Full paper

Towards Next Generation Project Management Simulation

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Abstract

This position paper describes the current climate of IT project management simulation and aims to paint the way forward for the next generation of simulators. By examining the successes and limitations of pioneering work in the field, a vision for the future of IT project management simulation is developed. This vision comprises of a set of features that cover simulation, teaching, and assessment aspects of IT project management. To coincide with the feature set, the expected challenges related to developing a corresponding project management simulator are also outlined and considered. Given the power of current development technologies, the creation of a project management simulator that meets the rich feature set and overcomes the identified challenges is deemed both a feasible and useful project. This would provide an improved interactive educational tool for IT project management students and teachers.

Keywords: Computing education, project management, simulation.

1 Introduction

Teaching IT project management can be seen to consist of two main phases: how to plan a project and how to manage a project. Teaching and assessment of the planning phase can be achieved relatively well, as the planning phase outputs can be produced individually. For example, the student can assume the role of the project manager in the planning phase. In this role the student can systematically produce cost, time and resource estimations, identify tasks, allocate resources, build a Gantt chart and develop a risk management document, etc. The theory of planning a project is first taught and through each student's practical application of the theory to given scenarios, the planning phase outputs (e.g. cost estimates, Gantt chart, etc) can be produced, thus providing means for assessment.

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The management phase is however not as easily taught or assessed. Although the theoretical aspects of how a project should be managed can be taught, providing an environment where students can practically apply this theory can be somewhat more challenging. For a student to assume the role of a project manager during the management phase and practically apply the theory that has been taught, some major obstacles need to be overcome. Specifically, to manage a project, a number of elements need to exist: a project, and all the resources that are to be managed in order to complete the project (this of course includes project team members). One approach is to divide the class into project groups and assign one member the role of project manager. This however, only gives the select few the experience of managing a project. Recently the concept of using software that simulates the project management phase has been employed by educators and trainers in order to put each individual student in the role of the project manager.

This paper will proceed by giving an overview of pioneering project management simulation tools and will identify the general successes and the limitations of these tools. Based on this review, areas for improvement will be identified and a set of ideal features for the next generation of project management simulation will be presented. Potential challenges to the development of these ideal features will also be outlined and considered. The paper will conclude by presenting a plan forward in order to make the next generation of project management simulation a reality.

2 Simulation

The concept of simulating real world scenarios in order to provide a learning experience is used in many areas of education and training (Dempsy et al., 1997). The motivation for using simulations can vary, ranging from cost and safety, i.e. flight simulators (Rolfe, Staples, 1988) through to practicality i.e. emergency scenario training (Philipkoski, 2009). Other motivating factors stem from arguments supporting the use of games and the gaming experience in order to enhance learning (Squire and Jenkins, 2003). The reasons for choosing to use a project management simulator usually include: time limitations, cost limitations, resource limitations, and convenience.

Although not all specific to IT, a number of project management simulators already exist for both commercial training and academic instruction. These software packages include: Celemi Cayenne (Celemi, 2009), Clarrus (Clarrus, 2009), Double Masters (Double Masters, 2009), Fissure (Fissure, 2009), Forio (Forio, 2009), Polstar PM (G2G3, 2009), Prendo (Prendo, 2009),

Race to Results (HPDC, 2009), SimProject (MHHE, 2009), SimulTrain (STS, 2009), SMG (SMG, 2009), and Synergest (Synergest, 2009). Although each of these simulators has been independently developed, they all share some common characteristics. Following is a generalised description of a typical project management simulation from both the student user perspective and the teacher user perspective. These perspectives were derived from a combination of experimentation and review of the above mentioned project management simulators, trial versions, demos and documentation.

2.1 Student perspective

Student users typically begin the simulation by being provided with some initial information pertaining to the project that they are to manage. This initial information usually consists of a description of the project, a set of team members, a budget, a timeframe, a set of tasks that make up the project (often in the form of a Gantt chart). From here a typical 'turn' or 'round' begins, users are able to/required to make a number of decisions. This typically revolves around allocating or re-allocating resources (team members to certain tasks). These resource allocation decisions should generally be made after considering various pieces of information (e.g. budget, time, team member expertise). Other more general decisions are sometimes also required (e.g. staff training, meeting schedules, etc). Once all decisions for the turn have been made, the user proceeds to the next turn. The transition between turns is often either time based or simply occurs when the user is ready to move on. Upon beginning the next turn the user is presented with feedback from previous decisions, new information that has arisen, and another set of decisions to make. This process continues until the project is completed or aborted.

2.2 Teacher perspective

From a teacher user's perspective, depending on the simulator, the teacher will usually be able define some variables before the simulation begins (e.g. team size, budget, time frame, duration of simulation, etc). Again, depending on the simulator, the degree of project customisation varies, in some cases customisation is non-existent. Also with some simulators, the teacher user is required to action responses/decisions between student user turns (i.e. act as the part of the project team and manage other project variables). At the conclusion of the simulation the teacher user is often presented with a report of how each student finished the simulation (i.e. actual cost, actual time, etc).

Having presented a generalised overview of a typical project management simulator, the next section will provide a comparison of some of the more popular project management simulators, highlighting both their successes and limitations.

3 Current Project Management Simulators

Table 1 shows a comparison of the 12 different project management simulators mentioned in section 2. The 12 simulators are evaluated against various desirable features, many of which have been drawn from the common feature set of existing project management simulators. It must be noted that the feature set is not an exhaustive set of simulation features. It should also be noted, that due to uniqueness, the features of each simulator were unable to be perfectly mapped to each of the comparison features. The comparison table is a single perspective, provided as a point of reference for a basic comparison of the different simulators.

As the table shows, the basic areas of project management are commonly included in existing simulations (i.e. organisation background, cost management, time management, risk management and resource allocation). Other areas, such as providing a Gantt chart or network diagram are also often included. However, many of the existing simulations fall short in a number of feature areas. A notable area is the lack of simulation customisation. This is shown in table 1 by empty (or near empty) rows. In particular the inability to customise, turns, projects, simulation duration, and life cycles. This is particularly restricting when reuse of the simulator is required, as this can lead to an increased risk of students 'learning' the simulation. It is also worth mentioning that a number of the simulations (i.e. Celemi Cayenne, Clarrus, Fissure, Polstar PM, Race to Results and Synergest) are designed to be used during two to five day intensive training sessions or workshops (these workshops are also often group based, facilitator driven, and intertwined with physical resources). Although this can be a suitable mode of delivery in a business environment, it is however, not the normal mode of delivery in tertiary education. A more advanced feature area commonly lacking revolves around the modelling and simulation of human behaviour. This again is shown by the empty (or near empty) rows in table 1. In particular, organisation culture, individual and team attitudes, morale and interpersonal communication (e.g. gossip, slander, apologies, encouragement, etc) can form a significant part of managing a project, and ideally should be included in a project management simulation. Without incorporating the effects of human behaviour, simulations get reduced to simple number games.

4 Next Generation Simulation

Based on the current state of existing project management simulations, it can be seen that there is room for improvement. Significant areas of improvement appear to be in those of customisability and human behaviour simulation. Section 4.1 is a virtual 'wish list' or feature set of what could be desirable in a next generation project management simulator beyond what is already offered by existing simulators. This list has been derived partly from the areas where current simulators have been identified as lacking and partly from what this author regards as useful features of an educational software tool. The feature set is open to debate, and is expected to be refined over further research and discussion.

Table 1: Existing Project Management Simulator Feature Comparison

	Celemi Cayenne	Clarrus	Double Masters	Fissure	Forio	Polstar PM	Prendo	Race to Results	SimProject	SimulTrain	SMG	Synergest
Organisation Background	✓		✓	✓		✓	✓	✓	✓		✓	✓
Pre project feeling												
Organisation Culture												
Planning						✓		✓	✓			✓
Scoping		✓	✓	✓				✓	✓			✓
Cost Management	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Time Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risk Management	✓		✓	✓		✓	✓	✓	✓			✓
Resource Allocation		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Outsourcing			✓			✓						
Quality		✓		✓				✓				✓
Audits												
Morale					✓		✓					✓
Interpersonal Communication												
Attitude Simulation							✓			✓	✓	✓
Network Diagram			✓	✓				✓		✓	✓	✓
Gantt Chart			✓	✓		✓		✓		✓	✓	✓
Customisable Turns												
Customisable Projects									✓			
Customisable Life Cycle												
Customisable Duration									✓			
Concept targeting												
Training Mode												
Test Mode												
Activity reports		✓					✓		✓			
Individual Users		✓	✓				✓			✓	✓	✓
Standalone Software			✓		✓		✓			✓	✓	✓
Facilitation not required			✓		✓		✓		✓	✓	✓	
Web Based			✓		✓				✓	✓		
Free												
Open source												

4.1 Feature set

- Organisational characteristics/background
- Pre project feeling
- Team attitude
- Customisable projects
- Customisable life cycles
- Customisable duration
- Customisable turns
- Simulated outsourcing
- Simulated audits
- Team dynamic simulation
- Human behaviour simulation
- Morale, work ethic, culture simulation
- Ongoing effect of decisions made
- Interpersonal communication impact
- Concept targeting
- Training mode
- Test mode
- Individual users
- Standalone application
- Web based
- Free
- Assessment metrics
- Assessment reports
- Activity reports
- Development of team spirit
- 3D walk around interface

5 Challenges

Given the proposed feature set, a number of potential challenges can already be identified and addressed. The first challenge concerns customisation. In order to provide a simulation system that allows customisation without compromising the integrity of the simulation, a balance needs to be met between what should be customisable, what should remain fixed and how best to achieve this customisation. An initial approach to this challenge of customisation is to aim to create a template driven simulator. In this scenario, the core simulator would remain separate from projects it would simulate. Each project would be self contained, and a particular project could be 'run' by the simulator. This would also allow for the sharing of simulation projects. It is envisioned that each project would be initially based on a fixed template with numerous variables which would then allow for customisation. However, what these customisable variables would be, and what impact they would have on the simulation is a topic requiring further research and discussion.

The second challenge concerns human behaviour simulation. Successfully simulating human behaviour is no easy task (Pew & Mavor, 1998). Trying to provide this behaviour simulation in a high pressure, team oriented, project environment only adds to the complexity of this task. In order to successfully implement this degree of simulation, substantial artificial intelligence would need to be incorporated. However, an alternative to this approach would be to interleave the artificial intelligence (AI) with artificial artificial intelligence (AAI), a concept pioneered by Amazons Mechanical Turk (Barr & Cabrera, 2006). The idea of AAI is to use human intelligence to supplement AI when problems of a certain complexity are encountered. This is potentially a very feasible option if the simulator is being run over an extended time frame (i.e. weeks) with each turn being represented by a day. The lecturer could function as the AAI component as a way to keep in touch with the students use of the simulation while at the same time increasing the realness of the simulation by providing real human responses. Although a relatively new approach requiring further investigation, the idea of using AAI for project management simulation seems very interesting.

6 Conclusion

In this paper the current climate of project management simulation has been presented, and areas for improvement have been identified. A mutable list of desirable features for the next generation of project management simulation has been presented for open discussion. Finally, initial approaches to addressing potential challenges to implementation have also been introduced. Areas requiring further investigation have also been identified.

The next phase in this stream of research will include: refining the feature set, researching template driven application models, researching modelling and simulation of human behaviour, and investigating the practical use of artificial artificial intelligence (AAI).

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