StrateJect: An Interactive Game for Project Management Experiential Learning

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Abstract:

The inadequate use of project management techniques and available standards like *PMBOK* (published by PMI) in execution of real projects can be traced predominantly to the lack of efficient project management education strategies. Most Project Management education strategies today are based on theoretical, one sided learning methods which have low retention rates and do not address application of the project management concepts to real projects. Project Management is inherently an experiential learning, where learning by experience and motivation to apply to actual projects are central issues. An experiential learning process for project management requires an environment where a learner can act as project manager executing a project without the costs and risks associated with an unsuccessful project delivery. This can be broadly accomplished by two education strategies- One is business simulations and the other is usage of project management games. In this paper we use the latter strategy and present a technique to provide experiential learning to project managers based on a "Board Game" design, similar to the popular game "Monopoly" (Called as "StrateJect"). A System Dynamics model describing the game design, a simulator, and a game machine that handles user interactions and presents project management learning are presented. Also, we present an experimental study that evaluates an experiential learning process based on the proposed game.

Some salient features of "StrateJect" include:

- Multi level based game which provides for application of project management concepts of *PMBOK 5* (published by Project Management Institute, PMI) to a virtual project in an industry of user choice.
- Creation of collaborative environment where members can network with other project managers and monitor their performances which creates a Gamification environment to create motivation for users to learn application of project management in a competitive setting.
- Ease of customization for application of concepts of *PMBOK 5* (Published by PMI) to various Industries and different departments within the same organization to customize project learning.

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Keywords:

Experiential Project Management Learning; Project Gamification; PMBOK Gamification; PMBOK Games; Project Management Strategy Games; Project Management Application; Game based PMBOK education; Game Based Project Management Learning; Educational games; Flow; Experiential learning; Game design; Game-based learning; e-Learning; Human–computer interaction; Interactive learning environments; Teaching/learning strategies;

1 Introduction

Project management can be considered as a universal concept and is applicable to all industries and functions, but according to the software engineering literature and recent researches (1; 2; 3; 4) its adoption in software projects is still inadequate and deficient. The high number of software projects that are cancelled each year and the number of projects presenting schedule and cost overruns (1; 2) may be consequences of this lack of awareness of project management.

It is widely accepted that experienced project managers perform better than inexperienced managers in concluding their projects successfully, that is, within their planned schedules and budgets. Project management is strongly dependent on knowledge and skill of the project manager (5; 6) to evolve a project strategy as it unfolds. However, still many project managers are promoted from technical teams due to their successes in previous projects without proper training and education to acquire project management skills (3). Thus, education strategies adopted to prepare project managers play a very important role in preventing project failures due to inadequate use of project management techniques on software projects, providing the basis to improve the present scenario of so many failed projects.

This paper discusses current project management education strategies and their deficiencies and ways to overcome them with the help of Project Management Games as an education strategy. We consider the application of games to support project management training and learning. We have developed a game, namely “StrateJect”, and used it in two experimental studies to evaluate our hypotheses concerning the usefulness of games to a project management training programs. This paper presents the game structure and results obtained from the studies. The paper is organized in eight sections. The first one comprises this introduction. The next section discusses the deficiencies presented by the traditional instructor centric education strategy when applied to project management learning and some research that has been made to complement this approach with other tools. Section 3 and 4 presents the details of game that we have developed and its architecture. Section 5 presents the simulation model, while Section 6 describes the game machine. Section 7 discusses the experimental studies that were executed to evaluate the game usefulness to learning project management. Section 8 concludes the paper by presenting our final conclusions and considerations.

2 Experience in Education

One of the requirements for project management educational success is motivation and one of the best motivations for learning project management comes from taking a role in real projects and evaluating the outcomes of decisions made in the project (7). By analyzing the results of strategy adopted to complete the project, decisions made and evaluating its impact on overall success of the project, a person can enhance his or her management skills and ability to make better decisions in future to achieve project success. This approach is a significant improvement over the case study approach that was developed early in the 20th century and is still widely deployed in organization learning methods (8).

Most of our current project managers are technical managers who were promoted to become project managers considering their technical skills, without proper training to assume their new responsibilities. Even those who receive some training usually learn through traditional educational strategies, which are content-centric: they focus on “what to learn” instead of “why to learn” and “How to apply”. The instructor decides what, when and how learning will be conducted, usually by using classes, textbooks and tests (9). The essential drawbacks of such methods are that there is no instant feedback and an inherent assumption that all the learners require similar project management learning. Two characteristics of software project management present difficulties to the application of the content centric educational approach.

- First, it should be noted that only adults undertake project management: so, project management training is essentially adult training.
- Second, large-scale software projects are complex elements and their behavior is often too complex for mental analysis and learning by reading or listening.

In regards to adult training, pedagogical studies (10) have shown that the content-centric approach is not adequate for adult learning, since adults prefer to learn based on experience and learn better when they can apply education to solve their current problems. Thus, learning by experience and motivation are essential for better project management education in such a setting. Concerning complexity, the traditional education approach may not be adequate since project management strongly depends on past experiences and knowledge. While analyzing a decision, a manager usually seeks in his memory for a similar situation in other projects or uses his perception to capture current reality and mentally predict its future state according to available alternatives (11). This approach requires that the manager has experienced similar situations in the past either in other projects or through other forms of experiential learning. In the learn-by-error approach to management training (implicitly taken when no formal management education is provided to novice managers), this experience comes from participating in failed projects which is extremely expensive to conduct at a larger enterprise level. In the experiential approach, this experience comes from creating and analyzing descriptive models of software projects and making decisions in virtual projects which are more affordable in comparison to real projects.

Large software projects are characterized by dynamic complexity in the form of feedback loops, delays, and cause-and-effect relationships which are distant in time. Their behavior cannot be

efficiently predicted by mental models (12). Such interpretation often leads project managers to make wrong decisions in real projects. Since project behaviors cannot be easily derived from basic principles (the content to be learned), the content-centric approach must be complemented by mechanisms that support experiential learning. Mentoring novice managers through pilot-projects is an example of various such mechanisms. However, it is not always possible to create real projects for manager trainees due to practical constraints on schedule, budget, and risk. In addition, such an approach is very expensive and time consuming. Another alternative could be the adoption of games based or simulation based project management learning and this paper focuses on the former approach. Gamification can reduce training time, budget and risks while enhancing the experiential nature of project management education. While real projects can last for months and their failures may have a high cost, practitioners can create a similar project model in a few hours, focusing their attention on relevant events occurring throughout the project execution and hiding the details that may confuse the trainee while learning a major lesson. Project Game models can be quickly analyzed and configured for several distinct development situations that could happen in large projects, with long schedules and large teams. This provides the ability to customize the project learning to the unique situations which arise or may exist in the project teams. The use of simulation to support project management education for the same purpose has been analyzed by several studies (13; 14). The usage of games to support project management education is however a more recent phenomena and is a subject of analysis in this paper.

In a recent paper (15), Pfahl et al. present a controlled experiment to evaluate the effectiveness of using a simulation model in education. In this study, subjects were separated in two groups. One group managed a software project with the aid provided by a simulation model. The second group acted as a control group, using the COCOMO model as a predictive tool for project planning while the experimental group used a simulation model. The results of the study indicate that the use of simulation models provides a better understanding about typical behavior patterns of software development projects. However, the unique use of simulation models is insufficient to project management education. Simulation is usually a predictive approach: models try to capture some specific real world issues so as simulation can present good insights about the results obtained from particular decisions made. Results are mostly represented by numbers or graphics that are abstract representations of what is really happening within the model during the simulation.

Some drawbacks of simulations for education goals are presented in (16; 17). A problem with simulation tools is their lack of a real project development environment look-and-feel. Since the interaction with the project environment does not resemble a real situation, student's motivation can be limited while using simulation tools. An experiential learning process for project management requires an environment where practitioners can act as managers. Besides, in an artificial learning situation, student motivation and engagement play an important role. Some special drivers for creating such motivation include self-realization, challenge, victory, rewards, pleasure, and fun. In this sense, games provide a better education by adding fantasy, visual effects, and a more compelling interaction model for

practitioners. Digital games are also a growing market to adults: the average American player age is 29 years while the average work-force age is 39 years (9). The trends globally are also similar and India, the average age of a work force is even lesser. However, playing is usually considered to be the opposite of working and hence more appealing for adult education. Some current research works present the adoption of game concepts in software engineering education, such as the SimSE Tool (18) and the SESAM Project (7). Our approach is a significant extension of such tools which has far more game features and education aspects embedded.

3 The "StrateJect"

To evaluate the impact of game-based learning approach to project management learning, we have developed a Project Management strategy execution game, called The StrateJect (19). The diversity of game styles makes it difficult to establish a game taxonomy, but we consider adventure or puzzle as well suited for educational goals aiming at reasoning, judgment, decision-making and system thinking. By using the game, the user is asked to act as a project manager, planning and controlling software project with success, i.e. complete within the planned schedule and budget estimates. The game construction is based on three main elements, as can be seen in Figure 1: a simulation model, a simulation machine, and a game machine, which will be detailed on the following sections.

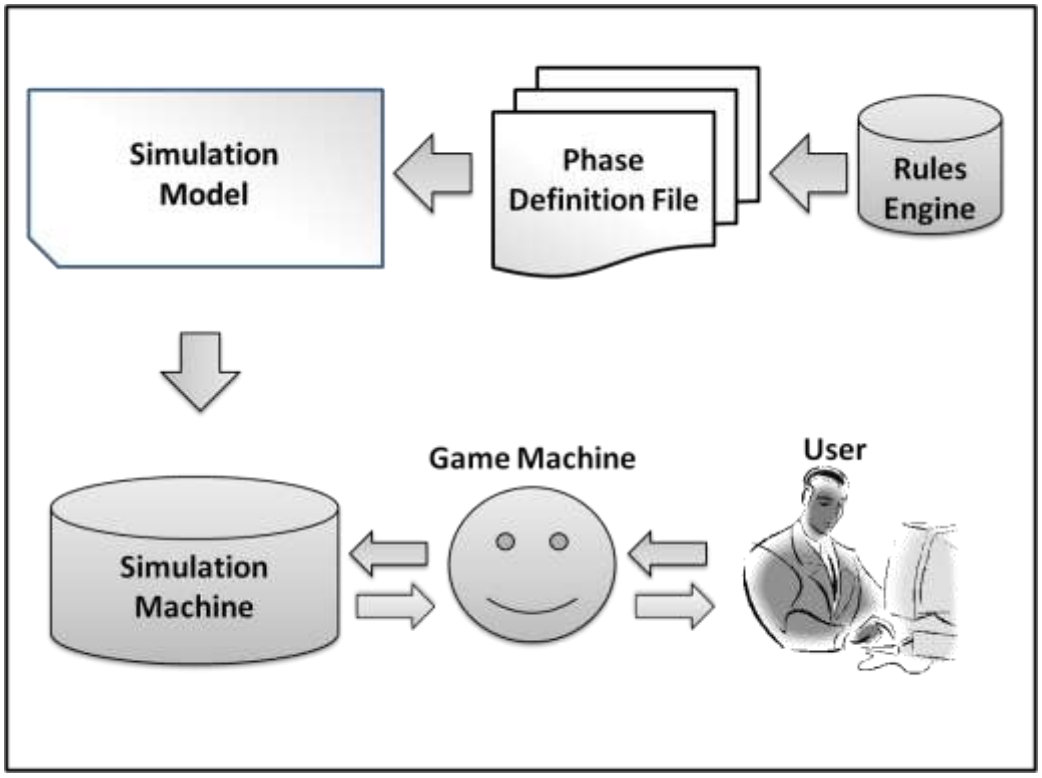

Figure 1: The "StrateJect" Game structure

4 StrateJect Game Simulation Model

The simulation model of the game represents the project management world and the aspects that will be simulated and presented to the player. Such behavior is determined by the structure of the elements that participate in the system and the relationships among them. Such structure and relationships are described in the model through mathematical equations. This modeling discipline has already been used in the development of software project models (20), which became a base for subsequent reviews and extensions by other authors. One of these extensions is the scenario-based project management paradigm (16), which separates uncertain aspects from known facts in project models. This separation occurs by building distinct models (namely scenario models) for each uncertain aspect that can influence a software project. These are incorporated with the help of “Risk Modeling” which are an integral part of any project management execution as shown in Figure-2. The models can be more easily developed, modified, integrated and expanded to embrace project management knowledge from the technical literature and practice. Scenario models provide a library of generic project management events and theories that an instructor can integrate to a project model and present to management trainees during a gaming session. These can be further customized to the needs of the team and the industries they work in. By using games, it is possible to evaluate the impacts of the desired scenarios over the expected project behavior.

Figure 2: Screenshot illustration of StrateJect Game Simulation Model

5 StrateJect Game Simulation Machine

The Game simulation machine is the element responsible for controlling simulation steps, iteratively calculating model equations to evaluate system elements' behavior. Different from ordinary simulators, the simulation machine for a game must be interactive and must respond to the decisions made by the user. Using ordinary simulators, a learner playing the role of a manager should prepare a plan (configuring model elements and relationships) and follow it until the end of the game. This static structured simulation does not represent with confidence the reality: during a software development project, the manager makes

decision all the time during the development process – not only during the planning phase – modifying the original plan (and thus, the model structure) to better control the project. The StrateJect Game simulation machine developed in our work is able to translate and simulate System Dynamics models and to process events during the game. This dynamic structured simulation can take into account player actions over the model structure during the game run without rebuilding the behavior generated by previous game steps.

6 The Game Machine

The game machine is the element that the player interacts with and receives visual feedback from the model game simulation. It is able to create a project life cycle technique with continuous phases. Each phase represents a separate game simulation model, configured externally in a configuration file. This flexibility allows the adoption of several different educational goals using the same game depending the learning needs of the project team. The player starts the subsequent phase immediately after finishing the preceding one. During a phase, the project development takes place with hired team members who remain fixed during the phase of the project. The productivity and weekly salary information is presented and the user can choose the project human resources which will affect the budget and schedule of completion of the work in the phase. The various roles in the game include.

- Project Manager – This is the player's role, responsible for project planning and several decision-making during the game;
- Project Human Resources - The team to develop the project. Each resource has different skills and characteristics such as weekly salary, productivity, specified domain expertise etc;
- PMO - Represents all the other project stakeholders and responsible for the project plan acceptance, providing finance during development.

Each game phase is also divided into five steps: Begin stage, Project Planning, Planning Acceptance, Project Execution and End stage. These are described in more detail below.

6.1 Begin Stage

The beginning of a phase presents the project to be managed by the player. The project description document includes the description of the project to be delivered, special scenarios that may impact the development and project characteristics: quality, schedule, budget demands and constraints are presented. The expectations and the conditions of the project and the rules of resource selection are presented to the user.

6.2 Project Planning

In this step, the player is asked to develop a project plan to be executed. The player must select and hire appropriate resources from those available in the game as illustrated in Figure-3. The number and the kind of resources selected will impact the budget, delivery schedule and quality of the work. These resources once selected cannot be modified till the end of the project phase. There is provision for estimating the risk reserves which may be required to deal with project risks.

Figure 3: Screenshot illustration of Resource selection Panel

6.3 Planning Acceptance

Once the project plan is ready, it must be sent to the PMO for acceptance as shown in Figure-4. The plan can be approved or not depending on the budget requested. A project plan is refused if its overall estimates are over the constraints described in the project presentation at the begin stage. If the project plan is refused, the player must plan for it again until it is accepted.

Project Planning	Requirements Gathering	System Design	Software Development	Integration Testing	Software Deployment
No.Of Weeks = No.Of game rounds estimated per phase	3	4	3	3	3
Cost Planning					
Team Salary Cost per phase= no. of weeks * Sum of weekly salary of all chosen team members	14400	19200	14400	14400	14400
Risk Reserves Per Phase	1000	1000	3000	1000	1000
Training Budget Per Phase	200	400	200	400	200
Interest Cost Per Phase	200	400	200	200	200
Communication Cost Per Phase	600	200	200	400	400
TOTAL Cost per phase	16400	21200	18000	16400	16200
PROJECT TOTAL (BAC - Budget At Completion) = Sum of Cost of all five Phases of the Project					88200

Figure 4: Screenshot illustration of Project Plan Acceptance by PMO

6.4 Project Execution

The time and funds available for development are shown in the bottom on the screen as illustrated in Figure-5. Project execution runs in continuous turns, consuming project resources as the development proceeds. The player must be aware of the project behavior and take corrective actions at the end of each phase based on the EV and TCPI metrics for the phase of the project completed.

Figure 5: Screenshot illustration of Project Finance during the Game

6.5 End Stage

The phase ends when the user runs out of budget before the completion of project phase (failure) or when all the phase is done under budget with success. At the end of each phase, the user evaluates the project performance which will help in planning the next phase of the project.

7 Game-based Learning Evaluation

In the software project management context, to depict the game utility and the improvements that our research should develop, two runs of a case study were conducted to evaluate the adoption of The StrateJect game within a training concept. The training was divided into game and discussion sessions. During the game session, the subjects were asked to play one round of the game which involves five phases of a software project development. When the game was completely finished, an instructor and all subjects participated in a discussion session. The instructor presented common scenarios and approaches of project management which came up during the game, positive and negative examples for specific decision-making situations, allowing the practitioners to better interpret their actions and performance during the game. The first study was conducted with 18 subjects in May 2014 (All participants were project management practitioners managing project teams ranging from 3 to 10 members each) from a large Market Research KPO company which has its software project development department based out of

Hyderabad, India. The second study was conducted with 30 subjects in June 2014 (All participants were project management having project management experience of more than eight years) from a large software development company with a development center based out of Hyderabad, India. All subjects received training in project management topics (e.g. project budgeting, project schedule tracking, performance evaluation using Earned value and TCPI analysis etc) and in the game utilization. The training session lasted three full days in both the cases. The game lasted for approximately about 180 minutes in both the cases on the fourth day of the training which involved each participant playing against the computer in taking turns to finish the project as early as possible within the budget. The game has various features to enable social interactions among players and see live scores of all the participants creating psychological and organizational issues. Other features like Project Learning Center (PLC) in the game, detailed explanation of the user actions, consequences, lessons learned, and alternative routes for decision-making during the execution of the game were well received. This has greatly helped the users to evaluate their own performance after executing each phase of the game to improve their decision making skills in the next phase of the game.

Only two of the subjects were able to outperform the computer in completing the project faster than the computer within the budget provided. Despite the failure of many participants, the subject's feedback was considered highly positive as participants appreciated the ability to apply the concepts of project management to a Gamified project situation. The training concept with the game instrument was considered motivating, dynamic, practical and enjoyable. Subjects pointed out some important aspects such as psychological pressures (from continuous-time turns and compelling visual effects), high difficulty as a motivating challenge to the player and the entertainment factor while executing the game without losing the engagement to achieve the goals. Post training surveys were conducted to gather feedback from the participants to evaluate the performance the game based training on project management learning outcomes.

To better understand the evaluation results obtained with the game based training, it was compared with the evaluation results of a four day class room based training completed for 30 participants in the software development company in April 2014. Table 1 shown below summarizes the feedback and results of the evaluations obtained for the game based learning in comparison to the class room based learning of project management. Few notable points from the evaluation are pointed out below.

- The project management skill has substantially increased in both the learning formats.
- Interest in project management has shown significantly higher increase in the case of game based learning (96% for game based learning in comparison to 80% for class room format).
- All the participants felt game based training was good while it was limited to 60% in class room format.
- The interactions were rated more positively in game based training (88% in comparison to 40% for class room format).

- The largest difference was in terms of the feeling of fun and user initiative to read additional project management related learning documents. 100% participants felt the game based format was fun, while only 20% users felt that way for the class room session. In addition, 84% of participants have read project related education documents in the case of game based learning while that was an a paltry 10% for class room format.

Table 1: Comparison of Game Based Learning Evaluation Results with Classroom based Learning

Game Based Learning (StrateJect) Evaluation Results				Content Based Learning (Traditional) Evaluation Results			
	Reduced	Remained Same	Increased		Reduced	Remained Same	Increased
Project Management Skill	0%	0%	100%	Project Management Skill	0%	3%	97%
Interest in Project Management	0%	4%	96%	Interest in Project Management	0%	20%	80%
	Good	Cannot Say	Bad		Good	Cannot Say	Bad
Game Based Training	100%	0%	0%	Lecture Based Training	60%	20%	20%
Social Interactions with colleagues	88%	8%	4%	Interactions with colleagues	40%	40%	20%
	Yes	Cannot Say	No		Yes	Cannot Say	No
Was game based training fun?	100%	0%	0%	Was lecture based training fun?	20%	40%	40%
Did you read the documents in Project Learning Center (PLC)?	84%	0%	16%	Did you read any additional project management material provided during training?	10%	0%	90%

8 Final Considerations

In this paper we analyzed the adoption of practical mechanisms to complement the traditional content-centric education strategies for project management learning. The focus in this paper is on training software project managers, since the lack of knowledge of management techniques and the inadequate use of management techniques is considered to be a root factor that inhibits project success. This has to be validated in other industries as well. Game based project management education is well suited to be introduced in an experiential learning situation, such as required by manager trainees. They give to the participant an opportunity of experimenting the consequences of executing or neglecting important project management functions, confront him or her with complex issues that must be resolved during project development, and test different approaches and solutions of project management, learning by observing their consequences. To keep up with software project models evolution and unique challenges of teams, the simulation machine presented in this paper should be extended to show more state transitions and graphical feedback, enriching the player perception and entertainment.

Besides the game based model, many other research areas can be highlighted: pedagogical evolutions to the training concept with project simulations, art evolutions over game usability

and multimedia presentation, research on traces over player actions and performance, and psychological researches about cognitive and motivational issues related to game-based education to name a few.

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10 Authors' Profiles

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Mr. Srikanth Kumar Kota: Srikanth has completed his Bachelors in Engineering and has done his MBA in Marketing and Operations from IIPM, Delhi. He has worked in diversified industries like IT/ITES, Manufacturing, FMCG, Retail and Education Sectors in senior Project Management roles and has 10+ years as a senior project consultant for various organizations. He worked in several Senior Management roles relating to Project Management, Business Excellence and Quality Management.

Mr. Srinivas Potti: was worked as a Regional Manager for operation (Hyderabad, Pune, and Bangalore) at Nucleus Group. He has deep experience in Project management across various verticals and has successfully sold many projects and was the chief executive for "Unleash", a project management monitoring tool. Srinivas worked with TCS and is currently working as a Project manager at Kantar GDC based out of Hyderabad. Srinivas holds a Bachelor's from Osmania University (OU)

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11 References

1. *Industrial-Strengh Management.* **BROWN, N.** 4, s.l. : IEEE Software, 1996, Vol. 13. PP: 94-103.

2. **STANDISH GROUP.** *The Chaos Chronicles. The Standish Group International.* 2003.

3. *A Case Study on Project Management in Industry: Experiences and Conclusions.* **MANDL-STRIEGNITZ, P and LICHTER, H.** Antwerp, Belgium : European Software Measurement Conference, 1998. pp. 305-313.

4. *The maturity of project management in different industries: An investigation into variations between project management models.* **Terence J. Cooke-Daviesa, Andrew Arzymanow.** 6, Netherlands : Elsevier, 2002, Vol. 21. Pages 471–478.

5. *The Influence of Project Managers on Project Success Criteria and Project Success by Type of Project.* **Ralf Müller, Rodney Turner.** 4, s.l. : Elsevier, European Management Journal, 2007, Vol. 25. Pages 298–309.

6. *Experience as a factor in the selection and performance of project managers.* **Rubin, I. M, Seelig, W.** s.l. : IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, Sep 01, 1967, Vols. EM-14. P. 131-135.

7. *Simulation in Software Engineering Training.* **DRAPPA, A., LUDEWIG, J.** Limerick, Ireland : Proceedings of the International Conference on Software Engineering, June, 2000. pp. 199-208.

8. **FORRESTER, J.W.,.** System Dynamics and the Lessons of 35 Years. [Online] 2004. [Cited: 02 22, 2014.] http://sysdyn.clexchange.org/sdep/papers/D-4224-4.pdf.

9. **PRENSKY, M.** *Digital Game-Based Learning.* s.l. : McGraw-Hill, 2001.

10. *Andragogy in Action.* **KNOWLES, M.** San Francisco, CA : s.n., 1984.

11. *Mental Models of Dynamic Systems.* **DOYLE, J.K., FORD, D.N., RADZICKI, M.J., TRESS W.S.** s.l. : Avaliable online at http://www.wpi.edu/Academics/Depts/SSPS/Faculty/Papers/27.pdf, [01/07/2003].

12. **STERMAN, J.D.** *System Dynamics Modeling for Project Management.* Cambridge, MA, USA : MIT System Dynamics Group, 1992.

13. *Do Management Flight Simulators Really Enhance Decision Effectiveness.* **MAIER, F.H, STROHHECKER, J.** Cambridge, USA : Conference of the International System Dynamics Society, July, 1996.

14. **MERRIL, D.** *Training Software Development Project Managers with a Software Project Simulator.* Tempe, AZ, USA : Master Thesis Proposal Arizona State University, available at http://www.eas.asu.edu/~sdm [01/07/2003], 1995.

15. *An Externally Replicated Experiment for Evaluating the Learning Effectiveness of Using Simulations in Software Project Management Education.* **PFAHL, D., LAITENBERGER, O., DORSCH , J. RUHE, G.** s.l. : Empirical Software Engineering, 2003, Vol. 8. pp. 367–395,.

16. *Supporting Risk Analysis on Software Projects.* **BARROS, M.O., WERNER, C.M.L. and TRAVASSOS, G.H.** 1-2, s.l. : The Journal of Systems and Software, 2004, Vol. 71. pp. 21-35,.

17. **FORRESTER, J.W.** *Industrial Dynamics.* Cambridge, MA : The MIT Press, 1961.

18. *Towards Game-Based Simulation as a Method of Teaching Software Engineering.* **OH, E., VAN DER HOEK, A.** Boston, MA, USA : Proceedings of the 2002 Frontiers in Education Conference, 2002.

19. PlayJect: Learn Project Management by Playing Games and Simulations. [Online] PlayJect Inc, 2012. [Cited: 08 24, 2014.] http://www.PlayJect.com.

20. **ABDEL-HAMID, T.K., MADNICK, S.E.** *Software Project Dynamics - An Integrated Approach.* Englewood Cliffs : Prentice-Hall, 1991.

21. *Digital game-based learning: Towards an experiential gaming model.* **Kiili, Kristian.** 1, s.l. : ELSEVIER, 2005, Vol. 8. 13-24.

22. *Successful implementation of user-centered game based learning in higher education: An example from civil engineering.* **Martin Ebnera, Andreas Holzinger.** 3, s.l. : ELSEVIER, 2007, Vol. 49. 873-890.

23. *Not just fun, but serious strategies: Using meta-cognitive strategies in game-based learning.* **Bokyeong Kim, Hyungsung Park, Youngkyun Baek.** 4, s.l. : ELSEVIER, 2009, Vol. 52. 800-810.

(9)