Literature review
Simulation game for project management training and research

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Abstract

The promise of simulation games is to engage and motivate players through direct experiences with the game world. To the author's knowledge, no literature survey on the subject of simulation games in project management was undertaken over the past couple of decades. Hence the subject of this paper is to review and update the literature on issues related to using simulation games in project management education and research. The paper presents a literature survey that will be discussed in the following sections: 1) general pedagogical views on simulation games as training and educational tool. 2) The reported range of using games in the field of training and research in project management.

Keywords

Project management education & training, simulation games.

1 General Pedagogical Views on Simulation Games

Management games are used to create experimental environments within which learning can occur and be observed. While assignments, case studies and role plays provide training and experience with reality, the unique characteristics of simulation games as an education tool is the inclusion of a time-line (Chuda 1996). The inclusion of time as an element in the simulation game implies that game participants have to live with their previous decisions as the game evolves.

The game artefact itself can be a board, computer, internet, a classroom, and so on. However, most of the reported simulation games in the literature take place in a computer assisted environment. See for example, (Rowe, Gruendeman et al. 1968; Estes 1974; Deitzler 1978; Harris and Flower 1984; Jakubowski, Kulikowski et al. 1984; Pamukcu and Pruett 1985; Cano and Saenz 2003); (Prisk and Dunn 2002).

Others such as (Klassen and Willoughby 2003) and (Hood and Hood 2006) reported a classroom based simulation games using other artefact than computers. Commercially there are several known simulation games in management. (Elgood 1997) provides an extended list of several management simulation games including Babel Tower, Bridge the gap, The puzzle and others.

Effectiveness of simulation games in management education/training compared to other instructional methods is still unclear. (Chuda 1996) argues that despite the lack of consensus regarding the teaching and grading methods to be used in conjunction with such games, it is clear that well—conducted simulation games can provide excellent experiential atmospheres for students of management. (Chuda 1996) raises a number of questions, such as; are games valid as educational tools? How effective and efficient are simulations for educational purposes? (Pfahl, Laitenberger et al. 2003; Pfahl, Laitenberger et al. 2004) conducted several experiments in order to evaluate the learning effectiveness of using simulations in software project management education. They concluded that the simulation-based role-play scenario is a very useful approach for learning about issues in software project management.

(Randel, Morris et al. 1992) concluded that subject matter areas where very specific content such as mathematics can be targeted are more likely to show beneficial effects for gaming. That is unfortunately not the case in project management. The skills required to perform project management can be generally divided into two main categories. 1) Soft skills: answering the when's and whys in the management context. Topics like leadership, team alignment, negotiation, communication and stakeholders' management are in the heart of soft skills. The problems lie under this domain is highly ill defined and are strongly dependent on project's context. The second domain of project management answers mainly the hows. It is concerned with planning and control aspect of management. In the planning and control domain, project managers deal largely with problems related to trade off between time, cost and quality (Kerzner 2006). The two domains are indeed hard to separate since any effort to understand, the more so to plan, organize and control resources in any project must rely upon a realistic description of the dynamics in and around such projects.

The theoretical foundation of simulation games as a learning/teaching tool is provided by the model of experiential learning. Experiential learning theory consists of several models that stress the importance of direct experience and reflective observation. (Kolbe 1984) experiential learning model that consists of four stages is the central work in the field of experiential learning. According to the model learning begins with a concrete experience followed by collection of data and reflective observations about that experience. In the abstract conceptualization stage a learner makes generalizations, draws conclusions and forms hypotheses about the experience. In the final stage, the learner tests these hypotheses and ideas through active experimentation in new circumstances. Generally, the model stresses the continuous nature of learning and the appropriate feedback which provides the basis for a continuous process of goal-directed action.

A study based on Felder Learning Style Index was conducted in 2005 at the Norwegian University of Science and technology. (Hussein and Nyseth 2005) The study confirmed the existence of different learning styles among student groups. The ILS results provide support for arguments advanced already by (Felder 1993) for variation in engineering teaching strategies. The investigation shows that the vast majority of students who have participated in our questionnaire are active learners (82%). Strictly lecture-based teaching that provides no active and cooperative learning experiences inside or outside the classroom works to the disadvantage of the majority of the student population. The survey shows also that a considerable majority of student population are sensing learners (69%). Instruction that emphasizes only abstract concepts at the expense of concrete real-world applications and examples puts the sensing majority at a disadvantage. Simulation games are well suited instructional strategy that suits this target group.

(Raia 1966) has concluded that simulation games when used as supplementary teaching aid it can enhance learning and heightened student interest. (Raia 1966) pointes also to the fact that simple games are as effective as complex games, they also provide the students with the same benefits. He also confirmed that games tightens interest and motivation, however there are no conclusive evidence that simulation games yield better learning compared with other instructional methods.

(Cano and Saenz 2003) points out that despite wide spread use of simulation games it is still not clear what conditions have to be provided in order to obtain optimal learning through simulation games. They presented the concept of project management simulation laboratory where users share their knowledge and get some insight on project management practice through the simulator. In their frequently cited paper (Keys and Wolfe 1990) takes a broad look at the management gaming movement and summarizes how the field has evolved to its current state. Several models of experiential learning applicable to gaming are explained. Included are studies on the educational value of management games and a review of the literature that deals with management games and simulations as research laboratories. The paper provided also a classification of simulation games in management. They classified management games into the following categories:

- Epigrammatic: short time, and are not computer scored, single concept exercises, generally referred to as experimental exercises.
- Simulations that deal with the entire organization provide a balanced number of decision variables from different subunits in the organization is called top management games.
- Functional games concentrate on a single subunit in the firm such as marketing or accounting.

(Elgood 1997) summarized the advantages and disadvantages of using simulation games compared to ordinary lectures as follows:
Disadvantages:

1- simulation requires more time to cover the same amount of material and ;
2- They are less rigidly programmed than a lecture, so there is no guarantee that all material will get sufficient emphasise.

Advantages:

1- Games can have considerable subject knowledge built into them; they can pose a problem, demand an answer, and respond to the answer providing an excellent device for learning by experience rather than by hearsay.
2- Massive difference in student motivation. Game pa rticipants are actively involved in the game; they are interested; and are doing rather than listening.
3- Games provide an opportunity for group discussions and debates

2 Simulation games in project management

Project management is defined as (PMI 2004) the application of skills, tools, knowledge and techniques to project work activities to meet project requirements. Project management is accomplished through the use of processes such as initiating, planning, executing, controlling and closing. A project is a temporarily effort undertaken to attain a unique goal under the constraints of time, resources and costs.

Although the literature on project management field is vast and enormous, see for example (Kerzner 2006), the literature about simulation games in project management is limited. Most of the research studies in the field of simulation games are focused on business games. Little evidence of this kind of research has been found in project management simulation games (Cano and Saenz 2003)

Reviewing the current literature on simulation games shows that we can distinguish broadly between the following categories of simulation games:

A) Functional simulation games: The vast majority of simulation games reviewed fall under this category. These exercises usually deal with isolated concepts (single or multiple.) Decision making in this kind of games is based on mathematical models and are mainly applied in order to balance or trade-off between multiple project objectives such cost, time, performance and so on. This kind of simulation games also include experiential exercises (Epigrammatic) for well defined problems such as forecasting project durations, resource usage and levelling, cost estimation, cash flow control, and logical relations between project activities or combination.

The first reported simulation game that falls under this category is the GREMEX game (Rowe, Gruendeman et al. 1968). GREMEX is R&D management simulation exercise designed to provide a simulated project management environment for instruction of R&D project management techniques. The target group is R&D executives. The exercise was designed as both a training device and also as a management research vehicle. Training objective was to provide a synthetic experience illustrating the types of problems that can come up in an R&D project, what lead time is necessary to make certain that a balanced, coordinated effort is achieved, and how Technical, Cost and Time objectives must be properly coordinated in the planning and control facets of project management. Research opportunities in the exercise were about what information is most useful, what new information and what format would be desirable in the project management operation.

(Estes 1974) describes a Project Activity Management Simulator (PAMSIM). The purpose of PAMSIM is to provide new means of teaching project analysis and management. The author emphasis that the simulation game is a supplement, not replaces) the traditional textbook-lecture-homework approach by permitting the student to interact with a dynamic simulated project environment. The events in the simulation game takes place randomly. The simulation covers topics like duration estimates and resource levelling in the presence of random events such as weather delays.

(Reinschmidt, Litchfield et al. 1975) proposes a computerized project management game developed to assist in understanding and teaching the economic and managerial problems of urban building development. The computer game stresses the importance of financial planning, cash flow management, team organization, procurement and use of information, interaction with competing teams, and analyses of risks and alternatives as guides to decision-making.

(Baird and Flavell 1981) presented a game that simulates a project which is described in terms of a network. The player is presented with a sequence of ‘project meetings’ at which he must make certain decisions. The outcome of each decision will affect the total cost of the project. (Pamukcu and Pruett 1985) presents a game called (IPM). Interactive project management game (IPM). The game focuses on scheduling, resource leveling, risk assessment and response. The simulation is done on weekly bases under the assumption that once a simulation started it can not be stopped.

(Rounds, Hendrick et al. 1986) describes an interactive game whose objective is to strengthen project management progress reporting skills. The program is set up by the player to specify the desired type, frequency, and detail of reports as well as the intensity of predefined problems that the program introduces to

disturb the project. Once established, the program begins to cycle through the project, typically on a monthly basis. As reports are produced, the player attempts to identify when a problem has occurred and selects appropriate solutions from among alternatives provided by the program.

B) **Project leadership simulation games**: This category cover simulation of the issues rising at the leadership level of project management, e.g. those concerning identification and selection of project execution strategy, project work breakdown structure, project organization structure and contract strategy. Unfortunately there has been very little reported research into simulation of these types of issues.

(Exman and Rauch 1990) presents the Σigma game. This work focuses on measurement of the player's performance, with the aim of increasing productivity and providing meaningful comparison of different projects. A term named the PERT surprise is defined and measured which expresses the discrepancy between actual behaviour and previous planning along the project history. The winner is the player who is least surprised. (Training 2006) describes a simulation game that can be run in a variety of ways depending on the objectives developing leadership, management and team working, project management, performance management, negotiation, delegation, risk management and team-coaching.

(Martin 2000) presented a simulation game called C&C where in addition to the three critical elements of time, cost and quality; further elements of morale and safety were introduced, representing the less tangible aspects of management. The participant in the simulation (the player) takes the role of project manager. The simulation is in two phases; phase 1 involves the selection of contractors for the 18 activities of the project; phase 2 then runs the project from start to completion. During the running of the project in phase 2 several events occur, some planned, others not; the project manager must make decisions about how to deal with these events. The decisions taken will affect the cost, duration, quality, morale or safety of the project and the participant's performance in these areas is assessed.

3 Conclusions

The unique characteristic of simulation games is the inclusion of time-line in addition to having the competitive elements of games. Simulation games are not about the direct application of skills to solve a particular case or a problem. This characteristic makes the use of simulation games in training for solving well defined problems - such as network calculations, resource levelling or cost estimation- superfluous.

There are a number of simulation games and software tools that are currently used in training and education of project management. They are with variable degrees used as a tool for 1) exploring and understanding concepts and problems of project management. 2) Experimenting with factual information.

Current simulation games can be classified broadly into two main categories. This classification is consistent with the actual practice in the field of project management:

1) Functional simulation games targeting functional project management problems such as balancing cost, time and scope.

2) Leadership simulation games dealing with softer issues such as developing project strategy, negotiation and decision making in pursuit of several objectives.

Most of the current games with are being used in education primarily falls under functional simulation games and usually insensitive to the dynamics of actual project context. Other reported shortcoming with these games includes oversimplification. The oversimplification is manifested in the type, timing and range of events occurs during the game. Indeed the oversimplification is intended to make the simulation possible since any simulation requires a reference model and this model is usually an abstraction of the reality. However, the players may simply keep experimenting with actions and settings until their scores or results improve. Such behaviour, based only on trial and error, does not enhance learning. This is especially true in case of computer supported simulation games.

There is very little evidence in the literature that simulation games have been used as a research vehicle during planning phase of projects for validating or testing a strategy or a scenario. The reported research opportunities in the presented games were about investigating the usefulness of the information provided, their types and format. Further research should be conducted on the possibility of using simulation games as a generic tool during project planning for conducting trade-offs and to investigate or test the outcome of a given decision, action or scenario in the real world. There are already some efforts to use simulation games to investigate the would-be behaviour of team members under simulated working conditions in order to reveal how these persons would react under certain conditions. Simulations games are also used as a training vehicle for increasing group effectiveness.

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