Exploring key aspects influencing project participants behavior in early phase using in-class gaming simulation
-A case study in experimental research-

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SUMMARY

The goal of this paper is demonstrate the potentials of gaming simulation as a research method in project management using continuing and further education CFE classroom as an arena for both learning and research.

Gaming simulation is used for identifying key aspects that govern project participants attitude in early phase. To achieve this goal the research was conducted in 2 phases. In the initial phase, and through 4 rounds of in-class gaming, observation and self assessment, a list of aspects that were observed by the participants and grouped and categorized by the author were produced. 7 independent key aspects were identified after the first phase of the research and qualified as the basis for the second round of experiments. In the second round of in-class gaming participants were asked to select which of these aspects have been dominant in the way they responded to the game. The purpose was to extract the more critical aspects that participants observed as significant during gaming, and if probably addressed they would be able to perform better. The results were then statistically analyzed in order to conclude that 3 out of 7 aspects are significant. These aspects are; 1) tendency to over focus on the technical solution, 2) tendency to make own assumptions during planning and execution, 3) effect of personal emotions, such as fear, diffidence, competitiveness, eagerness and finally cultural barriers. Three other less significant contextual aspects where also identified. These are; 1) lack of project competence, 2) time pressure, and 3) uncertainty or confusion because of the quality of information or inability to comprehend information.

The results obtained using gaming as research method are consistent with previous published literature. The paper concludes that gaming simulation could be used in project management research. Threats to validity and reliability can be controlled to a satisfactory level if the game design and configuration guarantee adequate level of realism and insight

1. Introduction

The gaming simulation used in this paper was originally developed as a learning aid in a project requirements management course that was held for the Norwegian army in the period 2006-2008. The game was originally used to explain the most common pitfalls during requirements development phase. After having run the game for over 2 years and for more than 10 classes, thus satisfying the rule of ten sessions needed to be played before a gaming simulation is ready for use according to (Duke 2004), the author realized that exercise can as well be used as a research tool in order to identifying key aspects that affects project participants performance in particular at project initiation phase. Considering that the majority of the participants has project management experience and is aware of the importance of up-front planning, communication and involvement to attain success. The subject of project success factors was first covered by Pinto and Covin (1989) where they present evidence of the following critical factors such as: clarity of goals, top management support, clear project plans, client relationship and communication. Other references list similar set of factors that are important to attain successful completion. See for instance (Lim and Mohamed 1999), (Belassi and Tukel 1996), (Collins and Baccarini 2004; Do Ba Khang 2008). Although the research on generic success factors is vast, research has yet to address the underlying aspects that influence project participant's behavior and could damage or threatens the overall project management effort.

Gaming is increasingly gaining standing as an established and useful learning method in several disciplines (Hofstedet 2009). The approach is considered to be risk free; it encourages exploration and trial-and-error actions with possibility of instant feedback and therefore stimulates curiosity and learning. Traditionally, the classroom has been used as an arena for teaching and learning and not as an arena for conducting experimental research, except when experimenting, for instance, with various teaching and assessments practices or strategies. Our argument in this paper is that classrooms that have diverse participants profile could be used as an arena for conducting research. It is believed that the increasing demand for live-long-learning and demands for further and continuing education brings along with it new opportunities for conducting experimental research within the classroom. Experimental research that goes beyond searching for effective teaching methods and practices but seeks to add new knowledge within a specific field or branch, such as project management. In order to conduct research from within the classroom we propose using gaming simulation as a method for this purpose. Gaming simulation will then serve as an instrument for both learning and research. In this paper, we shall show that gaming simulation can be used as an explorative research method in project management. Explorative or also known as inductive research is used to better understand possible causes or influencing factors for attributes of system. It is concerned with tentative formulation of relationships between phenomena and explanation of them (Velde, Jansen et al. 2004 p 17). Traditional exploratory research often employs several methods such reviewing available literature, informal discussions, and formal approaches through in-depth interviews or case/pilot studies. The paper will give a very short review of the strengths and weaknesses of each of these methods employed compared to gaming. The paper will then present the results from 6 rounds of classroom experiments that were conducted by the author in the context of a continuing education project management course on master level at the Norwegian University of Science and Technology. The numbers of participants in these experiments were roughly 150. Simple multiplayer gaming simulation was used in these experiments. The focus of these experiments was to use gaming to identify and categorize significant aspects influencing project participants behavior in early. The paper is organized as follow, section 1 presents an over view over the reported use of gaming as research method in project management. Section 2 elaborates on the advantages of using gaming as a research methodology and section 3 provides a comparison between most frequently used research methods. Section 4 presents the application example, including more in depth analysis of the participants profile, research question and design and comments on the validity, reliability and the generalizeability aspects. Section 5 presents the conclusions of the application example and recommendation to future work.

2. Research using gaming simulation in project management

In the field of project management, there is a multitude of simulation games that are currently used in training and education. These games can be classified broadly into two main categories. This classification is consistent with the actual practice in the field of project management (Hussein 2007):

- Functional simulation games targeting functional project management problems such as balancing cost, time and scope.
- Leadership simulation games dealing with softer issues such as developing project strategy, negotiation and decision making in pursuit of several objectives.

As far as gaming for research is concerned we have found very few references in project management literature. Most of the current research employs rather more traditional methods such as case studies and surveys. The literature review conducted shows that the use of gaming in project management research can be divided into five categories:

1) Gaming has been used to understand and identify important information needed by the management to be able to make decisions during project execution. Gaming was aiming to provide participants with synthetic training experience about what type of problems and

decisions needed during project execution. The research effort was rather a sub-product of gaming and not the main goal. Example of this category is GREMEX game described in Rowe, Gruendeman et al. (1968). 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.

2) Games were used to examine the behavior and performance of project teams under different conditions. 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 author also suggested the possibility of using the game to test hypothesis about factors that lead to best practice by comparing the behavior with different groups, skills and background. This was not done but only proposed as a possibility in the game. Once again, the research opportunity of the game is a sub goal of the main game.
3) The third category of games in research can be found in for example McCreery (2003). This game was developed to cover to what extent project management training through gaming actually improves the project management knowledge and skills of participants. Thus it falls under research about training value of games in project management and not directly related to generic success factors in projects.
4) The fourth category of games can be found in (Milis, Meulders et al. 2003). They describes a quasi-experiment seeks to identify a set of success criteria that are common in intra-organizational ICT projects. This work falls into exploratory research and the author used gaming likes methods to establish the final conclusions in the research
5) The fifth category of gaming in research is described in Hussein (2009) . The paper presented the results from in-class gaming simulations that were conducted to investigate several risk management related hypotheses..

3. Why using gaming?

Obviously we have no intention to discuss or join the debate about the most effective methods to conduct explorative or causal research in management. Our goal is to present a supplement mean to conduct research in parallel or hand in hand with training within the boundary of the classroom. To learn, participants are brought into an artificial environment that resembles a specific real-life situation so that they may acquire knowledge and skills that are relevant to some real-life situation. Specific knowledge and specific skills are to be acquired and, as a rule, it is known in advance what knowledge and skills should be acquired. According to (Raybourn and Waern 2004) learning results: 1) from contextual information embedded in the dynamics of the game, 2) from the organic process generated by the game, and 3) through the risks, benefits, costs, outcomes, and rewards of alternative strategies that result from decision making. Learning's climax is reached in the debriefing session. According to (Peters and Vissers 2004, p 4) debriefing can be considered the phase in which the game's learning objectives are made evident. In debriefing for learning participants are asked to explore possible connections between experiences they had while playing the game and experiences in real-life situations. That is what participants may have learned from playing the game.

Similarly explorative research opportunities in gaming can be realized by observing and collecting and then identifying patterns in participant's response to issues relevant to the subject of research. (Peters and Vissers 2004, p 4) refers to this usage of games in research as responsive simulation. Debriefing in this case is used to collect participants own observations or /and self-assessment to their own response or attitude. Casual research opportunities in gaming can also be realized through exercising control, randomization and comparison on the parameters or factors that are relevant for the research. Debriefing in this case is used to inform participants afterwards about research questions and hypotheses (Peters and Vissers 2004). Hofstedet (2009) places gaming simulation as a research method as an intermediate step between the study of a case in a real life

world and the more context free methods like questionnaires. Case studies and questionnaires are still dominating project management research while action research/participation action research is less common (Ottosson 2003). A gaming simulation can be thought of as a sub-group of action research and offers the possibility to study the interaction between participants too, though in a simulated context instead of the real world. (Hofstedet 2009) summarized the weakness and strengths of each category as shown in the table 1.

	Weaknesses	Strengths
Case studies	Low repeatability due to changing contexts. Generalizeability complex due to contextual bindings	Real world in-depth study. Observation of actual actions and direct communication.
Questionnaires / Surveys	No control over environment Little information about context. Answers can be socially acceptable instead of real behavior.	The power of large numbers, wide range and number of respondents possible Little disturbance of the actual behavior. Well-known method, incl. Solving issues like non-response, etc.
Action research	Low repeatability due to changing contexts. Influence of researcher on process. Generalisability can be complex, due to observation of one situation within its context.	Observations from within an organizational situation. Observation of the actual behavior. Longitudinal observations with possibility to find patterns that will not be found using iterative observation moments.
Computer simulation	No real observations. "Rich" human is modeled but can you model the tacit knowledge?	Virtually unlimited numbers of experiments Any possible setting can be tested. Testing hypothesized models with endless variation of the environmental and internal variables.
Gaming simulation	Simulated context, not for real. Large number of participants willing to spend time required.	Repeatable experiment. Observation of actual actions and behavior. Control over environment

Table 1. Weakness and strengths of current research methods reprints from (Hofstedet 2009)

4. Application Example 1: Gaming for exploratory research

In the previous sections we presented the position of gaming among other research methods. We have briefly reviewed the reported use of gaming in project management research, and we have concluded that gaming can be used as a tool to create a project like environment, then collecting data by assessing/observing the parameters that are under study and then identifying patterns in observations.

The present example demonstrates the use of the classroom as an arena for project management research activities through gaming as the main research method combined with participants as observers (Gill and Johnson 2002) and self-assessment. We use simple games in the process which according to Raia (1966) are as effective as complex games in achieving learning objectives.

4.1 Participants profile

The participants of the experiments described here are students taking essential project management course that is held by the author twice a year in two different locations. One course is held in Oslo and the other is held in Trondheim. Gender, educational background, type and work experience profile of the participants is quite diverse and none-homogenous. This characteristic provides an advantage and allowed the author to exercise control over the game's variables

according to the need or research question. It allows the researcher as well to cover a wider spectrum of research questions.

The course is held 4 times each year, which gives the author the chance to repeat the experiments as needed. Repeatability provides also better ground to fine tune the game variables and allows for better ground for comparison. Some participants are taking the course as a part of the obligatory requirements to take a competence based master degree in organization and leadership at NTNU. Others are taking this course is to seek more in depth understanding of methods and practices in project management or looking for new career opportunity in project management.

Average number of students attending each course location is around 30 students. Figure 1 illustrates typical age distribution among participants of this category.

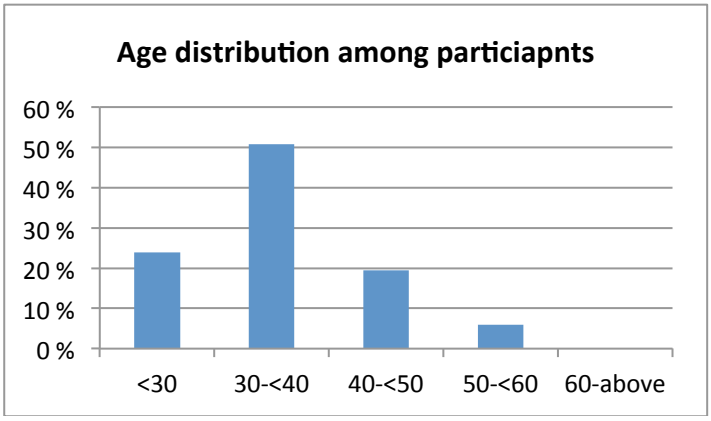

Figure 1. Age distribution among participants

Around 50% of the participants are in the age interval between 30-40 years old. They have higher university degree and few years work experience and some project management experience either as project participants or as project managers. The author have examined a random sample of 40 students among 180 and found that average project management experience of the sample is 8.28 years and median of 5 years. Statistical data of the sample is shown in table 2. If we take the lower bound of 95% confidence interval for the mean, which is 6,23, and multiplied with the number of students attending the course, we obtain roughly 200 years of work experience available at one time. This should be seen as a research opportunity that should not be missed.

			Statistic	Std. Error
Experience	Mean		8.28	1.013
	95% Confidence Interval for Mean	Lower Bound	6.23	
		Upper Bound	10.33	
	5% Trimmed Mean		8.04	
	Median		5.00	

Table 2. Description of statistical data: project management experience.

Table 3 shows also examples from the type of industry and job titles of the selected sample of participants.

Example of type of industry	Examples of Job title
Offshore modifications	R&D Project Manager
Air traffic control	Senior Advisor
Consulting	Project manager
Higher education, facility management	Project leader

Civil aviation	Product Marketing Manager - Learning,
Automation/Industrial IT	Principal analyst
Medical	Support Manager / Project coordinator
Railway	Maintenance Manager
Construction and maintenance	Department manager
Telecommunications	Maintenance planner

Table 3. Examples of type of industry and job titles.

The above data and figures indicate that the CFE classroom has all the elements that are needed to conduct research using gaming simulation because; 1) Participants have diverse background and project management experience. 2) Large number of participants allowing repeatability, thus increasing reliability of the instrument. 3) The game provides the participants with a controlled context that resembles a real project thus increasing the validity of the data observed. 4) Possibility of on-the-spot and real-time observation and assessment of participants behavior, response or attitude allowing true measurements and better grounds for comparison. 5) The researcher has full control over the casual factors and the context. Therefore, gaming simulation is an excellent tool when a repeatable experiment is needed for different groups of participant's respondents and contextual aspects are important to know.

4.2 Research question of the game:

The objective of gaming simulation is to explore and rank the key aspects that influence project participant's attitude at early phase. The research is to answer the following questions:

1) Identify key aspects that influence project participants behavior at project initiation phase.
2) Extract the most critical aspects that participants observed/assessed as significant during gaming and if probably addressed they would be able increase project overall performance

4.3 Research design

The research design was developed with three key components in mind; validity, reliability and generalizeability (Crowther and Lancaster 2009 p 126). Generalizeability: measures the extent to which results from data can be generalized to other situations. Reliability: relates to the extent to which a particular data collection method will give the same results in different occasions. Validity: relates to the extent to which the research method measures what it is supposed to measure.

The idea behind the research was engage the players in a gaming experience that resembles a real-life project situation and then collect, classify and rank the participants self-assessment of their behavior in the game. The final result of this assessment should provide an ordered list of the driving behavioral and contextual aspects that causes projects to fail or reduce their overall performance in real life.

The project example used in the simulation includes two main roles; the project owner and the contractor or project organization. The author assumed always the role of owner and groups of participants that are formed randomly assumed the role of the contractor or project organization. The gaming exercise starts eventfully on the first day of the course when the owner announces his decision to initiate a daring project to build the highest structure in town and invites groups to submit a project proposal.

Requirements include types of materials that should be used and allowed time frame. The groups are also informed that the submitted proposals must contain information about, the proposed height, estimate of number of sheets resembling cost estimate, and estimate for time needed to completion. The groups were also given a list of project constraints as well as other preferences and needs that should be satisfied. All these constraints and preferences were deliberately vague formulated and could be interpreted by several ways. For instance, one of the owner preferences

was that the product should have appealing design. The groups were also given a time frame to work on their proposal.

Even though the average work experience of the participants was roughly 8,25 and most of them have been working in project as project participants or as project managers virtually none of the groups followed the best practice of project management that is to involve the owner in order to reveal and prioritize the goals and objectives of the project in a satisfactory manner. This observation was the main focus of the followed debriefing session.

4.4 Phase 1: observation and categorization

Data collection was conducted on two phases. Phase 1 was run on 4 rounds of experiments; each experiment consisted of 5 experimental groups.

During the debriefing session, each participant was then asked to submit a written short self-assessment describing the underlying driving factors on the way each has responded to the events and processes in the game. Measures to control the threat to validity was to start gaming simulation by emphasizing that this game is not just a synthesized learning experience but also a tool to better understand the driving behavioral and contextual factors during project planning and execution. The participants were also asked to not to think of the exercise as a game but to try to react and select their responses as if they were in real project situation.

During the debriefing session, participants were asked to formulate the self-assessment report based on their behavior during the game and not to express a general personal opinion on the basis of former experience or readings. The selection of all the group members was random this was done in order to increase the condition for generalizeability. All the groups had access to the same type of information at the briefing session and during execution phase. This was done in order to keep the grounds for comparison intact.

The results of the short self-assessments were then collected and studied by the author. Patterns in these responses were also studied in order to produce a list of aspects that influenced participant's attitude during the game. The data collected from the participants (total number of 100 participants contributed to the observation). The answers collected were then grouped into 7 sub categories. These 7 sub categories and some of the quotation expressed by the participants are shown in the table 4.

Aspect	Quotation
Personal emotions such; eagerness, fear, culture, competiveness, diffidence, conformity	• I was very eager to get started • Unease to mark oneself by being the first be the one who start asking questions. • Norwegian style: do not stand up; do not take the lead • I only thought to win • Scared to come up with "stupid" questions • I followed the rest of the herd/group

Assumptions (the act of taking something for granted)	• I assumed that my understanding was the same as the project owner. • I thought I had a complete specification. I assumed that the group can decide the complete specifications • I thought I understood the product explanation, so I started working with it. • I only focused on project planning phase, did not think of execution
Focus Wed delivery / Problem-Solving / Creativity	• We focused on technical problem solving • Tried to be creative
Confusion /ambiguity	• Many views, hard to find the best solution and decide • Group members had no defined roles or did not have a role clarification. • Stress due to new people
Time pressure	• Time pressure caused the group to jump to conclusions. • Stressed due to short time • Finishing on time have become the central focus
Lack of competence	• No experience with project work
Realism	• I thought of it as just a play • I thought the real purpose of the tower construction was to become better acquainted with other students.

Table 4: A list of aspects as observed and reported by the participants in the game.

The Realism aspect has to do with validity of the gaming simulation as a method for data collection. Some of the participants did not experience the game as realistic as it was designed to be. It was therefore important to measure the significance of each aspect and its impact on the overall result. This was done in phase 2.

The starting point for phase 2 was therefore a hypothesis about significance of aspects identified in phase 1. The purpose of the phase 2 was to identify significant aspects that have major affect on participants' attitude.

H0: null hypothesis, all aspects are equally significant

H1: at least one of the aspects is more significant

4.5. Prioritization and statistical testing

Another 2 rounds of experiments were held, again the number of participants were roughly 50 participants. The same game was played, 5 groups in each round, however in these experiments and during the debriefing session the participants were not asked to write down their own self-assessment but they were asked to select 3 most dominant aspects from the produced list and then range them on a scale from 3 to 1 each having equal interval. 1 is lowest and 3 highest. It was emphasized that the rating should be based on each participant's self-assessment with reference to his or her own behavior during the gaming session. The results obtained after this phase shows that around 1% of the participants had "lack of realism" as one of the driving factors behind their behavior. The remaining factors of this category of participants were considered not valid and have been omitted. Table 5 shows the weighted score for each of the aspects developed in phase 1.

Aspect	Weighted score
Focus on creativity	36%
Making assumptions	24%
Individual emotions	16%
Lack of competence	8%
Time pressure	10%
Uncertainty/confusion	6%

Table 5. Weighted score of each aspect.

This result refutes the null hypothesis and suggests that all aspects are not equally significant. The most significant aspects are overfocus on creativity and technical solution and making own assumptions about project objectives, context and requirements without studying the inherent risks in these assumptions. Individual emotions also play a role in the way projects are conducted but not very significant. Cultural characteristics may have played a role in determining the weighted score of this aspect. This could be a subject of closer investigation.

Further investigation of the results shown in table 5 indicates that, we can broadly classify the key aspects into two main categories.

Category 1: Behavioral aspects. This category covers the way individuals selects their responses and includes the following factors:

A- Strong focus on problem solving or starting the "real" work without investing enough time on preparation and documentation effort.
B- Making several assumptions about the project without actually investigating the creditability/associated risks of these assumptions
C- Personal emotions such as being anxious to prove personal capability or avoiding the embracement by avoiding requesting clarifying statements about project objectives.

Methods to control the impact of this category will be the subject of the future research. A set of casual factors will then be identified and introduced into experimentation group to measure the effect of these measures on the these behavioral aspects.

Category 2: Contextual aspects. This category involves those aspects that are perceived as external influences by the project context. If accurately manipulated and controlled they will be eliminated or strongly reduced. This hypothesis however will be covered in future research through context manipulation.

D- Time pressure
E- Lack of project management competence
F- Uncertainty/confusion

5. Conclusions and future work

The paper demonstrates the use of gaming simulation as a research tool in project management using classroom as an arena for research. The paper has showed that the classroom provides an excellent controlled environment that allows experimentation with context and measurements of participant's behavior on the spot, in real time providing that the simulation has an adequate level of realism. The other significant results of the research contributes to previous research work on generic project success factors and identifies and rank the most underlying aspects that influence project participants attitude and may hamper project management performance

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