Challenges in Requirements Engineering for Mobile Games Development: The Meantime Case Study

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Abstract

The development of new market-driven software products involves several challenges for the requirements engineering process. The challenges are deeper in the case these products are mobile video games. In particular, the mobile games must satisfy a number of critical non-functional requirements (e.g. portability, gameplay, emotional issues). In addition to that, mobile games are developed for mass market, demanding from the development team to understand the requirements of very diverse and sometimes unknown groups of stakeholders. This paper presents the experience of Meantime, a global mobile game developing company, in conducting requirements engineering activities during the development of the Frogman game. It also presents some lessons learned in the process.

1. Introduction

The development of market-driven software products has gained increased interest from researchers and practitioners. These products have to satisfy different and distributed customers who may have very different needs. Commonly, real customers and final users are only identified after the software is implemented and available in the marketplace [2]. As a result, developers have to build products without having much information about customers and final users. This is a radically different view from bespoke software development where companies develop systems from scratch for known customers from the corporative market. The requirements engineering (RE) for market-driven products presents novel challenges compared to custom-specific RE [15]. In this paper we investigate a particular type of market-driven software product – mobile video games. As we will discuss through the paper, mobile games development presents several distinctive challenges to requirements engineering practice.

Video game is a fast growing industry, with revenues comparable to the film industry. According to Juniper Research [7], global mobile game market had global revenues of $3.1bn in 2006 and it is estimated to reach $17.6bn by 2011. The Asia Pacific region has dominated this market since its beginning. The mobile game supply chain includes mobile game developers, publishers, wireless carriers, brand owners and licensors.

Contrary to most of the software applications, no one is obliged to use a video game. This simple fact has a lot of consequences. Particularly, the game must provide a good *gameplay*, i.e., the capacity of seducing the player to be deeply involved with the game [10]. Good gameplay is central to success of the game and providing it is a big design challenge, since it includes various issues, from balancing tens of parameters, to forecasting user's evolution in the game [10]. In short, the attractiveness of a game is closely related to emotional attributes like fun and enjoyment [17]. However, measuring the level of player's enjoyment is rather difficult. This is certainly due to the subjective and hedonic nature of enjoyment [12].

Games for mobile devices are targeted to a wider audience than console or PC ones [5]. Users of mobile games have various profiles. They may not be hard-core gamers, who spend hours playing games. Instead, they are likely to play casual games as a way to fill 'dead time', to entertain themselves with easy to use but amusing games. Casual games have a few simple rules and an appealing game design. Often the game lasts few minutes and may be interrupted at any time. Game

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developers have to design games to attract the interests of different groups of players.

In order to attain significant market share, mobile game developers must also make their games available to a variety of handsets and wireless carriers [20]. This means that mobile games must satisfy stringent porting requirements. In addition, games targeting a global audience have to be adapted for different markets and cultures. This is both a constraint and an opportunity. On the one side, the game must be available in several languages, adhere to particular regional requirements and developers have to orchestrate complex distribution channels. On the other side, the increasing number of mobile phone subscribers, especially in developing countries, represents a huge unexplored consumer market.

Besides the distinct market and user issues involved in the mobile game landscape, the software development process also presents several challenges. Games are developed by a multi-disciplinary team of developers, game designers, visual artists, musicians, producers and testers. Mixed teams are known to be difficult to coordinate [6]. Besides that, time to market is a critical constraint; typically, the mobile game development cycle is very short, lasting between 4-6 months.

This paper aims to identify and discuss requirements engineering challenges that are highly relevant for mobile games industry. We report a study conducted at Meantime, a mobile game developing company based in Recife, Brazil. In the next section, we describe related work. In section 3, we present the Meantime experience in eliciting and specifying the requirements for the Frogman game. In section 4, we discuss insights and open issues.

2. Background

Given that mobile games are products developed for mass market, it is difficult to explicitly specify the game features that will attract such diverse and undefined set of potential users. Potts [2] suggests that requirements for off-the-shelf software products are invented rather than fully elicited from customers and users. Hence, satisfying user expectations is a hard task and demands considerable degree of creativity and market understanding. The importance of creativity in the requirements engineering process has been previously studied by Maiden and colleagues [14]. They suggest that traditional requirements engineering approaches, with its focus on elicitation, specification and management activities offer limited support to designing creative products.

Video games are good examples of highly creative products. The HCI field has a long history of game related research [20]. However, there has been little work in requirements engineering for game development. Callele's research [3] is considered one of the first works to address these issues. He suggests that the majority of problems found in game development are due to inadequate requirements engineering between the pre-production and production phases.

Another related field of research is modeling emotional requirements. Emotional requirements are concerned with emotional states experienced by the users of computer systems [19]. Ramos [8] observes the importance of user emotions to requirements engineering. The focus of her research was mainly on negative emotions, such as fear, rejection and conflict that users face while interacting with software systems. However, emotional requirements for mobile game users can be also defined in terms of joy, pleasant relaxation, among others. Emotional requirements are an important driver for game design [4]. Understanding emotional states of players is vital to design successful games.

In the next section, we present a study we have conducted at Meantime. The main objective of the study was to gather evidence from this mobile game company to investigate how requirements engineering issues are handled during the design and development of mobile games.

3. The Meantime Case Study

The experience reported in this paper is the result of collaboration between two researchers from UFPE and a project manager from Meantime Mobile Creations. The first author is specialist in requirements engineering while the other authors are experts in game design and development. We conducted an exploratory study to understand the challenges involved during the game design and examine its implications to the requirements engineering process. We describe the Frogman game developed by Meantime as case study to illustrate our findings.

Meantime is one of the leading mobile developer-publisher-distributors in Latin America and the leading mobile gaming company in Brazil. Meantime's in-house development team has produced more than 60 games (both proprietary and third-party titles). We present the Frogman game to explore two main issues: identify the critical requirements for mobile games, look at the intricate process to understand and satisfy the requirements of very diverse and globally dispersed

stakeholders (e.g. players, publishers, carriers, manufacturers).

The Frogman game is a casual game that explores bizarre and funny themes. A brief description of the game is presented [13]:

> *"Join the strangest and funniest circus ever. At the Freak Circus an act draws the spectators' attention: the jump of the Frogman. For this act, the Frogman climbs several platforms to perform dangerous jumps towards a barrel full of water. Help the Frogman reach his target so that he won't crash onto the floor. Cheer up the spectators by performing risky manoeuvres, passing through rings and crossing obstacles, during the most spectacular jumps of the century."*

The design of the Frogman game involved two main activities: idea generation and game design specification. We describe these activities in the following sections.

3.1. Idea Generation

At Meantime, the design of games starts with brainstorm sessions with game designers and graphic designers to explore market tendencies, successful cases and create ideas for the new game. The core of the game idea is composed by: game mechanics, basic rules of the game, theme, characters, environment, visual, and stories of the game.

The designers start analyzing the best games available in the market targeting a predefined market audience and exploring what makes these games successful among players. Meantime designers consider this task particularly difficult because understanding what people perceive as fun is very subjective.

Based on information gathered from other games, the theme and game mechanic was decided. The Frogman game, for instance, was inspired by other games: Circus Challenger (circus theme) and Yeti Sports (easy game goals and simple interface). As the game was developed to a variety of users from many countries, the game had to be simple enough to be played by everyone. The mechanic chosen was the simplest one: the scrolling down game, where the player should use just two keys to move the player to left or right, and his goal is avoiding obstacles. Another requirement was that the theme should be familiar to users from different countries. The circus theme fitted well because it is well-known in many cultures in the world.

Using all this information, the game idea was created and presented to some casual gamers (chosen arbitrary) and marketing staff responsible to distribute the game to publishers and carriers. Their feedbacks were used to change/improve the idea and theme, and then the game concept was completed. For instance, stakeholders asked for a funnier theme to be used in the game, so the "freaky" idea was introduced in the circus theme and, at the end, the Freaky Circus theme was created and employed as the key concept behind the Frogman game. Two other games were included in the "Freaky Circus" series.

At Meantime, the key requirement to define a good game concept is defining the right target audience for the game. An important observation is that the target audience for mobile games can be a rather large group of people (e.g. Vodafone mobile users based in Spain with interest in football). Some games may be attractive for a group of players but uninspiring for others. This means that designers must understand the correct interests and desires of a particular market segment. Relevant information about potential game users include: users most downloaded games to identify the preferred features for them, the average price this target audience is willing to pay for mobile games, how frequent they buy games, the period of the year they buy more games. These are important considerations for release planning. A key obstacle faced by Meantime is having access to the sources of information. The carriers (known as gatekeeper in mobile industry) have all information necessary to make a good market research, but they almost never reveal that information to developers/publishers. Given the difficulty to obtain complete player's information, Meantime team gathers information from mobile game websites. They also perform short studies with available players (sometimes developers´ kids and friends).

The idea generation process for the Frogman game took between 3 and 5 days and previous games ideas and techniques were reused. In fact, reuse strategies are frequently employed as a way to meet tight schedule constraints.

3.2. Game Design Document

After internal stakeholders approved the game concept, the game design document (GDD) was created by the game designer. The GDD includes information about the game concept and technical details of the game. The main goal was refining the game features as much as possible, so that the technical team (programmers and artists) can use the GDD to guide the development process.

The game design document is the main artifact of the pre-production phase. Similarly to a requirements document, it describes the requirements for the game,

but it also includes creative elements such as: storyline, description of sound and graphical effects, etc. The Meantime's game design document consists of: game basic information, target devices, game mechanics, player's goal, rules, universe, storyline, elements, characters, items, objects, score rules, artificial intelligence requirements, tutorial indicatives, cut scenes, levels, user interface requirements, sounds and the concept art used to create the identity of the main characters (see Figure 1).

In the Frogman game design, the player's main goal is to jump into a container of water from a height which may vary according to the phase. For this purpose, he must keep away from obstacles during his free fall, maintaining the trajectory of fall so that he can reach the container at the end of the fall, that is, to jump into the right place. As a secondary goal, the player must get the highest score possible. For that, he should collect items during his free fall.

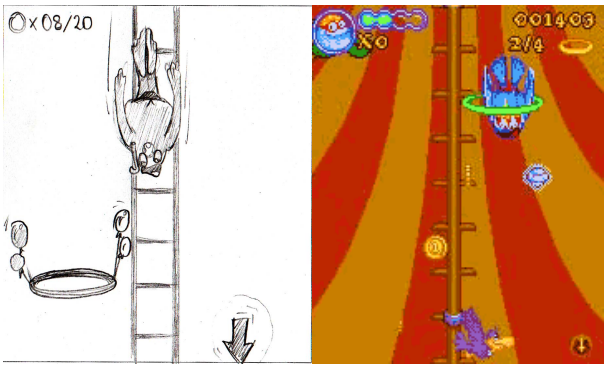

Figure 1. Conceptual art and final game screen

After the GDD was created, the game designer, the graphical designer leader and the technical team leader revised the document to check if all features were coherent and investigate how the document could be improved. Then, the teams decided whether it was feasible to implement the game to satisfy the specified features. Some conflicts arose between the technical team and the game designers during the decision of what could be implemented or removed from the game design. The technical leader asked to refine the document, as it was not detailed enough to serve as the basis for implementation. Even an apparently complete GDD is likely to change during the development process. It happens because many of the problems (like features hard to be implemented, gameplay problems, interface problems, etc) will only appear in future phases. Generally, the game design continues throughout the development phase. Important design decisions could only be taken during game production, such as level design (to determine the structure of all game levels) and game balancing (to adjust parameters such that the final game is not too easy or too difficult to play). Moreover, the tests performed by testers meant to represent the potential target public along the development process could also indicate changes or adjustments.

The GDD for the Frogman was created in 2 weeks, then revised and inspected by the team leaders in 1 week. Many challenges were faced during the pre-production phase of the game, such as:

- Create a game mechanic with simple rules and user interface that was accepted in many countries;
- Create a theme that was funny, innovative, and easy to understand in many countries;
- Include features that could make the game more fun;
- Find the best way to implement these features considering all the device restrictions (Frogman is currently available to 276 different mobile phone models from 7 manufacturers);
- Prove that the game would be a success to Meantime stakeholders (e.g. players, carriers, external publishers and company directors);

4. Discussion

In this section, we present the key findings and lessons learned from the study conducted at Meantime. Our study indicates that there are a number of difficulties involved in the requirements engineering process for mobile games.

Agile and creative requirements elicitation.

The elicitation of requirements for market-driven software products is known to be difficult [9]. Software products are developed for diverse consumer markets. New product development is particularly difficult because the product must present innovative features to attract customers. Marketing strategies are usually employed to gather stakeholder needs. Our experience suggests that the needs of potential game users cannot be fully anticipated. This is mainly due to strong pressure faced by developing companies to deliver new games to the market. Consequently, limited time is allocated to gather and understand user requirements during the game design phase. It is important to emphasize that time to market constraints is even greater to games for mobile devices than for console or PC.

Another key difficulty involved in eliciting requirements for games is that games are designed to entertain users while software systems are primarily designed to support work activities. This means that games must present features that amuse and entice users. For instance, mobile games must seduce the user

in the first minutes of the game; otherwise the casual player will look for another distraction. Requirements elicitation is concerned with understanding stakeholder needs and desires [1]. However, it is still an open issue in requirements engineering practice in understanding of enjoyment and fun attributes.

It is hard to involve real users.

Real players are important sources of information to design attractive games. However, it is generally difficult to identify the right target audience. At Meantime, for instance, the idea generation is mainly conducted by game designers and there is little direct contact with real players (only informal chats with friends and staff's kids who act as stakeholders). Consequently, designers may be biased to include their personal perception of what constitutes an interesting game for a specific target audience. Subjective requirements like fun are highly dependent on the target market. Meantime experience suggests that early user involvement could improve the game design and provide important feedback on gameplay requirements. Similar results regarding the role of user involvement in the early phases of product development have been reported in [18].

Better process to create the game design document.

The game design document is the key artifact of pre-production phase. The GDD can be compared to the requirements document, but it includes creative elements and it is usually not as precise as a standard requirements documents. It is worthy to say that the GDD is, at most, only precise enough to the very development team. The same GDD sent, for instance by a publisher, to two different game studios may yield different games.

Currently, in game industry in general, there is not a well defined or standard process to create the game design document. Even in the game literature, there is no consensus on how to create the GDD nor what kind of information may be included on it [10][16]. In general, game developing companies create their own informal processes. Often, the processes are based on well known processes and adapted to the company's needs. The average mobile game development cycle takes in average 2 to 6 months (Frogman took 6 months). This is a hard constraint involved in mobile game development, which means that if requirements are wrongly specified the impact over the project schedule can be disastrous. Therefore, the game design document should be a concise document due to time constraints, but also embrace sufficient information to ensure that decisions are clearly communicated between both design and development teams.

Mobile games must reflect tradeoffs between designers and developers.

Game design is an intrinsically creative task, while the game production involves solid technical knowledge in fields such as mobile computing and artificial intelligence. Meantime experience suggests that game design document must satisfactorily combine the design and technical views. Callele has found similar results. In [3], he discusses that the transition between pre-production and production needs to be carefully managed. Our study indicates that clearer RE processes are needed to support and refine the game design to inform the next phases of development. This has to be done in a smooth way so that the requirements engineering process is sufficiently detailed but without hindering the creative process. This is a significant contrast with traditional software development, in which the requirements specification can be considered a technical document.

We also found that conflicts may occur between designers and developers. This happens because game designers, who are especially creative individuals, generally try to include features that are very hard to implement. They argue that such features may improve the gameplay and the overall look and feel of the game. However, there is no formal process to assess that; just common-sense is used. Normally, the final game is the result of tradeoffs among creative design, technical constraints and platforms constraints.

Mobile games have to satisfy critical non-functional requirements.

Mobile applications must adhere to strong portability requirements. Due to the large number of variations in terms of devices and carriers, a single mobile application must be available is several versions. Meantime has developed a specific process called MG2P (Meantime Game Porting Platform) to tackle the portability problem [20]. Gameplay is another critical non-functional requirement specific to the game domain. Gameplay reflects the player experience with the game. The process to achieve satisfactory gameplay is not precisely understood. Most game developing companies rely on designers' intuitive knowledge rather than on established processes simply because such processes are not available in current game design literature. We believe that improving our understanding on gameplay requirements is still an open issue.

5. Future Work

The overall objective of the study presented in this paper was to investigate the challenges involved in the design of market-driven products. In particular, we

explored the mobile game domain. We presented the experience of Meantime in designing mobile games and discussed that many challenges faced during the game design are requirements-related ones. Eliciting requirements for mass-market products and understanding gameplay requirements are considered key challenges faced during the game design. However, neither game design nor requirements engineering literature presents approaches to satisfactorily deal with such issues. It is worth noting that some of the challenges discussed in this paper are related to any type of game while others are specific to mobile games. Further studies are needed to precisely delineate the specificities of requirements for mobile games.

Various questions remain open. For instance, why does the game design document is not enough precise? Some possible answers are due to time to market pressure; because of the need of continuous refinement of the GDD; or because the teams are small, allowing the use of lightweight development processes based on individuals communication. Fun and enjoyment are quality attributes rarely described in the context of software systems. However, a sound understanding of these attributes is of fundamental importance to design successful games. We believe that other software product domains that do not explicitly take enjoyment into account could also obtain benefits from incorporating enjoyment requirements as a way to improve user satisfaction. Current research on qualitative modeling of non-functional requirements (e.g. NFR Framework [11]) may be a promising starting point to address enjoyment *softgoals*. In future, we aim to investigate how enjoyment requirements can be modeled and measured.

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