

USING SERIOUS GAMES FOR IDEA ASSESSMENT IN SERVICE INNOVATION

Complete Research

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Abstract

Serious games are an innovative way for tackling design objectives in a variety of IS contexts. In this paper, we explore the use of an online serious game for idea assessment in companies, an approach that is not covered in scientific literature so far. Thereby, we contribute to understanding (i) whether serious games can add to overcoming challenges in the area of idea assessment, and, (ii) whether there are potential biases of the game towards more incremental or radical ideas when played by teams differing in terms of their members' personality profile. In a first step, we employ the serious game Buy-a-Feature and run a qualitative pre-study under real-life conditions at a German Financial Services provider. Next, we conduct a lab experiment in which 250 participants prioritize a portfolio of 16 ideas by playing the game. Our results demonstrate high levels of engagement amongst the participants, perceived enjoyment, perceived ease of use and confidence with the games' outcomes. Moreover, teams with a high average score of the personality trait "Openness to Experience" exhibit a bias towards radical ideas, while all other team formations showed rather balanced results. Based on our results we reflect on managerial implications for the use of the game for idea assessment, particularly in a service innovation context.

Keywords: Big Five, Experiment, Idea Assessment, Personality Traits, Serious Games, Service Innovation, Team Formation.

1 Introduction

In 2012, the mayor of San José, a city of a million people in the Silicon Valley, engaged in an innovative and at that stage unique experiment. In light of the immense financial pressure San José was struggling with, the mayor asked 90 representatives of neighborhood associations to help prioritize the city's annual budget by playing a *Serious Game* (Greeley, 2012; Tett, 2012). The game was carried out as a face-to-face event in the town hall. After less than a day the participants agreed on the allocation of resources as well as a concrete set of actions to generate savings. The mayor was handed over recommendations for a more balanced budget, while, at the same time, getting buy-in from key representatives of the area's inhabitants. The success of this remarkable experiment demonstrated the power of serious games in real-world scenarios and led to inquiries from many further US cities. Moreover, it raises the question to what extent serious games, i.e. "games used for

purposes other than mere entertainment” (Susi et al., 2007, p. 1), can also contribute to solving other real-world problems in which teams with diverging opinions aim at reaching an agreement. Meanwhile, an online version of the game used in San José is available, providing web and mobile front-ends. Hence, the former board game became a Group Decision Support System for remotely operating small- to medium-size teams (DeSanctis and Gallup, 1987). In this paper, we study the application of this online game for idea assessment and investigate whether it helps to address challenges known to be relevant in a service innovation context.

While idea assessment in general has been covered in scientific literature for a long time (e.g. Baker and Freeland, 1975; Cooper and Brentani, 1984; Adams et al., 2006), new challenges have emerged in the past decade suggesting a revisit of the topic. In particular, open and collaborative innovation approaches have led to increasingly large idea portfolios. Bjelland et al. (2008), for instance, reported that more than 46,000 ideas were generated in IBM’s 2006 Innovation Jam. As a result, Barczak et al. (2009) found that up to 40% of ideas selected for continuation in companies did not undergo a formal assessment. Instead, they were rather pushed forward, with half ending up with no funding (Barczak et al., 2009), a phenomenon also known as *hollow go-decisions* (Cooper, 2009). While these issues apply to innovation management in general, service innovation adds an additional challenge. Services are considered co-creation of value, i.e. emerging from the interaction of service providers and customers (Spohrer and Maglio, 2008). When service provision is carried out by humans (e.g. in professional services), these people hold first-hand market knowledge that their respective organizations should seize (Feldmann and Kohler, 2014). Since these peoples’ primary duties are customer-related, their participation in idea assessment is not self-evident. Hence, particularly appealing idea assessment approaches may help to address this issue. Notably, West and Bogers (2014) stated that recent research – in particular regarding Open Innovation – focused rather on obtaining ideas than subsequent steps of the innovation process.

To tackle the outlined challenges, research indicates that idea assessment could benefit from the support of information systems. Unfortunately, only about 20% of organizations leverage software support for idea assessment (Schulze et al., 2012). Hence, there is a need for research on new methods for idea assessment that (i) are IT-supported, (ii) are more attractive to organizations and their members, (iii) cope with increasingly large portfolios, (iv) tap the market knowledge of large groups of their service-providing staff, and (v) help to repair the separation of decision and resource provision framed as hollow go-decisions. Approaches supporting internal openness may help to do so and therefore we believe that leveraging the power of serious games is a promising approach.

In order to explore the potential of serious games in the context of idea assessment, we conduct an experiment in which 250 participants have to agree on funding a set of real start-up ideas by playing the game. As research on innovation management points out, the importance of team formation is critical (Schar, 2011; Kress and Schar, 2012), so we systematically vary teams with respect to their members’ personality trait *Openness to Experience*, one dimension of the widely accepted *Big Five Model* from personality psychology. The research questions we address are as follows:

RQ1: *Do serious games contribute to responding to the challenges of idea assessment in service innovation?*

RQ2: *To what extent does the formation of teams in terms of openness to experience influence the outcome of a serious game for idea assessment?*

The remainder of this paper is organized as follows: In the next section, we outline the theoretical background of our study, by covering recent developments in idea assessment, the field of serious games, types of innovation, and personality psychology. Then, we describe the design of our experiment, followed by the presentation and discussion of its results and managerial implications. Finally, we conclude the paper by summarizing the study’s outcome, reflecting on limitations, and outlining follow-on research.

2 Related Work

In our study we aim to understand whether *Serious Games* for idea assessment have a bias towards certain types of innovations when played by teams varying in terms of their formation. The study is based on a review of literature on (a) idea assessment in service innovation and innovation management in general, (b) *Serious Games* and their usage in innovation management, (c) typologies for the classification of innovations, and (d) team formation based on personality profile.

2.1 Idea Assessment in Service Innovation

Idea assessment, in literature also referred to as idea screening, selection, or evaluation (e.g. Scheuing and Johnson, 1989; Herstatt, 1999), marks the transition from the divergent to the convergent phase of the innovation management process. At this point selected ideas receive initial funding for further development (Hansen and Birkinshaw, 2007), which is considered to be especially critical, as even strong idea portfolios are useless without intense screening and resource provision (Cooper, 2009).

Interestingly, the topic of idea assessment has received relatively little coverage from the scientific community in recent years (Schulze et al., 2012; West and Bogers, 2014). Nevertheless, several facets of idea assessment have been addressed. Some authors discussed assessment criteria and rating scales to improve the assessment of ideas (Sundbo, 1997; Dean et al., 2006; Aas, 2010; Riedl et al., 2010). In their studies Riel et al. (2004 and 2011) explored idea assessment from the perspective of information processing and team formation in terms of organizational roles, experience, and applied perspectives of team members. As part of a discussion on customer involvement in the service innovation process, Alam and Perry (2002) also addressed the potential of involving customers in idea assessment. Other authors touched the topic briefly when providing an overview of best practices on service innovation processes (Brentani, 2001; Vermeulen and Dankbaar, 2002; Smith et al., 2007; Aas, 2011).

Furthermore, the general innovation management literature addressed the topic of approaches for idea assessment. These publications mostly stay neutral in terms of use for products or services. Alternative ways for assessing ideas include classical decision-making in boards, varying in terms of size and formation (Riel et al., 2011). To improve board decision-making, facilitation techniques such as the Nominal Group Technique (Van de Ven and Delbecq, 1972) and information aggregation mechanisms, e.g. the Delphi study (Dalkey and Helmer, 1963), have been introduced. Building on the idea of aggregating information from a large group of people, crowd-based mechanisms such as prediction markets, also referred to as idea markets (Soukhoroukova et al., 2012; Stathel, 2010), have become increasingly popular in the past decade. Finally, as outlined in a case study by Muller et al. (2013), the most recent crowd-based approach for idea assessment is the application of crowdfunding mechanisms inside companies. Also, studies comparing the performance of the various approaches are common (Van de Ven and Delbecq, 1974; Blohm et al., 2011; Graefe and Armstrong, 2011). In addition, the importance of IT solutions for idea assessment is explored and emphasized (Hrastinski et al., 2010; Schulze et al., 2012; Westerski et al., 2011).

2.2 Serious Games

Although *Serious Games* as a term is not new (Djaouti et al., 2011), it only became widespread with the introduction of the Serious Games Initiative at the Woodrow Wilson Center for International Scholars in Washington, D.C., in 2002 (Susi et al., 2007).

While many scholars still struggle with its exact definition, there is common ground on the core meaning of the concept. Serious games are “(digital) games used for purposes other than mere entertainment” (Rejeski and Sawyer, 2002; Susi et al., 2007; Ritterfeld et al., 2009, p. 6; Astor et al., 2014). Notwithstanding that their primary purpose is not entertainment, serious games can very well be enjoyable, fun, and easy to use (e.g. Rejeski and Sawyer, 2002; Susi et al., 2007). Some researchers

found the definition to be blurry, in particular, since the term *Gamification* has gained popularity in recent years. Correspondingly, papers discussing the similarities and differences between those two and further related terms have emerged (Deterding et al., 2011; Xu et al., 2011). Deterding et al. (2011) define gamification as “the use of game design elements in non-game contexts” (p. 9). Correspondingly, gamifying idea assessment would, for instance, be the use of badges as incentives for participation.

However, in this paper, we focus on serious games. With regards to their purposes, the majority of these games aim for providing training and education – a.k.a. game-based learning (Michael and Chen, 2005; van Eck, 2006). Nevertheless, as shown by Djaouti et al. (2011), serious games get increasingly utilized for other goals such as advertising, information, and simulation. In terms of areas of application, games are, amongst others, used in corporations, education, healthcare, defense, or public policy (Michael and Chen, 2005; Susi et al., 2007; Burke et al., 2009; Göbel et al., 2010; Djaouti et al., 2011). In business and IS contexts in particular, serious games have been discussed by many authors, however, mostly with a focus on training or education (Corti, 2006; Léger et al., 2006 and 2011; Riedel and Hauge, 2011). Moreover, scholars from IS research have recently addressed the differences, potential, and design of competitive vs. collaborative games (Liu et al., 2013).

While games and serious games are often considered as innovations themselves, the application of serious games to support innovation management has received surprisingly little attention in the scientific literature. The publications of Duin et al. (2009) and Hauge et al. (2008) are the only papers in this regard. These authors addressed the early stages of the innovation process, i.e. idea generation, and outline the development of a game that aims to support the generation of ideas for disruptive innovations. From a practitioner point of view, a few additional publications can be added. Related to the innovation management process, Gelperin (2011) introduces six serious, cooperative games that help to support requirements understanding in development projects. In their book *Gamestorming*, Gray et al. (2010) presented 80 games for various business purposes. In fact, most of these games can be considered facilitation techniques for workshops rather than full-blown games. Amongst the games described by Hohmann (2006 and 2013), many follow the notion of collaboratively played board games. For the evaluation of idea portfolios, he suggests two games: *Buy-a-Feature*, the game used in the San José Budget Games, and *Innovation Ambition Matrix*, an in-person facilitation game based on a paper by Nagji and Tuff (2012). For our research, we select the online version of *Buy-a-Feature* for its clear game style and its implementation as a web-based Group Decision Support System.

2.3 Innovation Types

In our study we aim at finding out whether idea assessment by using a serious game has a bias towards certain types of ideas. Ideas, i.e. “concepts or plans formed by mental effort” (Newell et al., 1962), and innovations are not the same. However, innovations derive from the generation and implementation of ideas (Van de Ven, 1986). Hence, ideas describe the concept of innovations ex-ante. Therefore, to categorize ideas for our study, we consider various innovation typologies presented in literature.

We screened 37 related papers, with a majority of them being from the mid-1980s to the mid-2000s. In general, most innovation typologies are not product or service specific. Nonetheless, given the earlier focus on product innovation management in research, many refer to product innovation examples. Due to their general non-specificity, we considered all of them. However, the aim to implement our study as a lab experiment with students deciding on start-up ideas imposes some limitation on the applicability of innovation typologies. Accordingly, those typologies that refer to the history of a given organization, i.e. including categories such as “product line extension” or “revision of existing product” (Booz et al., 1982; Heany, 1983; Johne and Snelson, 1988) were excluded. Furthermore, since our portfolio consists of start-up ideas which are not yet fully realized, a classification of ideas prior to their implementation should be possible. This makes typologies difficult to use that refer to an innovation’s market impact or perception, e.g. Christensen’s (1997) sustaining and disruptive

innovation. Also, for clearer distinction, we aim at typologies with more than two categories of innovation, i.e. popular differentiations such as incremental vs. radical / break-through innovations (Song and Montoja-Weiss, 1998; Schmidt and Calantone, 1998) do not qualify. Finally, we favor approaches which provide orientation on how to classify the innovations in question, and which demonstrate considerable recognition by the scientific community in terms of citations. This leaves us with the “niche creation, architectural, regular, and revolutionary” typology of Abernathy and Clark (1985), and the “incremental, modular, architectural, and radical” typology of Henderson and Clark (1990). Abernathy and Clark structure innovations along two axis, markets/customer – ranging from conserving existing linkages to creating new linkages – and technology/production – ranging from conserving existing competence to obsolete existing competence. The latter typology distinguishes the dimensions of core concepts – ranging from reinforcing to overturning - and linkages between core concepts - ranging from unchanged to changed. We decided to use both typologies for our study due to their matrix structures providing a helpful orientation to classify ideas in practice.

2.4 Personality Traits in Innovation Management

As outlined in a research review by LePine et al. (2011), various scholars have examined and stressed the importance of team formation based on personality traits for team effectiveness. However, they also point out the difficulty of concluding from the personality traits of individuals to team performance. Hence, they state that “researchers have yet to focus enough attention on the linkages between team member's personality and most of these team processes” (p. 326).

In our aim to understand how team formation in terms of personality traits influences the outcome of the serious game, we need to derive an assumption on which personality traits may impact a team tendency towards certain kinds of innovation types. Unfortunately, literature on personality psychology stays vague on the relation between personality traits and collaborative decision-making in an innovation context. It rather concentrates on creative team performance (Schilpzand et al., 2011; Kress and Schar, 2012). While being creative and deciding for something creative is arguably not the same, we continue to derive a hypothesis from this stream of literature. Notably, some studies shed light on the link between creativity and personality traits on individual as well as team level. For this, most papers build on the ‘Big Five’ personality taxonomy, which has become a generally accepted framework (e.g. Barrick and Mount, 1991). It combines all personality traits into the five dimensions *Extraversion*, *Conscientiousness*, *Agreeableness*, *Neuroticism*, and *Openness to Experience*. Schilpzand et al. (2011) found that openness to experience is a key concept for team creativity. However, variance and minimum of team members’ openness to experience scores tend to account for exceptional creativity (Schilpzand et al., 2011). In a different study, Reilly et al. (2002) recommended openness to experience to be relatively high for all team members, with all other factors staying heterogeneous to foster the development of radical innovations. Barry and Stewart (1997) found creative outcome of teams to be associated with their members’ extraversion level. Building on this, Schilpzand et al. (2011) suggested to explore the role of extraversion for team creativity.

Based on Schilpzand et al. (2011) and Reilly et al. (2002), we favored concentrating our experiment around openness to experience as the key factor for our treatments. We cross-checked our choice by considering another approach from innovation-related psychology, Kirton’s (1980) Adaption-Innovation-Inventory (KAI). It is a specific personality inventory, addressing individual’s “different styles of creativity, problem-solving, and decision-making” (p. 213). The KAI places individuals on a continuum from highly adaptive to highly innovative. Kwang and Rodrigues (2002) postulated correlations between the KAI and the ‘Big Five’, indicating that innovators gain significantly higher openness to experience and extraversion scores, whereas the conscientiousness score is significantly lower. Notably, openness to experience shows the highest correlation with Kirton’s innovator. As a remark, we favored the Big Five approach over the KAI for its availability in the native language of our experiment’s participants, wider coverage in related literature and straightforward evaluation.

Overall, relating the insights from literature to our research questions, we hypothesize:

H1: *By using serious games one can create an idea assessment situation that is enjoyed by participants and perceived as easy to use.*

H2: *Teams in which all members have a high openness to experience score have a stronger tendency to select radical ideas rather than other teams.*

3 Experiment

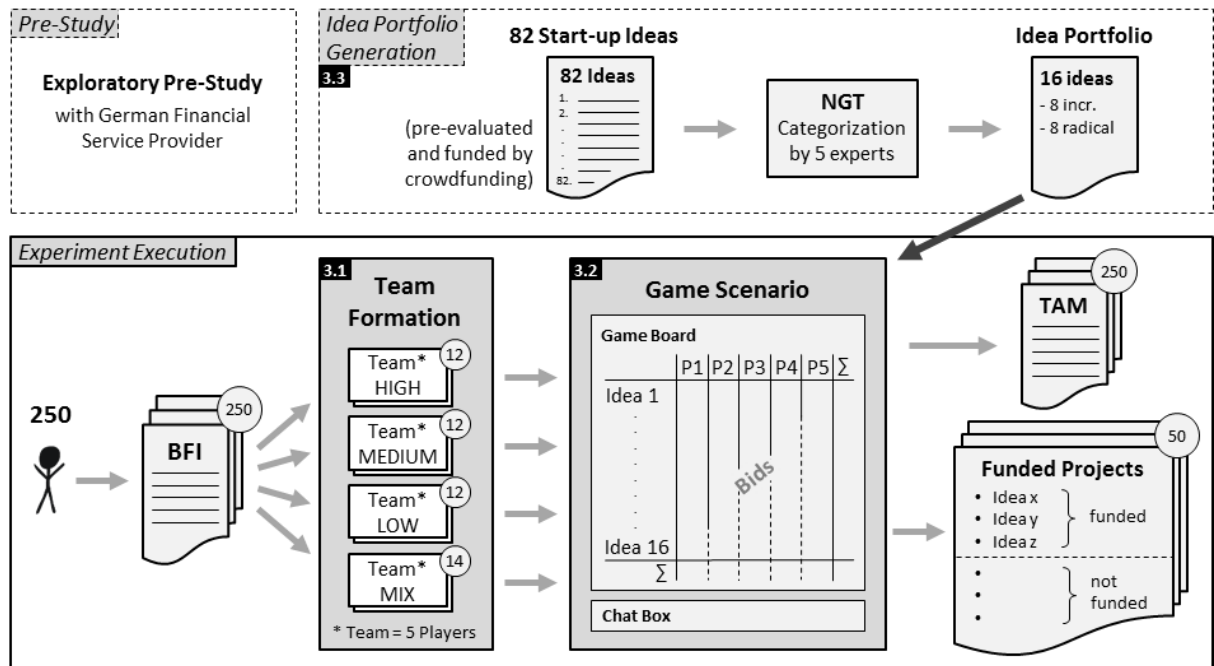


Figure 1. Experiment Design

3.1 Treatment Structure

In order to investigate the potential of serious games for idea assessment, we conduct a laboratory experiment in which teams of five participants each have to agree on funding a set of ideas (*funded projects*) by playing the online-version of the serious game Buy-a-Feature (Hohmann, 2006). As previous research stressed the importance of team formation for innovation management processes, we systematically vary team formation in our experiment by deliberately defining four different types of teams (HIGH, MEDIUM, LOW, and MIX). This differentiation is based on the team members' personality trait score *Openness to Experience*. In each session there are 15 participants, except in one session where 10 participants were allocated to two MIX teams. Upon entering the lab each participant completes an online Big Five questionnaire (BFI) based on which the openness to experience score is calculated (Lang et al., 2001). In each session participants are then assigned to HIGH, MEDIUM, or LOW teams according to their score. In other words, the HIGH team comprises of those individuals with the five highest openness to experience scores, and the LOW team is formed by the individuals with the five lowest scores in the current session. Correspondingly, the remaining five subjects are assigned to the MEDIUM team. Moreover, there are 5 sessions in which 15 participants are equally assigned to three MIX teams, which are supposed to represent teams with an average distribution of openness to experience scores – as expected to be found in any random group. For this, the participants are ranked and every third person is assigned to the same team leading to teams with low,

medium and high openness to experience scores. Each team then plays the serious game to agree on projects to be funded from a total portfolio of 16 ideas (8 radical and 8 incremental). There is no interaction across teams. The design of the experiment is summarized in Figure 1. Each major component of the experiment will be described in detail in the following subsections.

3.2 Game Scenario

The serious game used in our study, *Buy-a-Feature* (Hohmann, 2006), was composed to help designers of products of any kind to prioritize optional new features by letting customers play the game. Originally, the game was designed to be played face-to-face, similar to a board game. Meanwhile, an online version of the game has been created, providing action and chat protocols. During the game, 4-7 participants are endowed with the same amount of money to allocate on a list of 15-20 features, which are provided with a description and a price, representing indicators such as development costs or customer value. A budget is provided and equally distributed among the players allowing the team to buy one to two thirds of the features. Participants allocate their money while discussing and negotiating with the other players. The outcome of the game is a list of funded features. A supporting objective of the game is to ensure high rates of interaction between players. For this, the games are led by facilitators, who guide the game and encourage players to explain their intentions.

After introducing the game to a German Financial Services provider, we agreed on a qualitative pre-study in one of the bank's smaller markets in Eastern Europe. This study took place in January 2013 with promising results (Feldmann and Kohler, 2014). Participants reported a high level of enjoyment when using the game. Most of them were even willing to play it in their spare time. Furthermore, participants and leaders overall agreed with its outcome. Building on these positive signals, we decided to study the game more systematically in a lab experiment.

To incorporate the game developer's experience from using the game in practice, we engaged him in a workshop to discuss the game setup for our experiment. In this context, we confirmed our decision to use the online version of the game in order to (i) have full access to action and chat logs and (ii) minimize confounding effects due to visual interaction of the participants. In terms of price tags for the ideas, we opted for identical prices for all ideas (100 monetary units), since in reality the start-up ideas chosen for our portfolio exhibited almost identical monetary needs as well. Thus, the impact of differences in prices is eliminated. In order to mitigate differences across the three facilitators, they had to strictly follow guidelines, which precisely described the actions they can take and included pre-typed statements for the communication with the participants. Finally, the game's budget was set to 45% of all ideas' prices, following the developer's advice to allocate 40-50%. Thus, each player received 128 monetary units. Ideas are funded if they reached their price tag at the end of the game.

3.3 Idea Portfolio Generation

During the experiment, each team has an idea portfolio of 16 ideas to choose from. This portfolio, which is identical across all teams and treatments, has to fulfill the following requirements. First, participants need to be able to assess the ideas without having any specialized knowledge. Second, the ideas must not be confidential and, third, the portfolio has to contain the same amount of ideas per innovation type that we want to observe. We decided to use start-up ideas for our portfolio since they comply with all mentioned criteria. To generate our portfolio, we retrieved a list of 82 start-up ideas from the leading equity-based crowdfunding platforms in Germany (Seedmatch, Innovestment, Companisto) where all of them have been already positively assessed and received funding. For the identification of the start-up ideas' innovation types, we required a description of each idea that was manageable by a group of experts and would be usable in the subsequent games without modification. For this we took the descriptions posted onto the crowdfunding platforms by the start-ups themselves, extracted the sentences containing the facts on the idea (roughly 3-6 sentences per idea), and

subsequently edited these sentences into bullet points. We conducted this exercise in a team of three and asked a neutral person to cross-check the procedure.

The start-up ideas were then classified into the innovation types of the two innovation typologies outlined in the related work chapter (Abernathy and Clark, 1985; Henderson and Clark, 1990) through Nominal Group Technique (NGT; Van de Ven and Delbecq, 1972). The process was conducted by a facilitator and five researchers from the area of service innovation who were unfamiliar with the planned experiment. After the NGT we asked the group which typology they felt most confident about. They recommended the Henderson and Clark typology. Based on the majority of votes from the NGT participants, out of the 82 start-up ideas, 8 could be clearly identified as incremental, 11 as modular, 13 as architectural, and 8 as radical. In our experiment, we chose the extreme poles of the spectrum (incremental and radical), as these categories provide the strongest distinction between the different start-up ideas. Therefore, the portfolio consisted of the 8 radical ideas and the 8 incremental that showed the highest consensus.

3.4 Measures

Throughout the experiment, we rely on a set of measures. First, we apply the German BFI test (Lang et al., 2001), which contains 42 items that are measured using a 5-point Likert scale from 0 to 4. This test is the German representation of the English BFI-44 (John et al., 1991 and 2008). For each participant, the five factors are computed according to the test's scoring instructions: Openness to Experience (measured by 10 items), Conscientiousness (9 items), Extraversion (8 items), Agreeableness (8 items), and Neuroticism (7 items). Second, as the online version of the game is a group decision support system that was new to the experiment's participants, we employed relevant constructs from the Technology Acceptance Model (TAM3; Venkatesh and Bala, 2008), measured by a 7-point Likert, to judge on the perception and acceptance of the game. The studied constructs are: Perceived Usefulness, Perceived Ease of Use, Computer Playfulness, Computer Anxiety and Result Demonstrability (4 items each), as well as Perceived Enjoyment, Output Quality, and Behavioral Intention (3 items each). All participants' scores are calculated based on averages. Third, chats and bids that occurred in the games were recorded in log files, allowing analyses on funded projects, final bids, and player behavior.

3.5 Procedure

The experiment was conducted at the experimental lab of the Institute of Information Systems and Marketing at the Karlsruhe Institute of Technology on four consecutive weekdays in September 2013 and in accordance with the university's ethical guidelines. Each participant was compensated with a fixed payment of 10 Euro. The ORSEE software environment was used to recruit participants from a pool of university students (Greiner, 2004). Altogether, 250 students (mean age= 23.29; 185 male; 65 female) participated in 17 sessions. Subjects were randomly seated in the lab and received an envelope which contained an anonymous identification number. In order to reduce distractions and simulate remote collaboration, each participant sat in a cubicle with noise-cancelling headphones, i.e. was completely separated from other participants. All announcements were pre-recorded and then played loudly via speakers along with printed instructions to ensure that all participants were aware that they have received the same information. First, a short introduction was played to the participants explaining the steps to be taken during the experiment. These steps were also provided in writing. Then, participants completed a BFI questionnaire in their mother tongue (Lang et al., 2001). Subsequently, participants received a screenshot of the game where all the important game elements were marked and the game instructions were played. Afterwards, they had to demonstrate their understanding of the game instructions by answering a brief test. In the meantime teams were composed using the BFI openness scores as outlined above. After that, participants received the descriptions of the start-up ideas and they were played via speakers. Then, the links to the games were

sent to the participants and the games, which lasted 15 minutes, were started. Facilitators supervised the players' activities and acted according to the guidelines. After the game, participants filled in the TAM3 questionnaire (Venkatesh and Bala, 2008) and provided demographic information.

4 Results

4.1 Overview

The openness to experience score of the different teams was 63.7 on average. Table 1 provides an overview of the four different team types and the respective personality scores. Overall, the 250 participants of the experiment were grouped into 50 teams of 5 people each. Expectedly, the teams in the HIGH treatment exhibit the highest mean openness to experience score while teams in the LOW treatment have the lowest openness to experience score on average. The minimum and maximum values indicate that the LOW, MEDIUM and HIGH teams are disjoint with respect to their openness to experience score. In particular, the highest team score of LOW (54.5) is smaller than the lowest one of MEDIUM (57.0). And the lowest score in HIGH (71.5) is higher than the highest MEDIUM score (68.0). Moreover, the level of variance within these teams is low compared to the MIX teams. Taken together, these first results show that the team formation procedure was successful in the sense that participants were grouped in teams with homogeneous openness to experience scores of different levels (LOW, MEDIUM, and HIGH) or in teams with heterogeneous openness to experience scores in which all levels are equally represented (MIX).

Moreover, Table 1 also provides an overview on the other four BFI personality dimensions (neuroticism, extraversion, agreeableness, conscientiousness). One can observe that the average personality scores are overall comparable across treatments. Interestingly, however, the HIGH openness teams exhibit slightly higher extraversion scores and slightly lower neuroticism score.

Team Type	Number of Teams	BFI Openness Scores of the Teams				Further BFI Personality Dimensions (Mean Values)			
		Mean	Variance	MIN	MAX	NEU	EXT	AGR	CON
HIGH	12 (60 subjects)	79.1	35.4	71.5	86.0	37.5	67.1	63.1	37.5
MEDIUM	12 (60 subjects)	63.8	29.4	57.0	68.0	43.9	63.2	61.8	43.9
LOW	12 (60 subjects)	46.7	73.7	39.5	54.5	38.6	60.8	62.9	38.6
MIX	14 (70 subjects)	64.8	243.4	53.5	78.0	41.3	62.3	62.6	41.3
Total	50 (250 subjects)	63.7	101.4	39.5	86.0	40.4	63.3	62.6	40.4

Table 1. Overview of the different team types and the respective personality scores (NEU=neuroticism, EXT=extraversion, AGR=agreeableness, CON=conscientiousness)

This can be partially explained by the fact that the openness dimension tends to be positively correlated with extraversion and conscientiousness, as well as negatively with neuroticism (Lang and Lüdtke, 2005). However, the differences between the HIGH teams and the other teams with respect to neuroticism ($p=.203$), conscientiousness ($p=.977$) and extraversion ($p=.130$) are not significant at any conventional level. Nevertheless, in particular the extraversion dimension seems to be interesting in the context of serious games and service innovation. We will return to this point in the discussion.

Interestingly, all teams report a high level of perceived enjoyment (ENJ) across all treatments since averaged team measures are all greater than 5 (on a scale from 1 to 7). Further, 76% of the teams

funded 5 or 6 start-up ideas where 6 is the maximum and teams chatted on average 58.3 times (11.7 chats per participant) during the 15 minute game. These facts show that the high level of interaction and agreement that are desired are supposed to be true. Furthermore, the perceived ease of use (PEOU) reached an average of 5.8 on a scale from 1 to 7; result demonstrability (RES), an indicator showing how confident a person is to communicate the outcome of the game to other people, scored 5.3 in average; and output quality (OUT) also scored in the upper half with a score of 4.7. In addition to the TAM questionnaire, we asked the participants to state their mood level once before the game and once again after the game. Overall, the mood level rose from 4.8 to 5.2 (+7.6%), although the experiment kept participants busy for about an hour. With respect to our first research question (RQ1), we can conclude that participants perceive the game as enjoyable, easy to use, and feel confident representing the outcome of the game to others. Hence, the findings provide support for our first hypothesis (H1). From this, we can conjecture that the game potentially helps to increase popularity and regular participation of those staff members holding valuable market information.

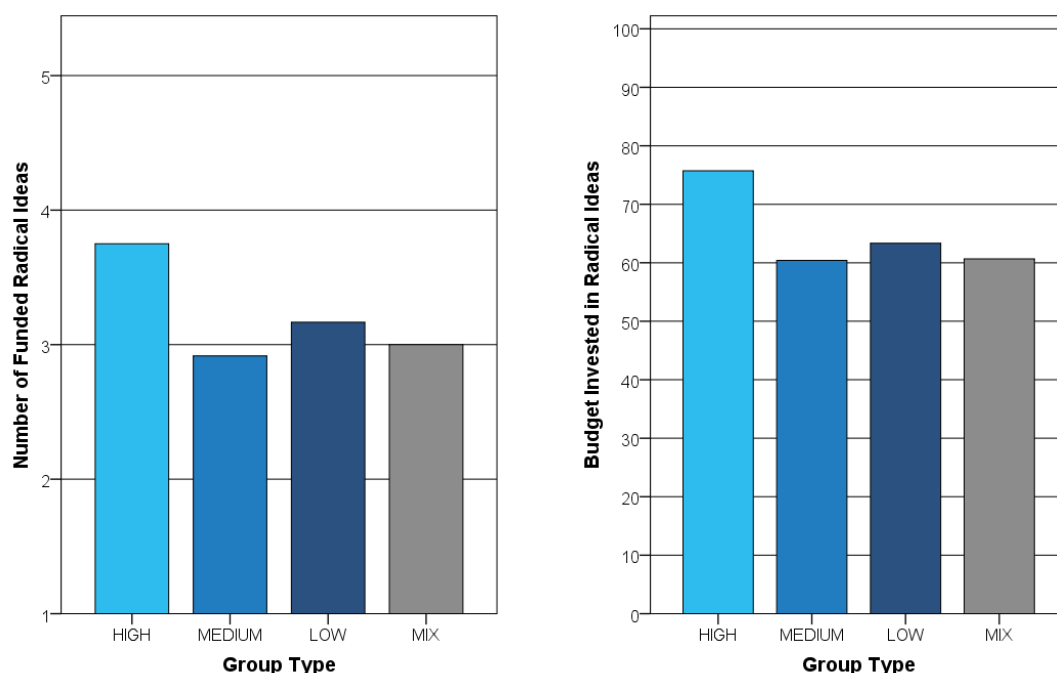


Figure 2. Number of funded radical ideas (left) and budget invested in radical ideas (right).

4.2 Funded Projects

With respect to the funded projects the different teams agreed upon, the left part of Figure 2 provides an overview of the average number of radical ideas funded per team. The bar chart indicates that the teams in the HIGH treatment select more radical ideas than the teams in the other three treatments, which tend to have a similar level. The MIX treatment contains two teams which exhibit extraordinarily high values on the extraversion dimension and are thus not directly comparable with the other teams. These teams also selected a comparatively high number of radical ideas (4 and 5) compared to the other MIX teams. They are therefore excluded from further analysis (all results reported in the following are qualitatively robust against this removal).

In order to test the impact of team formation on idea selection, we conducted an ordered logit regression with the number of radical ideas as dependent variable. The analysis reveals that the HIGH teams select more radical ideas than the other teams ($b=1.864$, $se=.779$, $z=2.39$, $p=.017$). By contrast, the differences between the MEDIUM, LOW, and MIX teams are not significant. Thus, in particular

the HIGH teams have a tendency towards radical ideas, while the other teams show more balanced investments. These findings support our second hypothesis (H2) and, with respect to our second research question (RQ2), confirm that team formation has a significant influence on portfolio prioritization and should thus be carefully considered when using serious games for idea assessment.

4.3 Individual Behavior and Perception

Next, we focus on the level of the individual subjects. The right part of Figure 2 provides an overview of how much budget the participants invested on average in radical ideas. Corresponding with the results on team level, participants in the HIGH teams invested more money in radical ideas than the participants of the other treatments.

Table 2 reports the results of two ordinary least squares regressions, in which we test the influence of team formation on the budget that the participants invested in radical ideas. Specification (1) reveals a significant influence of the treatment (dummy: *HIGH_treatment*) on the budget that participants invested in radical ideas. Specification (2) additionally accounts for the five personality dimensions. It reveals that participants' openness score alone does not have a significant influence on the investment decision while the dummy: *HIGH_treatment* remains significant and exhibits a strong coefficient. In other words, it's not enough that subjects individually exhibit a high openness score, participants with high openness scores need to be grouped in teams in order to invest significantly more in radical ideas. This confirms the results on the team level outlined in the last subsection. Consistently, specifications (1) and (2) reveal that participants with a comparatively high computer anxiety score are less willing to invest in radical ideas. Finally, conscientiousness is negatively correlated with investments in radical ideas, which is in line with related findings from literature (Kwang and Rodrigues, 2002).

Independent Variables	Budget Invested in Radical Ideas					
	(1)			(2)		
	Coeff.	SE	Sig.	Coeff.	SE	Sig.
Dummy: <i>HIGH_treatment</i>	13.544	5.014	.007 **	15.024	6.229	.017 *
Dummy: <i>gender_female</i>	-4.836	5.232	.356	-3.087	5.498	.575
Computer Playfulness	.688	2.540	.787	1.668	2.750	.545
Computer Anxiety	-4.948	2.503	.049 *	-5.306	2.534	.037 *
Perceived Enjoyment	.861	1.989	.666	1.243	2.031	.541
Openness				-.040	.188	.831
Neuroticism				.070	.140	.617
Extraversion				-.112	.129	.384
Agreeableness				-.078	.161	.629
Conscientiousness				-.328	.156	.037 *
Constant	63.825	16.149	.000 ***	89.575	22.334	.000 ***
			R ² = .063			R ² = .094
			N = 240			N = 240

Table 2. Regression result for budget invested in radical ideas, standard errors in parentheses. (Coeff. = coefficient, SE = standard error, Sig. = significance)

5 Discussion and Conclusions

This paper contributes to the field of idea assessment, an under-researched field according to recent publications (Schulze et al., 2012; West and Bogers, 2014). Service innovation literature suggests that signaling user needs (den Hertog et al., 2010) is a critical capability for service firms. Correspondingly, leveraging the market knowledge of staff providing services to customers (e.g. in

professional services) in the generation, as well as evaluation, of new service ideas is essential. Therefore, particularly appealing methods for these tasks increase the likelihood for these individuals' participation. In our study we explore the use of a serious game, *Buy-a-Feature*, for idea assessment in a controlled experiment, an approach that is uncovered in scientific literature so far. In the experiment we ask 250 students to assess a portfolio of 8 incremental and 8 radical ideas by playing the game.

To address our first research question, we aim to understand users' perception of the serious game. We find support for our first hypothesis (H1) that the game is enjoyable and easy to use. Moreover, participants show confidence towards the game's outcome. With caution, we may interpret this as an indication for the serious game to converge towards stable and accepted team results within a relatively short time. Overall we consider our findings as signs for a mechanism that is appealing to its participants. Therefore the game addresses challenge (ii) from the introduction partly, leaving the question of attractiveness for organizations open. Although, one might argue that the organization benefits indirectly from the game's appeal, attractiveness for the organization may relate to further performance measures. Furthermore, the game is IT-based and suggests a structured process, hence, it responds to requirement (i). Moreover, if implemented with real budgets, the game allows to address the challenge of hollow go-decisions (v). However, using the game for large portfolios (iii) and involving large audiences (iv) might be difficult.

In response to the second research question, we strive for a better understanding of the impact of teams varying by the openness to experience score of their members on the game's results. Overall the game seems to lead to a balanced outcome when played by an average set of participants. We find support for our second hypothesis (H2) that teams scoring high on openness to experience demonstrate a tendency towards investments in radical ideas (exhibiting strong coefficients). Surprisingly, the LOW teams do not show a tendency towards incremental ideas as one might conjecture. Also, belonging to a homogeneous high openness to experience team seems to impact individuals' investment behavior. From a strategic perspective, the identified bias of teams with a high openness score might be beneficial for companies pursuing a first-mover or early-adopter strategy, i.e. searching for the best radical ideas. Notably, the role of team BFI scores in idea assessment addresses a gap in literature.

While our study is the first that investigates the application of serious games for idea assessment, it embodies several limitations. While we aim to improve idea assessment in service firms, we relied on students and a start-up portfolio for our experiment for reasons of feasibility. This may result in a bias compared to real-life situations, since the students were not personally impacted by the ideas and therefore the outcome of the game. Arguably, this may lead to a higher level of radical ideas overall. Also, the students had no upfront opinions about the ideas which may rarely be the case in reality. A future larger field study may help to address these issues, compare results and derive more practical managerial implications. Additionally, in our study we rely on openness to experience as the main driver and key independent variable. However, as seen with the outliers in the mixed teams, in particular extraversion may also have an influence on the tendency of teams in terms of innovation types. In addition to openness to experience, literature points out the importance of extraversion for team creativity. Therefore, exploration of further BFI dimensions might complement our research. Moreover, the use of further treatments for team formation (e.g. field of study, gender) might also be interesting. From an IS point of view, it will be beneficial to compare the outcome and perception (e.g. enjoyment) of the game when played face-to-face versus online. Finally, comparing the outcome of idea assessment via a serious game with other, more established approaches such as the use of rating scales (e.g. Riedl et al., 2010) shall allow us to judge on the attractiveness of the mechanism for organizations.

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