

Gamification for Software Development Processes – Relevant Affordances and Design Principles

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Abstract

A Gamified Information System (GIS) implements game concepts and elements, such as affordances and game design principles to motivate people. Based on the idea to develop a GIS to increase the motivation of software developers to perform software quality tasks, the research work at hand aims at investigating relevant requirements from that target group. Therefore, 14 interviews with software development experts are conducted and analyzed. According to the results, software developers prefer the affordances points, narrative storytelling in a multiplayer and a round-based setting. Furthermore, six design principles for the development of a GIS are derived.

1. Introduction

Users of information systems (IS) expect more and more quality, which ended in numerous quality standards, such as ISO/IEC 92126 or ISO 9001. Besides the development of a feasible product, software development processes should ensure IS quality [1]. Regardless whether agile or traditional development methods are chosen, tasks, such as testing software, exist, which are perceived as uninteresting and rather boring [2, 3]. In the end, this might lead to poor software quality.

Motivating people to do things, which they initially would rather omit, is one goal of gamification, which originally stems from the media industry. It was first documented in 2008 and has been gaining popularity in academia since 2011 by the inspiring articles of Deterding et al. [4] and Liu et al. [5]. Gamification uses the entertainment factor, which is derived from (video) games and transfers it to repetitive, monotonous tasks in order to make them more appealing and entertaining for the people performing those [4]. In addition, gamification has the potential to enhance a service with gameful elements to support the overall value creation [6]. Integrating the “engagement and enjoyment of a gameful process” into real world activities contribute to the achievement of real goals [7]. So far, the most common application

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areas for gamification are health care, financial services and, in general, research and education [8].

Many IS scholars investigated the use of gamification for software development processes. While some works focus on the development and application of GIS [e.g., 9–11], other research groups investigate the effects of a GIS in a certain environment [e.g., 12–14]. Nevertheless, the requirements for a GIS applied by software developers to motivate working on monotonous tasks, such as testing and code documentation, are not investigated, yet. Thus, the relevant affordances and game design principles for such a GIS are rather blurry. A mismatch between gamification design elements (GDE) and users’ characteristics may play a significant role in the use of a GIS [5]. Moreover, Blohm and Leimeister [15] suggest investigating the environment of a GIS.

The goal of this research work is to guide GIS developers in designing a GIS, whose target group comprises software developers. Against this background, the work at hand aims at answering the following two research questions. *Which motivational affordances are relevant for a GIS targeting software developers (RQ1)? How should a GIS be designed for software developers (RQ2)?* We answer these questions with a focus on motivational affordances as well as design principles and apply a case study [16] and conduct interviews [17]. The paper contributes to the body of knowledge in two ways. First, we shed light on relevant affordances of software developers, which may inspire the GIS development. Second, based on insights into GIS perceptions of software developers, we derive principles for designing a GIS for that target group, which guides the development of a GIS prototype.

2. Foundations

2.1. Gamification

In the context of service science, Gamification is defined as: “a process of enhancing a service with affordances for gameful experiences in order to

support users' overall value creation" [6]. Gamification applies typical game elements and game design techniques in a context unrelated to a game [5]. Games trigger a behavior that is both essential and normal for humans, such as joy, competition or concentration, whereas the focus is on achieving a fixed goal [7]. Starting from this basic behavior, gamification pursues the main purpose of increasing motivation. By using game-based elements, monotonous tasks become more diverse for the persons performing them, which are perceived as players [5]. Six types of players exist: Socializers, Free Spirits, Achievers, Philanthropists, Players and Disruptors [18]. Each of them have different characteristics and need different GDE in order to be satisfied with the GIS.

In addition to promoting user engagement [19], gamification is considered as a process for improving general value creation [8]. The reuse of entertainment technologies in everyday environments leads to increased satisfaction and optimism among gamers [7]. The increased well-being has a positive effect on the productivity of the tasks to be performed [15].

Codish and Ravid [20] derived two decisive characteristics of gamification. On the one hand, a *utilitarian approach* is pursued, which perceives a game as an aid and makes it easier to handle given tasks. On the other hand, the *hedonic approach* is used. The latter focuses on the deepening and immersion of the player in a system. It increases the curiosity of the participants and motivates them to continue playing [20]. In addition to the increasing user activity, the combination of both characteristics leads to the increase in efficiency that is characteristic for successful gamification projects [19].

In order to change user behavior for strategic purposes [8] and to successfully apply a gamification approach to task accomplishment [5], it is necessary to choose the right game design principle and to introduce goal-oriented affordances and mechanisms. Deterding et al. [4] define a game design principle as "evaluative guidelines to approach a design problem or analyze a given design solution". We follow that definition for the work at hand.

In an extensive literature review, Koivisto and Hamari [7] derive 46 different affordances that can be applied in a game. They are assigned to the categories performance/progress, social, immersion/deepening, non-digital elements and others [7]. The game design links the chosen affordances with the game mechanics and forms the game framework. It influences user interactions and must be consistent with the intended purpose of the target system [5].

2.2. Gamification for Software Development

Regardless of the chosen type of development process (traditional [21] or agile [22]), corresponding tasks are more or less interesting and caching for software developers. The testing of software for example belongs to the later and is perceived as rather boring [2, 3]. In order to reconstruct the body of knowledge of GIS for software development projects, we searched for research papers that address both, gamification and software development. We are particularly interested in research methods, respondent groups, and whether the authors explicitly evaluate the GDE. We further classify the hits into three dimensions: software prototype usage, evaluation, as well as the type of respondents of the study. In total, ten research papers address the topic at hand.

The literature analysis reveals three research works, in which the authors completely implement a GIS and evaluate the results by software development teams [9–11]. In addition, Neto et al. [23] evaluate a GIS with a limited functional scope with software development experts and Dubois and Tamburrelli [24] does the same but with students and applies a survey as primary data elicitation method. The remaining four projects [12–14, 25, 26] do not apply a software prototype but introduce results based on physical games. Three out of four papers use students within a university course for its evaluation process [12–14]. Solely Passos et al. [25] connect a GIS with a qualitative evaluation and focus on gamification for task management. They used the ticketing software Jira as a basis for evaluation and compared the output (i.e. completed tickets) with and without the usage of the presented GIS.

"Gamification design elements must match users' characteristics" is one of the gamification design principles, proposed by Liu et al. [5]. The different user types of a GIS play an important role in making them appealing and successful [18]. Thus, it makes a difference who plays a certain GIS. To our best knowledge, no research exists that explicitly deal with the elicitation of GIS design requirements from software developers. We close that gap by interviewing software development experts and analyzing the results by a qualitative content analysis, which we explain in the next section.

3. Research Design

3.1. Overview and Methodology

In order to answer the research questions, we decided to apply an inductive, qualitative research

approach and adapted the research process, suggested by Vogelsang et al. [27]. The proposed four major phases and its individual goals are depicted in Figure 1. The first two phases comprise the preparation and conduction of focused interviews. They enable the elicitation of subjective GIS perceptions of the interviewees. In phase Three, the analysis of the transcribed memory protocols is prepared, aiming at extracting core statements and assigning them to categories. In phase four, we analyze the interviews and determine the relevance of each category according to its frequency. In addition, we derive principles for designing a GIS for software developers.

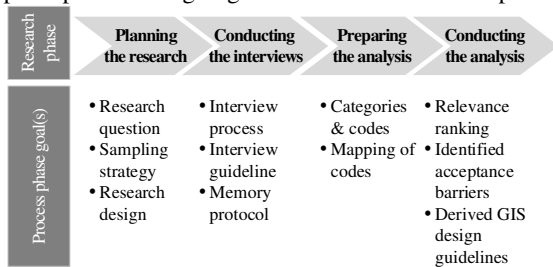


Figure 1. Research process

3.2. Research Planning and Conduction

We aim at shedding light on the design of a GIS for software developers. Therefore, we investigate a single case [16] and conduct interviews and a qualitative content analysis [27]. We received the permission to investigate an IT service provider that just reorganized its development processes and implemented DevOps and Scrum procedures. The company agreed in interviewing software developers and project members, which allows for choosing a purposive sampling strategy for selecting participants. We focus solely on interviewees who have an extensive knowledge in the topic of software development projects. Therefore, possible interviewees must have at least one year for working experience in software development projects.

For orientation during the interviews, a flexible interview guideline is developed, which opens up room for varying the formulation of questions and demand strategies. All interview questions are opened in order to offer the interview participants a maximum range of possible answers. They can express situation-related memories, feelings, or assessments. Each interview is conducted in a reserved and non-directive manner. Due to a company policy, audio recordings and subsequent transcriptions were not allowed. However, by avoiding speech recordings, potential interview partners are expected to be more willing to participate and to be more open in their responses. We document the results by means of notes

taken during the interviews (the interviewer also takes the notes). In addition, a corresponding memory record is created, which is immediately available for the subsequent analysis. Instead of the exact wording, we document the essential statements of the interview participants, leaving out filler and delay words.

We structure the interview into three parts: introduction & warm-up, main part, and conclusion. All questions are provided in Table 1. Depending on the answers given by the interviewees, further, we potentially ask more in-depth questions. In this way, we create a fluent course of the conversation.

The first interview part aims at familiarizing the participant with the topic gamification. At the beginning, we explain the principles of gamification by using a few examples. In the main part, we raise open-ended questions in order to gain insights into the gamification perceptions of the participants. In doing so, we consciously focus on the GIS affordances and barriers, which the interview participants bring in. In addition, we collect information on favorite game genres. Finally, the interviewees have the opportunity to express additional suggestions or wishes.

Table 1. Interview guideline

Phase	Question
Introduction & warm-up	What do you understand by the term "gamification"?
	Have you already received experience with a game that has helped you in your everyday life or made everyday tasks easier?
	Please describe this gamification situation.
Main	Which tasks from your everyday professional life could be integrated into a game?
	How should these tasks be performed in a game?
	How do you evaluate a gamification approach in combination with Jira?
	Which is your favorite game? Which contents are decisive?
	What would you change about this game if you had the opportunity?
	If you were to develop your own game, what would you value most?
Conclusion	Is there anything else about gamification that is important to you but has not been expressed in response to any of the previous questions?

3.3. Preparing and conducting the analysis

According to the deductive content analysis [17], the encoded statements need to be assigned to categories. Therefore, we consider the five main categories of performance/progress, social,

immersion/deepening, non-digital elements and other, consisting of the 46 affordances according to Koivisto and Hamari [7]. The core statements extracted from the memory protocols are systematically assigned to the corresponding categories. One single statement might be categorized several times, when more than one category is addressed by the encoded statement. For example, after the assignment of a statement to the category multiplayer, a further assignment to the category cooperation or competition can occur, to clarify the type of multiplayer mode desired. Furthermore, we distinguish between negative (e.g. “I do not like avatars”), neutral (e.g. “I have heard about VR games”), and positive core statements (e.g. “I love playing role-play games”). It serves to determine the relevance and the tendency of individual affordances. Relevance is determined as the difference between positive and negative core statements and the tendency indicates which direction predominates [27].

If an interviewee mentions the affordances in a core statement, a direct assignment of the corresponding category takes place. However, we also consider indirect core statements. If a game element is not explicitly mentioned, a statement may contain evaluative power, when the corresponding game element can be derived indirectly. For example, we use a statement of an interviewee, whose favorite game is Skat, due to the short playing time, which leads to a positive assignment to the category Non-digital elements - physical cards as well as the category Miscellaneous - round based. Furthermore, Skat is a multiplayer game, which is why the category Social - multiplayer also receives a positive rating.

Finally, we present the results in terms of three measures, as suggested by Vogelsang et al. [27]: *interview frequency*, which counts the number of interviewees who mentions a certain concept, *statement frequency*, which refers to the number of statements regarding the concept, and *relevance*, which sum-up positive and negative concept ratings. Furthermore, the different GIS barriers that interviewees talked about are noted. Based on the results, we deduct a list of barriers, ordered by its interview frequency and prepare principles for the development of a GIS for software developers.

3.4. Case description and demographics

We conduct 14 interviews with employees, working for a large IT service provider in Germany. The company employs around 500 people in the area of IT, whereas around 200 people directly work as software developer. In order to gather a broad spectrum of experiences and opinions, we select interview participants with different qualifications and

functions, as suggested by Vogelsang et al. [27]. In order to achieve the highest possible coverage of potential participants, an e-mail was sent to all software developers within the investigated IT service provider, which contains a brief explanation of the initial situation and a request for an interview. Interviewees comprise junior and senior developers, software architects as well as project managers. The interviewees' age ranges from 23 to 58 years. The average length of an interview is 17.1 min. with a standard deviation of 4.73. Table 2 provides an overview of the interviewees and a unique numbering, which we later use for referring to individual interviewee statements. The qualitative content analysis of the interviews reveals that eleven of the 14 participants regularly play games. Half of the interviewees consciously deal with the topic.

Table 2. Interview participants

Int	Gen	Age	Qualification	Function	Exp	Dur
I1	m	34	B. Sc. Informatics	SSD	6	14
I2	m	41	Mathematician	Software architect	20	20
I3	m	26	Industrial clerk	Junior developer	4	24
I4	m	39	Dipl. Informatics	Project manager	19	16
I5	m	50	Dipl. Chemist	SSD	23	12
I6	m	41	Mathematician	SSD	20	16
I7	f	47	Mathematician	SSD	28	10
I8	m	41	Mathematician	SSD	22	12
I9	m	58	Mathematician	Project manager	38	22
I10	m	57	Mathematician	SSD	38	14
I11	m	32	M. Sc. IT-Management	Team leader	11	24
I12	m	52	Insurance clerk	SSD	31	10
I13	m	44	Mathematician	SSD	23	20
I14	m	23	Student	Junior developer	1	26

Int: Interviewee, Gen: gender; Exp: job experience; SSD: Senior Software Developer; Dur: duration in min.

4. Results

4.1. Overview

In total, 104 relevant statements emerged from the interviews, out of which we create 134 category assignments. Furthermore, we extract 31 game affordances from the interview participants' favorite games and include them into the result set. In the course of this, eleven different themes are mentioned, but eight of them only once. Examples are fantasy or mystic games, as well as futuristically designed content. The genre, which is most often named with

four mentions, is medieval, followed by sports (three mentions) and adventure games (two mentions).

In general, the interviewees perceive the topic of gamification positively. Solely 19 out of 104 core statements receive a negative tendency. Table 3 provides an overview of all affordances and its belonging categories. In the following, we describe each category and the affordances, which receive a at least relevance score of three.

4.2. Achievement / progression

Collecting loyalty *points* in supermarkets is one of the most frequent gamification experiences of the interview participants (relevance 10). Seven interviewees report regularly using loyalty systems and benefiting from the resulting advantages. Interviewee 5 also considers such a system with regard to the playful representation of his or her daily work tasks. I3 can imagine that: "a points system would be motivating".

Another relevant affordance is *Quizzes*. Four interview participants favor the solving of puzzles or tricky tasks that require logical thinking (I6, I7, I9, I13). Interviewee 7 adds: "A certain intellectual challenge must be provided, a game should be won by intelligence [...]. (I7). For the interviewed experts, the affordance subcategory *Challenges and quests* are as relevant as points. It is important that users be continuously offered new and interesting challenges that they have to master. Regarding this category, interviewees mention simulation games, such as Age of Empires, because they represent realistic challenges (I2, I5, I7, I11, I13).

The topic *performance stats* is discussed six times in total. Weekly, monthly and yearly statistics are the main reason for interviewee 9 to use his current fitness app. In addition to receiving feedback, the presentation of performance results is also discussed. Interviewee 11 refers to the collection of badges in order to represent performance: "Collecting badges would be an idea [...] then others can see what knowledge or qualifications you have". Three interviewees talk about the topic of *Progress, status bars and skill-trees*, which is also a kind of feedback. Interviewee 2 and 14 mention that a progress that is visible all the time is the decisive reason for playing their favorite game. Interviewee 14 wishes to "see [the] progress [and] percentage of what has already been done and what has not yet been done". Interviewee 9 mentions progress bars as a tool for representing his tasks.

Table 3. Relevant affordances

Category	IntFrq	StaFrq	Rel	Tend
Achievement / progression				
Points, score, XP	8	10	10	+
Quizzes	5	8	8	+
Challenges and quests	5	12	8	+
Performance stats	4	6	6	+
Progress, status bars, skill-trees	3	4	4	+
Levels	3	3	3	+
Badges, achievements	3	3	3	+
Leaderboards, rankings	3	3	3	+
Increasing difficulty	2	2	2	+
Timer, speed	3	3	1	+
Social				
Multiplayer	7	12	12	+
Cooperation and co-working	5	6	6	+
Customization	4	5	5	+
Peer-rating	1	1	1	+
Collective voting	1	1	1	+
Competition	9	22	0	o
Immersion				
Narrative, storytelling	5	12	12	+
Virtual world, 3D world	7	12	11	+
Avatar, virtual identity	3	3	3	+
Role-play	1	1	1	+
Non-digital elements				
Real interactive objects	6	6	6	+
Physical cards	3	3	3	+
Real world/ financial reward	2	2	2	+
Physical playboard	1	1	1	+
Miscellaneous				
Round-based	8	10	10	+
Full version	3	3	3	+
Adaptive difficulty	2	2	2	+
Funny videos	2	2	2	+
Repetition, health points	1	1	1	+
Training and test environment	2	3	-1	-
Virtual currency	1	1	-1	-
Assistance, virtual helpers	2	2	-2	-

IntFrq: interview frequency; StaFrq: statement frequency; Rel:relevance; Tend:Tendency

Another relevant affordance is *Levels*. Interviewee 12 states: "basically, I like the level principle; with each level rise, challenges become more difficult". For interviewee 3 "continuous improvement and promotion opportunities are important [...]". In addition, interviewee 5 reports that

levels are a positive affordance of his favorite game. However, this affordance only receives a relevance value of three and therefore does not prevail over the sub-categories explained above. The same applies to the affordances *Badges*, *achievements* and *Leaderboards*, *rankings*. The interviewees seldom mention aspects belonging to these categories, which indicates its low importance for GIS.

4.3. Social

With twelve positive core statements, the sub-category *Multiplayer* is the most relevant social affordance. Three favorite games named by the interview participants are pure multiplayer games. Another six favorite games come with an optional multiplayer mode. Interviewee 3 answers the question of what is especially important for a game by saying: "you should be able to play both with and against each other". Since the multiplayer category does not clearly define whether a game is played with or against each other, we investigate the affordances *cooperation and co-working* as well as *competition*. While interviewees mention the topic of cooperation six times, the topic of competition receives 22 mentions but is of no relevance. The number of positive and negative core statements of this affordance is balanced and prevent a clear position of the interviewees. In addition to the previously quoted statement regarding teamwork, interviewee 11 clearly points out "competition should be avoided". In contrast, interviewee 13 says that "competitions and competitive battles [are] motivating". However, interviewee 2 wishes to play "[...] against a well-developed AI" rather than team members.

The subcategory *Customization*, which describes the ability of a game to be customized and personalized to a player, receives a relevance score of five and a positive tendency. Interviewee 1 states that a player "should have a lot of freedom". Someone's own decisions should impact the game (I4). Interviewee 14 says that players may "change the course of the story, everyone writes their own story".

4.4. Immersion

In total, the interview participants mention seven times that an exciting, stirring storytelling is an important core element of a game. "A cool story with a lot of humor is very important" (I2). Interviewee 14s' favorite game "offers a gripping story in which you can get lost and hide and forget your surroundings". Regarding the gamification concept to be developed, interviewee 6 mentions: "A story-based approach would be interesting".

The second most relevant affordance in the immersion area is *Virtual Worlds/3D*. That affordance receives eleven positive and one neutral core statement. Half of the assignments originate from the interview participants' favorite games. Interviewee 4 describes the reasons for his favorite game as follows: "I like this atmosphere, the different planets and places". For interviewee 14, "the beautiful game world" is also a reason for his favorite game.

Regarding *Avatars*, Interviewee 9 would like to see the mapping of project planning in a gamification environment. In the course of this, he imagines "free [human] resources in the form of avatars to which open tasks can be assigned" (I9). Interviewee 6 wishes to get "many different, new figures" within a game. In addition, avatars are a valuable method for representing different types of players, which is an important element in motivating potential participants.

4.5. Non-digital and miscellaneous elements

In the area of non-digital elements, six interview participants report that they regularly use a pedometer, sports, or fitness tracker. We assign such information to the subcategory *real interactive objects*, but the reasons for using such a device refer to other affordances. For example, interviewee 6 uses a pedometer to collect awards for the distances he covered or to compare himself with the performance of friends and family members. Interviewee 9 favors weekly, monthly and yearly statistics, reported in an application that uses the collected data.

Other non-digital elements are *physical cards* and *real word/ financial rewards*. Three interviewees mention that their favorite game is Skat (I8, I10) and Solitaire (I9), which leads to three relevance scores of the affordance physical cards. Regarding the subject of real rewards, interviewee 3 mentions the need for "a real prize, something that really exists". Interviewee 11 mentions financial rewards. "Gambling for money" (I11) is one reason for playing his favorite game.

With a relevance score of ten, the most relevant affordance within the category Miscellaneous is *round-based*. The interviewees often mentioned time advantages of round-based games. Interviewee 6 refer to his favorite game and mentions that "in between there is always a time slot for a short match". The "short playing time" is also a decisive for interviewee 8. The other assignments stem from interviewees' favorite games, such as FIFA (I3), or Sudoku (I9).

Another important GIS affordance is the applicability (*full version*), which receives a relevance score of three. Interviewees perceive a share version or an advertisement interruption as annoying: "When I solve Sudoku online, I am disturbed by the

advertisements, I would like to turn them off" (I9) and "advertisements are annoying" (I12). Even if the statements are negative, they lead to a positive frequency and weighting, since full versions usually do not show advertisements or game interruptions.

The affordances *introductions / test environments*, *virtual helpers* and *virtual currencies* receive a negative tendency. Interviewees wish to get a very simple game without a long introduction or learning tutorial. The game must be "self-explanatory" (I10), which is the main reason for the negative relevance of virtual helpers. If a virtual helper needs to be consulted, the game is not intuitive. Virtual currencies are perceived as too unfair, as "the costs within the game are often too disproportionately" (I3) represented.

5. GIS design principles

Besides insights into relevant affordances, the interviewees discussed the requirements for the adoption of a GIS for software developers, which draw a broader picture. Based on these discussion results, we derived six design principles for a GIS that addresses software developers and provide them in Table 4.

In total, we extract nine core statements regarding the requirement of homogeneous tasks. It is necessary to find a general assessment basis for performed real world tasks, whereas its quantification is a first challenge. Regarding the integration of a ticketing system into a GIS, Interviewee 1 states: "Tickets cannot be weighted because there is too little experience". In addition, interviewee I1 clarifies that "it is very difficult to categorize the tickets and to create an equal basis or level of difficulty for all". Furthermore, interviewee 5 explains: "Anybody has tickets of different sizes, so time should not matter, that would be unfair". Regarding the judgement of ticket working time, Interviewee 9 refers to different working times: "Many [colleagues] work solely 50 to 80 percent; this is unfair in contrast to employees who are 100 percent present". Consequently, the first design principle comprises the *prevention of direct time measurement*. Instead, we recommend considering the processing time of a ticket combined with an individual time limit per ticket. If a task is solved within its set time limit, three minutes of play could be released to the respective employee. The time specifications apply to employees who work full-time in the company. For employees having a part-time job, a factor is needed, which compensates missing working time.

Six interviewees consider the risk that the GIS may distract software developers from the actual

activities that need to be performed to solve a task. Interviewee 5 points out that a GIS "might be fun, but it would distract people too much from the actual work". Interviewee 8 states: "Tasks are done inaccurately because you want to be fast". The second design principle addresses this risk and aims at avoiding the suffering of task quality by *establishing the GIS as a reward*. Software developers should not perceive the game as the main reason for completing their tasks. Therefore, it is essential to clarify that the GIS primarily contributes to quality improvement.

Table 4. GIS design principles

GIS design principle	Description
Prevent direct time measurement (1)	In order to equalize the starting positions and the chances to win (particularly for part-time workers), the time spent for achieving tasks should not be considered as an affordance.
Establish the GIS as a reward (2)	Establish the game in a way that software developers do not perceive the game as the main motivation for completing their regularly tasks. Make clear that the GIS contributes to quality improvement instead of finalizing tasks with less quality in order to receive points for the game.
Implement a GIS solely for projects with active task management (3)	Since agile software development projects apply task management software quite often, an implemented and widely accepted task management tool is required before the GIS can be established.
Completely anonymize players (4)	Employees are to some extent afraid about data breaches and work monitoring. To avoid such concerns, game data must be anonymized. At least, the level of anonymization should be configurable.
Avoid Competition (5)	Software developers think and act in teams and do not want a raw competition. Thus, mutual support to handle a game challenge must be focused in the game design.
Implement fraud checks (6)	Software developers often know more about cheating than other gamers. In addition, they want to try it, if possible. Thus, the game must provide a sophisticated concept for fraud prevention.

Five interview participants expressed their concerns regarding the application of a task management tool, whose GIS integration is meaningful. The statement: "Maybe the [GIS] will finally lead to the Jira being maintained regularly" (I2) illustrates that a task management tool is not fully established in all areas of the company. Accordingly, the concept must be designed in such a way that team leaders are not only convinced by the application of the game, but also by the regular use of a task management tool. The necessary usage of a task management system motivates the third design principle: *Implement a GIS solely for projects with an active task management and standardized tasks.*

Paying attention to *privacy* is another acceptance barrier, mentioned by five interviewees. The possibility of being monitored by the employer is one of the challenges that needs to be addressed by the GIS design. Interviewee 7 expresses her fear as follows: "One has the feeling of being monitored and feels under pressure". As a result, the concept has a "too high stress factor" for her (I7). Interviewee 9 clearly states: "[The] feeling of performance control must be avoided". As a possible solution, he adds that only anonymous information within the game should be presented. The fourth design principle addresses this data privacy risk and demands the *complete anonymization of players*. When starting the game for the first time, a player may e.g. define a freely created username, which only he knows. Furthermore, numerical values and statistics, such as the number of completed tickets, played game minutes or collected points should solely be visible for the player.

Besides to the monitoring fear, competition receives eleven negative statements. Evaluating the corresponding affordance reveals a balanced perception of competition. Nevertheless, the probability of losing game attractiveness through a hard competition is quite high, which leads to the fifth design principle: *Avoid direct competition*. Due to the high level of critical consideration, direct competition between the individual GIS players needs to be avoided. Instead, the gamification concept should aim at promoting cooperation between team members.

Finally, three interview participants refer to the risk of *fraud*. Thiebes et al. [28] argue that implemented affordances are rejected by participants as soon as a possibility of fraud is identified. The interview participants see this possibility in a task management system, integrated by a GIS. Interviewee 6 points to the opportunity of faking "[...] tickets for which no real task exists". Therefore, it is important that "[...] you have to somehow rule out that people cheat" (I4), which motivates the sixth design principle: *Implement fraud checks*. In this respect, artificial

intelligence might help to find suspicious tasks, which for example are closed directly after it was opened.

6. Discussion and outlook

The article at hand provides the results of a case study about relevant affordances and principles to design a GIS for software development projects. In total, 14 interviews with software development experts of an IT service provider deliver the data for evaluating the relevance of GIS affordances. Regarding RQ1, a GIS for the target group of software developers should primarily implement the affordances points, narrative storytelling in a multiplayer and round-based setting. According to Koivisto and Hamari [7], points are investigated 138 times so far (narrative story telling: 22 times, role-play: 6 times and multiplayer: 3 times). Thus, the elicited relevance of the affordance points is in line with the observations of other gamification studies, conducted in other environments. Surprisingly, challenges, quests and badges are mentioned quite seldom in comparison to the findings of Koivisto and Hamari [7]. In addition, role-play and multiplayer games are rarely investigated so far, but reached a high rank within the interviewed software development experts of our study. When implementing such affordances, it is of particular relevance to prevent a loss of productivity, which may easily occur through long stories etc. However, we believe that these affordances play a significant role in making a GIS attractive for the target group of software developers.

Blohm and Leimeister [15] suggest to pay more attention to the environment and setting, in which gamification is applied. Moreover, it is important to understand the context of gamification [29]. In particular, the affinity of different employee groups for video (games) is essential for the success of the GIS [28]. Our results confirm the hypothesis that "a workspace with mostly young employees would be the most promising environment for successfully applying Gamification, as older employees' affinity to digital games might not be sufficient" [28]. We noticed a higher interest in gaming by the younger interviewees compared to the reactions of the older ones.

Regarding RQ2, we present principles for the design of a GIS for software developers. Our findings regarding homogeneity of starting positions refer to fairness in organizational cultures [30]. Only if the starting positions are equally shared among all players, it is worth to play the game. In our study, some interviewees report that they do not work full-time and thus are afraid to get a starting disadvantage at the beginning of the game. Thus, the fact of part-time employees and other events that lead to unequal

starting positions must be considered in the game design. In line with Blohm and Leimeister [15], we confirm that task quality may suffer, if the main purpose of activities are not aligned to the game elements. The interview participants report about their concerns that employees quickly end a task without paying attention to the quality in order to win extra points for the game as fast as possible. Particularly, the domain of software development is dependent on task quality. Development tasks, which are not conducted accurately, might lead to serious software failures. Consequently, the tasks of employees must match to the chosen game elements, which is in line with the task congruence principle [5].

The study results further confirm the risk of non-acceptance due to privacy concerns [31]. In a work environment, such as a software development project, employees might feel monitored and controlled by their supervisors and project managers, which might lead to GIS abuse. Thus, data collection should be reduced to a minimum and we suggest consulting the workers council of the firm to approve all data collections. Finally, our results confirm the role of fraud, which is discussed in existing gamification study results among cheating [31, 32]. In the context of cheating, Thiebes et al. [28] stress the role of underlying rules: "If underlying rules are not clearly defined, it enables cheating, which can lead to rejection of implemented game elements by other employees" [28]. One interviewee in our study mentions the risk of cheating when it comes to a linkage between the GIS and the existing task management system of the firm. In addition and in contrast to other user types, software developers have the knowledge to hack an IT-system. Moreover, they might be more interested to explore potential security holes of the GIS. Consequently, the implementation of fraud checks in the GIS becomes an important issue.

Furthermore, the interviewees stress the dynamism principle of game design [5] in a way that they require preventing competition. Moreover, they wish to play in a team and less against each other. Against this background, we believe that software developers are more likely to be part of the player types socializer and free spirit rather than disruptors or achievers.

The study's research contribution is twofold. First, relevant affordances for the design of a GIS for software developers are provided and discussed. Second, the design principles shed light into requirements for the development of a GIS, applied in software development processes. The results enable the comparison of relevant affordances in different industries and may contribute to a theoretical framework for the acceptance of GIS. From a practical

perspective, the results provide the requirements for the development of a GIS prototype and may lead game designers in developing a game for the target group of software developers.

The expressive power of the results is limited. Since we conducted a single case study, all interviewees stem from one IT service provider and have additionally a strong gender bias. In addition, due to company policies, we had to work with interview memory notes, which might reduce the accuracy of the statement assignments. Furthermore, we conclude from the interviewee's favorite game characteristics to the motivational affordances of him. Finally, our research work focus on the elicitation of affordances of GIS rather than receiving insights into the concrete player types of software developers.

From a behavioral science perspective, the results encourages researchers to repeat the study in other industries in order to compare the relevant affordances. Furthermore, we suggest investigating the player types of software developers by applying the Hexad player types scale [33]. From a design science perspective, a prototype is required in order to gain insights into the effectiveness of the applied affordances.

7. References

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