present both in the “growth” and “stability” phases. It is interesting that the Rand Journal of Economics does not maintain its centrality in the “stability” phase.

Figure 7 – Association network between journals by period

Journal network by geography

Figure 8 – Association network between journals by geography

The same groupings can also be found in the geographical analysis. The main difference between the two samples is the presence of media advertising research in the US.

Analysis of keywords

The second analysis involved the association of keywords (Figure 9 and Figure 10), based on the analyses of texts, titles, and abstracts of the selected articles. To avoid irrelevant associations, a cut-off criterion of a minimum of five joint citations was applied.

The results indicate the existence of three major thematic groupings as follows.

- **Economic concepts:** This group includes theoretical work on 2SM concepts, such as network externalities, buyers, sellers and intermediaries behaviour, etc.
- **Payment schemes:** words in this group are related to payment schemes, particularly credit cards.
- **Media Advertising:** This group gathers words related to media advertising platforms. The key words in this group are advertising, content provider, and newspapers.

Keywords by period

Figure 9 – Association network of keywords by period

The analysis by period shows that the same three groupings are present in the “growth” and “stability” phases; the only change is in the density of the existing groups. However, a new theme emerges, namely, discussion regarding search engines such as Google.

Keywords by geography

Figure 10 – Association network of keywords by geography

In contrast with the previous analysis, in the geographical analysis we see differentiation among regions. The American keyword network shows only one group, advertising, while other words are very diffuse. In contrast, the “other countries” network shows clustered research, with the three well-defined groupings of advertising, payment schemes, and economic concepts. This may indicate North American literature on the subject is mainly focused on discussing network effects and platforms in the advertising business.

Thematic evolution of studies

Networks in Figure 9 and Figure 10 demonstrate the evolution and trends in 2SM studies, which is depicted in Figure 11. Theoretical foundations were established in the 1980s and 1990s, when network economics was developed. Subsequently, 2SM theory and concepts were discussed together with payment schemes studies, especially because, in the early 2000s, there was a surge in public lawsuits against credit cards, and 2SM theory was used as a basis for the defending arguments. Then, studies on the advertising sector, in which network effects are negative, were developed, and more recently, Internet search engines have been studied. The geographical analysis shows that most US studies have focused on advertising.

Figure 11 – Chronological evolution of the studies on 2SMs

The thematic evolution shows that, after concepts are established, they are successively applied to different research objects, and there is a life cycle in which the debate is exhausted for each object and then progresses to another one.

Co-citation analysis

This analysis reveals how the texts are linked with respect to their citations. As expected, texts that occupy the central nodes of the co-citations network are those that were previously identified as the most cited, specifically Rochet and Tirole (2003, 2006), Armstrong (2006), and Caillaud and Jullien (2003) (see Figure 12 and Figure 13). The co-citations network shows groupings very similar to those found in the keyword analysis. Texts can be sorted into four groups.

- Basic concepts: Texts that establish network economy concepts and constitute a basis for the development of 2SM theory
- Competition and strategy: Pioneer texts on 2SMs, which have defined fundamental concepts
- Payment schemes: Studies on payment platforms (credit cards, debt cards and online debt cards)
- Media Advertising: Studies using three research objects, namely, TV, magazine and newspaper advertising

The texts associated to “basic concepts” group are mostly dated from the 1980s and 1990s. Specifically, Katz and Shapiro's text (1985) is the foundation for most studies, as it explores the concept of network externality. Other texts have also been fundamental for theory development, such as Farrel and Saloner (1985) who discussed networks externalities associated to product compatibility, economies of scale and technology inertia from product standardization; Berry (1994), who studied the influence of product differentiation in price and utility; and Economides (1996) who analysed different networks associated to product compatibility and their influence in pricing and in the market equilibrium.

Co-citations network by period

The “growth” period has no clear clusters, while in the “stability” period has three thematic groups were developed. First, there is a central cluster containing basic concepts such as competition and strategy. It is a merger between two clusters identified in the keywords analysis, microeconomics, and regulation, management, and strategy. The remaining clusters, payment schemes and advertising, are the same as in the keyword analysis. Observe that the central cluster explore the networks effects of 2SM

comprehensively, while payment schemes is only associated with positive indirect network effects and advertising is associated in contrary form (negative).

Figure 12 – Textual association of the network by period

Co-citations network by geography

The North American source texts network is again well distributed, with no clear groupings, while the “other countries” network shows three clear groups, similar to those found in the “stability” period.

Figure 13 – Textual association of the network by geography

2.4.2.2 Consolidation of analyses

The overall results are summarised in Table 2.

Table 2 – Consolidation of analyses, segregations, and groupings

Analysis	Growth	Stability	USA	Other countries	General
Journals	<ul style="list-style-type: none"> • Economy • Economic perspectives, management and strategy 	<ul style="list-style-type: none"> • Economy • Economic perspectives, management and strategy 	<ul style="list-style-type: none"> • Economy • Advertising 	<ul style="list-style-type: none"> • Economy • Economic perspectives, management and strategy 	<ul style="list-style-type: none"> • Economy • Economic perspectives, management and strategy • Advertising
Keywords	<ul style="list-style-type: none"> • Economic concepts • Payment schemes • Advertising 	<ul style="list-style-type: none"> • Economic concepts • Payment schemes • Advertising 	<ul style="list-style-type: none"> • Economic concepts • Advertising 	<ul style="list-style-type: none"> • Economic concepts • Payment schemes • Advertising 	<ul style="list-style-type: none"> • Economic concepts • Payment schemes • Advertising
Chronology	1° Economic concepts 2° Payment schemes 3° Advertising	1° Economic concepts 2° Payment schemes 3° Advertising 4° Search engines	1° Economic concepts 2° Advertising	1° Payment schemes 2° Economic concepts 3° Advertising	1° Economic concepts 2° Payment schemes 3° Advertising 4° Search engines
Co-citation	<ul style="list-style-type: none"> • Competition and strategy • Basic concepts 	<ul style="list-style-type: none"> • Competition and strategy • Basic concepts • Payment schemes • Advertising 	<ul style="list-style-type: none"> • Competition and strategy • Basic concepts 	<ul style="list-style-type: none"> • Competition and strategy • Basic concepts • Payment schemes • Advertising 	<ul style="list-style-type: none"> • Competition and strategy • Basic concepts • Payment schemes • Advertising

The chronological development shows that the evolution of the studies did not suffer discontinuity, and in the stability phase, studies followed the same strands started in the growth phase. As for geography, interestingly, studies on payment schemes are concentrated in Europe, although major credit card issuers are based in the US and antitrust lawsuits were filed in that country. There is a clear concentration of studies in certain sectors, i.e., payment schemes and advertising, which opens the possibility for further research in other sectors. As for theory, despite its newness, concepts are well developed, and no open controversy was identified.

2.4.3 A review of the most cited texts

In addition to the bibliometric analysis, several of the main texts were analysed. The goal was to understand the arguments exposed by the authors of the most cited texts, specifically regarding theoretical foundations (basic concepts, competition, and strategy), payment schemes, and advertising. Appendix A contains a more comprehensive mapping of texts, including the main studies, their objects, key findings, and considerations.

2.4.3.1 Theoretical foundations

The co-citation network revealed a central grouping comprised of the following four texts: Rochet and Tirole (2003, 2006), Caillaud and Jullien (2003), and Armstrong (2006). They are the most cited texts in the 2SM literature. Katz and Shapiro (1985) is also a key text in the 2SM literature, and Anderson and Stephen (2005) is a fundamental reference text for articles that discuss advertising.

Katz and Shapiro (1985) studied markets with network externalities, one of the fundamental constructs of 2SM theory. It is cited by almost all main texts, such as Rochet and Tirole (2002, 2003, 2006), Armstrong (2006), Rysman (2004), Evans (2003), Anderson and Stephen (2005), Caillaud and Jullien (2001, 2003), Hagiu (2006), and Kaiser and Wright (2006), among others. Indirect network externality is the dominant concept in most studies, as it considers the effect of the number of agents on different sides of the market (Eisenmann et al., 2006).

There are also elaborations on different network externalities, as in for instance Rochet and Tirole (2006), who argue the existence of two network externalities in 2SMs, one by “subscription” and the other by “use”. This idea is disputed by Ronson (2005), who states that there is only one such externality, and the author explain that Rochet and Tirole (2006) have explored only two methods of revenue generation.

Caillaud and Jullien (2003) are frequently cited for having introduced the discussion on the precedence of sellers or buyers in joining the platform, which poses the “chicken and egg” question in the 2SM debate. Ultimately, each business model has its specific features, and therefore, the order in which agents adhere to the platform varies. For example, Muzzelec et al. (2015) state that in Internet-based business models, users have to be attracted first so that both sellers and investors can be attracted thereafter. In contrast, in the case of shopping centres, vendors have to be attracted first to define store portfolio and physical structure that will later attract customers.

Armstrong (2006) is also among the most cited texts. He discusses pricing and competition in 2SMs. His conclusions consider that price equilibrium depends primarily on three factors, namely, the magnitude of indirect network externality; the method of fee charging, either by subscriptions or transactions; and whether multihoming is possible. First, the bigger the indirect network externality magnitude, the greater prices will be, due to the monopolistic power exerted by the platform (Caillaud & Jullien, 2003). Second, there are two

fee charging methods, by transaction or subscription, and according to Armstrong (2006) utility is lower when transactions are the basis for fee charging. Third, on the one hand, the strongest is the multihoming behaviour, the lower prices will be, and on the other hand, the existence of multihoming increases the platform's user utility.

2.4.3.2 Literature on payment schemes

Payment schemes, such as debit and credit cards, and online payments systems, are a major theme in the 2SM literature. The most important texts related to this topic are Rochet and Tirole (2002), Evans (2003), and Wright (2004).

The discussion on payment schemes was instrumental for the consolidation of the 2SM concept. Its origin is attributed to the debate on the fairness of the fees charged by payment networks to merchants and whether networks violated antitrust laws. Evans (2003) explores payment systems and antitrust laws, and Rochet and Tirole (2002) discuss cooperation among banks to create payment networks, network access fees, the balance of power between payment networks and merchants, and the implications for welfare on both sides.

In his study, Wright (2004) identifies the errors derived from analysing a 2SM as a one-sided market. He lists eight fallacies that arise when such a misguided approach is used. In fact, both Evans (2003) and Wright (2004) argue that the lack of knowledge regarding 2SMs can be very problematic in policy-making, i.e., when only one side is taken into account. If only the subsidized side is analysed, it may lead to the conclusion that platforms are using a dumping strategy, and when only the overcharged side is considered, the small number of platforms and the premium over marginal costs they charge can be interpreted as cartel formation.

2.4.3.3 Literature on advertising

Business models based on advertising are unique among 2SM models because they have negative indirect network externalities (Evans, 2003). The negative effect arises because of the relationship between advertisement and customer satisfaction: in a media channel (television channels, magazines, newspapers, and websites for example), generally the greater the amount of publicity, the less satisfied the audience (Anderson & Stephen, 2005).

Three main papers can be identified in the advertising-related literature, namely, Anderson and Stephen (2005), Kaiser and Wright (2006), and Peitz and Valletti (2008). Anderson and Stephen (2005) discuss the effect of advertisement amount across several media and the welfare of both sides of the platform. They conclude that despite the negative effects of publicity for one side, there is no clear optimum amount of advertisement. Thus, platforms experience a revenue generation dilemma, as their earnings increase with advertisement, but at the same time, the audience is discouraged. On the other hand, reducing advertising increases audience but decreases revenues. Therefore, the advertising market illustrates the difficult task platforms face in a 2SM with negative indirect externalities to keep both sides on board.

Kaiser and Wright (2006) argue that magazines have two-sided platform properties. Their results show that readers are the subsidised side of the platform, while advertisers are the revenue source, and the greater the number of readers, the greater the amount charged to advertisers. Thus, even when readers pay for magazines, price does not necessarily result in profit. On the other hand, to access readers, advertisers pay beyond marginal cost and generate revenue and profits.

Peitz and Valletti (2008) explore the differences between subscription and free-to-air TV platforms. In their study, the authors analyse viewers welfare associated with the content provided by both TV systems. As a general conclusion, they observed that free-to-air TV has a bigger audience, as their content is directed to the general public; while subscription TV has a smaller number of viewers, as they reach for specific audiences. Due to the difference in viewer numbers, revenues also are different. In the case of free-to-air TV, the bigger the number of viewers, the larger the incentive to advertisers pay extra money, which compensates subsidizing viewers. In the case of subscription TVs, the specific content offered by platforms incentivises viewers to pay for it, while for advertisers, the smaller number of users lead them to pay less, thus, subscription TV compensates its smaller audience with two revenue streams, as opposed to the single revenue stream in free-to-air TV.

2.4.4 Consolidation of analyses

Descriptive statistics and keyword and co-citation networks provide a general understanding of the evolution and current foci of 2SM studies.

Theory development occurred concurrently to its application in specific industries, as exemplified by the conceptual review of Rochet and Tirole (2006) and discussion of credit card dynamics in Rysman (2007). The credit card system was instrumental in the early stage of discussion, as it encompasses all relevant aspects of a 2SM: two distinct parts must interact via a platform; two revenue flows are originated from the agents who use the platform; the larger the number of merchants (customers) on one side of the platform, the larger the benefit to customers (merchants) on the other side, which illustrates a positive network effect; finally, credit cards subsidize one side of the market, and collect revenues from the other (Rochet & Tirole, 2002).

However, although several authors, such as Eisenmann and Van Alstyne (2011), Rochet and Tirole (2003), Hagiu (2009), and Armstrong (2006), among others, have noted that many sectors are structured as a 2SM, the literature has mainly focused on only two economic activities, payment schemes and advertising, as illustrated in Table 2, that could be considered as a guide for future researches. More recently, a trend was identified with respect to studying new business models based on information technology.

The analysis of time periods indicates that there is a stable and continuous discussion regarding theoretical concepts. Regarding the geographical distribution, American studies have focused on economic concepts and on the advertising industry, showing a more general discussion regarding theory and a more focused approach regarding industries, as opposed to the European output.

2.4.5 Relevant missing points

There are still poorly explored themes in the literature. Among them, one can cite: platform lifecycle, influence of platform quality on user's choice, and technology development effect on platforms. Although there are some works on those themes, there is room for further theoretical development.

2.4.5.1 Platform lifecycle

As the literature mainly explores 2SM equilibrium state, there is not much on its dynamic or evolutionary aspects. There are a few papers that discuss platform lifecycle in the literature: Muzzelec et al. (2015), Evans and Schmalensee (2010) and Hagiu (2006), who

discuss internet-related businesses. They explore platform lifecycle stages, and the need to reach critical mass, which measures platform success. Specifically, Evans and Schmalensee (2010) points that the issue of critical mass related to multi-sided platforms has not yet been systematically studied in the literature.

Platform lifecycle is a relevant issue because, over time, market demand and customer requirements evolve, and firms may have to change their value propositions and business models. Firms can also change their competitive strategies, which also can lead to business model evolution. Also, the 2SM consolidation trend and multihoming effects pose different risk levels over the platform lifecycle, and thus, entry time is a relevant issue. Those aspects can be further explored by future research.

2.4.5.2 Quality effects in 2SM

As well as platform lifecycle, few papers discuss the effect of platform quality on user's choice. Platform quality is related to specific characteristics or features, that distinguish it from others. For example, Stremersch et al (2007) studied the effect of software quality vis-à-vis quantity in the videogame market. Evans and Schmalensee (2010) shows that the distribution of preferences, which is related to quality, influences the size of the platform network, which in turn dictates its success. The effect of user preferences on network size is also studied by authors who discuss the influence of TV channels content, which is directly associated to perceived quality by users (e.g. Gabszewics, 2004; Wilbur, 2008).

In the videogame market quality has been studied in two different ways, one associated to software and the other to hardware. The first subject has been more explored by researchers, as it involves cross network externalities with indirect effects. Studies that explored platform (in that case, game consoles) quality effects, understood that direct effects are less relevant than indirect ones, and thus, user choice is more associated to software availability than hardware features (Binken & Stremersch, 2009; Kim et al., 2014).

Videogame and advertising markets present different network externality characteristics, but in both cases, platform quality influences the user's choice. There is only a small number of papers that discuss this issue, and in most cases, authors assume that user's choice is mainly based on network effects (e.g. Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Doganoglu & Wright, 2005). However, network size is not always the main factor in user's choice: platform and platform user quality, as exemplified by the videogame market

also plays an important role (Binken & Stremersch, 2009; Kim et al., 2014). Weyl (2010) also explores the relevance of quality users, discussing the paradigm “quantity x quality” through price theory for multi-sided platforms.

2.4.5.3 Influence of technology development on two-sided platforms business models

Authors such as Rochet (2002), Kaiser and Wright (2006), Peitz and Valletti (2008) etc., explored the equilibrium state of industries such as advertisement, payments schemes, videogames etc. However, with technology development, and especially the Internet, platform value propositions and business models have changed significantly (Cramps et al., 2009, Muzzelec et al., 2015).

For example, in the videogame industry, internet access has improved best software identification by players, who have access to top charts and user rating systems. It has changed distribution: from physical support to online sales and distribution. Internet has also expanded the players' interaction to the global level, as one can play together to anybody in the world. Marchand and Henning-Thurau (2009) portray the evolution of the videogame business, proposing a framework to evaluate how value creation has changed over time, but there are several significant effects that have not yet been explored by the literature, such as the expansion of direct and indirect network externalities, the influence of quality on the consumption of primary goods, and the influence of technology development on platform consolidation.

2.5 *Conclusions*

This study analyzed the evolution of the 2SM literature and identified key texts and industry segments using bibliometry. The descriptive analysis provided an understanding of the evolution of research and its current status. It was essential to identify different perspectives to analyse keyword and co-citation networks considering period and geography factors.

The keyword and co-citation analysis helped to identify the theoretical cornerstones and the main themes and texts on this issue. The results suggest that 2SM theory has a unified framework of reference. In addition, results show that research to date has mostly focused on two sectors, payment schemes and advertising, although the theory can be applied to several

other activities, which provides a clear opportunity for new studies. In that respect, new studies focusing on Internet-based businesses, such as search engines, represent a favourable sign.

The limitations of this analysis are related to the use of a single database, the ISI Web of Science, and future work exploring other databases are thus required to corroborate its findings. However, as the sample is composed of more than two hundred articles, which cite more than four thousand distinct references, it provides a clear picture of existing research on 2SM.

The paper focus was on two-sided market concept , which is considered as an economic concept. However, there are other related platform concepts, not studied, that could expand the theoretical contribution of this work, such as business platform, multi-sided platforms, platform leadership, platform ecosystems, industry platforms etc.

2SM theory can still be applied to several industries, particularly those related to mobile services. New work could be conducted based in the section “missing points”, where was emphasised some points that were poorly explored in the previous literature and wasn’t recognized in this bibliometric study.

This paper attempted to provide an overview and a map to assist current and future 2SM researchers and expects to help them to quickly identify the theoretical bases and to identify numerous untapped research opportunities in the 2SM literature.

3 THE COMBINED EFFECT OF QUALITY AND EXCLUSIVITY IN TWO-SIDED MARKETS: AN EMPIRICAL ASSESSMENT IN THE VIDEO GAME INDUSTRY

Marcelo Makoto Higuchi, B.Sc. in Mechanical Engineering and M.Sc. Candidate in Production Engineering – Economics of Production and Financial Engineering, Post-graduate Program in Production Engineering – University of São Paulo, Brazil, Av. Prof. Almeida Prado, 128, 05508-070, São Paulo, SP, Brazil, +55 (11) 5525-5868, marcelo.higuchi@usp.br and marcelo.m.higuchi@gmail.com

Davi Nakano, D. Eng., Professor at Escola Politecnica, University of São Paulo Production Engineering Department, Av. Prof. Almeida Prado, 128, 05508-070, São Paulo, SP, Brazil, +55 (11) 30915363 – 423, dnnakano@usp.br

Manuscript submitted to the Journal of Marketing

ABSTRACT

In a two sided market (2SM), platform performance is affected by the size of the network and by the participants' behavior, if they are allowed and engage in *multihoming*, i.e., using more than one platform to access the other side of the market. Also, in some 2SM, platforms and network products are complementary, and thus product quality also affects platform performance. This is the case of the video game market: players (buyers) and game developers (sellers) are connected by platforms (consoles); and consoles and games are complementary. Previous research has discussed the influence of game quality or exclusivity in console sales, but few have studied them simultaneously, and this study analyzes their concurrent influence. Results indicate that quality has a predominant effect over exclusivity, and different combinations have positive or negative effects on console sales. Findings add to previous studies and point to further studies to identify characteristics that influence indirect network externalities associated with two-sided platforms.

KEYWORDS: video game market, simultaneous effect, two-sided markets, quality, *multihoming*

3.1 Introduction

A two-sided market (2SM) is composed of one or more platforms that mediate interaction between producers and buyers, and to keep transactional continuity, they charge fees on each party (Rochet & Tirole, 2006). The literature on 2SM has considered, for many years, that the indirect network effect was primarily associated to network size (Clements & Ohashi, 2004; Corts & Lederman, 2009; Shankar & Bayus, 2003; Stremersch et al., 2007). However, recent studies (Binken & Stremersch, 2009; Kim, Prince, & Qiu, 2014; Landsman & Stremersch, 2011) have shown that participants' characteristics and behaviors have also a significant influence on network effect.

Platform competition and network characteristics have been studied in markets such as television advertising (Choi, 2006; Peitz & Valletti 2008), videogames (Dube, 2004; Landsman & Stremersch, 2011; Shankar & Bayus, 2003), payment schemes (Rochet et al., 2002; Wright, 2003), software (Brynjolfsson & Kemerer, 1996; Gallagher & Wang, 2002). In the videogame market, Kim et. al (2014) analyzed the relevance of game quality (a characteristic) and Landsman and Stremersch (2011) studied the impact of *multihoming* (a behavior) on the indirect network effects.

However, research on the simultaneous effect of members' characteristics and behavior on network effects and, consequently, on platform performance, is scarce. Binken and Stremersch (2009) evaluated independently the influence of exclusive and non-exclusive game titles with different levels of quality on console sales. Kim et. al (2014) performed a similar analysis to assess game quality influence on indirect network effects. However, both studies did not evaluated the concurrent effect of quality and behavior. Also, Binken and Stremersch (2009) analysis was based on a restricted timeframe, right after game launch, and not on the entire games catalog, as it would be expect in the network literature, and Kim et. al (2014) focused mainly on the indirect network effects and not on their influence on platform performance (i.e., console sales).

This paper aims to contribute to fill this gap, it evaluates the simultaneous effect of quality and exclusivity of one side of the network on platform performance: more specifically, the simultaneous effect of quality and exclusivity of game titles on console sales. Results indicate that different combinations of quality and exclusivity can have either positive or negative effect on console sales, and that quality impact is greater than exclusivity on

console sales, which depart its results from what was found by Binken and Stremersch (2009), who did not observe significant difference.

This article is organized into five sections: (2) a literature review of two-sided market theory and quality and *multihoming* effects on video game market; (3) data collection and treatment; (4) the model and its variables; (5) the estimation results; and (6) finally, research findings and limitations, and also new avenues for futures research.

3.2 *Platforms, Network effects and Video games*

2SMs are composed by one or more platforms that connect and assure transaction continuity between two networks: consumers and vendors (Evans, 2003; Hagiu, 2006; Rochet & Tirole 2003). Their distinctive characteristic is the presence of indirect network effects, i.e., one side of the platform influences the participant's utility on the other side (Rochet & Tirole, 2003). Although research on 2SM and platforms is recent, there is already a well developed literature on network externalities, installed base and compatibility (Farrell & Saloner, 1986; Katz, 1985), platform competition (Caillaud & Jullien, 2003; Rochet & Tirole, 2003), *multihoming* (Armstrong & Wright, 2007; Carrillo & Tan, 2006; Doganoglu & Wright, 2006), pricing (Hagiu, 2006; Weyl, 2010), platform and agent differentiation (Kim et al., 2014; Peitz & Valletti, 2008), platform strategies (Eisenmann, Parker, & Van Alstyne, 2006), among others.

The videogame market is an example of a 2SM: consoles (and their producers) are platforms (e.g., Sony Playstation3, Microsoft Xbox One, Nintendo Wii-U etc.) that connect consumers (game players) to vendors (game developers) (Evans, 2003; Hagiu, 2006; Rochet & Tirole, 2003). It presents a typical 2SM strategy: one side (players) is subsidized, while the other side (game developers) is charged beyond marginal cost, they pay royalties to platforms, according to game sales (Rochet & Tirole, 2003; Rysman, 2009).

Consoles and video game titles are complementary products, sales of the first are affected by launch and sales of the second (Farrell & Saloner, 1986; Katz & Shapiro, 1985; Chou & Shy, 1990; Clements & Ohashi, 2004; Gandal, Kende, & Rob, 2000). Thus, video game platforms have to attract game players to incentive developers to produce new games, and they need game titles to engage more players to its network (Rochet & Tirole, 2006). Specifically, it is the number of available game titles, and not the number of developers or sold games, that benefits consoles players (Binken & Stremersch, 2009).

The literature indicates that the number of available titles (i.e., the network size) can be used to measure the magnitude of indirect network externality (e.g., Clements & Ohashi, 2004; Corts & Lederman, 2009); but research has also shown that it is underestimated when there are no distinction between game titles. For example, Binken and Stremersch (2009) and Kim et al. (2014) found that console sales are more strongly associated to the launch of a few top games than to the total number of titles released (the effect of game characteristics will be discussed in details in the next topic).

Platform success is also influenced by the strength of its network: the intensity of the connection between the platform and its consumers, who develop product loyalty and may share common personal interests or demographic characteristics with other members. For example, Shankar and Bayus (2003) studied competition between Nintendo and Sega 16-bits console sales from January 1993 to August 1995. They showed that despite the fact that Nintendo's player network was smaller than Sega's, it managed to surpass the second in gross profits thanks to its greater network strength. Another example is the loyalty that Apple products enjoy from their customers. Thus, network strength can be understood as a strategic resource that is difficult to imitate, which creates a link between clients and the company, assuring a captive consumers base (Barney, 1991; Wernerfelt, 1984).

3.3 Quality and Multihoming effects on platform sales

Video game sales distribution is concentrated on a few highly popular titles, and thus, there has been found a distinction between game titles influence on network effects and console sales. Those high selling games are called Superstar Software (Binken & Stremersch, 2009), killer games, or triple A games (Cadin & Guerin, 2006; Shankar & Bayus, 2003) and they have a high level of perceived quality and user acceptance, leading to high revenues and return on investment (Rosen, 1981).

As complementary goods, there is a positive correlation between games and console sales (Chou & Shy, 1990; Clements & Ohashi, 2004; Gandal, Kende, & Rob 2000), and it is expected that high quality (popular) games result in more console sales than low quality ones (Frels, Shervani, & Srivastava 2003). However there is not much empirical research that explore this fact: Binken and Stremersch (2009) studied the U.S. home video game market from 1993 to 2004 and found that the introduction of high quality games may have large effect on console sales, and that it overcomes the network size effect; and Kim et al. (2014) found that indirect network effects are underestimated if agent differentiation is not

considered. They evaluated the 7th generation video game consoles market in the United States, and observed that indirect network effects are approximately 30% underestimated when only aggregate game numbers are considered, i.e., without differentiating game quality.

Multihoming refers to the user behavior of accessing the other side of the market through more than one platform (Armstrong, 2006; Rochet & Tirole, 2003). Singlehoming refers to the use of only one platform to access the opposite side, while in *multihoming*, the user employs more than one platform (Landsman & Stremersch, 2011). In this paper, *multihoming* exists when game titles are available for more than one console, which allows players to avoid the lock-in effect to a single platform. According to Landsman and Stremersch (2011) *multihoming* decisions may substantially affect game developers and platforms profit.

There are benefits and risks associated with the *multihoming* strategy. Singlehoming (exclusivity) can promote superior gains for both buyers and sellers under specific market conditions, e.g., exclusive contracts may allow higher prices and profits for sellers and reduce signature costs and complexity for buyers (Armstrong & Wright, 2007). However it can be inefficient for established companies to gain more market share, while a *multihoming* strategy can help a firm to dominate the market, as it can lead to both an increase in its customer base and to the creation of entry barriers (Doganoglu & Wright, 2010).

Game platforms use two strategies associated to exclusivity: (1) high quality, top-selling games, tend to be exclusive; and (2) less relevant titles tend to be offered in more than one platform, which allows players to enjoy the benefits of non-exclusivity, avoiding the lock-in effect to a single platform (Eisenmann & Van Alstyne, 2006; Landsman & Stremersch, 2011; Shapiro, 1999).

There are two analytical models in the literature for *multihoming* (Landsman & Stremersch, 2011). The first model examines market equilibrium in the possibility of *multihoming* without exclusivity contracts (Armstrong, 2006; Caillaud & Jullien, 2003; Doganoglu & Wright, 2006; Rochet & Tirole, 2003, 2006), while the second examines equilibrium when a platform demands exclusivity contracts to grant access to its network (Armstrong & Wright, 2007; Doganoglu & Wright, 2010; Mantena Sankaranarayanan & Viswanathan, 2007; Shapiro, 1999). The first is relevant to understand seller's choice for a specific platform. The second is important to understand the platform competition when sellers may opt to single or multihome.

Few studies analyzed the simultaneous effect of quality and exclusivity on console sales. Binken and Stremersch (2009) studied game quality effect on console sales in two cases: exclusive and non-exclusive titles, and concluded that there was not difference between them. However, in a later study, Landsman and Stremersh (2011) observed a negative effect of non-exclusive (*multihoming*) games on console sales, which was more pronounced in the first years of a console life, decreasing over time. Therefore, extant literature is inconclusive about the simultaneous effect of quality and *multihoming* on console sales.

Also, Binken and Stremersch (2009) only evaluated the influence of game quality during few months after the game release. However, as a title remains in the vendors' catalog and there might be a cumulative influence on the growth of players' installed base, as it is expected in the network literature, which they acknowledge as a limitation of their study. The choice for one platform should be influenced by cumulative number of game titles launched.

From the extant literature, four assumptions can be made on game titles characteristics and behavior impact on console performance (Binken & Stremersch, 2009; Kim, Prince, & Qiu, 2014; Landsman & Stremersch, 2011; Stremersch et al., 2007):

1. High quality games have a positive and strong effect on console sales, i.e., the introduction of a high quality game induces greater console sales;
2. Low quality games have a positive and weak effect on console sales, which is associated to the game installed base, i.e., the more game titles available, the better the platform sales, even for low quality games;
3. Non-exclusive (*multihoming*) games have a negative effect on console sales, as they allow users to play them in more than one on their already owned platform;
4. Exclusive games have a positive effect on console sales, i.e., exclusivity drives up console sales as they demand a specific console to be played.

However, there is no findings in the literature about the combination of the points presented above. Thus, there are four research hypotheses that can be drawn (also depicted in Figure 14):

- H1: Exclusivity (+) and high quality (+) reinforce each other and have a positive effect on console sales;
- H2: High quality (+) overcome non-exclusivity (-) and thus their combined effect is positive on console sales;
- H3: Exclusivity (+) and low quality (+) reinforce each other and have a positive effect on console sales;

- H4: Non-exclusivity (-) overcome low quality (+) and thus their combined effect is negative on console sales.

Hypotheses H1 and H2 are straightforward and totally supported by the literature. Hypothesis H2 considers that the strong effect of quality on console sales is bigger than the negative effect of non-exclusivity. Hypothesis H4 considers that the *multihoming* negative effect is bigger than the weak effect of low quality games on console sales.

Figure 14 – Quality and Multihome Effects

3.4 Data: collection and processing

A unique database was created for this study, using data collected from different sources. Console sales, total number of games sold and best-selling titles numbers were collected from the VGZcharts website. Data on global console sales are reported weekly and were collected from 05/12/2004 to 08/07/16. Data on released titles for each console (release dates, critic scores, player scores, etc.) were collected from Moby Games website. Monthly figures for 10 consoles and 20,421 titles were gathered. Consoles prices were collected from Arstechnica website, and were adjusted for US inflation. Annual prices are available from 1977 to 2014, for 30 consoles.

As the purpose of this study is to compare sales for different consoles, the 7th generation of consoles was considered as the most suitable. The 7th generation consoles are: Nintendo Wii, Microsoft Xbox 360 and Sony PlayStation 3, all of them were launched in the mid-2000s.

As each source provides data on a different basis, numbers were treated and standardized. Data was adjusted to a common timeframe, following the format of console sales data, i.e., all figures were adjusted to a weekly format. For instance, price data was considered constant throughout all year weeks, as only annual numbers were available. Also, all game titles launch dates were aligned with console sales dates

For game quality², some further considerations were made. There is not a common definition on video game quality neither in the literature nor in the market. Sales volume and expert opinion have been the most frequent metrics. For example, Cadin and Guerin (2006) considered a quantitative metric based on game sales to determine the game quality. For expert opinion, Binken and Stremersch (2009) developed a heuristic, which was validated by experts from the marketing division of one company; Kim et al. (2014) used expert opinion from a website (Metacritic) as the quality measure.

However, the expert opinion not necessarily represents players' opinions. For example, in the cinema industry, some movies received negative expert reviews (e.g. the Rotten Tomatoes score), and had very good box office sales (e.g. "Batman vs. Superman: Dawn of Justice" and "The Da Vinci Code").

Marketing expenditures could explain that paradox. For example, Forbes magazine estimated that approximately US\$ 150 million was spent on promotion for Batman vs. Superman, about 36% of the entire budget of the movie. Marketing expenditures may have a relevant role on sales in the most diverse businesses. Shankar and Bayus (2003) showed how advertising plays a fundamental role on console sales.

To previously analyze whether quality is correlated to sales, and to investigate which metric should be used, a correlation analyses were performed between expert scores, player scores – another possible quality measure – and game sales, using data available on VGZCharts and Moby Games. Low correlations were observed among the three analyzed variables: (1) experts and player scores – 0.29; (2) experts scores and game sales – -0.08; (3)

² There are other ways to assess quality, such as game budget, but this kind of information generally is not available as public information

and player scores and game sales – 0.00. That indicated that player and expert scores, in fact, do not always represent the game quality and thus the return on sales.

Considering this discrepancy, a quantitative metric, based on game sales was used to segregate high and low quality games. According to Cadin and Guerin (2006) one million of unit sales could distinguish one low from one high quality game. Thus, two game samples were assembled: high quality games – the ones with sales in excess of one million copies; and low quality ones – sales below the stipulated metric. As result, 324 high quality games were identified on a total of 7.073, considering only the 7th generation of video game consoles.

Additionally, the segregation of exclusive and non-exclusive game titles for each console of the chosen sample was performed. Figure 15 below illustrates the *multihoming* levels of each platform analyzed. Some interesting characteristics related to the consoles exclusivity, can be observed: Nintendo has the lowest *multihoming* level, which can be related to its motion control technology; while Xbox 360 and PlayStation 3 present greater *multihoming* level, as they presented similar technical characteristics.

Figure 15 – Overview of exclusive and non-exclusive games

Figure 16, Figure 17, Figure 18 and Figure 19 depict the growth of games catalog, considering the four different segregations considered in this paper hypotheses.

Figure 16 – Superstar-Singlehome Games accumulated

Figure 17 – Superstar-Multihome Games accumulated

Figure 18 – Non-superstar-Multihome Games accumulated

Figure 19 – Non-superstar-Singlehome Games accumulated

3.5 Empirical model definition

A dynamic data model, based on (Binken & Stremersch, 2009; Clements & Ohashi, 2004; Landsman & Stremersch, 2011). was used to evaluate the hypotheses. To adjust for scale, logarithms were applied when necessary, also following previous literature (e.g., Basu, Mazumdar, & Raj, 2003; Dranove & Gandal, 2003).

The model is:

$$\begin{aligned} \ln H_t^S = & \alpha_0 + \alpha_1 \ln H_{t-52}^S + \alpha_2 H_t^P + \alpha_3 \ln S_{t-4}^{SS,SH} + \alpha_4 \ln S_{t-4}^{SS,MH} + \alpha_5 \ln S_{t-4}^{NS,SH} \\ & + \alpha_6 \ln S_{t-4}^{NS,MH} + \alpha_7 Dec_t + \alpha_8 Age_t + \alpha_9 Launch_t + \alpha_{10} PS3_t + \alpha_{11} Wii_t \\ & + \alpha_{12} Xbox360_t \end{aligned}$$

It is possible to segregate the model variables into ones with direct and indirect effects. Direct effects are associated with the console's own installed base of players (buyer side). In turn, the indirect effects are associated with the number of games released, representing the side of game developers (vendors).

3.5.1 Direct network externality

The fixed variable α_0 captures the heterogeneity of each console and it is time independent. The variable H_{t-52}^S denotes the players installed base in a “t-52” week to a given console, and it influences positively on the purchase of new consoles. The choice of the consoles’ installed base with an offset of 52 delayed weeks is based on the research of Kim et al. (2014).

The consoles’ price in a week “t” are given by the variable H_t^P , that negatively influences the purchase of new consoles, as exposed in by Binken and Stremersch (2009). It should be noted that pricing strategies can play as key role on console sales, as it’s in most of 2SM (Armstrong, 2006).

3.5.2 Indirect network externality

The variable $S_t^{SS,SH}$ represents the accumulated number of titles launched until period “t”, characterized by high quality and exclusivity. The catalog of games characterized by high

quality and non-exclusivity (*multihoming*) until period “t”, is represented by the variable $S_t^{SS,MH}$.

Variable $S_t^{NS,SH}$ represents the number of game titles launched until period “t”, considered as normal and exclusive. Finally, the catalog of games with normal quality and that do *multihoming*, until the period “t”, is represented by the variable $S_t^{NS,MH}$.

Control variables are: December sales (Dec_t), a variable associated to the game launches ($Launch_t$) and others representing each of the consoles evaluated ($PS3_t$, Wii_t and $Xbox360_t$).

3.6 Results

First, the isolated effects related to exclusivity and quality on game sales were investigated by two models. They fit the data very well ($R^2 > 0.75$). In addition, the simple segregation of two variables for each effect showed both expected and unexpected results. As expected, quality and exclusivity had a positive influence on console sales. However, unexpectedly, non-exclusivity (*multihoming*) did not yielded significant results, and lower quality games had a slightly greater influence on console sales than high quality games.

The main research model that considers simultaneously quality and exclusivity, presented a good adjustment, as expected. The model was built based on previous literature, and contains a large number of significant variables that affect the console sales ($R^2 = 0.78$). The estimated results of the console sales equation can be found in Table 3.

H1 was confirmed, the variable associated with an exclusive and high quality game has a positive effect on console sales ($\alpha_3 = 1.34E + 03$, $p \sim 0$). A low-quality and exclusive game also has a slightly weaker positive effect, ($\alpha_5 = 1.28E + 03$, $p \sim 0$) on console sales than a high quality game, validating H3.

H2 and H4 were also validated. The positive effect of high quality offsets the negative effect of *multihoming*, non-exclusivity and high quality games have a positive effect on console sales ($\alpha_4 = 6.70E + 02$, $p \sim 0$), while non-exclusive and low quality games have a negative effect on console sales ($\alpha_6 = -9.63E + 02$, $p \sim 0$), showing the expected predominance of the *multihoming* effect, which confirms H4.

Figure 20 shows that differences between variables related to exclusivity is minimal, i.e., the effect of high quality games on exclusive games is not pronounced. On the other hand, for non-exclusive games, the relevance of quality is pronounced, and non-exclusive and

low quality games actually have negative effects on console sales, while high quality and non-exclusive games have a positive effect.

Figure 20 – Ranges of quality & exclusivity variables

As for variables, the customer base, which represents the direct network externality, affects the console sales, having a positive and statistically significant effect ($\alpha_1 = 3.13E-08$, $p \sim 0$), following Shankar and Bayus (2003) findings. Price, although significant, has practically no effect on console sales ($\alpha_2 = 5.62E-03$, $p \sim 0$), similarly to results found by Binken and Stremersch (2009), but with a opposite signal.

Only some of the control variables used in the model are significant, such as the December and game launch variables, which is aligned with what was found in the literature (e.g., Binken & Stremersch, 2009; Kim et al., 2014; Landsman & Stremersch, 2011). Console variables are not significant except for the one associated to PlayStation 3, which is also similar to that one found by (Landsman & Stremersch, 2011).

Hardware Sales Equation - All Consoles				All Consoles - Exclusivity		All Consoles - Quality				
Variable	Symbol	Coefficient	Std. Error	Pr(> t)	Coefficient	Std. Error	Pr(> t)	Coefficient	Std. Error	Pr(> t)
(Intercept)	α_0	4,12E+00	6,40E-01	***	3,90E+00	5,31E-01	***	3,82E+00	6,51E-01	***
H_descloc	α_1	3,13E-08	4,10E-09	***	1,76E-08	3,34E-09	***	3,13E-08	3,12E-09	***
Price	α_2	5,62E-03	7,74E-04	***	3,33E-03	6,51E-04	***	3,22E-03	7,11E-04	***
SS.SH	α_3	1,34E+00	1,69E-01	***						
SS.MH	α_4	6,70E-01	1,31E-01	***						
NS.SH	α_5	1,28E+00	1,62E-01	***						
NS.MH	α_6	-9,63E-01	1,58E-01	***						
Dec	α_7	1,29E+00	5,13E-02	***	1,36E+00	4,96E-02	***	1,37E+00	5,10E-02	***
Age	α_8	-1,40E-02	4,19E-04	***	-1,38E-02	4,26E-04	***	-1,39E-02	4,29E-04	***
Launch	α_9	1,16E-02	1,02E-03	***	1,28E-02	1,03E-03	***	1,14E-02	1,04E-03	***
PS3	α_{10}	7,66E-01	1,34E-01	***	-1,95E-02	5,97E-02		1,65E-01	5,75E-02	**
Wii	α_{11}	1,06E-01	2,13E-01		-9,16E-01	1,43E-01	***	-5,04E-02	1,26E-01	
Xbox360	α_{12}	NA	NA		NA	NA		NA	NA	
MH					1,05E-02	5,16E-02				
SH					9,81E-01	8,15E-02	***			
SS								3,01E-01	9,04E-02	***
NS								5,50E-01	8,00E-02	***
R ²		0,7808			0,7712			0,7686		
p-value		<2.2e-16			<2.2e-16			<2.2e-16		

Table 3 – Estimation Results

* $p < 0.01$.** $p < 0.001$.*** $p \sim 0$.

3.7 Robustness

The model robustness was evaluated using different combinations of the data sample. The sub samples considered are the following: "Wii and Xbox 360", "Wii and PlayStation 3", "Xbox360 and PlayStation 3", "Wii", "Xbox360" and "PlayStation 3". Therefore, six tests were run to verify the model robustness.

The two console sub samples presented similar results to the original model, as can be observed in Table 4. Indirect network externalities effects, associated with the game catalog breakdown, have similar results in almost all models evaluated, supporting the results of the of the main model.

Direct network externality effects, associated with the customer base, has a positive effect on console sales and the price effect on console sales is insignificant. Additionally, the control variables presented similar effects as observed in the main model. The table (Table 4) below illustrates the results of the robustness analysis of the model.

Unlike the previously analyses, the test with a single console presented some unexpected results. Those findings are probably related to the particularities of each console network. For example it was expected that exclusive and high quality games (H1) should presents a more pronounced positive effect than non-exclusive and high quality games (H2), however, this fact was not true for all analyses. There are greater standard deviation in those variables than it was observed in other previous analyses, with more than one console, which could explain those unexpected results. The results of these analyses are found in Appendix A.

Table 4 – Robustness test of two consoles

Hardware Sales Equation		PS3 and Xbox 360		PS3 and Wii		Xbox 360 and Wii	
Variable	Symbol	Coefficien	Std. Error Pr(> t)	Coefficien	Std. Error Pr(> t)	Coefficien	Std. Error Pr(> t)
(Intercept)	α_0	6,20E+00	1,16E+00 ***	9,56E+00	1,82E+00 ***	6,28E+00	1,01E+00 ***
H_desloc	α_1	2,72E-08	4,70E-09 ***	-5,62E-01	1,44E-01 ***	4,02E-08	5,74E-09 ***
Price	α_2	5,25E-03	8,37E-04 ***	3,87E-03	1,19E-03 **	5,14E-03	1,04E-03 ***
SS.SH	α_3	1,16E+00	1,92E-01 ***	2,53E+00	3,39E-01 ***	1,94E+00	2,33E-01 ***
SS.MH	α_4	7,19E-01	1,47E-01 ***	4,84E-01	1,83E-01 **	1,12E+00	2,13E-01 ***
NS.SH	α_5	7,81E-01	2,61E-01 **	1,14E+00	3,70E-01 **	1,09E+00	2,04E-01 ***
NS.MH	α_6	-8,24E-01	1,61E-01 ***	-6,06E-01	3,74E-01	-1,56E+00	2,22E-01 ***
Dec	α_7	1,18E+00	5,88E-02 ***	1,26E+00	6,51E-02 ***	1,38E+00	6,41E-02 ***
Age	α_8	-1,12E-02	9,47E-04 ***	-1,51E-02	6,21E-04 ***	-1,55E-02	5,42E-04 ***
Launch	α_9	1,19E-02	1,08E-03 ***	9,38E-03	1,37E-03 ***	1,20E-02	1,37E-03 ***
PS3	α_{10}	6,26E-01	1,29E-01 ***	1,46E+00	2,48E-01 ***	NA	NA
Wii	α_{11}	NA	NA	NA	NA	4,14E-01	2,83E-01
Xbox360	α_{12}	NA	NA	NA	NA	NA	NA
R ²		0,657		0,816		0,8193	
P-value		<2.2e-16		<2.2e-16		<2.2e-16	

* $p < 0.01$.** $p < 0.001$.*** $p \sim 0$.

3.8 *Discussion of results*

Results show that decision of exclusivity (single-homing) has a fundamental role on console sales, as it was observed by Landsman and Stremersch (2011). However, it is not possible to affirm that high quality games has more influence on console sales than normal games in an exclusive scenario, which is different than what was pointed by Binken and Stremersch (2009) - variables associated with exclusive games presented same value while non-exclusive games variables are larger

Quality also has a relevant role on console sales. The results reinforce theory, in a system market the presence of special kind of complementary product can explain platform's success. However, it is still unclear which is the better way to evaluate quality for video game market, or in other 2SMs, as critics and players' scores do not presented positive correlation with console sales.

Strategies of game exclusivity and quality have an important role for console sales, but there are few studies that consider those dimensions simultaneously. This paper was addressed to fill this gap, and it was observed that: (1) exclusive and high quality games have great influence on console sales; (2) non-exclusive and low quality games have negative effect on console sales; and (3) the other two combination has a positive influence on console sales.

Also, the user decision to purchase a console is based on an accumulation of games released until the moment "t", but there should be a difference over time: loyal players early adopters are more likely to buy consoles with a lower number of game launches, while late movers will buy them later, with higher numbers. Although results about quality influence are the same, this analysis is different from Binken and Stremersch (2009), as they only evaluated the temporary effect of games release and not its cumulative effect.

3.8.1 *Implications*

Results show that both researchers and professionals in the video market must pay attention to game quality and exclusivity on console sales. 2SM studies have mostly paid attention to network size as a causal factor for platform sales. However, there are other factors to be considered and one should consider the combination of network characteristics and their influence in the market, as the decision to choose one platform may depend on these

combinations. Besides, it is important to notice that each characteristic has a specific influence on console sales, which can be positive or negative, and their combination may assume any direction.

The study also has relevance to professionals in the video game market. It is recommended that platforms constantly monitor game developers, seeking for new game releases, especially promising titles. Results suggest that exclusivity agreements, or when they are no longer possible, the acquisition of the game developer company may be a good strategy. It also highlights the importance of in house development: all console manufacturers have captive studios, and this paper stresses their strategic importance.

Moreover, game developers must improve their knowledge on what helps to create high quality games. They also need to pay attention when and how is good strategy for them to multi-home or single-home their game titles. This choice should have strategic and financials purposes (e.g., raising the barrier for new entrants, economically attractive).

3.8.2 Limitations and future research

This paper focused on the analysis of the simultaneous effect of two dimensions that characterize one side of the 2SM in video game market, and has some limitations that can be addressed by future work.

First, further studies can explore the same dimensions for different console generations, and expand the total number of empirical studies, which are still scarce. Also, this analysis can be replicated for different markets, such as movie and TV show streaming services, analyzing the relevance of content quality and availability on other platforms), and virtual stores, studying competition between platforms and platforms that contain other platforms.

A limitation is that timeframe influence on console sales was not considered. For example, a game title can be introduced as single-home and became multi-home after some time. That can lead to different results, as it was observed for *multihoming* by Landsman & Stremersch (2011). Further studies may explore the relevance if that behavior.

The segregation in low and high quality games can have a substantial influence on results. Thus, different metrics to segregate high and low game quality should be applied to confirm results, such as the use of critics' scores, players' scores, game titles sales as a

specific percentage of the total of consoles sold, other reference number of game titles sold, among other metrics.

Even considering the global aspect of the present research, the results could not be generalized, because only data for three 7th generation consoles were considered in it. Considering this limitation, future works should explore different generation of video game consoles, as there are substantial market changes through the years, such as the growth of online distribution and an increasing presence of Massive Multiplayer Online Games (MMOGs).

Despite its importance on sales, advertising expenditures was not considered, due to lack of data. However, most of the extant literature also do not consider them as Shankar and Bayus (2003) considered. A similar suggestion of further research was exposed by Landsman and Stremersch (2011).

The video game market is understood as a system market that has two products, console and games titles, as observed by Chou and Shy (1990), Clements and Ohashi (2004), and Gandal, Kende and Rob (2000). This study only evaluated the first action of a system market, which is the main product purchase. Future research can explore platforms' networks characteristics that influence the number of game developers or their games in the network. For example, platforms' customer base, number of titles sold, similar games, consoles' characteristics etc. are some variables that can affect this number. For example, Stremersch et al. (2007) studied some markets that hardware sales lead software availability, such as Compact Disc market.

Future studies could explore the buyers' side and its influence in the indirect network externalities and on console sales. For example, they could explore how buyers' side characteristics (e.g., cultural aspects, preferences, population age, human development index, education level, per capita income, among others) influences the console sales.

Moreover, further research also could explore the influence of consoles characteristics on platform sales, such as: Internet access, memory, virtual stores, type of controller, etc. Studies that explore this issue could be interesting for platform's owner (e.g., Nintendo, Sony, Microsoft), because it could help them to focuses their efforts to characteristics more relevant for game players, thus, driving better solutions for their buyers.

There are two interesting avenues for future research focusing on sellers' side. The first, it is a tentative to understand what dictates the success of high quality games, such as: continuation of previous game titles, famous characters (e.g., Mario Bros., Sonic, Pac Man),

based on books or movies, game play, etc. The second, is the economic evaluation related to game titles exclusivity, for which price and conditions is interesting to keep a title exclusive or not.

4 AGILE DESIGN: A COMBINED MODEL BASED ON DESIGN THINKING AND AGILE METHODOLOGIES FOR DIGITAL GAMES PROJECTSⁱ

Marcelo Makoto Higuchi¹ and Davi Noboru Nakano²

¹ Bacharel em Engenharia Mecânica - Ênfase em Mecânica Plena pela Universidade de São Paulo - USP. Brasil. Email: marcelo.m.higuchi@gmail.com

² Doutor em Engenharia de Produção pela Universidade de São Paulo - USP. Professor da Universidade de São Paulo - USP. Brasil. E-mail: dnnakano@usp.br

Paper published on the Journal of Business and Projects (GeP)

Available on: <http://www.revistagep.org/ojs/index.php/gep/article/view/528>

ABSTRACT

Traditional approaches to project management seek to discipline the execution and to organize different activities to be performed in order to reach the project goals. However, that focus may not be suitable for the beginning of projects that require creativity, as in the case of digital games. This article aims to develop a project management model that covers the whole process of digital games development, by combining two approaches, Design Thinking and Agile Methodology. The proposed model was constructed based on the theoretical framework of both methodologies, and has three parts: the Design Thinking phase, the Connection phase and the SCRUM phase. In order to evaluate the pertinence of the model, a qualitative exploratory study was conducted through semi-structured interviews with game developers of the Brazilian market. It was observed that many aspects of Design Thinking are used in the game development, that agile development is fully diffused in this process, and that association of both methodologies, besides being possible, can contribute to the efficiency of this process. The main contribution of this work is the presentation of an integrated model of project management that fully attends the process of the digital games development.

KEYWORDS: game development, Design Thinking, Agile Methodologies, project management

4.1 Introduction

The digital game market was worth around US\$ 100 billions in 2016 (Superdata, 2016), and game revenues have surpassed well established entertainment businesses as the movie industry. In Brazil, the digital game market in 2015 had approximately 33.6 million users, about one sixth of Brazilian population, placing Brazil as the 11th global market.

The development of digital games has two aspects: one is associated to software development, i.e. programming and coding, while the other is related to a more artistic perspective, e.g., graphic and character design, music, etc. Thus, many researchers as Akta and Orcun (2014), Albino, Souza, and Prado (2014), Hodgson and Briand (2013), Manninen and Kujanpa (2006) argue that game development can be considered a especial case in software development. Akta and Orcun (2014) consider that game development differs from software development essentially because of the creative aspect, that involves the game concept, aesthetics and entertainment.

Game creation is, by nature, an unstructured process. Historically, this process has been conducted following an intuitive and organic path (Brathwaite & Schreiber ,2009; McCarthy & Byron, 2005). However, recently, some researchers, as Albino et al. (2014), observed that the development process could be managed following project management practices, which involves task planning, scheduling and coordination, taking into account deadlines, development costs and quality standards.

However, the literature on game development methods has focused mainly in the technical aspects of game development, the management practices usually performed in the intermediate and final stages. The initial stage, when creative content is developed, still need specific studies.

There are approaches that deal with managing complex, ill-defined projects that also require creativity. Many of them focus on attending user's needs, like Design Thinking (DT), an approach applied to solve complex problems, as in game development, in which there is often no clear definition of how best meet player's needs.

This article proposes a model for digital game development that combines DT with agile methods for project management. Thus, the model can be applied to both the creative and technical stages of game development, covering all the stages of the game development process. Also, as the digital game market became very dynamic and increasingly competitive, game developers, to a certain extent, have paid more attention to the value proposition of their

titles and less on the game development process, which reinforces the usefulness of the model suggested in this article.

The remaining text is structured in four sections: a literature review on Design Thinking and Agile Methodologies (AM), game development and software design, and the proposed model; a description of the methodology of this study; the analysis and discussion of results; and a conclusion section, with ending remarks, limitations and possibilities for future research.

4.2 *Literature review*

4.2.1 Design Thinking Approach

Although the term Design Thinking was coined in the 1980s by Aldridge (1980), it only gained relevance in the late 2000s (Fleury, Stabile, & Carvalho, 2016), with Brown's (2008) research. He argues that DT can be considered a discipline which encourages practitioners to apply a user centric approach, as designers do, and to apply their methods for solving complex or poorly structured problems, known as Wicked Problems (Rittel & Webber, 1973) or Ill-Structured Problems (Simon, 1973).

Ill-Structured and Wicked Problems

A Wicked Problem (WP) cannot be well defined, separate into parts, and accept an infinite number of solutions. It is characterized by confusing and conflicting information, which makes them difficult to be structured (Rittel & Webber, 1973).

A Ill-structured problem (ISP) presents a poorly defined structure (Simon, 1973). Thus, in order to characterize it, one has to define what a Well-Structured Problem (WSP) is in that context, to then oppose it to an ISP: all problems that do not have all the characteristics of a WSP can be understood as ISP. Solutions for ISPs can be proposed by experts, e.g. designers, who are able to make logical connections and to find possible best alternatives among the infinite possible solutions.

Kimbell (2011) argue that both WPs and ISPs are directly associated to Design Thinking and Buchanan (1992) defined a typical DT problem: the creation and development of a non-existing product or service.

According to those definitions, one can affirm that the conception of digital games is both an ISP and a WP, as it has infinite possible solutions, there is no obvious and well-defined criterion for quality and performance evaluation and it contains confusing and conflicting information, which hinders its structuring.

Different approaches of Design Thinking

DT has been associated with resolution of ISPs and WPs (Buchanan, 1992; Dorst, 2006; Dorst, 2011). There are several definitions for DT, and some authors proposed a comprehensive definition, using a semantic analysis of the existing literature (Fleury et al., 2016):

“Design Thinking is a human-centered approach applied to wicked problem-solving that starts with the understanding of different users’ perspectives. It involves multidisciplinary teamwork based on the balance between cooperation-conflict among different actors in a co-creation process, in which the conflict of ideas become the genesis for the establishment of innovative solutions.”

However, as there is more than one definition for DT, there is also more than one way to describe DT's approach (Kimbell, 2011, 2012): (a) Design Thinking as a cognitive style, (b) as a general theory of design, and (c) as an organizational resource. Each of these descriptions has a specific focus: in the cognitive style approach, the focus is placed on designers and experts (Cross, 1982, 2006; Dorst, 2006); in the general theory of design the subject is discussed as discipline or an autonomous field (Buchanan, 1992); and in the organizational resource approach, DT can generate innovation for businesses (Brown, 2009; Martin, 2009). In this text, DT is understood following the last view, as a resource for organizations, since the digital game market is very dynamic, and thus, innovation is essential for development studios.

DT approach as a resource for organizations

As consequence of increasing market competition, the use of more effective design approaches can be considered as essential for any company. In this line, many authors emphasize the use of designers' skills to business problems such as new product development and the re-assessment of production processes as effective solutions (Dorst, 2011; Kimbell,

2011; Martin, 2009; Razzouk & Shute, 2012). Other authors understand DT as a human-centered methodology that facilitates innovation (Bauer & Eagen, 2008; Brown, 2009; Dunne & Martin, 2006), essential for competitive advantage, and Martin (2009) even states that the use of DT is mandatory for companies seeking innovations, since it balances analytical skill to intuition.

Thus, the use of DT has received attention in the management community. They feel the immediate need to differentiate their strategies to solve complex and ill-formulated problems experienced by their organizations (Brown & Katz, 2011; Stacey, Griffin, & Shawn, 2002). For example, Lockwood (2009) illustrates that by applying DT it is possible to discover unmet consumers' needs, and to generate competitive edge for the company.

Designers or practitioners that use a DT approach should have the following characteristics (Brown, 2008):

- Empathy: being able to visualize the world from diverse points of view, such as colleagues, customers, etc.;
- Integrative thinking: using a bird's eye view, considering all relevant points for problem-solving, even when they are contradictory;
- Optimism: no matter how complex problems are, there is always a potential solution that is better than existing ones;
- Experimentation: proposing questions and exploring its constraints in a creative manner, which that can lead to entirely new directions;
- Collaboration: working collaboratively and having multidisciplinary knowledge.

Stages of the Design Thinking

According to Brown (2008), every design process must go through three stages: Inspiration, Ideation and Implementation (Figure 21).

In Inspiration the project questions are formulated, which are the motivations for searching for solutions. These questions always focus on the fulfilment of end-user requirements in relation to the product to be elaborated. For example, Bonini and Sbragia (2011) consider that all possible questions can be summarized in a single question, which would be: "What is the solution that my clients need? ".

Figure 21 – Design Thinking stages

Source: elaborated by the authors, based on Brown (2008)

Ideation is characterized by the generation, development and testing of ideas, looking for answers to the issues raised during the Inspiration phase. In this step best ideas are generated and chosen in order to accelerate the prototypes creation. The test of ideas and solutions is done through simple prototypes. According to Brown (2009), the focus of this stage is the creation and conceptualization of the solution and, therefore, it is the more fundamental step to formulate and improve a solution. And, as pointed by Bonini and Sbragia (2011), this process alters traditional thinking, which first imagines a solution, designs it, to then build a product or a service. In DT an idea is tested quickly, and the design is essentially based on experimentation.

After defining the solution to be pursued, in the last phase, Implementation, the concept is developed and the final product is created, which is placed in market.

This process is the most usual in the literature. However, there are other DT approaches, such as the Bootcamp Bootleg of the Stanford University d.School (2008), which considers the existence of five stages: Empathy, Definition, Ideation, Prototyping and Testing. Another process is the HCD (Human Centered Design), which contains seven steps: Observations, Narratives, Themes, Opportunities, Solutions, Prototypes and Implementation Plan (IDEO, 2011).

According to Larsen and Majgaard (2016) game design has received considerably attention in the last years. However, there is little research that explored the use of Design Thinking in the game development process, as it's shown by Hayes et al. (2008) in their literature review. The main result of Hayes et al. (2008) is that existing software and

educational applications generally emphasize the production phasesⁱⁱ, like programming, over the creative ones, like creating concepts associated to game design. Thus, the authors stressed the potential value of the use of DT in game development education. These findings reinforce the usefulness of the model developed in this text, which will cover both the creative and the production phases of the game development process.

Brown (2009) illustrated other example that shows the relevance of the Design Thinking in the video game industry, studying the Nintendo Wii case. Before Wii, most of video game developers focused mainly on hardware development. However, Nintendo developers looked first for clients'ⁱⁱⁱ needs, thinking how they could create a video game more appealing to a wider market. This illustrates how a different design approach, design thinking, has had significant relevance in Nintendo Wii success.

Through the literature analysis it was shown that the DT process focuses on construction of creative solutions focused in the clients' needs, leaving, however, management and production tasks to a second plane. Thus, an integrated model as proposed here is needed to attend the entire game development process.

4.2.2 Agile Methodologies

The Agile Manifesto, elaborated in 2001, revolutionized software engineering (Dingsoyr et al., 2012). The creators of this manifesto, a group of practitioners and academics, discussed how to make software development faster and more efficient. As result the Agile Manifesto was elaborated, containing four fundamental principles (Dingsoyr et al., 2012; Agile Alliance, 2001):

- Collaborative development, with privileges and process restrictions agreement;
- Lean mentality to reduce unnecessary work, e.g., excessive documentation;
- Clients and employees are key to improve the quality of projects;
- Uncertainties are always present in software development, and the attempt to control variations using statistical analysis has limited results.

4.2.3 Main focus and characteristics

Many agile methods for project development were proposed: Extreme Programming^{iv} (XP), SCRUM, Crystal Methods, Dynamic System Development Method (DSDM) and

Feature-Driven Development (FDD). Research has also studied several aspects such as: the adoption of agile methods in projects (Boehm, 2002); the effectiveness of pair programming in software development (Williams, Kessler, Cunningham, & Jeffries, 2000); trust, self-organization and communication in development teams (Moe & Dingsoyr, 2009) ; test-driven development results (Erdogmus, Morisio, & Torchiano, 2005); adoption and post-adoption issues of software development (Cao, Xu & Ramesh, 2009).

The main focus of agile methods is on fast delivery of high-quality software, and thus, iterative development, quality of products, etc., are considered as secondary aspects (Dingsoyr et al., 2012). Despite the single focus, many authors discussed agile development from different perspectives. For example, some authors understand that agility embeds the ability to quickly and flexibly respond to changes in the business environment and technology (Henderson-Sellers & Serour, 2005; Higsmith, Consortium, & Cockburn, 2001); it promotes maneuverability and fast response to client demands (Cockburn, 2007); it allows efficient incorporation of user requirement changes during the project (Lee & Xia, 2010); it allows fast change and learning, and high customer value (Conboy, 2009).

Agile development methods are also recognized as flexible alternatives to traditional methods such as ISO 9000 and CMMI (Dingsoyr et al., 2012). Due to the contrasting characteristics between traditional and agile methodologies, many authors compared those approaches and also the combination of them (Dingsoyr et al., 2012). According to Albino, Souza, & Prado (2014), the agile methodologies of project management are different both qualitatively and quantitatively from traditional methodologies such as the PMBOK® ((PMI), 2008).

In the next subtopic is presented the SCRUM, an AM used in the model proposed in this work.

4.2.4 SCRUM

SCRUM can be considered one of the main, if not the main, agile methodology (Albino et al., 2014). It was developed by Ken Schwaber and Jeff Sutherland in the early 1990s. It defines a process in which projects advance in iterations, known as sprints. There are three key actors in SCRUM (Schwaber, 2004):

- Product Owner: represents the project demand, in some cases the client, he typically controls project requirements and defines their priority;

- **SCRUM Master:** is the project manager, he applies SCRUM to different projects, and he uses his understanding on project goals to assist the team;
- **SCRUM Team:** the team is responsible for the project development, they help to determine project effort, they can self-organize, separating the requirements requested by the Product Owner into tasks and deciding who is responsible for each of these tasks.

According to Cooper (2014) the SCRUM methodology can be understood as an incremental process that allows to demonstrate the product to the client by performing work packages (sprints).

Figure 22 and Table 5 – SCRUM stages, explain SCRUM in more detail, highlighting its iterative cycles and the main actors of each step until product development conclusion.

Figure 22 – SCRUM stages

Source: elaborated by the authors, based on Schwaber (2004)

Table 5 – SCRUM stages^v

#	Stage	Stage description	Main actors
1	Vision	Product Owner's view about the product to be developed. It can start as vague vision, both in market and technical aspects, but it will become clearer with the project progresses. The PO is responsible for assuring vision and maximizing project funders' Return On Investment (ROI).	Product Owner (PO)
2	Product backlog	Items list, of functional and non-functional requirements, and corrections. During the project, items are added, removed, and their priority may change.	Product Owner
3	Iteration (<i>Sprint</i>) planning meeting	Meeting in which the PO, SM and ST decide what will be accomplished in the <i>Sprint</i> . In the first stage the PO presents what he wants in the "Product backlog" and the ST defines what can become a functionality in the next iteration, generating the "Sprint backlog". In the second part of the meeting the ST defines the tasks required to implement each item of the "Sprint backlog".	Product Owner, SCRUM Master (SM) and SCRUM Team (ST)
4	<i>Sprint backlog</i>	Contains selected items from the "Product backlog" and the tasks required to turn those items into functionalities. During the <i>Sprint</i> only the SCRUM Team and Master SCRUM can change this list.	SCRUM Master and SCRUM Team
5	<i>Sprint</i>	A 30-day consecutive period in which ST and SM work to produce what was defined at the "Iteration planning meeting"	SCRUM Master and SCRUM Team
6	SCRUM daily meeting	15-minute meetings are held to check the progress and difficulties faced by the ST. The SM conducts the "SCRUM daily meeting" and ST's members should answer three questions: What have you done since the last daily meeting?; What will you do until the next daily meeting?; What were the problems faced in the accomplishment of your work?	SCRUM Master and SCRUM Team
7	Iteration review meeting	Meeting conducted by the SM and held at the end of the iteration, which ST presents to the PO what was accomplished.	Product Owner, SCRUM Master and SCRUM Team
8	Iteration overview meeting	Meeting held by SM, ST and PO, aiming to raise what was good in the last iteration and what could be better in the next.	Product Owner, SCRUM Master and SCRUM Team

From the Figure 22, one can affirm that the development process is iterative, thus, the vision and work list can be altered at any moment during the project (Cao et al., 2009).

The steps shown in Table 1 can be grouped in four phases, as follows:

- Planning: steps 1, 2 and 3 are associated with overall project planning, from the requirements and values to the planning of the sprints;
- Construction: steps 4, 5 and 6 are when tasks are defined for the construction of product characteristics during sprints and also daily meetings are conducted to assess difficulties and create empathy among team members;
- Inspection: step 7 is when product characteristic developed in the sprint is presented to the final customer for evaluation; and
- Adaptation: step 8 is when improvement points are defined and necessary adjustments and adaptations will be executed in later sprints.

At the end of all sprints, the Product Owner will receive a high quality final product, to which he actively contributed for its development.

4.2.5 Association of game development with software engineering

As discussed by Albino et al. (2014) the development of games, or game design, can also be considered as a process of software development, since both processes have many similar stages.

According to Sloper (2002) the process of creating digital games has five stages^{vi}: design, pre-production, production, post-production and post-release. The software development process has the following activities (Sommerville, 2003): software specification, software design and development, software validation and software evolution.

It is possible to list the similarities between the two processes, such as the “pre-production” and “software specification” steps that are made the requirements and final product definitions, for example, the setting the game platform, graphic properties, programming language etc.; “production” and “software design and development”, both stages are associated with the process of development of the final product; “post-production” and “software validation”, stages associated with final product testing and refinements; “post-launch” and “software evolution”^{vii}, steps considering the use and consequent product evolution with the intention of keeping it continually attractive to its end customers^{viii}.

However, the first process in game design “conception” is not contemplated in software development process. It can be carried out either individually or in a group: when performed collectively, it is usual to use the brainstorm technique, in which various ideas such as: themes, game play, target audience, platform etc. are discussed (Berthm, 2007). This stage requires creativity, and is not addressed in software development methods^{ix}.

4.2.6 Proposal of integrated model: Design Thinking and Agile Methodologies

The game development process has both artistic and creative, and technological characteristics, which allow to integrate the two approaches: Design Thinking and Agile Methodologies. Both offer competitive advantages, in product differentiation and in cost efficiency. The Design Thinking approach can be applied to the creative aspect of the game development process, while Agile Methodologies can be used on the prototyping and development of the final product.

In addition, the literature shows that both approaches have many similarities, which strengthen their combined use in digital games development. Table 6 highlights similarities between DT and AM.

Table 6 – Synergies between Design Thinking and Agile Methodologies

Characteristic	Design Thinking	Agile Methodology
Solution of poorly structured problems	Essentially associated for solving poorly formulated and complex problems (Buchanan, 1992; Dorst, 2011; Kimbell, 2011; Razzouk & Shute, 2012).	As uncertainties are part of software development, thus project developers have to deal with poorly structured problems (Dingsoyr et al., 2012; Lalsing, 2012; Nerur, Mahapatra, & Mangalaraj, 2005).
Customers desires are key to project development	All DT approaches are essentially human-centered and emphasize user experience (Bauer & Eagen, 2008; Brown, 2009; Dunne & Martin, 2006).	Final customers and project collaborators are active in final product development, thus ensuring a better quality and suitability of the final product (Abrahamsson, Conboy, & Wang, 2009; Siau, 2005; Williams & Cockburn, 2003).
Iterative productive process	The DT process is iterative, there is no clear barrier between stages, iteration are fundamental for solution development (Brown, 2008; Fleury et al., 2016).	Agile processes are mainly iterative, e.g., SCRUM Sprints (Williams & Cockburn, 2003; Schwaber, 2004).

Team collaboration (interdisciplinary and multidisciplinary ^x)	DT practitioners work in teams, being characterized by their interdisciplinarity and multidisciplinary (Johansson-Skoldberg et al., 2013; Seidel e Fixson, 2013).	Developers who use AM work fundamentally in multidisciplinary teams, composed by programmers, project managers, testers etc. (Dingsoyr et al., 2012; Moe & Dingsoyr, 2009).
Fast prototyping	Fast prototyping is fundamental in the Ideation stage, the use of simple prototypes allows to identify new creative and innovative ideas. (Liem & Brangier, 2012; Vetterli, Brenner, Uebernickel, & Petrie, 2013).	AMs focus on the most efficient development of projects, assuring a high quality product and cost efficiency (Henderson-Sellers & Serour, 2005; Highsmith et al., 2001).

Considering the game design process presented by Sloper (2002), the combination of DT with AMs proposed in the present work (Figure 23 – Proposed model for game development combining Design Thinking and Agile Methodologies) considers that the initial stages “Conception” and “Pre-Production” follow a DT approach, whereas the final stages, “Production”, “Post-Production” and “Post-Launch”, are conducted using AMs.

Figure 23 – Proposed model for game development combining Design Thinking and Agile Methodologies^{xi}

Figure 23 represents the first insight of the proposed model that will be described with more details in the next section. The model was created considering that game development is typically unstructured; thus, it's suggested a combined model to improve the game development through a project management using DT and AM.

Specifically, DT is associated with the Conception and Pre-Production stages of Sloper's (2002) process, to help game developers to work in their ideas in a deeply and structured form. The others steps of Sloper's (2002) process use, the most used AM methodology in the game development process.

4.3 Methodology: Assessment of DT and AM use by developers

To evaluate the degree of knowledge and use of Design Thinking and Agile Methodologies by developers, an exploratory, qualitative research approach was adopted, to better understand the process of game development. Semi-structured interviews were conducted with five Brazilian game developers^{xii}, working in different companies. For the selection of respondents, two criteria were considered: (a) experience in game developing and (b) a leading role in the company, e.g., as a manager or partner.

Company A has launched its first game recently, for cell phones, and its game already have more than a 100 thousand in just three months. Company B can be considered as the most successful in the sample, obtaining more than 100 million downloads of one game, but now its founders are focused on another market, thus it has not released more games in recent years.

Although the Company C was created very recently, the respondent is an experienced developer, with more than 6 years in the business. Company D develops games for cell phones^{xiii} and computers and, recently, its developers are concluding its most ambitious game. Company E recently changed the target platform, it used to develop products for cell phones and computers, and now it's developing virtual reality applications. Table 7 provides a consolidated description of respondent firms.

Table 7 – Companies' characteristics

	Company A	Company B	Company C	Company D	Company E
Company's age	2,5 years	10 years	3 months	4,5 years	1,75 years
Games launched	1 game	More than 50 games	7 games	9 games	6 games
Developers background	Systems information, game designers etc.	Engineers, business administrators, designers etc.	Computer scientists and industrial designers	Game designers	Engineers, game designers etc.
Platform target	Cellphones	Cellphones	Computers and consoles	Cellphones and computers	Virtual reality devices

Questions were structured in two large blocks: socioeconomic information and project management questions about DT and AMs. In the case of the DT, the questions had two

purposes: to verify if the game developers were familiar with it, and to verify if they already had used techniques related to that approach. Technique selection was based on the literature, and can be found in Table 8. All interviews were in person and hand notes were taken.

Table 8 – Stage and techniques of Design Thinking application

Stage	Related Techniques	Description
Inspiration	Strategic challenge	Proposing questions such as “How can we...”
	Challenge selection	Evaluation and selection of challenges to be pursued by the team
	Knowledge sharing	what is and what is not known for solving the problem, and what needs to be studied to solve the proposed question
	Research planning	Research planning considers: users, clients, experts, contexts and benchmarks
	Questionnaires	Development and application of questionnaires to users, clients and experts
	Research	Research of benchmarks and problem contexts
	Sharing	Sharing the information and perceptions found in the “Inspiration” phase, and possible solutions
Ideation	Personas	Creation of fictitious characters, who serve to refine the possible solutions
	Empathy map	Understanding personas, what they feel, see, hear, speak and do, their weaknesses and their strengths
	Synthesis	Synthesizing all learning
	Brainstorming	Creation of possible solutions
	Customer Journey	Description of the user’s journey taking into account his thoughts and feelings; allowing to propose possible solutions
	<i>Blueprint</i>	Visual notation that represents the solution process, including actors and activities
	Prototyping	Creation of a prototype that expresses all practitioners’ ideas
Implementation	Hyphoteses and tests	Hyphoteses for solution, and tests for validation of hyphoteses
	Pivoting	Solution change based on the results of performed tests

Considerations	Main considerations of the group of practitioners on the solutions' development
----------------	---

Source: Elaborated by the author, based on IDEO (2011)

Regarding the questions associated to AMs, which game developers are more familiar to, they focused on the frequency and phase of the development process in which they are used. In this case it was asked directly if they knew and used an AM, and at which of Slopers (2002) process stages they started to be used.

4.4 *Analysis and results discussion*

4.4.1 General vision about the Design Thinking approach

All interviewees were somehow familiar to Design Thinking. One interviewee watched a short internet video about DT while another participated in a course on the subject. However, even after taking the course, he was not able to apply it for game development. Remaining respondents had poor knowledge on DT.

However, from the interviews and the literature review, it was observed that the game development fits all^{xiv} characteristics listed by Brown (2008) for DT:

- Empathy: game developers think like players, always seeking the highest satisfaction of their desire;
- Integrative thinking: game developers think in an integrated way, associating game features to client demands, e.g., market segment, how they will meet the player's needs, which kind of control mechanisms they will use, how to maintain and expand their customer base etc.;
- Optimism: developers are always optimistic about their solutions, as they strive to meet their own desires, which, to a certain extent, are similar to users' demand;
- Experimentation: in the game development process it's common that many prototypes are created and tested;
- Collaboration: game development is by nature collaborative and multidisciplinary; hardly ever a game is fully developed by a single person and it requires experts from various areas, such as animation, creation etc. A typical developer profile is

one that holds expertise in one area and superficial knowledge on about other areas, which facilitates collaborative work.

To evaluate the use of the techniques presented in Table 8, it was created a classification to assess to what extent game developers use the technique. Four grades were created: (1) Complete, when the game developer use the technique totally, as described in Table 8; (2) Partial, when the technique is partially used; (3) Residual, only some actions are employed in game development; and (4) None, when techniques are not used at all.

The result of the evaluation is presented in Table 9, which presents the percentage of all techniques and how much they are used. For example, in Company A, 44% percent of all techniques presented in Table 9 are fully used. It can be seen that most of the techniques presented in Table 9 are used by the interviewees (all the interviewees use the techniques in a Complete and Partial form in approximately more than 69%).

Despite the positive results about the use of the DT techniques, it should be noted that the developers were unaware of their nomenclatures and also didn't know how to define them in a clear way. Also, they apply those techniques only partially in most cases. For example, in the "Research Planning" technique, all respondents stated that they use to plan, but they do it in a less formalized way.

In conclusion, DT techniques have been used by developers mainly associated with creative aspects of game development, and as expected, they are used them mostly in the Conception and Pre-production stages as it was indicated by the interviewees. As an example, in the creation of a new game, developers initially seek game benchmarks, informally, without documentation all the process.

Table 9 – Classification of the use of DT techniques

	Company A	Company B	Company C	Company D	Company E
Complete	44%	44%	50%	31%	44%
Partial	44%	31%	25%	50%	25%
Residual	13%	13%	13%	13%	13%
None	0%	13%	13%	6%	19%

4.4.2 Use of DT's techniques

Table 9 illustrates that most of the DT techniques are used by developers, but some are not used at all. Those techniques are now listed, with the main reasons why they are not applied.

- Questionnaires: none of the interviewees use questionnaires to identify tastes and interests of their possible clients^{xv}, because, in the majority of cases, they see themselves as their own clients, thus they use their opinion to develop their games;
- Personas: developers view themselves as their own personas, thus, they do not create a fictional person for game improvement;
- Empathy map: as personas are not created, this technique is also not used. Developers imagine themselves as their players, thereby, they can self-assess the weaknesses and strengths that will be used in the creation of their games;
- Customer Journey: the initial game scope is already well defined: the technical platform, game mechanics and type of users; therefore, developers already know, a priori, when and which platform players will use;
- Service Blueprint: none of the developers use blueprints, which involves both the user cycle and actors involved.

Although they do not specifically use such techniques, developers do take into account many aspects of them. For example, in the case of personas and the empathy map, as they consider themselves as possible clients^{xvi}, they already know how to define what would be a product that would fully meet their desires.

4.4.3 General vision about the use of Agile Methodologies

As expected all developers use agile methodologies in the development of their games. According to them, their use starts between the Pre-Production and Production stages of Sloper's (2002) process. In addition, the most commonly used agile methodology is the SCRUM.

In the Pre-production stage the requirements of the games are defined in the same way as the in a regular software. For games development, specific requisites are: game mechanics, technical platform, game genre, target audience, graphic structure, game options etc. That

step fits as the initial part of the software development, in the case not necessarily entering in the cycles of development of functionalities, such as SCRUM sprints.

The Production stage is conducted following development cycles, in which developers produce game sections and test them at the end of each cycle, evaluating its functionalities.

The use of SCRUM is fully diffused among the interviewed developers, who understand it as an essential part for their game development process, from the first prototype to the final code.

4.4.4 Approaches combination DT and AM

As the interviews showed that both techniques similar to DT and AM concepts are commonly used by game developers, there is evidence of the possibility of integrating both approaches. Considering the combination of those two approaches there is great chance of improving game project management, especially in the initial stages, the creative ones, that nowadays do not have a structured process to explore and develop the game concepts ideas^{xvii}.

In fact, DT can be associated with the first stages of game production, which are characterized by high levels of creativity; while the final stages are characterized by the intensive development or implementation of ideas, when AMs can be used.

Thus, the main contribution of the proposed model, presented in the next section, is the addition of some DT techniques to help developers to structure and explore their ideas in a complete form. Besides, the game developers will have a project management approach to go through all the steps of game development process presented in Figure 23 – Proposed model for game development combining Design Thinking and Agile Methodologies.

4.4.5 Proposed Model

Considering what was exposed, a model that combines DT and an AM methodology (in this case, SCRUM^{xviii}) is proposed, as depicted in Figure 24.

Figure 24 – Proposed methodology - Design Thinking & SCRUM

In Figure 24 is possible to see the proposed model of project management for game development, in a macro vision it has two phases, one associated to DT (left side) and other to SCRUM (right side). In the middle, the connection of these two approaches, that is, the end of DT process and the beginning of SCRUM methodology. In the following paragraphs the proposed model is described.

- DT phase
 - Inspiration: It's the beginning of the game development process, where developers willing to produce a new game, choose initial ideas about game type and share knowledge on similar games, game mechanics etc. After that, they define, through a plan, how to better understand the player's needs, using interviews, questionnaires and benchmarks;
 - Ideation: Phase when ideas will be improved or discarded, and also when game concept is developed. In this stage, developers will share all knowledge obtained in the Inspiration phase, and will brainstorm to define and synthesize better ideas for game concept. Thus, despite game developers do not use most of the techniques presented in Table 4, they use is emphasized to assure empathy to game players;
 - Implementation: Last phase associated to DT before entering the SCRUM stage. This phase will help game developers to refine their ideas through experimentation. During Implementation prototypes that depicts all

hypotheses on game mechanics, scenarios, gameplay are created. Then, those prototypes are tested to validate or refute the game hypotheses, to find the best game concept.

- Connection phase (DT + SCRUM)
 - Vision and Product backlog: This is when SCRUM starts. In this phase, the development team will act as the client, who has a vision of the game concept and will define the product backlog. By the end of the DT process, game developers will have a clear vision of the game concept, ensuring a better definition of the product backlog;
- SCRUM phase
 - Iteration meeting: It is the point where decision on which parts of the game will be developed in the Sprint, considering production restrictions and team expertise;
 - Sprint backlog: it is the result of the “Iteration meeting”, a formal list that contains selected items from the “Product backlog” and tasks required to turn those items into game parts;
 - Sprint: a 30-day consecutive period where game developers works to develop all items contained in the “Sprint backlog”;
 - SCRUM daily meeting: short meeting in order to check the general progress and difficulties faced by the game development team;
 - Iteration review and overview meeting: meeting conducted by the game development manager (or SCRUM Master) held at the end of the iteration, where is presented the game part developed. Besides, it’s discussed what was good in the last iteration and what could be better in the next.

In sum, DT techniques are used to improve the stages of the vision and work list, which are not managed with the use of SCRUM, as they are the most creative part of the game development process and reflect project owner demands. Vision stage is improved by using all techniques presented in Table 8, as they give a broader view of the game concept, taking into consideration external opinions and not only the developer's view. The work list will be more assertive, as the creation of prototypes and hypotheses validation allow developers to advance towards a better specified and detailed game, ensuring both faster development and greater success of the game in question.

It's emphasized that the interviews were fundamental to validate the proposed model^{xi}. First, it was seen that the game developers^{xx} do not have any structured project management approach to develop the concept of the game and commonly they use similar techniques from DT, exposing that they have some familiarity with DT; considering what was pose the DT will help them in the project management of the creative part of the game development. Second, as expect the use of AM^{xxi} is diffused between the interviewees, mainly associated to the production parts of the game development process. Thus, the combined use of those two approaches in all the game development process could be considered as possible both in practice and theory.

4.5 Conclusion

This paper discussed game development process, an issue that currently needs more discussion. Game development should be essentially user-centered, as a game are should fulfill players' demands. Thus, the use of Design Thinking can contribute to the improvement of game design and production, because its techniques incite and explore new ideas. For example, the DT technique of developing personas create a view of the extremes of the user population, for instance, children and the elderly are the extremes of an age normal curve, and thus, if the developer can create a solution that meet demands from these two extremes it certainly will attend a larger number of players. As expected, game developers already use Agile Methodologies in their game development process. It was also observed that the most popular AM among developers is the SCRUM.

Through the interviews it was observed that, in fact, the DT was more associated with the initial stages of game development and Agile Methodologies to final stages, and also considering the synergies observed in the literature (Table 2), it was proposed and validated a integrative model with both approaches DT and AM.

The model is depicted in Figure 24 : the game development process begins with focus on DT practices to then use AMs practices, for instance, SCRUM.

In sum, this new model contributes to improve the project management in a game development process, now covering the entire process, since the creative parts until the productive ones. In a company vision, the DT can contribute to a strategy of product differentiation and also can serve to more fully understand game requirements, while agile

development practices can increase development efficiency, thus, the use of both approaches could be considered as two competitive advantages to a game company.

4.5.1 Limitations

The results seen in this research cannot be generalized to the entire Brazilian and world market. However, the proposed model was based on field evidence, as professionals from five companies were interviewed and their contribution can certainly be expanded.

4.5.2 Futures researches^{xxii}

Finally, three opportunities for future research can be indicated: first, broadening the respondents' base, which will allow the possibility to verify the generalization of the results found in this research. Secondly, conducting an action research, focusing on the combined use of DT with AMs, and identifying strengths and weaknesses of the use of the integrated approach. The third one is to expand research in DT literature to find more techniques that would fit into the development of games, being the choice of the best based on opinions of developers or experts of the games area.

5 CONCLUSIONS

The digital game industry is in constant evolution, in the last years its scope has expanded with the development of new technologies. The expansion is mainly associated to new game developers that are producing casual games for portable platforms, such as cellphones and tablets. Casual games attracted a bigger number of game players, from different gender and age groups. It is a global trend, which has also happened in the Brazilian market.

The digital game industry also is expanding economically and became more relevant than other traditional entertainment industries, such as the movie industry. This economic fact is one more example of motivation to elaborate the present study.

This study focused in three facets of the digital game industry, which are: video game market as two-sided markets; the effects of characteristics and behavior of game titles in consoles sales; and digital game development project management. However, there is number of opportunities for further research, which could explore points presented in each paper or other issues related to this market. For example, research about the influence of digital games in players' behavior, such as violence, educational learning, motor coordination, happiness, among others.

The current study explored three distinct themes that brought new perspectives to the current literature and can lead to further research. In the first article it was studied economic theory of the two-sided markets related to the video game market. Through a bibliometric study on literature of 2SM, main texts, trends and development, research avenues for future research were identified. It is an interesting starting point to explore and understand the economics of platform's market, which is intimately associated with the digital game market.

The second article explored the influence of game titles quality and exclusivity on console sales. Research findings indicate that different combinations of these two dimensions may influence positively or negatively on console sales. Besides, the quality dimension has predominant effect over exclusivity on platform sales. Finally, this study, as previous literature, showed the relevance of these two characteristics on platform's usage and consumption, and it is expected that these findings may contribute for both researchers and professionals of the digital game market.

The last one explored practices of project management for game development. Most of project management approaches in the literature are not suitable for the first phase of projects

that require creativity, as in the case of digital games. The paper proposed a new project management model, covering the entire process of digital games development through a combination of Design Thinking and Scrum. This last study, different from the others, presented an internal perspective of the digital game market that may improve game developers success through better solutions to the players' needs. Besides, there are some avenues for further researches that could better validate this new approach or also improve it.

Finally, the dissertation provided an overview of three different themes related to the digital game industry with different research approaches. Each article explored a specific literature gap, thus, this dissertation may contribute for the academia that research the video game market. Besides, it is also expected that this study may support practioners giving them insights for new strategies and project management.

6 REFERENCES³

- (PMI), P. M. (2008). A Guide to the project management body of knowledge - PMBOK - 4^a ed. Pennsylvania: Project Management Institute.
- Abrahamsson, P., Conboy, K., & Wang, X. (2009). “Lots done, more to do”: the current state of agile systems development research. *European Journal of Information Systems*, 18(4), 281–284.
- Akta, A., & Orcun, E. (2014). A survey of computer game development. *The Journal of Defense Modeling and Simulation: Applications, Methodology, Technology*, 13(2), 239–251.
- Albino, R. D., Souza, C. A. de, & Prado, E. P. V. (2014). Benefícios Alcançados por Meio de um Modelo de Gestão Ágil de Projetos em uma Empresa de Jogos. *Revista de Gestão e Projetos - GeP*, 5, 15–27.
- Aldridge, M. (1980). New Design Thinking sets Roll Formers Future. *Metalworking Production*, 124-127.
- Alliance, A. (2001). Principles: the agile alliance. *Acess in 2016, available in Agile Manifesto: <http://agilemanifesto.org/principles.html>*
- Anderson, S. P., & Coate, S. (2005). Market provision of broadcasting: A welfare analysis. *Review of Economic Studies*, 72(4), 947–972.
- Armstrong, M. (2006). Competition in two-sided markets. *Journal of Economics*, 37(3), 668–691.
- Armstrong, M., & Wright, J. (2007). Two-sided markets, competitive bottlenecks and exclusive contracts. *Economic Theory*, 32, 353-380
- Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120.
- Basu, A., Mazumdar, T., & Raj, S. P. (2003). Indirect Network Externality Effects on Product Attributes. *Marketing Science*, 22(2), 209-221
- Bauer, R., & Eagen, W. (2008). Design thinking: Epistemic plurality in management and organization. *Aesthesis: International Journal of Art and Aesthetics in Management and Organizational Life*, 2(3), 568–596.

³ In accordance with APA (American Psychological Association) style

- Bendassolli, P. F., Júnior, T. W., Kirschbaum, C., & Cunha, M. P. e. (2009). Indústrias criativas: definição, limites e possibilidades. *RAE - Revista de Administração de Empresas*, 49(1), 10–18.
- Berry, S. T. (1994). Estimating Discrete-Choice Models of Product Differentiation. *Rand Journal of Economics*, 25(2), 242–262.
- Berthêem, A. C. (2007). Desenvolvimento de Jogos Eletrônicos: Teoria e Prática - 2ª ed. São Paulo: Novatec.
- Binken, J. L. ., & Stremersch, S. (2009). The Effect of Superstar Software on Hardware Sales in System Markets. *Journal of Marketing*, 73(2), 88–104.
- Boehm, B. (2002). Get Ready for Agile Methods, with Care. *IEEE Computer*, 1(35), 64–69.
- Bonini, L. A., & Sbragia, R. (2011). O modelo de design thinking como indutor da inovação nas empresas: um estudo empírico. *Revista de Gestão e Projetos*, 2(1), 03–25.
- Brathwaite, B., & Schreiber, I. (2009). Challenges for game designers. Boston, MA: Charles River Media, Boston, MA.
- Brown, T. (2008). Design Thinking. *Harvard Business Review*, 86(6).
- Brown, T. (2009). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. *HarperBusiness*, Vol. 31.
- Brown, T., & Katz, B. (2011). Change by design. *Journal of Product Innovation Management*, 28(3), 381–383.
- Brynjolfsson, E., & Kemerer, C. F. (1996). Network externalities in microcomputer software: An econometric analysis of the spreadsheet market. *Management Science*, 42(12), 1627–1647.
- Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues*, 8(2), 5–21.
- Cadin, L., & Guerin, F. (2006). What Can We Learn from the Video Games Industry? *European Management Journal*, 24(4), 248–255.
- Caillaud, B., & Jullien, B. (2003). Chicken-and-egg: competition among intermediation service providers. *The RAND Journal of Economics*, 34(2), 309–328.
- Cao, L., Mohan, K., Xu, P., & Ramesh, B. (2009). A framework for adapting agile development methodologies. *European Journal of Information Systems*, 18(4), 332–343.
- Carrillo, J. D., & Tan, G. (2006). Platform Competition: The Role of Multi-homing and Complementors. *Working Papers*.
- Chen, C. (2006). CiteSpace II: Detecting and Visualizing Emerging Trends and Transient

- Patterns in Scientific Literature. *InterScience*, 359-377.
- Choi, J. P. (2006). Broadcast competition and advertising with free entry: Subscription vs. free-to-air. *Information Economics and Policy*, 18(2), 181–196.
- Chou, C.-F., & Shy, O. (1990). Network Effect without Network Externalities. *International Journal of Industrial Organization*, 8(2), 259-270.
- Clements, M. T., & Ohashi, H. (2004). Indirect Network Effects and the Product Cycle: Video Game in U.S., 1994–2002. *Journal of Industrial Economics*, 53(4), 512-542.
- Cockburn, A. & Highsmith, J. (2001). Agile Software Development: The People Factor. *Computer*, 34(11), 131–33.
- Cockburn, A. (2007). Agile Software Development: The Cooperative Game. *Addison-Wesley*.
- Conboy, K. (2009). Agility from first principles: Reconstructing the concept of agility in information systems development. *Information Systems Research*, 20(3), 329–354.
- Consalvo, M. (2009). Hardcore casual: game culture Return(s) to Ravenhearst. *Proceedings of the 4th International Conference on Foundations of Digital Games*, 50–54.
- Cooper, R. G. (2014). Invited Article: What's Next?: After Stage-Gate. *Research-Technology Management*, 57(1), 20–31.
- Corrall, S., Kennan, M. A., & Afzal, W. (2013). Bibliometrics and Research Data Management Services: Emerging Trends in Library Support for Research. *Library Trends*, 636-674.
- Corts, K. S., & Lederman, M. (2009). Software exclusivity and the scope of indirect network effects in the U.S. home video game market. *International Journal of Industrial Organization*, 27(2), 121-136.
- Crampes, C., Haritchabalet, C., & Jullien, B. (2009). Advertising, competition and entry in media industries. *Journal of Industrial Economics*, 57(1), 7–31.
- Cross, N. (1982). Designerly ways of knowing. *Design Studies*, 3(4), 221–227.
- Cross, N. (2006). *Designerly Ways of Knowing*. Berlin: Springer.
- d.school. (2008). Bootcamp Bootleg. Acess in 25 de Fevereiro de 2016, Available in d.school: Institute of Design at Stanford: <<http://dschool.stanford.edu/wp-content/uploads/2011/03/METHODCARDS2010v6.pdf>>
- DCMS (Department for Culture, M. a. (2001). Foreword 2001. Acess in 11 de 2017, available in GOV.UK: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/183544/20

01part1-foreword2001.pdf

- Dingsøyr, T., Nerur, S., Balijepally, V., & Moe, N. B. (2012). A decade of agile methodologies: Towards explaining agile software development. *Journal of Systems and Software*, 85(6), 1213–1221.
- Doganoglu, T., & Wright, J. (2006). Multihoming and compatibility. *International Journal of Industrial Organization*, 24(1), 45–67.
- Doganoglu, T., & Wright, J. (2010). Exclusive dealing with network effects. *International Journal of Industrial Organization*, 28(2), 145–154.
- Dorst, K. (2006). Design Problems and Design Paradoxes. *Design Issues*, 22(3), 4–17.
- Dorst, K. (2011). The core of “design thinking” and its application. *Design Studies*, 32(6), 521–532.
- Dranove, D., & Gandal, N. (2003). The DVD-Vs.-Divx Standard War: Empirical Evidence of Network Effects and Preannouncements Effects. *Journal of Economics & Management Strategy*, 13(2), 363–386.
- Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: An interview and discussion. *Academy of Management Learning and Education*, 5(4), 512–523.
- Economides, N. (1996). The Economics of networks. *International Journal of Industrial Organization*, 14(September 1994), 673–699.
- Eisenmann, T. (2007). Managing Networked Businesses : Course Overview for Educators. *Harvard Business School*, 5-807–104, 1–65.
- Eisenmann, T., Parker, G., & Alstyne, M. W. Van. (2006). Strategies for Two- Sided Markets. *Harvard Business Review*, 84(10), 12.
- Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic Management Journal*, 32(12), 1270–1285.
- Erdogmus, H., Morisio, M., & Torchiano, M. (2005). NRC Publications Archive Archives des publications du CNRC. *IEEE Transactions on Software Engineering*, 31(1), 1–12.
- Evans, D. S. (2002). The Antitrust Economics of Two-Sided Markets by the Antitrust Economics of Two-Sided Markets. *SSRN Electronic Journal*.
- Evans, D. S. (2003). The antitrust economics of two-sided markets. *Yale Journal on Regulation*, 20(2), 325–381.
- Evans, D. S., & Schmalensee, R. (2010). Failure to Launch: Critical Mass in Platform

- Businesses. *Review of Network Economics*, 9(4), 1–26.
- Farrel, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation. *Rand Journal of Economics*, 70-83.
- Farrell, J., & Saloner, G. (1986). Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation. *The American Economic Review*, 76(5), 940-955.
- Fleury, A. L., Stabile, H., & Carvalho, M. M. De. (2016). An Overview of the Literature on Design Thinking : Trends and Contributions. *International Journal of Engineering Education*, 32(4), 1704–1718.
- Fleury, A., Nakano, D., & Cordeiro, J. H. D. O. (2014). Mapeamento da Indústria Brasileira e Global de Jogos Digitais. *BNDES*, 1-266.
- Frels, J. K., Shervani, T., & Srivastava, R. K. (2003). The Integrated Networks Model: Explaining Resource Allocations in Network Markets. *Journal of Marketing*, 67(1), 29–45.
- Gallaughier, J. M., & Wang, Y. M. (2002). Understanding network effects in software markets: Evidence from Web server pricing. *MIS Quarterly*, 26(4), 303–327.
- Gandal, N., Kende, M., & Rob, R. (2000). The dynamics of technological adoption in hardware/software systems: The case of compact disc players. *The RAND Journal of Economics*, 31(1), 43-61.
- Guerras-Martín, L. Á., Madhok, A., & Montoro-Sánchez, Á. (2014). The evolution of strategic management research: Recent trends and current directions. *BRQ Business Research Quarterly*, 17(2), 69–76.
- Guthrie, G., & Wright, J. (2007). Competing payment schemes. *Journal of Industrial Economics*, 55(1), 37–67.
- Hagiu, A. (2006). Pricing and commitment by two-sided platforms. *The RAND Journal of Economics*, 37(3), 720–737.
- Hagiu, A. (2009). Two-Sided Platforms : Product Variety and Pricing Structures. *Journal of Economics & Management Strategy*, 18(4), 1011–1043.
- Hayes, E. R., Gee, J. P., Games, I., Torres, R. J., Peppler, K., Kafai, Y. B., ... Briggs, K. (2008). *New Perspectives on Learning Through (Game) Design. Proceedings of the 8th International Conference on International Conference for the Learning Sciences - Vol. 3*, 253–257.
- Henderson-Sellers, B., & Serour, M. K. (2005). Creating a Dual-Agility Method: The Value

- of Method Engineering. *Journal of Database Management*, 16(4), 1–23.
- Highsmith, J., Consortium, C., & Cockburn, A. (2001). Development : The Business of Innovation. *IEEE Computer*, 120–127.
- Hodgson, D., & Briand, L. (2013). Controlling the uncontrollable: “Agile” teams and illusions of autonomy in creative work. *Work Employment and Society*, 27(2), 308–325.
- Howkins, J. (2001). *The Creative Economy: How People Make Money from Ideas*. London: Penguin.
- International Game Developers Association. (2009). *2008-2009 IGDA Casual Games White Paper*. Casual Games SIG.
- Johansson-Skoldberg, U., Woodilla, J., Çetinkaya, M. (2013). Design Thinking : Past , Present and Possible Futures. *Creativity and Innovation Management*, 22(2), 121–146.
- Kaiser, U., & Wright, J. (2006). Price structure in two-sided markets: Evidence from the magazine industry. *International Journal of Industrial Organization*, 24(1), 1–28.
- Katz, M. L., & Shapiro, C. (1985). Network Externalities, Competition, and Compatibility. *The American Economic Review*, 75(3), 424–440.
- Kim, J. H., Prince, J., & Qiu, C. (2014). Indirect network effects and the quality dimension: A look at the gaming industry. *International Journal of Industrial Organization*, 37, 99–108.
- Kimbell, L. (2011). Rethinking Design Thinking: Part I. *Design and Culture*, 3(3), 285–306.
- Kimbell, L. (2012). Rethinking Design Thinking: Part II. *Design and Culture*, 4(2), 129–148.
- Kuittinen, J., Kultima, A., Niemelä, J., & Paavilainen, J. (2007). *Casual games discussion*. *Proceedings of the 2007 conference on Future Play - Future Play '07*, 105.
- Lalsing, V. (2012). People Factors in Agile Software Development and Project Management. *International Journal of Software Engineering & Applications*, 3(1), 117–137.
- Landsman, V., & Stremersch, S. (2011). Multihoming in Two-Sided Markets: An Empirical Inquiry in the Video Game Console Industry. *Journal of Marketing*, 75(6), 39–54.
- Larsen, L. J., & Majgaard, G. (2016). Expanding the Game Design Space – Teaching Computer Game Design in Higher Education. *Designs for Learning*, 8(1), 13–22.
- Lee, G., & Xia, W. (2010). Toward agile: An integrated analysis of quantitative and qualitative field data on software development agility. *MIS Quarterly*, 34(1), 87–114.
- Lemes, D. O., Tomaselli, F. C., & Camarotti, S. (2012). A economia digital e o mercado de jogos para dispositivos móveis. *XI Brazilian Symposium on Games and Digital Entertainment*, 1–5.

- Liem, A., & Brangier, E. (2012). Innovation and design approaches within prospective ergonomics. *Work*, 41, 5243–5250.
- Lockwood, T. (2009). Frameworks of Design Thinking. *Design Management Journal*, 4(1), 3.
- Manninen, T., & Kujanpa, T. V. (2006). Game production process, a preliminary study (ELIAS project reports), Ludo-Craft, ELIAS-project (European Union Interreg III A Karjala), *University of Oulu, Finland*.
- Mantena, R., Sankaranarayanan, R., & Viswanathan, S. (2007). Exclusive Licensing in Complementary Network Industries. *NET Institute, New York, NY*.
- Marchand, A., & Hennig-Thurau, T. (2013). Value creation in the video game industry: Industry economics, consumer benefits, and research opportunities. *Journal of Interactive Marketing*, 27(3), 141–157.
- Martin, R. (2009). The Design of Business: Why Design Thinking is the Next Competitive Advantage. *Harvard Business Press*.
- McCarthy, D. C., & Byron, S. (2005). The complete guide to game development, Art, and Design. *East Sussex, UK.: Ilex*.
- McDonald, E. (2017). The Global Games Market 2017. *Acess in 11 de 2017, available in Newzoo: <https://newzoo.com/insights/articles/the-global-games-market-will-reach-108-9-billion-in-2017-with-mobile-taking-42/>*
- Moe N., Dingsoyr B. T., & Tore, D. (2009). Overcoming Barriers to Self-Management in Software Teams. *IEEE Software*, 26(6), 20-26.
- Muzellec, L., Ronteau, S., & Lambkin, M. (2015). Two-sided Internet platforms: A business model lifecycle perspective. *Industrial Marketing Management*, 45, 139–150.
- Nair, H.; Chintagunta, P.; Dube, J. (2004). Empirical Analysis of Indirect Network Effects in the Market for Personal Digital Assistants. *Quantitative Marketing and Economics*, 2, 23–58.
- Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of Migrating to Agile Methodologies. *Communications of the ACM*, 48(2), 72–78.
- Newzoo. (2017). The Brazilian Gamer 2017. *Acess in 11 de 2017, available in Newzoo: <https://newzoo.com/insights/infographics/the-brazilian-gamer-2017/>*
- Peitz, M., & Valletti, T. M. (2008). Content and advertising in the media: Pay-tv versus free-to-air. *International Journal of Industrial Organization*, 26(4), 949–965.
- Persson, O., Danell, R., & Schneider, J. W. (2009). How to use Bibexcel for various types of

- bibliometric analysis. International Society for Scientometrics and Informetrics, 9-24.
- Pritchard, A. (1969). Statistical bibliography or bibliometrics? *Journal of Documentation*, 348-349.
- Razzouk, R., & Shute, V. (2012). What Is Design Thinking and Why Is It Important? *Review of Educational Research*, 82(3), 330–348.
- Reisinger, M., Reesner, L., & Schmidtke. (2009). Two-Sided Markets with Pecuniary and Participation Externalities. *The Journal of Industrial Economics*, 32-57.
- Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), 155–169.
- Rochet, J., Tirole, J. (2002). Cooperation among competitors: some economics of payment card associations. *RAND Journal of Economics*, 33(4), 549–570.
- Rochet, J.; Tirole, J. (2003). Platform Competition in Two-Sided Markets. *European Economic Association*, 1(4), 990–1029.
- Rochet, J., & Tirole, J. (2006). Two-sided markets : a progress report. *RAND Journal of Economics*, 37(3), 645–667.
- Rosen, S. (1981). The Economics of Superstars. *American Economic review*, 71(5), 845-858.
- Roson, R. (2005). Two-sided markets: A tentative survey. *Review of Network Economics*, 4(2), 142–160.
- Rysman, M. (2004). Competition between networks: A study of the market for yellow pages. *Review of Economic Studies*, 71(2), 483–512.
- Rysman, M. (2007). An Empirical Analysis of Payment Card Usage. *Journal of Industrial Economics*, 55(1), 1-36.
- Rysman, M. (2009). The Economics of two-sided market. *Assessment*, 23(3), 125–143.
- Seidel, V. P., & Fixson, S. K. (2013). Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. *Journal of Product Innovation Management*, 30, 19–33.
- Shankar, V., & Bayus, B. L. (2003). Network effects and competition: An empirical analysis of the home video game industry. *Strategic Management Journal*, 24(4), 375–384.
- Shapiro, C. (1999). Exclusivity in Network Industries. *George Mason Law Review*, 7(3), 673-683 .
- Schildt, H. A. (2002). Sitkis: A software for bibliometric data management and analysis. *Institute of Strategy and International Business*, 6(1), Helsinki, 2002.

- Shy, O. (2011). A Short Survey of Network Economics. *Review of Industrial Organization*, 38(2), 119–149.
- Siau, K. (2005). A Retrospective Review of JDM from 2003 to 2005 and a Discussion on Publication Emphasis of JDM for the Next Two to Three Years. *Journal of Database Management*, 16(4), 58–71.
- Simon, H. A. (1973). The structure of ill structured problems. *Artificial Intelligence*, 4(3–4), 181–201.
- Sloper, T. (2002). Following Up After the Game is Released: It's not Over when it's Over. *Game Design Perspectives*.
- Sommerville, I. (2003). Engenharia de Software - 6ª ed. São Paulo: Addison Wesley.
- Stacey, R. D., Griffin, D., & Shaw, P. (2002). Complexity and Management: Fad or Radical Challenge to Systems Thinking? *Journal of Macromarketing*, 22(2), 198–201.
- Stremersch, S., Tellis, G. J., Franses, P. H., & Binken, J. L. G. (2007). Indirect Network Effects in New Product Growth. *Journal of Marketing*, 71(3), 52–74.
- Superdata. (2016). Market brief year in review. Acess in April de 2017, available in SuperData: <https://www.superdataresearch.com/market-data/market-brief-year-in-review/>
- Tomaselli, F. C., Serio, L. C. Di, & Oliveira, L. H. (2008). Fatores Críticos para o Sucesso no Mercado de Videogames Domésticos: Sony e Microsoft na Batalha Pelo Domínio da Sala de Estar. *XXXII Encontro da ANPAD - EnANPAD*, 1–16.
- UNCTAD. (2008). Creative Economy Report 2008. Acess in 11 de 2017, available in United Nations Conference on Trade and Development: http://unctad.org/en/docs/ditc20082cer_en.pdf
- UNCTAD. (2017). Creative Economy. Acess in 11 de 2017, available in United Nations Conference on Trade and Development: <http://unctad.org/en/Pages/DITC/CreativeEconomy/Creative-Economy-Programme.aspx>
- Vetterli, C., Brenner, W., Uebernickel, F., & Petrie, C. (2013). From palaces to yurts: Why requirements engineering needs design thinking. *IEEE Internet Computing*, 17(2), 91–94.
- Weinberger, M. (2015). Business Insider. Acess in 11 de 2017, available in Business Insider - The 11 top-grossing video games of all time: <http://www.businessinsider.com/the-11-top-grossing-video-games-of-all-time-2015-8/#11-westward-journey-series-pc-2001--39-billion-1>
- Wernerfelt, B. (1984). A Resource-Based View of the Firm. *Strategic Management Journal*,

5(2), 171-180.

Weyl, E. G. (2010). A Price Theory of Multi-Sided Platforms. *The American Economic Review American*, 100(100), 1642–1672.

Williams, L., & Cockburn, A. (2003, junho). Agile software development: It's about feedback and change. *IEEE - Computer Society*, 36(3), 39–43.

Williams, L., Kessler, R. R., Cunningham, & W., Jeffries, R. (2000). Strengthening the case for pair programming. *IEEE Software*, 17, 19–25.

Wright, J. (2003). Optimal card payment systems. *European Economic Review*, 47(4), 587–612.

APPENDIX

6.1 APPENDIX A – Chapter 2

Table of groups, themes and associated objectives

Author	Principal theme	Objects	Themes/ Issues	Conclusions/ considerations
Rochet e Tirole, 2003	Competition and strategy in 2SM	Several*	Basic concepts of 2SM, such as network externalities, pricing, payment schemes etc; competition and business models in 2SM.	A 2SM platform needs to effectively make cross-subsidy between both sides.
Rochet e Tirole, 2006	Competition and strategy in 2SM	Several*	Network externalities of subscription and transaction charging methods; basic concepts of 2SM, such as network externalities, pricing, payment schemes etc; competition and business models in 2SM.	A consolidation of extant literature until 2006.
Caillaud e Jullien, 2003	Competition and strategy in 2SM	Several*	Basic concepts of 2SM, such as network externalities, pricing, payment schemes etc; competition and business models in 2SM; market equilibrium and market structure.	Competitive strategies; the divide and conquer strategy; relevance of transaction prices; profit of intermediaries tends to be higher with market dominance.
Rysman, 2009	Competition and strategy in 2SM	Several*	Strategies in 2SM: pricing and platform openness (verticalization); 2SM and public policies, pricing regulation.	Authors refer to the small quantity of studies on how open should a platform be, and which side should allow entrance.

Evans, 2003	Competition and strategy in 2SM	Several*	Antitrust policies and 2SM; discussion about the ideal pricing structure and investment to maximize indirect network externalities.	Relevance of 2SM theory to analyze internet platforms; importance of pricing structure and investments to “keep both sides on board”; alert to regulatory organizations about the correct internet platform.
Ellison, 2003	Competition and strategy in 2SM	Several*	Presents a different view of 2SM; network effects on the same side and the other side; locational influence.	Proposes the existence of a plateau associated to network externalities; and increasing returns associated to geographic agglomeration.
Armstrong, 2006	Competition and strategy in 2SM	Several*	Competition in 2SM; existence of three competition models: monopoly, platform competition and competitive bottlenecks.	Analyses positive indirect network externalities and equilibrium determinants: network externalities magnitude, payment schemes, choice between only one platform or multiple platforms; affirms transaction taxes reduce the benefits associated to the network externalities.

Katz e Shapiro, 1985	Economics concepts of 2SM	Several*	Different network externalities: direct network externalities through the act of purchasing goods, indirect network externalities associated with purchasing of a complementary good and the positive consumption externalities involving goods purchasing with services added levels.	Competition model for several markets with network externalities; the fundamental role compatibility has in markets with network externalities; permission of industries to do side payments can influence the probability of compatibility adoption; side payments or royalties could present direct effects for cartel creation.
Farrel, 1985	Economics concepts of 2SM	Several*	Standardization, compatibility and innovation in products; network externalities associated to product compatibility; economies of scale from product standardization; technology inertia from standardizations	Based on complete information and similar preferences, standard products does not become obsolete
Farrel e Saloner, 1986	Economics concepts of 2SM	Several*	Innovation inhibition through network externalities from product compatibility and standardization; prices incompatibilities associated with technological change.	There is inertia to change to new technologies, even in conditions of perfect information.

Economides, 1996	Economics concepts of 2SM	Several*	Analysis on networks externalities and their effect on pricing; compatibility assessment, technological standards, and its effects in pricing and service quality; equilibrium structure and verticalization.	Existence of two types of networks: “single way” and “two ways”; compatibility is associated with network effects; products compatibility, verticalization and price selection are relevant for strategic decision-making in business with network externalities.
Berry, 1994	Economics concepts of 2SM	Several*	Product differentiation; product utility level; product differentiation and pricing.	Analysis of a single model of imperfect competition with differentiated products; product choice, market share and pricing are derived from the Nash’s equilibrium theory.
Rochet e Tirole, 2002	Payment schemes	Credit card and debt card	2SM and different payment schemes; development of a framework in which merchants and consumers decide adopting payment cards.	Analysis on standardization of payment schemes through cards and bank associations.
Baxter, 1983	Payment schemes	Credit card and debt card	Monetary flows in payment transactions.	Regulatory mechanisms are fundamental for the market equilibrium of payment schemes.

Guthrie, 2007	Payment schemes	Credit card	Competition in payment schemes; competition between merchants in 2SM.	Influence of direct network externalities on both sides, authors consider the study as complement to Rochet (2002) who studied competition between merchants and platforms, and its effect on transaction prices.
Wright, 2004	Payment schemes	Credit card	Errors considering a 2SM as a single sided one.	Assessment problems in 2SM regulation, due to lack of knowledge about it.
Schmalensee, 2002	Payment schemes	Credit card and debt card	Antitrust policy in the market of payment schemes; analysis of different financial flows associated with payment schemes; welfare associated to transaction fees.	Optimal private fee depends on merchant's banks and the card owner, and not on its collective market power.
Rysman, 2004	Advertising	Yellow pages	Network externalities and competition in the yellow pages market; demand model for a directory, advertisers demand; empirical study based on yellow pages data.	High competition market is more beneficial for both sides; profit reduction of yellow pages due to competition; influence of positive indirect network externalities to both advertisers and readers.

Cramps, 2009	Advertising	Television	Competition in the advertisement industry considering advertiser revenues subscription fees; model of competition in media market with free entrance; excessive advertiser entrance and advertisement insufficient.	Validation of the negative influence of advertisements on TV viewers; positive influence of advertisers in relation to users subscription fees; content influence regarding subscription fees, when users are more prone to pay to access a specific content.
Wilbur,2008	Advertising	Television	Empirical demand model for advertisers and TV viewers; price equilibrium and advertisement of free-to-air channels and cable channels; price elasticity and demand of advertisers.	Reduction in advertisement increases the audience, proving the negative effect of indirect network externalities; advertisers are sensitive to change in advertisement prices; there are more preference for content for advertisers than to TV viewers; advertisement avoidance eventually reduce platforms revenues.
Anderson e Stephen, 2005	Advertising	Radio broadcasting and television	Welfare analysis in radio broadcasting; ideal resource allocation for a specific radio program; optimal level of advertisement; program investment and return to radio stations.	Competition between two radio stations leads to platform swap; the marginal benefit for advertisers to pay, exceeds the social benefit (there is much more listeners than advertisers) and its decrease the probability of existence of few advertisements; Platforms benefit

the audience instead
of announcers.

Argentesi, 2007	Advertising	Newspaper	Newspaper industry competition case study; analysis on 4 different elasticities: reader demand related to cover price, reader demand related to amount of advertisement, announcer demand related to announce price and announcer demand related to newspaper circulation.	In the newspaper market Conventional price plus markup practice does not work; price deregulation do not necessarily lead to a competitive regime.
Kaiser e Wright, 2006	Advertising	Magazines	Analysis of 2SM and magazine market.	The subsidized side in magazine market is generally the readers; thus, the side that generates revenues is advertisers.
Gabszewics, 2004	Advertising	Television	Content and advertisement in television industry; competition between television channels; profits, tv audience and welfare; existence of advertisement regulation in tv industry.	Specific content channels are normally paid, and they have more aversion to advertisements than general content ones; popular channels attract more advertisements, and in counterpart it has a less diversified content.

Choi, 2006	Advertising	Television	Competition model for television companies (free-to-air channels x pay channels); content provision, advertisement level; nature of market failure; regulation in television advertisement market.	Advertisements, even informative ones, reduce de utility for TV users; development of a competition model between television channels (free x pay)
Peitz e Valletti, 2008	Advertising	Television	Competition model for television companies (free-to-air channels x pay channels); comparison of advertisement intensity and content schedule in platform competition; comparison of welfare between free-to-air and cable channels.	Different revenue sources due to the business model (free-to-air x cable); free-to-air channels have similar contents; cable channels have specific content for specific users.

*several means that is exposed some objects, generally, more than two, using it as examples, and not as the main article focus

6.2 APPENDIX A – Chapter 3

Hardware Sales Equation							
Variable	Symbol	PS3		Wii		Xbox 360	
		Coefficient	Std. Error Pr(> t)	Coefficient	Std. Error Pr(> t)	Coefficient	Std. Error Pr(> t)
(Intercept)	α_0	1,32E+01	2,46E+00 ***	-2,61E+00	6,29E+00	5,24E+00	2,09E+00 *
H_desloc	α_1	-2,46E-01	2,17E-01 0,00E+00	-5,58E+00	1,28E+00 ***	3,00E-08	3,53E-08 ***
Price	α_2	4,06E-03	1,40E-03 **	-1,90E-04	2,38E-03	5,30E-03	1,18E-03 ***
SS.SH	α_3	6,84E-01	3,90E-01 .	2,19E+00	6,67E-01 **	1,25E+00	2,66E-01 ***
SS.MH	α_4	1,19E+00	2,29E-01 ***	4,21E+00	6,28E-01 ***	8,05E-01	2,77E-01 **
NS.SH	α_5	8,85E-01	4,63E-01 .	5,97E+00	1,93E+00 **	1,08E+00	4,73E-01 *
NS.MH	α_6	-1,41E+00	6,93E-01 *	9,31E+00	2,09E+00 ***	-1,01E+00	2,40E-01 ***
Dec	α_7	1,03E+00	8,02E-02 ***	1,36E+00	8,36E-02 ***	1,31E+00	8,81E-02 ***
Age	α_8	-7,37E-03	2,65E-03 **	-4,25E-02	3,00E-03 ***	-1,29E-02	5,62E-03 *
Launch	α_9	1,05E-02	1,50E-03 ***	-4,73E-04	3,35E-03	1,34E-02	1,67E-03 ***
PS3	α_{10}	NA	NA	NA	NA	NA	NA
Wii	α_{11}	NA	NA	NA	NA	NA	NA
Xbox360	α_{12}	NA	NA	NA	NA	NA	NA
R ²							
p-value							

* $p < 0.01$.
 ** $p < 0.001$.
 *** $p \sim 0$.

-
- ⁱ Because the article has already been published some observations about it were done as end notes
- ⁱⁱ Generally in the game development literature it's emphasized the part related to the software development, such as the Agile Methodologies use, instead of the creative activities, like character creation
- ⁱⁱⁱ Clients should be understood as game players
- ^{iv} Extreme Programming is vastly used to develop new games, its approach has many similarities with SCRUM, that is the Agile Methodology chose to be part of the combined model proposed in this research
- ^v Table created to associate the relation between SCRUM stages and its main actors, this association is relevant to better understand the proposed model
- ^{vi} Sloper (2002) has considered games with the possibility of continuous improvement; thus, this approach is restrict to this kind of games and not universal
- ^{vii} The steps of post-launch and post-production may not exist depending on the game that will be developed
- ^{viii} End customers should be understood as game players
- ^{ix} A better sentence is "... is poorly explored in software development methods.", instead of "... is not addressed in software development methods"
- ^x The term multidisciplinary was presented meaning the idea of multiples disciplines or knowledge; however, considering both approaches it could present different meanings, for the Design Thinking case it can be seen disciplines, such as arts, computing, engineering, biology etc., and for the SCRUM it expected that the term is more related to a technical multidisciplinary
- ^{xi} A figure improvement could be done through details addition of all parts of the proposed model
- ^{xii} The Brazilian market is characterized by a growing number of game developers, mainly small companies and they generally develop games for mobiles devices, which in average request less investment and resources (Fleury et al., 2014).
- ^{xiii} The term "games for cellphones" should be understood as games for mobile devices, mainly those for cellphones and tablets

^{xiv} A better sentence is “...has some similarities with characteristics...”, instead of “...fits all characteristics...”

^{xv} Here it considers data for the new game that will be created, but it is expected that game developers has a previous knowledge of their potential customers (players who will buy the games)

^{xvi} Most of game developers declare themselves as possible players of their own game in development, this vision is fair, but it restricts the game public and it is not the best strategy in a competitive market

^{xvii} Agile Methodologies are not completely creativity devoid, but generally it is more focused in the software development area, that is characterized by its technical aspect

^{xviii} Although the SCRUM is the most renowned Agile Methodology among the Brazilian game developers (Fleury et al., 2014); according with an expert, in the Brazilian academy of digital games the Extreme Programming is the approach most effective

^{xix} Interviews were only used to validate the theoretical model, however, to validate this new approach it is necessary to implement it in some projects, as it was proposed as future research

^{xx} This game developers has specifics characteristics, e.g., all of them are Brazilians, they are small companies etc.; thus, it is important not to generalize to all the game developers; this point was presented as a research limitation

^{xxi} Although the AM is diffused between the interviewees, is not clear if they follow all the AM practices; thus, considering it, a future research could explore how they apply Agile Methodologies

^{xxii} Other avenues for future researches are: practical tests with the new approach, aiming to validate it; explore the origins of the game developers, collecting information about the taught content (ex. SCRUM, XP, DT etc.) in some universities or courses of game development