Digital Game Usage Lifecycle: a systematic literature review

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ABSTRACT

The digital game product lifecycle is a model that shows the usage of a game over time, being also called usage lifecycle. This lifecycle includes aspects related to motivational usage, modeling and tendencies of future behavior, providing the opportunity to apply advanced techniques of artificial intelligence to deal with those aspects. The main goal of this paper is to present existing research on game usage lifecycle, identifying the needs and concerns around the management of it, highlighting opportunities for academic researches. A systematic literature review (SLR) is applied with no date restrictions. The SLR found 26 works. It was possible to identify lifecycle models and metrics that constitute them, some game producers' needs and concerns, players' profiles related to the usage and strategies to keep the game "alive". The review identified that game usage lifecycle can be interpreted with two main models: a model with the usage itself (such as the time spent playing), and a model which represents the player motivation. Another finding was the possibility of measuring the players' motivation over the usage lifecycle. In some cases, the motivational model can identify risk situations where the usage model cannot. Some similarities between the game usage lifecycle and the game genre lifecycle were also found. A few papers focused in identifying the actual stage of a game. The SLR also showed a lack of usage data freely available for research use.

Keywords: game lifecycle, game life cycle stages, game product lifecycle and systematic literature review.

1 INTRODUCTION

The game product lifecycle is a model that shows the usage of a game over time, being also called usage lifecycle. The usage lifecycle is not exclusive for games, every software has its own lifecycle with specific characteristics. Besides the development lifecycle, the usage lifecycle starts when it is used for the first time, by its first user. Moore defined in [1] the model for the software usage lifecycle, and being a digital game a kind of software, the game's model curve tends to be similar. Figure 1 illustrates the model. The area above the curve is the number of users over time.

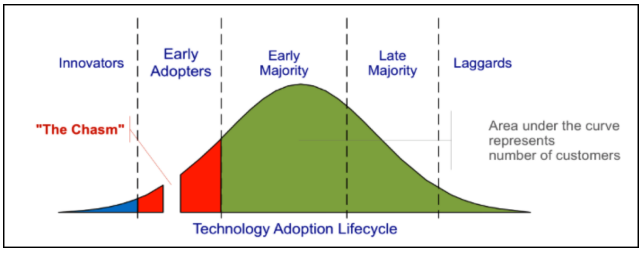

Figure 1 : Software usage lifecycle, extracted from [1].

The model has stages that illustrates the software acceptance by its user. First an initial increase occurs. If the software was not accepted, then "The Chasm" may happen (ending the lifecycle abruptly); otherwise, the usage grows until a top value is reached and after that it starts to decay. Every software has a purpose to exist, and that purpose motivate people to use it. The end of the lifecycle can occur when the purpose does not exist anymore, or there is a better available software that deals with the same problem.

Despite the existence of different kinds of games, common and relevant aspects that surrounds the game usage lifecycle are illustrated and discussed in this paper. One of them is the change on the players' motivation over time. That motivation can be expressed by the players' usage. When a player plays, usage data can be generated, offering a way to try to understand the actual player's feelings. Game producers compute metrics over the usage data to help in the process of decision-making. Decisions are made according to the situation identified (bad or good, details in section 3.3). Some researches applied Data Mining algorithms over usage data to identify and predict the future usage, identifying new perspectives, such as the players' commitment over time.

Besides the usage lifecycle, another important lifecycle associated to games is the game genre lifecycle. The genre is an abstract concept of groups of game mechanisms presented in a game. Understanding the players' motivation associated to those mechanisms is very important, because it can mitigate some risks associated to a new game release (the beginning of the usage lifecycle).

The objective of this paper consists in identifying the state of art about game usage lifecycle. The identified knowledge is used to answer six proposed research questions that help in highlighting opportunities for academic researches. This paper describes aspects related to: models, metrics, players' profiles, game producers' profiles and some researches that worked with usage data. Those aspects can be divided in four main groups, as follow: usage lifecycle metrics and models, players' profile, usage lifecycle management and genre lifecycle (sections 3.1, 3.2, 3.3 and 3.4 respectively). Next, the Systematic Literature Review is described.

2 SYSTEMATIC LITERATURE REVIEW PROTOCOL

The systematic literature review was done applying a protocol which contains the following specifications: research objectives, research questions, keywords, search databases, publication period, search fields, inclusion and exclusion criteria. This SLR was implemented in six main steps:

1. Definition of objectives and research questions.
2. Definition of search databases and keywords.
3. Analysis of keyword effectiveness and search databases credibility.
4. Keyword improvement.
5. Reading of works.
6. Application of inclusion and exclusion criteria.

2.1 Research Questions

The objective of this SLR is to identify models, properties and interests involved in digital game usage lifecycle. In order to

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summarize those aspects, the following research questions were proposed.

2.1.1 RQ1: How is the lifecycle currently defined?

The RQ1 aims at identifying the current game usage models. There are many kinds of game genre, and we want to understand their modeling and behavior.

2.1.2 RQ2: What are the lifecycle stages?

This question aims at identifying the game usage lifecycle stages. We intend to connect the stage with the players' motivational degree.

2.1.3 RQ3: Do stages vary according to the game genre?

The RQ3 looks for possible variations on the stages according to the game genre. It is possible that some stages exist only in certain kinds of games.

2.1.4 RQ4: What are the interests involved in the game lifecycle?

This is a very important question, because it can identify some needs that lead to new researches about this topic.

2.1.5 RQ5: After a game is available on the market, does some monitoring on the lifecycle exist?

RQ5 is an extension of RQ4. After understanding the needs about the lifecycle, one can look how game producers monitor their games through some mechanisms or metrics.

2.1.6 RQ6: Does a measure of which stage a game is in exist?

We advocate that a game usage lifecycle is defined by its players' voluntary usage. The objective of this question is to identify how to measure the actual stage of a game in the lifecycle.

2.2 Research Strategy

Next, the keywords, research databases, inclusion and exclusion criteria and the search method are defined.

2.2.1 Keywords

After reading some papers related to game usage lifecycle, the following keywords were chosen: "game lifecycle", "game life cycle stages" and "game product lifecycle". We also added these Portuguese keywords: "ciclo de vida de jogos", "estágios do ciclo de vida de jogos" and "ciclo de utilização de jogos" in order to include research papers published in Brazil or Portuguese speaking countries.

2.2.2 Search Databases

Initially the following search databases were used for this research: ACM Digital Library, IEEE Xplore, ScienceDirect, SpringerLink, AAAI, GDC (game developer conference), SBGames (Brazilian games symposium), Google Scholar and Gamasutra (a blog about games). The databases of ACM, IEEE, ScienceDirect, SpringerLink and AAAI were chosen because they have Computer Science papers. The databases of GDC, Gamasutra and SBGames were chosen because they are focused in the game field. Google Scholar was chosen as a great collector, because besides academic papers, it also has term papers, thesis, dissertations and registered patents.

After an analysis, GDC and SBGames were removed. GDC was removed because it does not use the same protocol usually applied to academic research, such as peer reviewing. SBGames was removed because its papers are already in the IEEE database. The Gamasutra is a blog in a game field and has many news, some of them are academic researches. Although it does not have the same criteria applied to academic research, we kept this database as a motivational factor, because it has interviews with game producers and academic papers, which have the same focus of this research. The content of Gamasutra help us answer some of the proposed research questions, something that did not happen with the GDC database (focused on game development).

2.2.3 Inclusion and Exclusion Criteria

The exclusion criteria are: works not in Portuguese or English, and works which do not have a link with the digital game usage lifecycle.

The inclusion criteria are: any work which adds knowledge about digital game usage lifecycle, such as: models, variables, metrics, game producers' interests and players' profiles.

2.2.4 Search Method

There was no limit on the publication period. Search in full-text initially using the combination AND for keywords, like, the keyword "game lifecycle" is the occurrence of the word "game" AND the word "lifecycle" in any part of the text.

After a first search, we obtained a total of 6,876 papers, not counting the 35,600 registers returned in Google Scholar (these numbers for only one keyword). Analyzing a sample of papers a lack of papers focused on the theme of this research was identified, and then we changed the search method. The new strategy consisted in searching keywords in its completeness, for example, the paper must contain the sentence "game lifecycle" in any part of the text, not only "game" in one part and "lifecycle" in another one.

The new strategy obtained 90 papers for all the six keywords and presented assertiveness about the content. This new search shows us that this research theme is incipient in the academic community, and motivated us to explore more the field.

2.3 Summary of Works Found

After applying the research protocol, the results were obtained as shown in Figure 2:

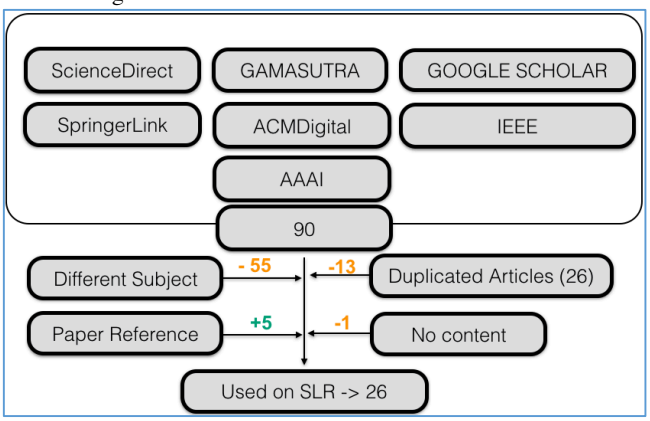

Figure 2 : Summary of found and accepted works.

Among the 90 works returned, 13 was duplicated and one had no content (from Google Scholar). After that first selection, the papers, thesis, dissertations and interviews were read and then 55 was discarded because they do not fit the inclusion and exclusion criteria, resulting in 21 works accepted. After executing an analyze about the accepted papers references, five more papers were added because they presented interesting aspects related to game usage lifecycle, such as the software lifecycle from Moore [1]. The final number of accepted works was 26. For each work, its name, source (academic or professional), authors' country, affiliation and year of publication are described in Table 1.

Table 1: Details of accepted works.

Work Name	Source	Authors' Country	Affiliation	Year
Crossing the Chasm.	Academic	USA	HarperCollins Publishers	1995
Different Approaches to Implementing Player Centered Game Design: A Comparison Study.	Academic	Western Australia	Murdoch University	2007
Heretic Kingdoms: Reluctant Hero - Designer Diary.	Professional	UK	iHobo	2006
The business and dynamics of free-to-play social-casual game apps.	Academic	USA	MIT	2012
The monetary value of virtual goods: An exploratory study in MMORPGs.	Academic	China and Singapore	Huazhong University of Science & Technology and National University of Singapore	2010
Exploring the Online-Game Life Cycle Stages.	Academic	China	Fudan University and east China university of science and technology	2010
Dynamic difficulty controlling game system.	Academic	South Korea	Chung-Ang University	2007
NPD: More Kids Playing Games, PC Play Dominates.	Professional	USA	Gamasutra	2007
MMO Chat: Scott Hartsman.	Professional	Canada	Gamasutra	2011
IGN Announces In-Game Ad Technology Launch.	Professional	UK	Gamasutra	2005
NetEase Revenues Rise On Strong Online Game Performance.	Professional	USA	Gamasutra	2009
Focus On Korea: T3's Kim Talks Hitmaking With Audition.	Professional	USA	Gamasutra	2008
The Circle of Life: An Analysis of the Game Product Lifecycle.	Professional	USA	Gamasutra	2007
Neo-rogue and the essence of rogue likeness.	Academic	Poland	University of Lodz	2013
Mobile Gaming in Vietnam: Launching and Marketing Perspective.	Academic	Finland	Kajaani University of Applied Sciences	2015
HoneyTracks game analytics.	Professional	Germany	HoneyTracks	2012
Predição do Estágio de Nicho em Jogos RPG Massivos de Multijogadores utilizando o Comprometimento.	Academic	Brazil	Pontifícia Universidade Católica do Paraná	2016
Understanding repeat playing behavior in casual games using a Bayesian data augmentation approach.	Academic	USA	University of Houston	2017
The peculiar problems of the gaming industry: customer retention in MMOPRGs.	Academic	Iceland	Reykjavik University	2017
Crime scene reconstruction: Online gold farming network analysis.	Academic	South Korea and USA	Korea University, State University of New York at Buffalo and Soonchunhyang University	2017
Understanding the videograme genre: a qualitative analysis of the "playing contract".	Academic	Romania	University of Bucharest	2015
Games without Frontiers. Theories and Methods for Game Studies and Design.	Academic	Finland	University of Tampere	2007
Akquisition und Kundenbindung. In Holland H. (Eds) Digitales Dialogmarketing,	Academic	Germany	Leinfelden-Echterdingen	2014
Building and sustaining PROFITABLE customer loyalty for the 21st century.	Academic	USA	University of Connecticut	2004
A Key Risk Indicator for the Game Usage Lifecycle.	Academic	Brazil	Pontifícia Universidade Católica do Paraná	2017
Principles of Marketing	Academic	USA and UK	Harvard University, Chicago University, University of Sussex, Royal Holloway University of London and University of North Carolina at Chapel Hill	2002

3 RETRIEVED WORKS

This session shows the knowledge returned from the retrieved works. These works contain information about: models, metrics, game producers' needs, players' motivational stages, usage lifecycle management and game genre lifecycle.

3.1 Usage Lifecycle Metrics and Models Overview

Digital games are usually software-profit, and the game producers aim at keeping the maximum quantity of active players as possible. There are many kinds of game genres and players' profile, but despite of that, games are basically available in two main ways: for "free" or paid. Speller in [4] showed that some games are sold in the "shelf" (physical or virtual store) and the player must buy it to play. Another strategy for paid games are monthly payments, where the player has access to the game for a time-span after paying for it. The other way to provide the game on the market is for "free". This strategy consists in distributing the game for free and offering paid services in an internal virtual market. The "free" strategy enables the player to start to play without any payment, different from the other strategies, where the player must pay to play. As showed by Speller, "shelf" games tend to have a high level of sales in the beginning of commercialization (first few weeks). On the other hand, monthly payment and "free" games have their revenues varying over time (months). Figure 3 illustrates the sales of a "shelf" game (Call of Duty: Black Ops) and in Figure 4 monthly payment and "free" behaviors are illustrated (those games are from the game producer called Zynga). It is possible to identify that there is a different behavior between these two figures, where in the first one the sales are higher in the first weeks and in the second one where the profit comes over months.

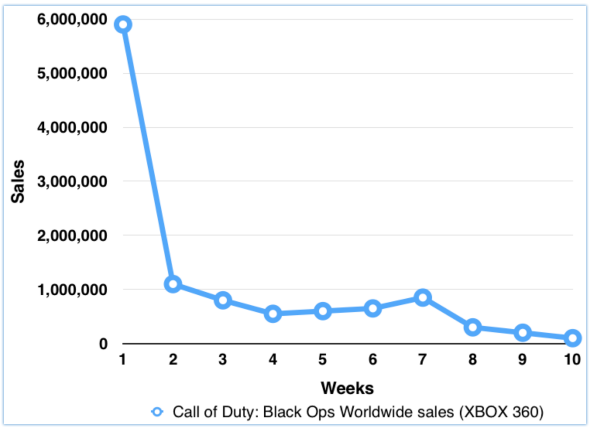

Figure 3 : Call of Duty: Black Ops Sales, adapted from [4].

The behavior illustrated in Figure 1 presents an initial acceptance, growth of users until a top value, a decay of usage and after that the end of the lifecycle. That behavior can be identified in the games with monthly payment and "free" availability (Figure 4 for example). It is possible to fit the Moore's model [1] into the Figure 4 behavior. Initially, there is a growth of players (acceptance), a top of usage and then a gradual decay over time. Despite that behavior fits in that description, the same does not occur in the case of "shelf" games (Figure 3) where the top value is in the beginning of commercialization. However, "shelf" games could have higher profit in the beginning, monthly payment and "free" games have their profit overtime. It is common that monthly payment and "free" games have more players than the "shelf" games, but it is not necessarily the best marketing strategy. In the case of "free" games, from 1% to 3% of their active players use the internal game market (1% to 3% are profitable) [4].

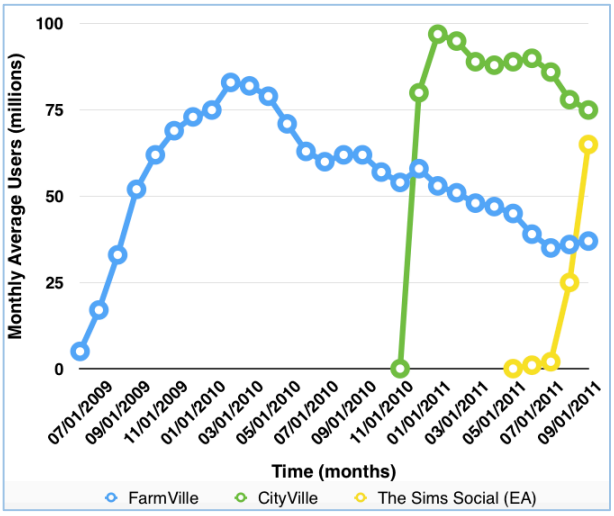

Figure 4 : Monthly Active Users from FarmVille, CityVille and The Sims Social ("free" games), adapted from [4].

The research presented by Wang and Mayer-schonberger [5] studied the "player speed" in usage lifecycle of MMORPGs (Massively Multiplayer Online Role Playing Games). This kind of game is usually provided through monthly payments or for "free". Wang and Mayer-schonberger identified that players who pay tends to leave the game earlier than the player who does not pay, because who pay consumes the game content faster. Wang and Mayer-schonberger showed that the financial end of the game Lineage II could be identified based on the internal transaction of real money, through a metric called RMT (real-money trading).

The game FarmVille was one of the most successful "free" games and one doubt that came with that success was "how will be the future behavior?". Speller studied in [4] many metrics that could illustrate the usage lifecycle of that game and proposed a dynamic system that could, given some inputs, return a result of a possible usage behavior. Wang and Mayer-schonberger also identified in [5] the main metric used by game producers to analyze the usage lifecycle, the metric named MAU (Monthly Active Users). Figure 5 illustrates the FarmVille's MAU behavior. Besides MAU, Speller also identified the following metrics:

- Rate of new users per month: that metric can be influenced by advertising and the actual mood degree of its players. "Shelf" games have a fast decay of this metric over time.
- Rate of conversion of free users to paid users (players who started to pay) per month: this metric represents a strong acceptance signal. The player starts to learn faster. "Shelf" games do not have this property.
- Abandonment rate per month.
- Average player lifetime.
- DAU (daily active users).
- MAU (month active users).
- MUU (month unique users).
- Sticky factor = DAU/MAU. That factor defines the adherence of players to the game.

"Free" games are usually on-line and that characteristic helps in collect metrics like DAU, MAU and MUU. On the other hand, "shelf" games are usually off-line, making it difficult to obtain those metrics.

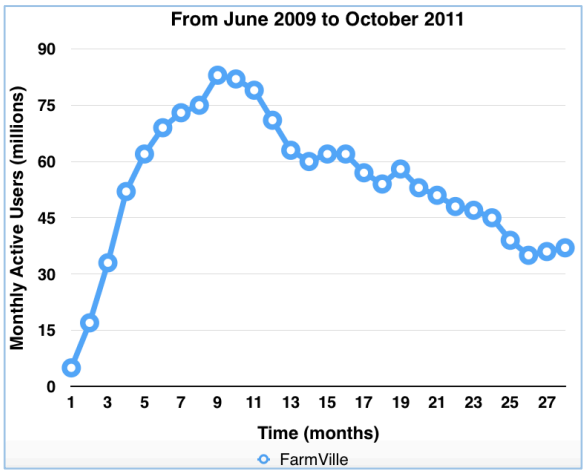

Figure 5 : FarmVille's MAU adapted from [4].

The final product of Speller [4] could be applied to games that have usage data collection procedure. It consists in a dynamic system that can simulate future behavior of MAU based on the metrics extracted from usage data. Figure 6 shows different scenarios for FarmVille (an optimistic, a pessimistic and a normal forecast).

Like Speller in [4], the approach applied by Hui in [18] consisted in evaluating the changes on DAU and MAU behavior over time for casual games. Hui could identify that daily incentives help in increasing the income.

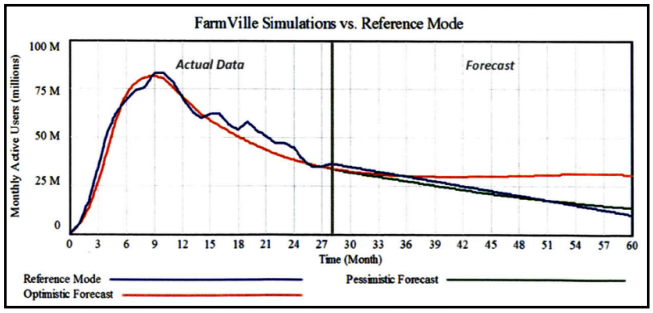

Figure 6 : MAU's simulation, extracted from [4].

A research that focused in identifying risk situations in the usage lifecycle based on the players' attachment was the research of Kummer and colleagues [25]. They used the same commitment measure of [17] to propose a new Key Risk Indicator (KRI) which illustrates the increase or decrease of players' motivation over time through the application of Data Mining algorithms. Kummer et al. identified the players' motivation associated to game upgrades and compared to the MAU behavior. They could identify that in some cases the MAU cannot identify a risk situation where the proposed KRI can [25]. Figure 7 shows a situation where the MAU increases after a game upgrade and the KRI decreases (2008-10). In that situation, looking from the MAU's perspective, the risk situation will be first identified in the third month after the upgrade, because it is when the number of active players becomes lower than the number before the upgrade. From the KRI's perspective, in the upgrade month a risk was identified, because the players' motivation continued to fall. The proposed KRI varies from 0 to 1, where 1 means the best players' motivation of the series.

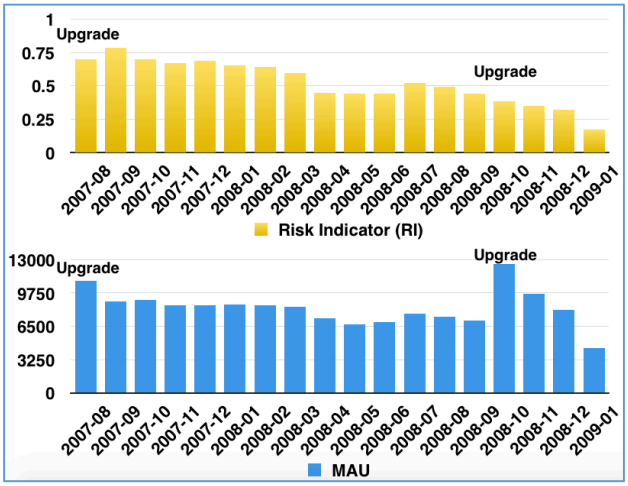

Figure 7 : Comparison between the MAU and the KRI perspective, adapted from [25] (usage data from World of Warcraft).

3.2 Players' Profiles Overview

The players' profile was the object of study of Zhu and colleagues in [6]. They interviewed players from an MMORPG about their feelings and motivations and, based on that, they identified four motivational stages.

The first one is the Try stage. In this stage, the player is very curious and starts to discover if his or her expectancy will be met. If a bad feeling exists the player can give up, even if there are unseen contents that could please the player.

The second stage is the Tasting stage. Now, the player spends more time playing, exploring his or her options and accumulating "profit" (e.g., items, levels, friends, objectives, etc.). In this stage, the player already learned the basic mechanisms and start to chase more complex mechanisms. Easy activities do not please the player anymore.

The third stage is called Retention. The player is no more in "love" with the game. Although the game is not more interesting, the player is still playing because his or her friends play. For the game producer, this is a critical stage, because it is necessary to make decisions to reanimate the players (e.g., releasing game upgrades), otherwise, the abandonment will occur.

The last stage is the Abandonment. The "love" in playing the game drops and the player spends less time playing. It is very important that the game producer takes care of the game. Bugs and illegal scripts can exist. Players who uses it can destroy the gameplay quality of the correct players. The game can become a "no man's land".

The lifecycle is related to the time that a player spends playing. The average lifetime of an on-line game is from two to five years. Usually, the players pass from these four stages detailed previously ([6]); however other ways can exist, such as:

- Frustration: the player's high expectancy is not met. In this case, the player leaves the game in the first stage (like "The Chasm" of Moore [1]).
- Frustration and encouragement: the player's high expectancy is not met, but the player does not leave the game because other factors changed his or her mind (e.g., friends).
- Too much interest: the player pass through the three firsts stages very well, but if the game does not provide any new content, the player will leave quickly.

People has distinct physical and psychological abilities. A game that is easy for one person could be difficult to another one. To deal with this situation, games usually have an internal mechanism to set the game difficulty; the problem with this approach is how to define what is easy and hard without a subjective point of view. Um et al. proposed in [7] an automatic mechanism to set the game difficulty based on two metrics: FDC (factor of difficulty control) and FUA (factor of user adaption). With this automatic control, the game stays interesting for a longer period, improving the duration of the usage lifecycle.

Some games have a lifetime smaller than the development time due to the static game mechanisms (the game difficulty does not change, or it is too much easy or too much difficult). This problem can be identified through the Um et al. [7] solution, comparing the actual ability versus the actual difficulty with the ideal ability versus ideal difficulty.

One aspect that influences the player's ability is his or her age. Kids have a high degree of learning; however, they have difficulty in managing complex activities. Alexander made available in the GAMASUTRA website [8] a research that illustrates the preferences of games and platforms for children over their youth. Kids usually start playing in PC and in mobile devices and then migrates to consoles. They play few hours per week, 39% are on-line games with 91% of "free" games. From 6 to 8 years old, kids start to become serious players. That age is good to captivate future players. Linked to that idea of players' preferences, the work of Thanh in [15] describes some game genre preferences between different countries.

An interview with a game producer CEO made available by Ludgate in [9] shows some concerns about the entire lifecycle of MMO (massive multiplayer on-line) games. The CEO highlights that the motivational factor of the players is very important to the

success or failure of a game. A player must feel that he or she is evolving, achieving objectives and completing challenges that are not trivial.

The retention of players was studied by Müntner in [19]. In her studies, she identified some aspects such as when a player is buying a new game, he or she has a degree of mistrust that can generate unmet expectations [23]. The greater the confidence with the game the greater the chance of fulfilling the expectations [26]. Good experiences increase the chances of players buying new games from the same game producer [26]. Müntner highlights that a player must be more than a satisfied user, he or she must be a fan, because a fan can create other fans. Kotler et al. identified in [26] that the cost in maintaining the active players is lower than the cost of acquiring new players, and because of that, retention is a very important priority to game producers. Blum illustrated in [23] five types of player retention:

- Local retention: players stays loyal to the game because their actual location or position is relevant (e.g., a level in a RPG).
- Contract retention: players stay loyal because of a contract.
- Economic retention: the application of pricing and value merits are economic ways of keeping players loyal.
- Technical retention: the game offers innovating mechanisms that please the players.
- Emotional retention: the player has a high trust, personal relationship (with employees too) or customer satisfaction inside the game.

An approach described by Kumar and Shah in [24] was a loyalty system. That system gives to the players some bonus and prides based on their usage helping in that way in "feeding" the players' motivation.

As the players are the main element of the lifecycle model, Stewart showed in [2] the relevance of designing a game based on the player (target audience). Aspects as the learning curve and the interest of the players are important to keep the lifecycle as long as possible. The focus on the players must occur before, during the game development and after it. It is important to identify in the market the players' needs, and then create a game based on it. The internal game mechanisms must be easier to understand, as well the possible bugs must be treated. A satisfied player will tend to keep playing the game and to buy new games of the same genre when they are released.

One of the most abstract player profile is the illustrated by Bateman in [3] which refers to the casual and the hardcore players. The casual player is the opportunistic player. That player will play when he or she is waiting in a queue of a bank, for instance. Casual players will not play for many hours and have interest in playing games with easy learning and fast matches. On the other hand, hardcore players like challenges, they "live" the game, spend many hours playing and like to become experts in the internal game mechanisms. Independent of the player profile, as more players a game has, more profitable the game is, therefore it is very important that game producers try to captivate the maximum numbers of players as possible [21].

Those reports show that game producers must know their target audience to keep the players playing as long as possible. Independent of the type of the game, players must feel well and motivated to play, and game producers must look at it to identify good or dangerous situations. Identifying the actual motivational stage of the players is a valuable information that helps in keeping the lifecycle alive.

3.3 Usage Lifecycle Management Overview

Another concern besides keeping the active players is the generation of new players. The new players rate has variables that affect it, such as: marketing, word of mouth (the act of spreading good news to other people) and players' interest. A strategy that has got success in the availability of games is called game platform [4]. Those platforms offer links between games and easiness for game management. Now, a player has an account that can access many games, different from before, where the player "see" only one game at once. The platform provides an easy way where a player migrates from one game to another, play a demonstration of a game, receive advertise and receive a motivational bonus (contacting a player when he or she starts to demonstrate disgust can change the player's mind [4] [19] [24]). The platform can be used as a tool by the game producers to try to control the flow of users between games. Even if a player leaves a game, he or she stays in the platform, receiving news that can motivate he or she again. There are companies that works only with this kind of platforms [10].

As some of the game producers' concerns about the usage lifecycle were identified. Some companies started to specialize and to offer assistance to game producers to deal with specific metrics. Honeytracks [16] is an example of a company that works with it. It evaluates the game characteristics and then starts to follow the behavior of the usage lifecycle through some metrics. The game producer defines a target value for a metric and then the Honeytracks company offers solutions. For example, if it is desired to grow the MAU, metrics like: rate of conversion of free users to paid users, the cost to obtain a player, demographic and geographic data are observed and then some decisions are proposed. If the reduction of the abandonment rate is desired, then the following metrics are observed: MAU, player usage time, average player usage time and abandonment rate.

A good lifecycle management is not necessary only when dangerous situations are identified (e.g., abandonment rate greater than the new player rate), it is also necessary when good situations are identified (e.g., high profitability). The good lifecycle management helps in obtaining the maximum possible benefit or in taking advantages over this good situation. Graft showed in [11] a case from a Chinese game producer (NetEase) who had got too much success with its games that new strategies became necessary to deal with the positive situation (e.g., provide its games in other platforms). NetEase gained a good income due to the longevity of its games which have loyal players and a great on-line community. Like the case of NetEase, Sheffield and Alexander showed in [12] an interview from an CMO from the company T3 that had got success with a dance game and decided to take advantage of the good situation. The CMO wanted to provide the game in other platforms, aiming at captivating potential players and prolonging as long as possible its game usage lifecycle.

The generation of new game content is a strategy to motivate the active players in continue playing [4] [25]. In some moments, the release of a new game version could be profitable or necessary, it depends whether the game is showing signals of a possible decay of usage or it is already decaying. In other cases, a release of a new game could be desired, and related to that, Speller identified in [4] a situation called self-cannibalism where the new game "eats" the players of the older one. It is illustrated in Figure 8. It has a good perspective where the new game gains many players faster and a bad perspective because it helps in ending the previous game lifecycle.

In some games with internal economies where players can buy and sell products through virtual money, a problem that affects a great number of players can exist. Sometimes, "bad players" (bad guys) sell the virtual money for real money to other players, affecting the internal game economy and the balance between the players. This problem occurs (with a certain frequency) in

MMORPGs [20]. The players that sell the virtual money for real money are called Gold Farmers. Game producers seek and ban the Gold Farmers, but it is not an easy challenge, because Gold Farmers are a group of players with a high hierarchy system. The study of Kwon and colleagues [20] proposed a way to identify the hole group of Gold Farmers with their hierarchy, helping game producers to deal with this kind of "bad player". It is interesting to notice that the most important aspect of a game (its users) can be a problem, depending on their behavior related to other players.

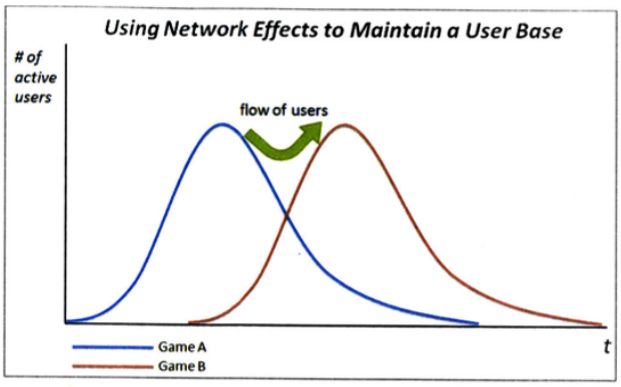

Figure 8 : Example of self-cannibalism, extracted from [4].

3.4 Game Genre Lifecycle Overview

There is another factor that influences the usage lifecycle, the genre lifecycle. Cook defined in [13] a game genre as games that share the same mechanisms of risk and award, like: sport, race, first person shooter, strategy and RPG games. Căşvean [21] also studied about the game genre, and showed that one game could belong to many genres (considering a genre as an abstract concept that represents a set of characteristics). Căşvean described that genres could be formed by a set of existing genres. Järvinen described in [22] that a genre is a subjective idea that is found "in the junction of game themes, system behavior, emotions and moods". Cook collected the number of games developed over time and identified some patterns. Figure 9 shows the games released from 1981 to 1995 for the genre "Action Platformer".

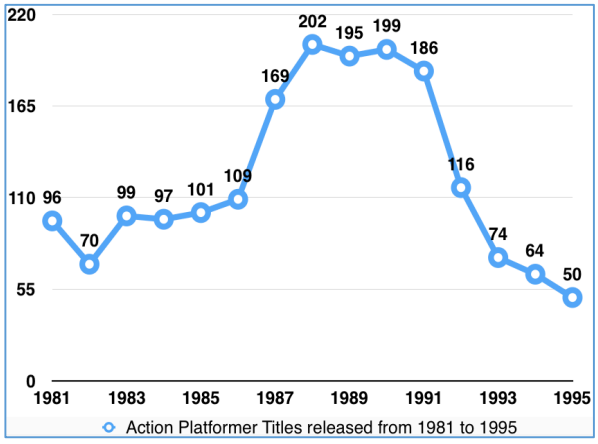

Figure 9 : The quantity of action platformer games released, adapted from [13].

Cook defined the model presented in Figure 10 for the game genre lifecycle.

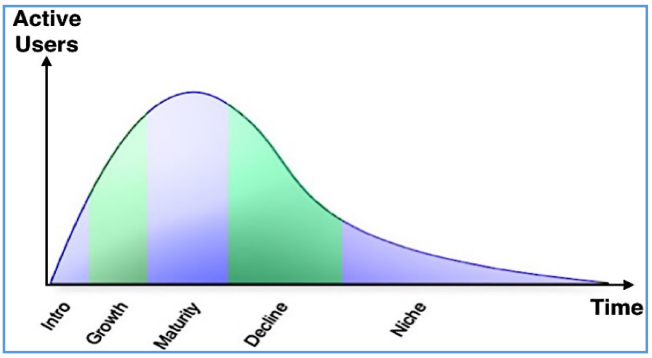

Figure 10 : Game genre lifecycle stages, adapted from [13].

It is possible to identify similarities between the software lifecycle [1], the usage lifecycle (MAU's representation) [4] and the genre lifecycle [13]. All models have an initial grow, a stable period and then a gradual decay. It is possible to assimilate the natural human degree of interest with the behavior illustrated on those models. The genre stages were defined as:

- Introduction (Intro): game mechanisms are innovative and generate curiosity.
- Growth: the public accepted the genre and more games of that kind were developed.
- Maturity: great game producers adopted the genre. Căşvean in [21] described that sticking genres in that stage (maturity) lowers the risks involved in developing a new game.
- Decline: fewer games are developed over time. The genre attracts fewer players than before.
- Niche: there is no financial return, great game producers leave the genre and some games are maintained for love and not for money.

Another finding of Cook was the relation between the players' profile and the genre lifecycle stage as follows (players tend to specialize in a genre they like):

- Initial learning: player learns the game mechanisms, according to the ease of use and the understanding about the game, the player accepts or not the new genre.
- Master: the player dominates and understands how the game mechanisms work.
- Tool: the player uses the game mechanisms more as a tool to achieve his or her objectives.
- Burnout: the game mechanisms do not please the player, and do not provide any more objectives to achieve.

Cook also identified a relation between the players' abilities and the genre lifecycle:

- New Players: a new experience of learning and fun.
- Mature Players: knowledgeable of game mechanisms. Efficient in achieving objectives. The player is a follower of the genre. If a game of interest does not provide new versions, the player looks for other similar games in the same genre.
- Niche Players: lack of interest. The player loses his or her ability. They can be characterized by three types:
    - Fire keeper: the player does not give up the genre, and stays playing.

- Lapsed player: new live objectives prevent the player to play, and his or her abilities drop.
- Players with no network support: players who found the game for the first time with no references, although this game can be obsolete at the time.

As a conclusion, Cook highlights the importance in understanding the target audience profile of a game genre, because it helps in identifying players' behavior tendencies.

It is crucial to associate the game usage lifecycle with the genre lifecycle. The genre lifecycle refers to the conceptual idea of the game mechanisms, and it can be a bad idea developing a new game who has its concepts (genre) old and without great interest of its target audience. One alternative to deal with that consists in changing the mechanisms of risk and award that define the genre. Garda studied in [14] the creation of new genres. On her studies, she identified that a genre can be created based on another genre or from a new idea, starting a new game genre lifecycle.

A study that aimed at identifying the actual stage of a game was the study of Kummer et al. [17]. They proposed a new measure called commitment. For each player, this measure is computed based on the time spent playing and in the achieved score (through Data Mining algorithms). They defined three commitment degrees, as: low, average and high. For each time-span (e.g., monthly or daily) the quantity of players on each commitment degree is computed and then the Niche identification is applied. Based on the work of Cook [13], Kummer and colleagues defined the existence of Niche when the number of high committed players are bigger than the number of low committed ones. Figure 11 illustrates the relation MAU versus Commitment Degrees over time. It is possible to identify that the number of low committed players (new players) follows the MAU's growth, however the number of average and high committed players do not. The months where the Niche stage were detected are described in Table 2 (the first detection occurred in the 28th month of the series; the last month of the series is the 37th).

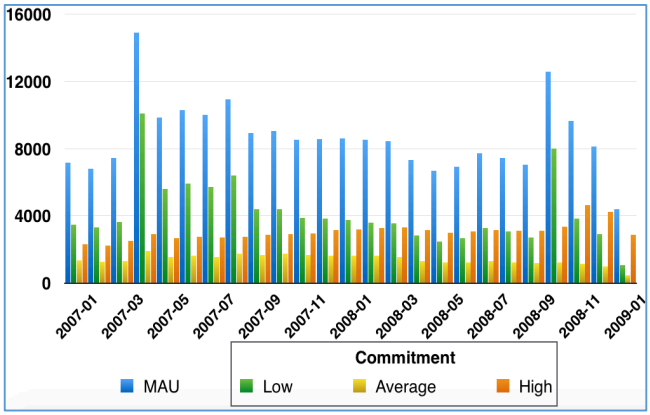

Figure 11 : MAU and commitment behavior over time, adapted from [17] (usage data from World of Warcraft).

Table 2: Niche month summary, extracted from [17].

Month Count	Month	Stage
27	2008-03	Other
28	2008-04	Niche
29	2008-05	Niche
30	2008-06	Niche
31	2008-07	Other
32	2008-08	Niche
33	2008-09	Niche
34	2008-10	Other
35	2008-11	Niche
36	2008-12	Niche
37	2009-01	Niche

In Table 2 is possible to identify that after the first appearance of the Niche, it does not occur until the end continuously. In 2008-10 an upgrade interrupted the Niche situation, however it was not good enough and the Niche occurred again in the next month. In 2008-07, the Niche was not identified, probably due to the vacation month.

4 Results and Discussions

In this section, the research questions are answered based on the content of the discussed works. Some implications and limitations are also discussed. At the end, the conclusion and some opportunities for future research are highlighted.

4.1 RQs Answers

Next, each research question is answered.

4.1.1 RQ1: How is the lifecycle currently defined?

The models identified by Moore [1] and Speller [4] present similarities. Basically, there is an introductory stage (acceptance), a growth of usage (user experience increased) and a gradual decay.

The game lifecycle is "fed" by the voluntary usage, and that motivation in continuing to play is influenced by the game producers' decisions (e.g., release of new game contents). Game producers aim at keeping their players entertained and motivated, creating a relation of necessity between the players and the game.

The end of a game usage lifecycle can occur in two main ways: when the game is not profitable or when there are not active players [4]. "Shelf" games have their profit in the beginning of the lifecycle and as they are usually off-line, they do not have costs with bugs correction. The end of "shelf" games lifecycle occurs when there are no active players. Monthly payment and "free" games have their profit over time, and usually have costs with upgrades and bugs corrections. Therefore, even when there are active players, the game producer could choose to end the lifecycle because it is not profitable as it was before.

4.1.2 RQ2: What are the lifecycle stages?

The usage lifecycle stages can be divided in two perspectives: one for the game producer and another for the players. With the game producers' point of view, the main objective consists in following the value of some metrics (such as: new players rate, abandonment rate and profitability) to identify good situations (e.g., new player rate greater than the abandonment rate) or risk situations (e.g., abandonment rate greater than the new player rate). From the players' point of view, their motivational factor is the main aspect.

The stages from the game producer perspective are: introduction (beginning of commercialization), growth (increase of active players), stability (number of active players is stable), decline (drop of active players) and end (game is not profitable or there are not active players). The stages from the players are: try, tasting, retention and abandonment.

It is possible to relate the players' stages with the game producers' stages, where: the players' try stage relates to the game producers' introduction stage, because both stages illustrate the beginning of commercialization and the first players' experiences (acceptance). The players' tasting stage is related to the game producers' growth stage, because on those stages, the number of active players grows together with the game acceptance (players start to consume the game content faster than before). The players' retention is related to the game producers' stability, because the number of active player stays stable and a disgusting sentiment starts in the players' mind. The game producers' decline and end stages can be related to the players' abandonment stage, because all those stages refer to the lack of motivation in continuing playing, leading to the abandonment.

We understand that the genre lifecycle stages identified by Cook in [13] can be assumed as game usage lifecycle stages, because those stages describe players' profiles like the profiles described by Zhu and colleagues in [6]. In that research line, Kummer et al. in [17] proposed a method to identify when a game is in the Niche stage. Their method is based on an also proposed new metric called commitment. They based their research on the Cook's work.

4.1.3 RQ3: Do stages vary according to the game genre?

There were found no differences between the lifecycle stages according to the game genre. There were identified some distinct motivational behaviors over the usage lifecycle [6]. As described by Zhu and colleagues in [6], the motivational stages are: try, tasting, retention and abandonment. If a game has a great number of players in the beginning of commercialization, the try stage tends to be longer. If the try stage has many players that accepted the game, then the tasting stage will be longer. If the game producer could keep the motivation of the players in the try and tasting stages, the retention and abandonment will occur later.

There are also catastrophe situations when the game is not focused in the players. A game could be attractive in the beginning and soon provoke a stampede. A game could be not accepted (not pleasing the player) or have its content consumed fast. To avoid this problem, game producers are very concerned in trying to keep alive the "flame" of interest of their players.

4.1.4 RQ4: What are the interests involved in the game lifecycle?

The interests involved in the lifecycle can be divided in two groups: the players' interests and the game producers' interests. The players want the game to stay interesting as long as possible, in order to continue having fun. The game producers want profit, and it is directly related to the quantity of players. Therefore, meeting the expectancy of players longer as possible is the main interest around the game usage lifecycle.

4.1.5 RQ5: After a game is available on the market, does some monitoring on the lifecycle exist?

Yes, it does. The monitoring about the lifecycle is mainly done through the following metrics: DAU (daily active users) MAU (month active users), MUU (month unique users), total of users and profitability [4]. Those metrics are observed over time, identifying rates of increase or decrease. The game producers use these metrics to define strategies to improve the total period of the lifecycle (based on empirical experiences [4]). Sometimes, specific metrics are treated at once.

The academic researches of Kummer et al. [17] and [25] proposed new ways to take care of the lifecycle from a motivational perspective, not looking only for the number of active players, but looking at their commitment to the game.

4.1.6 RQ6: Does a measure of which stage a game is in exist?

Yes, it does, but it is a subject with many opportunities for future research. Kummer et al. in [17] associated the genre lifecycle with the usage lifecycle and proposed a method to predict when the Niche stage is occurring based on a proposed metric called commitment. They deal with only one of many lifecycle stages, opening opportunity for other researches to try to identify the remaining stages.

In the other hand, companies like Honeytracks [16] aims at helping game producers in increasing good metrics and decreasing the bad ones. However, they do not present a systematic method to identify in with stage a game is in.

4.2 Implications for Research and Practice

We could identify some interest and concerns that exist in the players' mind and in the game producers' mind. The players' interests consist basically in entertainment and in continuing to play a funny game (through his or her motivation). The players' motivation varies according to the game producers' decisions which are done based on the usage metrics focusing in the profit. However, the game producers' decisions are made more by an empirical way, than based on a systematic method [4].

We understand that the metrics used to model the usage lifecycle, such as DAU (daily active users), are keep in the "safe box" of the game producers, because it is a valuable information. Unfortunately, it adds a certain difficulty to start a research about usage lifecycle. The lack of usage data is a great problem. The use of artificial data leads to results not as credible as the results of real usage data.

New researches about usage lifecycle may improve the game producers' management. The access to a very detailed usage data can start researches about modeling players over time, helping in identifying good or risky situations through many perspectives, such as the KDD (knowledge discovery in databases) one.

4.3 Review's Limitations

All the lifecycle models identified in this paper have the same behavior, the only difference was the duration of each lifecycle [4]. Therefore, it is possible that other models and behaviors exist, illustrating stages that have been not identified yet. As shown by Speller in [4], sometimes a game with great success arise, and the future behavior of that game becomes unknown due to its distinct usage data. It foments the fact that there are many models to be identified. Currently, games are not limited to physical distribution and it can represent another kind of usage lifecycle model not presented in this paper (maybe mixing business models like shelf, "free" and monthly payment strategies).

4.4 Conclusions and Future Works

This SLR investigated aspects which model the game usage lifecycle. Models, usage metrics, players and game producers' interests and concerns and game producers' strategies were identified. The relation between the players and the game producers were described.

Similarities between the software lifecycle [1], the usage lifecycle (MAU's representation) [4] and the genre lifecycle [13] were identified. The main common factor was the players' acceptance and its usage. Players are voluntary users, therefore the actions made by the game producers must aim at keeping alive the

players' motivation in continuing to play, by offering entertainment.

The interviews with game companies showed their interests and some actions made to manage the usage lifecycle. Based on the SLR findings, the six proposed research questions were answered. Those answers helped us in identifying some possible future works, such as: the lifecycle simulation, the automatic detection of good or risky situations, the identification of the actual game stage (on the fly), the identification of when an upgrade should occur and the prediction of future player motivation. All these future works can offer a challenge for researchers and advances for game producers and players.

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