

# A Board Game Proposal for Teaching Software Management and Software Development Process

Victor Travassos Sarinho

Universidade Estadual de Feira de Santana (UEFS)  
Laboratório de Entretenimento Digital Aplicado (LEnDA)  
Feira de Santana, Bahia, Brazil  
vsarinho@uefs.br

**Abstract**—Software Engineering (SE) education has a current challenge to provide sufficient hands-on experience for their students. Games has being considered as a powerful instructional method to achieve an objective, promoting an “active learning” to get the deep learning within acceptable teaching time, and serving as an entertaining means for drill and practice. As game-based learning represents a promising alternative to teach computing in higher education, this paper presents *Masters of the Process*, a board game proposal for teaching software management and software development process competences. As a result, a simple, interactive and multiplayer game was provided, able to teach important SE concepts in a practical, competitive and funny way.

**Keywords**—software development process; software management; serious games; board games;

## I. INTRODUCTION

Software Engineering (SE) is a mix of three kinds of abilities: Engineering and Computer Sciences Knowledge, Software Development Methods, and Management and Communication Skills [1]. As a result, their professionals are required to not only understand technical challenges, but also be up-to-speed on nontechnical issues, including management, communication, and teamwork [2].

Software industry requires technical and nontechnical SE professional abilities, but SE has been taught by means of traditional methods with small changes over the years [3]. Practical projects have been also highlighted as a possible solution [4], though some of the skills required by SE are not completely developed by using this method [1]. As a consequence, there is a current challenge in SE education to give sufficient hands-on experience to the students in actually building software [2].

Games has being considered as a powerful instructional constraints (rules) method to achieve an objective, such as winning, victory or pay-off [5]. They are believed to result in a wide range of benefits, increasing learning effectiveness, interest, motivation and persistence among the players [6], [7], [8], [9].

As game-based learning seems to be a promising alternative to teach computing in higher education [10], this paper presents *Masters of the Process*, a board game proposal for

teaching software management and software development process competences in a practical, competitive and funny way.

## II. RELATED WORK

Several types of board games have been built to enhance the SE educational activity. As an example, by the *Software Kaihatsu Game* (SKG) [11], students form teams to manage software firms and assume roles as a Chief Executive Officer (CFO) or a project manager. Throughout experiences at management of sales, cash, project, and accounting, they should find a way to promote their level, be able to attract profitable work, and lead a company to the “ultimate goal project”.

In *SimulES* [12], the player’s objective is to be the first to complete a pre-defined software project. Each player performs different roles such as software engineer, technical coordinator, quality controller and project manager, performing common tasks and decisions in the context of software development.

For the *Simsoft* game [13], teams of 2 or more players are formed to receive a scenario that describes the requirements for a small software development project. Taking the role of project manager, the players gather around a printed game board that shows the flow of the game to discuss the current state of the project, and to decide their next movements in order to manage the project from start-up to final.

The *Hard Choices* game board [14] represents a competition to release their product to the market place, according to activities of a software development production. In this game, players earn points for landing on a square with a tool, representing rewards for investing in technical infrastructure, or by not finishing in the last position, representing rewards for speed to market.

SEMAT (Software Engineering Methods and Theory) [15] is an initiative that aiming to collect the core elements essential to the development of software projects. Their players are encouraged to understand the concepts of the topic proposed by the game, such as the main features of a PMBOK process.

Finally, a modified version of the GetKanban game [16] presents a collaborative, physical board game that aims to teach the basics of Kanban, a workflow management system that is considered the progenitor of lean thinking (an Agile method). The game overall goal is to produce financial value, which is mainly done by gaining new subscribers which, in turn, is achieved by producing new features. In order to produce features, the players must decide how to assign workers to the features and control Kanban cards, also known as Work-In-Progress (WIP).

### III. METHODOLOGY

#### A. Design

*Masters of the Process* was designed to be an educational board game for SE students. The main objective is to complete a software project according to development stages inspired in RUP phases [17], in this case Inception, Elaboration, Construction and Transition.

As a simple game for 2-4 players, *Masters of the Process* starts with all players in the Inception phase with \$2000 budget each one. Players must configure their employees in software development activities, in order to complete the current RUP phase. The challenge is to apply the correct budget usage to allocate employees in correct activities according to RUP phases.

Event cards can be pulled by players, which brings possible project setbacks that must be solved by the player staff. Player wins when he finishes the 4 RUP phases of a project with more budget or before 4 rounds than the other players. Player loses when he has no more money to keep the project team in your turn.

Each player employee generates a production card in each player turn, according to the development activity allocated to work. As more than one employee can be allocated in the same production activity, more than one production card for the respective activity can be generated per player turn.

Production cards are used to complete the software development activities required in a RUP phase. For example, to move from *Inception* to *Elaboration* phase, a player must conquer: 4 Business, 2 Management, 3 Analysis & Design and 2 Configuration & Change production cards. A new RUP phase is started for the player only after the player spent the amount of production cards required by the current RUP phase. Each player receives a bonus of \$300 after complete a RUP phase of your project.

For the event cards, most of them present a project setback which add bugs and costs to the project activities of the player. For each bug added, a new production card must be consumed to eliminate it, increasing the number of necessary player turns to complete the RUP phase.

Considering the game turn, each player can hire (\$30), fire (\$50), and train (\$20) employees in development activities. Only one employee can be hired or fired per turn. A limit of 3 employees can be trained at the same time. Training is

required to shift the employee from one activity to another. Only one player turn is necessary to complete the employee's training. A salary (\$30) is charged per player turn by each employee in the player team. After 4 player turns, the client makes a monthly payment (\$100) reinforcing the project budget. Only one bug can be outsourced (\$20) per turn, which will be solved after 2 player turns. Player must throw the dice before finishing the turn, pulling an event card if he takes a number less than 7.

#### B. Construction

A RUP main board (Figure 1) and the project game boards for each player (Figure 2) are design to represent development phases, software development responsibilities and employee allocation for development activities. Money, player token, dice, event cards and production cards were also used as play elements for the game. They are necessary to perform important mechanics for designed game dynamics documented as game canvas [18], such as throw the dice, pull event cards, earn production cards, select employee activity, employee training, solve bugs with production cards, go to next RUP phase, receive the client payment, and so on.

MASTERS OF THE PROCESS			
INCEPTION	ELABORATION	CONSTRUCTION	TRANSITION
Business	Business	Business	Business
Management	Management	Management	Management
Analysis & Design	Analysis & Design	Analysis & Design	Analysis & Design
Configuration & Change	Configuration & Change	Configuration & Change	Configuration & Change
	Implement	Implement	Implement
	Test	Test	Test
		Deployment & Support	Deployment & Support

Figure 1. RUP main board to represent current player phase.

Each player project board contains a heptagon with possible employee activities, a rectangular indicator of the production week to control the client payment, current employees in training, and outsourced bugs to be solved (Figure 2). The RUP board is modeled as rectangular RUP phases that show required production cards to complete a phase (Figure 1). Each player token is placed in one of this rectangles to indicate the current RUP phase of the player.

Regarding the event cards, 64 distinct project situations are described by them, including “Production Estimating Errors”, “Business Model Changes”, “Audit”, “Head Hunter”, and so on. Each event card describes some actions to be performed by the player, such as money payment, new bugs in software activities and lose available production cards. Special event cards can also be stored by the player, such as “Hire”, which allows to include an extra employee (more than one in a turn) at no additional cost, and “Head Hunter”, which allows a player to steal an employee from another player. Figure 3 illustrates some of these event cards, and

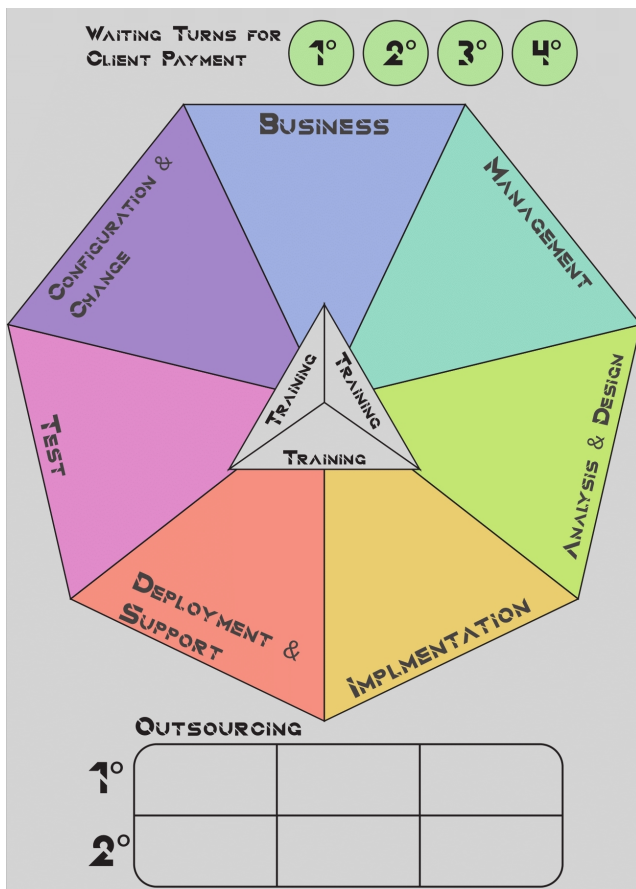


Figure 2. Project board for game players.

Figure 4 presents the production cards generated by the employee activities.

#### IV. RESULTS AND DISCUSSION

Regarding the final game produced, and making a brief comparison with previous described SE board games, Masters of the Process is a game that focuses on budget management, where the players assume a project manager role (*Simsoft*) in order to form and manage work teams (*SKG*). As players objective, they seek to be the first to complete the development phases of a system (*SimulES*), and to ensure the advantage of being the first to launch the product on the market (*Hard Choices*). Finally, the project cycle/workflow illustrated in phases (*GetKanban*) is also represented in the game, which must be accomplished by software activities that represent the essential elements of software development projects (*SEMAT*).

For evaluation purposes of the proposed mechanics and dynamics, an initial version was used by master degree students in a SE classroom. In this activity, the students participated in a game match with 4 players, which was performed after the conclusion of the Software Processes

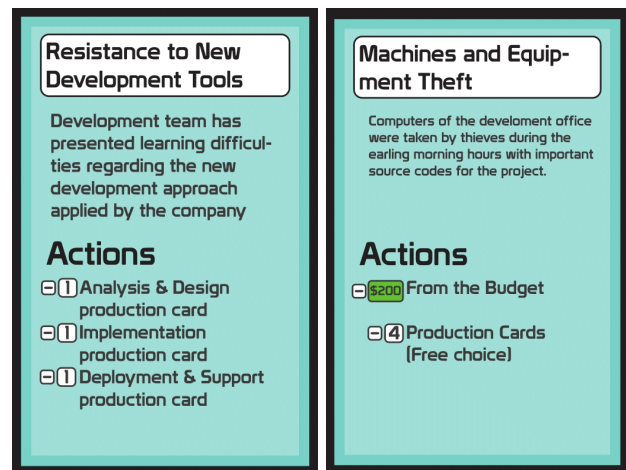


Figure 3. Event cards of the Masters of the Process game.



Figure 4. Production cards of the Masters of the Process game.

class. In addition, for validation purposes, a usability questionnaire [19] was also applied, concerned with evaluating how satisfactory the user experience in using the proposed game was.

As a result, it was possible to observe the great majority of the answers agreeing with the usefulness, ease of use, ease of learning and satisfaction presented by the proposed game (Figure 5). The best results obtained for each category were in the following order: 1) satisfaction; 2) ease of learning; 3) ease of use; and 4) usefulness. It is also important to reinforce the good performance achieved in the satisfaction category, highlighting the group consensus to the fun provided by the game itself.

#### V. CONCLUSIONS AND FUTURE WORK

This paper introduced Masters of the Process, a board game that simulates in a fun and engaging way the decision making by players as managers of a software project. To do this, game elements (money, team, bugs, event cards, production cards) are used by different mechanics (change the player phase, hire employee, receive production card) to accomplish the proposed game dynamics (correct allocation of the project team, eliminate bugs and other problems that

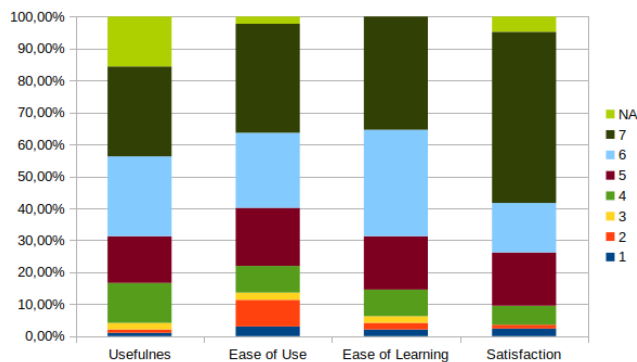


Figure 5. Percentages of responses obtained by usability category in the evaluated class.

arise in a project, complete the development phases and finalize the project).

The satisfaction, usefulness, ease of learning and use of the game was also identified by the evaluated students, confirming that the proposed game can combine fun with SE learning. However, it is also clear that there is a need to expand the possibilities of benefits and problems over the player project caused by event cards during the game play, as well as the expansion of possible interaction approaches between the game and their players.

As future work, it is intended to produce a digital version of the proposed board game, to apply the use of augmented reality in the game cards, to seek an integration of the game with social networks for a viralization purpose, and to introduce the use of digital devices to improve the paper-based version support, such as electronic wallets to control player budgets for example. An extended version to explore the agile world is also under study, as well as a game variation to support short matches among players. The application and evaluation of the game in different SE classes, as well as the implementation of the improvements suggestions identified by the evaluated students, will also be carried out in the near future.

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