Quasi-experimental method to identify the impact of ambiguity and urgency on project participants in the early project phase

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Abstract—**The goal of this paper is to demonstrate the potential of gaming simulation as a research method in project management. Gaming simulation is used for identifying the impact of ambiguity and urgency on project participants' attitudes in the early phase. By ambiguity we mean lack of clarity of goals and objectives of the project. Urgency refers to time pressure, in the sense that the project has to be completed within specified time frame.**

The results of the experiments shows that ambiguity and urgency leads to three significant response patterns by the project participants 1) the tendency to overly focus on the technical solution, 2) the tendency to make unverified assumptions 3) significance rise to personal emotions, such as fear, diffidence, competitiveness and eagerness.

The results obtained using gaming simulation as a research method are consistent with previously published studies. The paper concludes that gaming simulation can 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 an adequate level of realism and insight.

Keywords—gaming; project management; simulation; ambiguity

I. 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 the requirements development phase. After having run the game for over two years and for more than 10 classes, thus satisfying the rule of needing to play 10 sessions before a gaming simulation is ready for use [1], the author realised that exercise can also be used as a research tool in order to study key aspects that affect the performances of project participants, particularly in the project initiation phase. Considering that the majority of the participants have project management experience and are aware of the importance of effective communication, planning and involvement to attain success.

The subject of project success factors was first covered by [2]. These authors presented evidence of the following critical factors: clarity of goals, top management support, clear project plans, client relationship and communication. Other references list similar sets of factors that are important to attain successful completion, see [3], [4], [5, 6].

Although the research on generic success factors is vast, the author believes that research has yet to address and investigate the impact of lack of these factors on project participants' attitudes in the early phase, which could damage or threaten the overall project management effort.

Gaming is increasingly gaining standing as an established and useful learning method in several disciplines [7]. The approach is considered to be risk-free; it encourages exploration and trial-and-error actions with the 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 assessment practices or strategies.

Our argument in this paper is that classrooms that have diverse participant profiles could be used as arenas for conducting research. It is believed that the increasing demand for lifelong learning as well as further and continuing education brings along with it new opportunities for conducting experimental research within the classroom. This might be experimental research that goes beyond searching for effective teaching methods and practices and 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 show that gaming simulation can be used as an explorative research method in project management. Explorative research (also known as inductive research) is used to better understand possible causes or influencing factors for attributes of a system. It is concerned with the tentative formulation of relationships between phenomena and the explanation of them [8 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. This paper will give a brief review of the strengths and weaknesses of each of these methods compared with gaming. It will then present the results from 8 rounds of classroom experiments that were conducted by the author in the context of a Master's project management course at the Norwegian University of Science and Technology. The number of participants in these experiments was roughly 300. Simple multiplayer gaming simulation was used.

The paper is organised as follows. Section 1 presents an overview of the reported use of gaming as a 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 the most frequently used research methods. Section 4 presents the application example, including more in-depth analysis of the participant profiles, research question and design and comments on the validity, reliability and generalisability aspects. Section 5 presents the conclusions of the application example and makes recommendations for future work.

II. RESEARCH USING GAMING SIMULATION IN PROJECT MANAGEMENT

In the field of project management, a multitude of simulation games 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 [9]:

- 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 the pursuit of several objectives.

As far as gaming for research is concerned, we have found very few references in the 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:

- Gaming has been used to understand and identify the important information needed by management to be able to make decisions during project execution. Gaming aims to provide participants with synthetic training experiences about the types of problems and decisions during project execution. The research effort was rather a sub-product of gaming and not the main goal. An example of this category is the GREMEX game described in [10]. Research opportunities in the exercise were about what information is most

useful and what new information and what format would be desirable in the project management operation.

- Games were used to examine the behaviour and performances of project teams under different conditions. Martin [11] 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 hypotheses about factors that lead to best practice by comparing the behaviour of different groups, skills and backgrounds. This was not carried out 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.
- The third category of games in research can be found in, for example, [12]. 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 the training value of games in project management and is not directly related to generic success factors in projects.
- The fourth category of games describes a quasi-experiment that seeks to identify a set of success criteria that is common to intra-organisational ICT projects [13]. This work falls into exploratory research that uses gaming-like methods to establish the final conclusions in the research.
- The fifth category of gaming in research is described in [14]. The paper presented the results from in-class gaming simulations that were conducted to investigate several risk management-related hypotheses.

III. WHY USE GAMING?

We have no intention to discuss or join the debate about the most effective methods of conducting explorative or causal research in management. Our goal is to present a supplementary means to conduct research in parallel or hand-in-hand with training within the boundary of the classroom.

According to Peters [16, p 4], debriefing can be considered the phase in which the game's learning objectives are made evident. In debriefing, learning participants are asked to explore possible connections between experiences they had while playing the game and experiences in real-life situations. In other words, what participants may have learned from playing the game.

Similarly, explorative research opportunities in gaming can be realised by observing and collecting and

then identifying patterns in participant responses to issues relevant to the subject of research. Peters [16, p 4] referred to this usage of games in research as responsive simulation. Debriefing in this case is used to collect participants' own observations and/or self-assessments of their own responses or attitudes.

Casual research opportunities in gaming can also be realised through exercising control, randomisation and comparison on the parameters or factors that are relevant for the research. Debriefing is used to inform participants afterwards about research questions and hypotheses [16].

Hofstedet [7] summarised the strengths and weaknesses of each category as shown in Table I.

TABLE I. **STRENGTHS AND WEAKNESSES OF CURRENT RESEARCH METHODS [7]**

	Weaknesses	Strengths
Case studies	Low repeatability because of changing contexts. Generalisability complex because of 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 behaviour.	The power of large numbers, wide range and number of respondents possible. Little disturbance of the actual behaviour. Well-known method, incl. solving issues such as non-response, etc.
Action research	Low repeatability because of changing contexts. Influence of researcher on process. Generalisability can be complex because of the observation of one situation within its context.	Observations from within an organisational situation. Observation of the actual behaviour. Longitudinal observations with the possibility of finding patterns that will not be found using iterative observation moments.
Computer simulations	No real observations. "Rich" human is modelled but can you model tacit knowledge?	Virtually unlimited numbers of experiments. Any possible setting can be tested. Testing hypothesised models with endless variations of the environmental and internal variables.
Gaming simulation	Simulated context, not for real. Large numbers of participants willing to spend time required.	Repeatable experiments. The observation of actual actions and behaviour. Control over environment.

IV. THE QUASI EXPERIMENTS

A. Participant Profiles

The participants of the experiments described here were students taking the essential project management course that is held by the author four times a year. The gender, educational backgrounds, and work experience profiles of the participants were diverse and heterogeneous. 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 also allows the researcher to cover a wider spectrum of research questions.

Because the course is held four times each year, the author has the chance to repeat the experiments as needed. Repeatability provides better grounds for fine-tuning the game's variables and provides better grounds for comparison. Some participants take the course as a part of the obligatory requirements to take a competence-based Master's degree in organisation and leadership at NTNU. Others take this course in order to seek a more in-depth understanding of project management methods and practices or because they are looking for new career opportunities in project management.

The average number of students that attend each course is 30. Around 50% of participants are aged between 30–40 years old. These students have higher university degrees and a few years of work experience as well as some project management experience either as project participants or as project managers. The author examined a random sample of 40 students among the overall population and found that the average project management experience of the sample is 8.28 years with a median of five years.

Table II shows examples of the type of industry and job titles of a selected sample of participants.

TABLE I. EXAMPLES OF THE TYPE OF INDUSTRY AND JOB TITLES

Examples 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	
Construction and maintenance	Maintenance Manager
	Department manager
Telecommunications	Maintenance planner

The above data and figures indicate that continuing and further education classrooms have all the elements that are needed to conduct research using a gaming simulation because of the following factors:

1) Participants have diverse backgrounds and project management experience,

2) a large number of participants allows repeatability, thereby increasing the reliability of the instrument,

3) the game provides participants with a controlled context that resembles a real project, thereby increasing the validity of the data observed,

4) there exists the possibility of on-the-spot and real-time observations and assessments of participants' behaviour, responses or attitudes, which allows for true measurements and a better grounds for comparison, and

5) the researcher has full control over the casual factors and the context.

Therefore, a gaming simulation is an excellent tool when a repeatable experiment is needed for different groups of participants and when it is important to know the contextual aspects.

B. Research Question of the Game

The research aims to identify the impact of ambiguity and urgency on project participants' behaviour in the project initiation phase.

The research design was developed with three key components in mind: validity, reliability and generalisability [18 p 126]. Generalisability measures the extent to which results from data can be generalised to other situations. Reliability relates to the extent to which a particular data collection method gives 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 to engage players in a gaming experience that resembles a real-life project situation and then to collect, classify and rank the participants' self-assessments of their behaviour in the game.

The project example used in the simulation includes two main roles: the project owner and the contractor or project organisation. The author always assumed the role of owner, and the groups of participants that were formed randomly assumed the role of the contractor or project organisation. The gaming exercise started eventfully on the first day of the course when the owner announced his decision to initiate a daring project to build the highest structure in town and invited groups to submit a project proposal.

Requirements include types of materials that should be used and the allowed timeframe. The groups were also informed that the submitted proposals must contain information about the proposed height, an estimate of the number of sheets (resembling a cost estimate) and an estimate for the 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 and could be interpreted in several ways. For instance, one of the owner's preferences was that the product should have an appealing design. The groups were also given a timeframe to work on their proposals.

Even though the average work experience of the participants was roughly 8.25 years, few of the groups followed the best practice of project management, namely to involve the owner in order to reveal and prioritise the goals and objectives of the project in a satisfactory manner. This observation was the focus of the following debriefing session.

C. Phase 1: Observation and Categorisation

During the debriefing session, each participant was asked to submit a short written self-assessment describing the underlying driving factors behind how he or she responded to the events and processes in the game.

Measures to control the threat to validity included starting the gaming simulation by emphasising that it was not just a synthesised learning experience but also a tool to better understand the behavioural and contextual factors during project planning and execution. Participants were also asked not to think of the exercise as a game but to try to react and select their responses as if they were working on a real project.

During the debriefing session, participants were asked not to express a personal opinion on the experience. The selection of all group members was random in order to increase the condition for generalisability. All groups had access to the same type of information at the briefing session and during the execution phase in order to keep the grounds for comparison intact. The results of the short self-assessments were then collected and studied by the author. The patterns in these responses were studied in order to produce a list of aspects that influenced participants during the game. The data collected from the participants were then grouped into 5 sub-categories. These sub-categories and some of the quotations expressed by participants are shown in Table III.

TABLE II. A LIST OF ASPECTS AS OBSERVED AND REPORTED BY PARTICIPANTS.

Aspect	Quotation
Personal emotions such as eagerness, fear, competitiveness, diffidence and conformity as well as cultural barriers	I was very eager to get started. Unease to mark oneself by being the first to start asking questions. Norwegian style: do not stand up; do not take the lead. Scared to come up with "stupid" questions I followed the rest of the herd/group. Stressed because of the short time.
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 could decide the complete specifications I only focused on the project-planning phase. Stress owing to new people. Finishing on time become the focus.
Focus on delivery / problem-Solving / creativity	We focused on technical problem solving. Tried to be creative.
Lack of competence	No experience with project work.
Realism	I thought of it as just a game. I thought the real purpose of the construction was to become better acquainted with others.

The Realism aspect refers to the validity of the gaming simulation as a method for data collection. Some participants did not view the game as realistic as it was designed to be. Competence in project management was

one of the underlying assumptions to conduct this research. It was thus important to measure the significance of each aspect and its impact on the overall result. This was done in phase 2.

The further investigation of the results in Table III indicates that we can broadly classify the key aspects into two main categories.

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

1) Strong focus on problem solving or starting the "real" work without investing enough time in preparation and documentation.

2) Making several assumptions about the project without actually investigating the creditability/associated risks of these assumptions.

3) Rise to personal emotions such as being anxious to prove personal capability or avoiding embarrassment by not clarifying statements about the project's objectives.

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

Category 2: Contextual aspects. This category involves those aspects that are perceived as external influences. This includes

- Realism or uncertainty about the objectives of the game.
- Lack of project management competence

D. Phase 2: Ranking and Results

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

H0: null hypothesis, all aspects are equally significant

H1: at least one of the aspects is more significant.

Another round of experiments were held. The same game was played, with five groups in each round; however, in these experiments and during the debriefing session the participants were not asked to write down their own self-assessments. They were asked to select the aspects in the produced list and then rate them on a scale from three (highest) to one (lowest). It was emphasised that this rating should be based on each participant's self-assessment with reference to his or her own behaviour during the gaming session. The results obtained after this phase showed that around 1% of participants had "lack of realism" as one of the driving forces behind their behaviour. The results further have shown that around 5% of the respondents had lack of competence as one of the factors influenced their performance in the game.

The self-assessments provided by these respondents were considered invalid and were omitted. The final list

Table IV shows the weighted score for each of the aspects developed in phase 1.

TABLE III.   WEIGHTED SCORE OF EACH ASPECT.

Aspect	Weighted score
Focus on delivery / technical solution	54%
Making assumptions	32%
Individual emotions	14%

This result refutes the null hypothesis and suggests that now all aspects were not equally significant. The most significant aspect is overly focus on creativity and technical solutions. The second in line is tendency to making assumptions about the project's objectives, context and requirements without studying the inherent risks in these assumptions. The third factor is individual emotions, which also played a role in the way projects were conducted (albeit less significant one). Cultural characteristics may have played a role in determining the weighted score of this aspect. This could be a subject of closer investigation.

V.   CONCLUSIONS

The present paper demonstrates the use of a gaming simulation as a research tool in project management using the classroom as an arena for research. It shows that the classroom provides an excellent controlled environment that allows experimentation within the context and measurements of participant behaviour in real time, thereby providing the simulation with an adequate level of realism. The other significant results of the research contribute to the previous research on generic project success factors. The results of the experiments shows that ambiguity and urgency leads to three significant response patterns by the project participants 1) the tendency to overly focus on the technical solution, 2) the tendency to make unverified assumptions 3) significance rise to personal emotions, such as fear, diffidence, competitiveness and eagerness.

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