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Applying gamification for mindset changing in automotive software project management

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Abstract

Changing technologies, where development time for a new work product must be decreased with each year due to a higher customer competition, also leads to a change in mindset in the way in which product development is currently done. Gamification models are one of this “game-changing” strategies that was considered suitable to also be implemented in the automotive software product development topic, but not only in this area. This paper describes the current situation in adopting on large scale the product development phases as gamified scenario, together with the presentation of the results of several questionnaires applied on automotive project team members. The aim of the paper is to present a procedure for obtaining a gamification application on an automotive project describing in detail each step which needs to be fulfilled in an iterative way. As a starting point for the model, the DMA (Design – Mechanics – Aesthetic) procedure was used, supported with elements from the PC/game console development, but also the existing tools/frameworks were taken into consideration. The obtained method can be applied on each automotive project, but there are the steps/iterations which still need to be performed, while also the positive and negative aspects are presented.

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1. Introduction

In our times, one of the most wished-for targets through the companies is the competitiveness. For reaching a high level of competitiveness, companies should come with quality products, but one of the most important is to come exactly in time with the product. The new strategies applied by the big companies is to announce a product often before the design concept is finished and even before the product development is started. This marketing strategy generates a lot of interest from people's side to the product and also incomes before we have a product, but sometimes this generates also negative impact due to higher expectations or maybe the product quality is going down the people enthusiasm. Particularly, in engineering field, there are some examples that pointing exactly in this direction. (Abbasi & Wajid & Iqbal & Zafar, 2014, Holgeid & Thompson, 2013).

The complexity of software products (including here also the products which have at least a software component) is increasing from project to project, because the new products/functionalities are integrated to the already existing ones. Management of complexity for products comes together with increasing of time for product development, but current situation reflects exactly the opposite. Products needs to be delivered in shorter time than before, but with the same quality level and increased complexity. This sounds contradictory, but it reflects the current situation. From the classical project management methods this can be done only with increasing of the costs through hiring more developers, project leaders and buy off-the-shelf components (COTS) already implemented and try to customize them a lot. There are some research in this direction which shows that this can lead with a higher probability to project failing. (Dorsey, 2005, Short, 2014). Also, current research studies show that a high project management expertise and involvement in addition with high involvement from team side can lead to successfully of the project (Short, 2014).

Gamification is the process of applying game design and mechanics techniques to daily tasks context to enhance the quality and user experience for the product development. According to (Aseriskis & Damasevicius, 2014, Anderson & Rainie, 2012), gamification will lead an important role to development of innovative products and will be applied in more than 50% from the successfully projects. The added value using gamification into software project management resides into faster product development at least at quality level as its predecessors through increasing team member's loyalty, experience, satisfaction and boosting their engagement.

The paper presents a possibility for introducing the concept of "gamification" in project management to have a better involvement of the team into the project and a higher level of transparency for the tasks of the projects for the whole development team. The method for creating a "game" adapted to current project is the hardest thing in applying gamification because wrong creation of game, not taking into consideration the personnel, the customer and the culture of companies can lead from the beginning on a failed project. Therefore, the method for creation of a game needs to be done only after the actors involved are questioned and results are analyzed bases on previous experience. However, each branch of software development has its intrinsic characteristics we consider for our research only the automotive product development.

Next chapter of the paper explains the meaning of gamification concept from the current literature papers point of view and the reason for which it can be applied into software project management. Third chapter presents the results done of some different groups from automotive companies about implementation of gamification in their projects replacing the current used project management method. Based on these results, in the fourth chapter, we are proposing a model of how to use the gamification inside of your projects. The last chapter contains a summary for the related work and also next steps for future work.

2. Current methods and tools used in automotive product development

The development of new project management methods aims to minimize the risk of project to fails. In (Belassi, 1996), the authors shows that determining of the failure rate is a hard task because each stakeholder from the project is involved in a different way and perhaps the project is considered successfully by the customer, but targets from higher management does not meets expectations. According to most recent studies (Langley, 2015, Feldman, 2014), the project success is measured through the following factors described in Fig.1 and the key factors to success can be considered as described in Fig. 2.

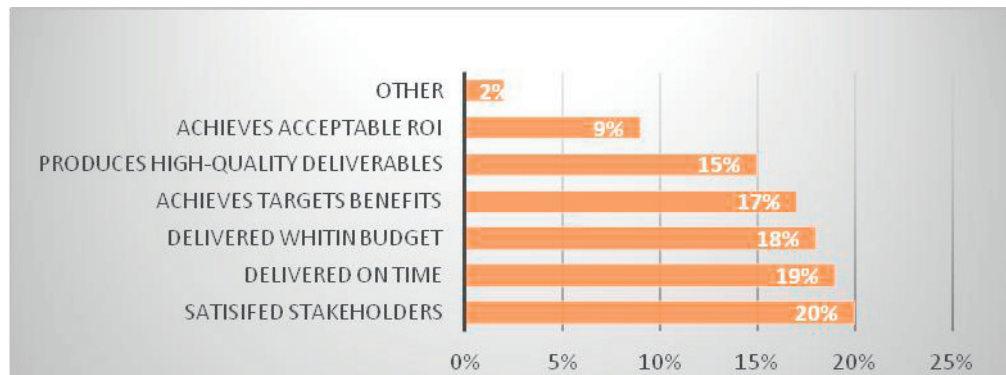


Fig. 1. Project success factors

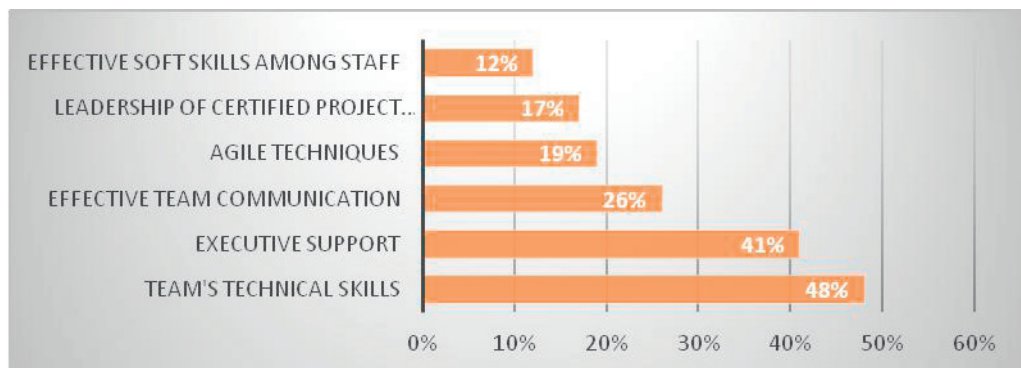


Fig. 2. Key factors to success

Remarkable here is that the team technical skills and effective communication among members combined with a strong support from executive management are leading in a high manner to a successfully project. Basically, gamification is aiming exactly these factors, but is not restricted to these since it comes also with a process method to support software development (agile, hybrid V-cycle, iterative). In the automotive industry the most used software development process cycles are old and archaic V-cycle and in the last time agile methods. Both of them are supposing people engagement, but the V-cycle can be done also with a low engagement from team side, but with a higher discipline. Of course, in our times V-cycle is not more adequate because number of delivers in a short time do not allow performing all operation needed to pass successfully all stages. Also, usually, automotive companies are big companies and have a higher inertia for change (Sull, 1999). Therefore, there is still used a hybrid version between V-cycle and the new agile methodologies. One way to pass easier to agile development is to use the current tools used by non-automotive companies. Even if the gamification is not direct stipulated in the process, the used tools are incorporating some game based mechanics inside. For e.g. companies/projects that are using Jira for e.g. as a project tracking tool are already using some gamification elements. Analysing the Fig.3 representing a typical Jira dashboard, the followings can be observed:

- There are already metrics defined for checking the number of LOC (lines of codes) for different projects and namespaces which can make aware the development team about each project member impact in the final code.
- Each project member can see the project status related the number of tickets and their importance/urgency classification and open reviews. This can give also to a project member an image of which colleague maybe needs help or has not time for new development.
- Road maps descriptions and statistics over burn down, burn up and velocity are already present. These are especially treated by the project management team, but also maybe be a base for the team members to increase their involvement in development with the purpose of speeding-up the development.



Fig. 3. Jira dashboard representation

A complete product development process is not involving only the software development process, but the concept described in the paper will take into consideration only this part. Currently, there are some methods also used and developed for management of development for complex projects. Some examples are Kanban, Scrum, Lean software development. There are also some studies on the combined methods for several methods and it seems that the results are improved. (Yilmaz & O’Connor, 2016). Current paper aim is to develop a framework that allows an easy development of software with the indication of blocking point in the early stage and also minimizing the risk through personnel involvement. According to (Yilmaz, 2013), gamification is a transformation process in which interaction patterns, game mechanisms, reusable game components are operationalized to solve problems in an intended environment that is situated within a real world context.

Designing of gamification process that fits to the company culture and environment of work it’s a hard task and should be done based on literature review and taking into consideration the former projects from where the essential procedures which makes the project successfully or a failing one should be re-used. Taking into consideration the methodologies from above, there are some similarities that can be reused for conceptual description of gamification framework as (Kniberg, 2009):

- They are focusing around devoted and experienced team
- They are limited the number of current tasks
- All of them are breaking the work into small parts with earlier releasable part.
- All methods suppose method to visualize project status and take actions based on current and old statistics.
- Organizational chart and responsibilities for the project should be clearly defined

- Rewarding of the team after each successfully step should be mandatory.

A typical organizational chart and responsibilities for an automotive project is represented in Fig. 4:

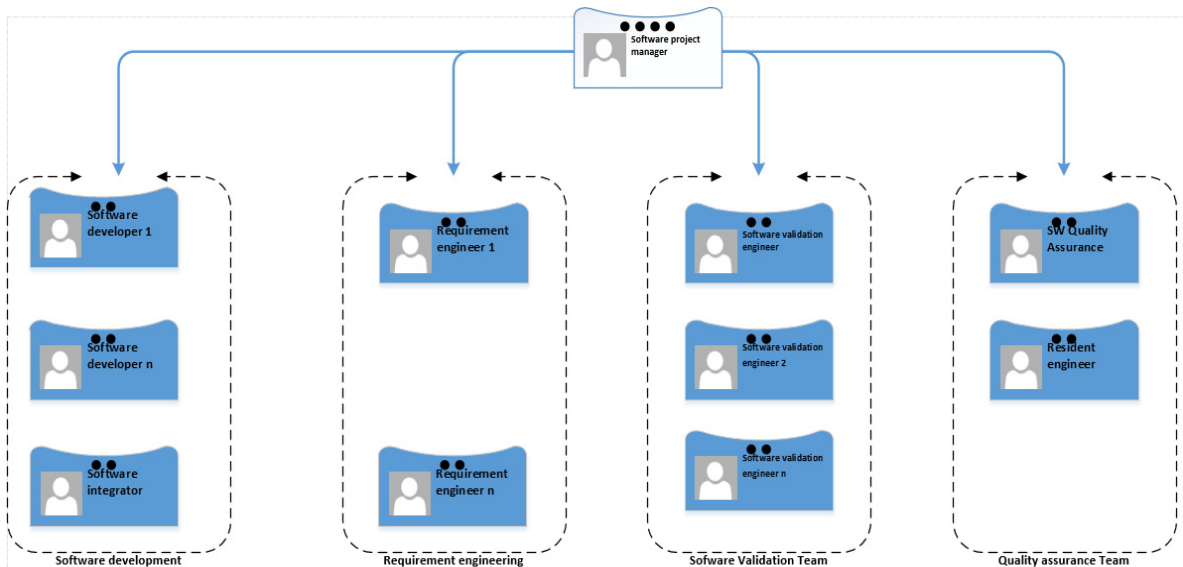


Fig. 4. Typical organization chart for small software projects in automotive industry

There are some research studies that propose game designing such a set of innovative and communication games with limited resources. This idea was raised firstly by Cockburn (Cockburn, 2004, Cockburn, 2007), Baskerville (Baskerville & Levine & Ramesh & Pries-Heje, 2004) and Holeman (Holeman, 1995) which designed methods considering the software development process as a balancing game or as a board game for learning of the development process. A mixed approach of Scrum and Kanban methods named *Scrumban* was described by Yilmaz in (Yilmaz & O'Connor, 2016). The results were encouragement since the user engagement and interest for personal development was increased.

The paper will propose the game design implementation based on the current literature and also on a set of questions for which the respondents are exactly the team which will apply the method.

3. Research method & analysis of results

One of the targets for gamification is to make the project successfully through the team members using the full potential of them combined with some clearly defined phases that needs to be completed. Team members are playing a very important role and in authors opinion's the game design should be targeted on them. For this, our instrument to check their enthusiasm and opinion related what should be kept or new introduced is a set of questions that is relieving their belief about the current software development process. The data collected for this research study was collected from 44 software engineers within several teams from an automotive company, all working on the same department and using a hybrid V-cycle method. All teams involved in the study are working on body domain controllers ECU. 1/3 team members are currently familiar with concepts of gamification since they are using Jira for task management. All team members are familiar with V-Cycle development process and 1/3 of them have also knowledge of agile methodologies. 1/2 of the team members are integrators of generic components where the delivery time of expected functions is within 4-6 months, while the rest of them has delivery time of expected functionality within 2-3 months. Analysis of the team members on gender, responsibility into project and age are described in the below table. Average age when the team member gets employed is 23 years old.

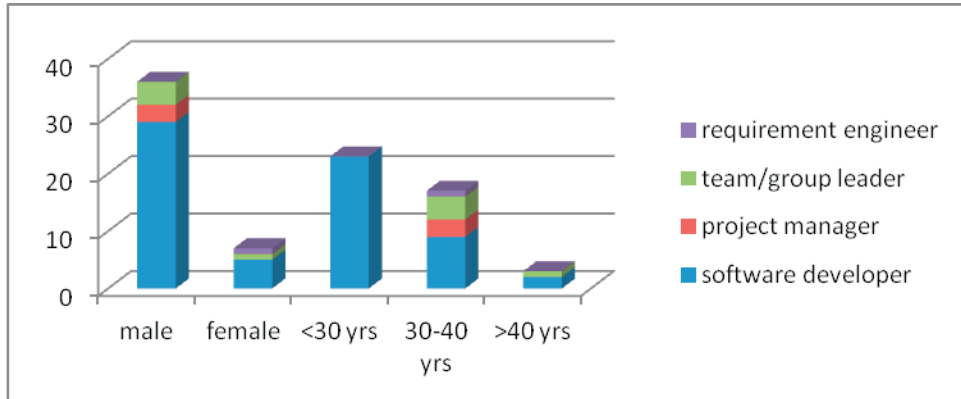


Fig. 5. Repartition of respondents on gender/age/position in project

The questions were grouped in four clusters, but distributed randomly, each of them targeting a specific clause such as :

- Adding visualization and overview over the current project status will improve efficiency (Q12,Q13)
- Applying of gamification techniques will improve efficiency (Q3, Q4, Q14, Q15, Q16).
- Currently applied process development is adding satisfaction (Q1,Q2, Q6,Q9, Q10,Q11,Q17)
- Willing to apply for a new software development process. (Q7,Q8, Q18)

Basically, a gamification game design should be done based on company objectives in a way in which it fits to human component. The questions were calibrated to deliver the same meaning with the same rating for all questioned and “a pleased/not pleased” answer to be near three grade. Below, there is table where the mean is represented for each question related to average mean of all questions. Analyzing the graph from below, the highest rating corresponds to the last question, in terms that a new development process will be received positively.

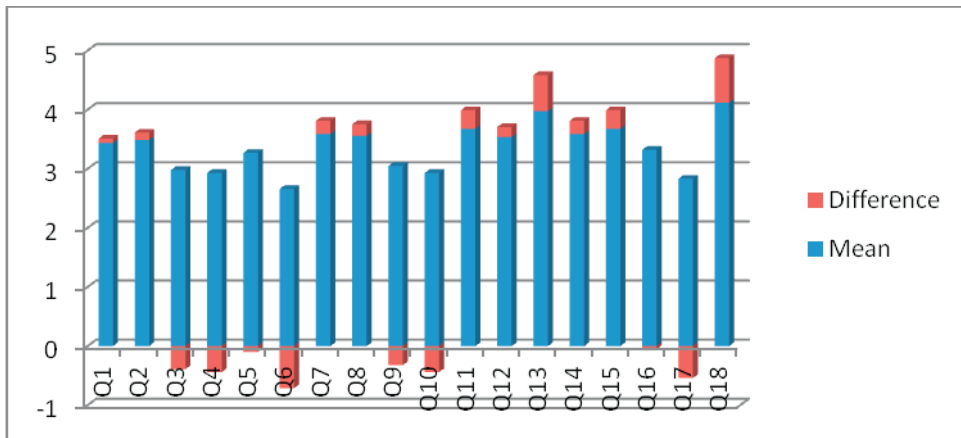


Fig. 6. Analysis of distribution of ratings peak per each question

For each cluster, a deep analysis reveals the following conclusions from Table 1.

Table 1. A synthesis of pros and cons as questionnaire results

Cluster name	Pro	Cons
Visualization	Dashboard/project status/current task status	Individual statistics/personal records
Gamification	Rewards/virtual interactive points	Leader boards/scoreboards
Current development process	Customer/developer interactions	many project meeting/low satisfaction/no novelty
New development process	Novelty/increasing team performance	-

Below, there is a filter for each cluster to check the influence of aging and current organizational position. It has to be remarked that females will allow easily the visualization together with a new process development process besides males, especially the ones over 40 years. Going deep with interpretation of data, it seems that project managers and team/group leaders wants to have new processes and charts to monitor the progress of the projects. On the other side, seems that for a software developer this will not bring benefits and they are afraid of monitoring. A short analysis of gamification related questions, statistics that involves for e.g. the number of new added code lines or proposed improvement are considered to not bringing added value. Also, a leader boards/scoreboard approach will not be received very well through most of the software developers, but adding additional virtual points that can be spent in a personal way or personal rewarding after each milestone together with dashboards related project status, but not a personalized one can be embraced easily. For the gamification proposed model all aspects needs to be taken into consideration.

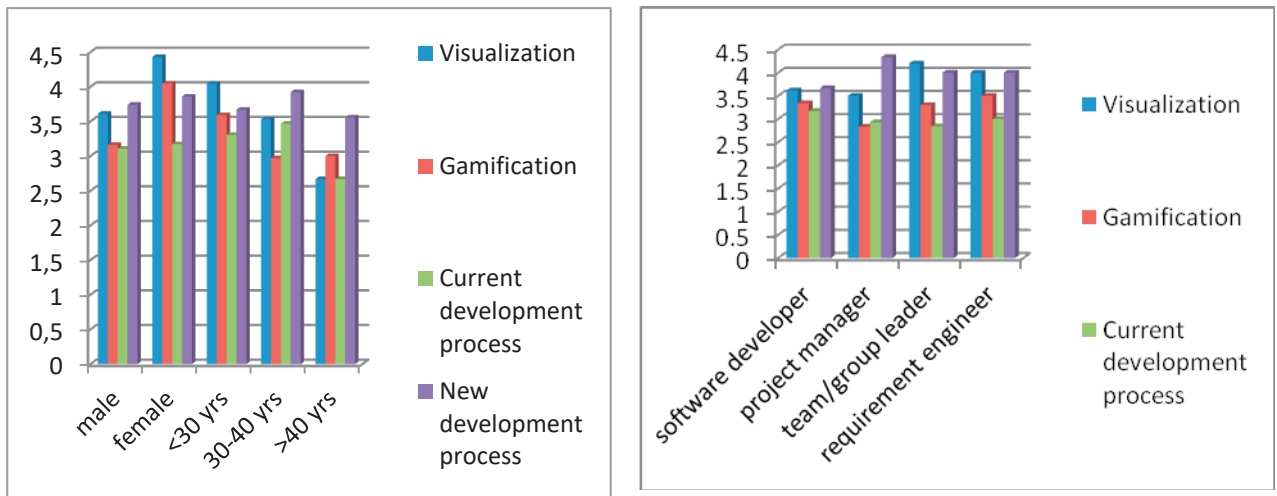


Fig. 7. (a) Analysis of distribution of ratings for clusters on gender/age
(b) Analysis of distribution of ratings of clusters on project position

In conclusion, a new development process combined with a gamification method emphasizing the team performance and project status, more than personalized results and criteria seems that can be assimilated very easily. Usage of correct tools for gamification like *RedCritic Connector*, *Jiraffe*, *FreeLancerEngine Wordpress plugins* can lead to improvements into schedules and loyalty of the project team.

4. Gamification model proposal

A model for gamification into software development should cover the entire development lifecycle starting with planning of the software project management team and ending with industrialization of the software product. The starting point for the description of method is the MDA (“Mechanics-Dynamics-Aesthetics”) described in (Hunicke & LeBlanc & Zubek, 2004). According to the authors of method, the “Mechanics” presents the components of the game through data representation and algorithms which are used for describing static gameplay. “Dynamic” stands for the dynamically approach of the mechanics elements in terms of inputs-outputs for the all players. Output of both concepts from user perspective represents the “Aesthetics” side which describes the emotional content of the players and their interactions.

First step into creation of a game mechanics, similarly with a PC/console game is to set the objectives of gamified process in terms of why we need this change and where it needed to be changed based on the retrospective checking of previous projects or even sprint. Here, not only the project management team needs to be involved, but also the company management team because common targets needs to be achieved. After these points are clearly stated, next step is to create the team based on the already set objectives. Of course, this requires a pre-assessment of the requested abilities and available members which can be selected for the project where the main goal is to find the suitable member which fulfills the role profile. (E.g. embedded C experience > 3 years, but the “competitive” player profile, requirements engineer experience > 4 years, but “hard-working” player profile). We see similarities with video games development where some of the first activities is to find exactly the target gamers. Here we should map the “mechanism and dynamics” part on the best suitable member. First step consists of early creation of the “mechanics” and many of the “aesthetics” targets that needs to be considered.

Basically, the second step starts with defining of the mechanics elements based on the used development process such as allocation points in leaderboards or player profile, extra opportunities for strength profiles, rewards for completed tasks, types of task completion, releases rewards, technical/non-technical leaderboards points allocation. In this step, the main goal is not to refine how this “mechanics” will interact, but to have a clear definition of each item that will be usable in the next steps together with pre-requisites consists from type of members which is necessary for item implementation. The output of the step is a list of items, conditioned by the required type of player’s “aesthetic” (e.g. hard working, follower, and thinker). Optional can be delivered also suggestions/remarks of facts what was learned from previous projects.

Next step it’s also the most important and hard to obtain it from an iteration because it starts to link between them the previous items from step 1 and step 2. Which is needed to be taken into consideration is how the step 2 artefacts are combined with process development steps fulfilling in the same time the objectives from step 1. Here, for example, a bad “mechanics” can lead to the situation when some members of the team are constantly in top of leaderboards and some of team members are constantly in lower side, but not maybe due to their performances as their tasks nature. For a system engineer for e.g. a task can be considered to be finished at end of the release where all requirements were implemented, but for a software developer during a release a number of 20 issues can be implemented. One method to avoid this can be to weight the tasks rewards based on their types (complexity vs estimated effort), but also to create for each role of the projects personalized rewards to create an ethically working environment. One example of how the step 2 items can be combined can be found in (Ceska, 2015).

The steps from above should be done into iterative steps until all gaps are considered to be filled with suitable members, all activities described by used software development method are considered and covered and risk is minimized. Also, if during the gamified process, risks are identified in development/delivery of work products, then this should be considered as a starting point for other n-iteration steps (run-time game changing strategy). This will involve adding or removing of some MDA elements. Operation is not so easy because some of the member’s “aesthetics” should be reworked and the dynamics steps should be added or removed keeping the constraint as process development steps cannot be removed or their order changed. An example of some risk factors that can appear are: leaving of some project members, estimation accuracy were not close enough to match the initial planning, number of reworked items are too many, losing trust from customer side which cause more deliveries that initial estimated, but identification of the risk in an early phase give more time for game adaptations. A briefly description is presented in the next picture:

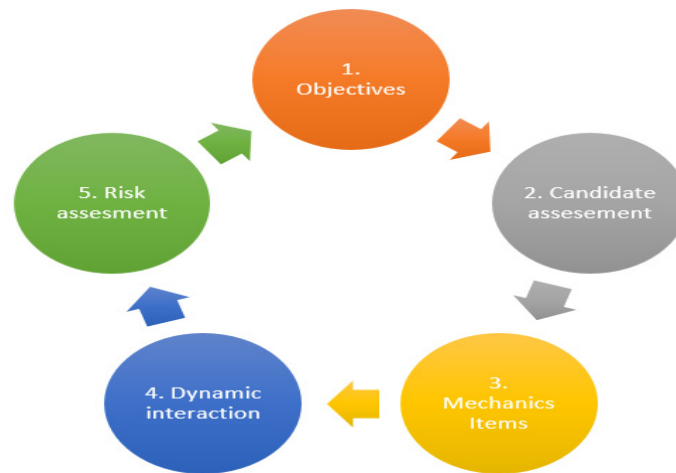


Fig. 8. Description of iterative process for gamification

Next step of the research is to apply the model over the questioned teams and check through a strong defined KPI (Key Performance Indicators) factors if the overall satisfaction of people increased together with project development indicators. An example of KPI can be considered as follows (all KPIs are related the “non-gamified” project development method):

- number of days spent for solving the same amount of estimated features
- number of reworked issues related the number of new implemented features
- “Happiness” factor of the project members related the current development method.
- customer ratings for the delivered work products

This indicators can be measured easily through questionnaire method without adding complex logic for tuning the questionnaire parameters. The advantage of the proposed method is that it can be applied very easy on all used development lifecycle (e.g. waterfall, incremental, agile, Kanban, v-cycle) from automotive world, but it has also disadvantage because cannot be stated that is applied in the same manner for each team, for each project within even the same company. Each automotive company should add inside also its corporate mind-set, its own values. Also, applying the method before knowing what each member wants, without creating for each team member a set of pre-interview to find it’s “aesthetic“ type can lead not to improvement as expected.

5. Conclusions

During our days, each week we hear in media that a new innovative project was cancelled or stopped for the moment because it was considered that it’s not meeting the expectations or it’s already failed. Due to higher rate of such projects combined with innovations that makes the life more comfortable which makes the team members not so engaged as before, the multitude of jobs into technical areas and the increasing of the competition among company leads to a change of the old paradigms. Today, development speed together with quality level and costs can make from a company one of the top leaders or exactly the opposite. The paper presents a method for a “game-changing” attitude over the software development method through gamification. This paper presents the current status in usage on large scale into automotive projects of the gamification together with a described process for developing of the game mechanism for its usage in a real project.

The contribution of the authors in development of new frameworks based on gamification starts with a questionnaire which was addressed to an automotive software company team members which results were analyzed and used as pre-requisities later for description of a steps that needs to be followed in order to have a personalized gamified experience. What can be seen into analysis of the results, peoples are willing to embrace a personalized

gamification model on their currently working model since negative results were seen to questions where current used method was the main topic. The development and iterative process which needs to be applied for obtaining the “gamification application” are described in the current paper together with associated risk factors.

This paper is the first paper from a research study which next step consists of implementation of software packages to support the proposed model and of course based on the results to validate the proposed model. Also, the iterative proposed model can be a starting point for implementation of an expert system in which defining the project objectives, available team members and chosen development life cycle to lead to a “best fitting” gamification application.

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References

- Abbasi N., Wajid I., Iqbal Z., Zafar F. (2014) Project Failure Case Studies and Suggestion, *International Journal of Computer Applications* (0975 – 8887), Volume 86 – No. 6.
- Holgeid K., Thompson M. (2013), A Reflection on Why Large Public Projects Fail. *The Governance of Large-Scale Projects Linking Citizens and the State book project*.
- Dorsey, P (2005), Top 10 Reasons Why Systems Projects Fail, *Harvard Kennedy School*.
- Short, A (2014), Reasons for software failures.
- Aseriskis D., Damasevicius R.(2014), Gamification of a Project Management System, *The Seventh International Conference on Advances n Computer-Human Interaction*.
- Anderson J., Rainie L. (2012), The Future of Gamification. *Pew Research Center*.
- Belassi, W., (1996), A new framework for determining critical success/failure factors in projects, *International Journal of Project Management*, volume 14, issue 3 (pp 141-151).
- Langley M., (2015), Capturing the value of the Project Management, *Pulse of the Profession®: Capturing the Value of Project Management*.
- Feldman J., (2014) Enterprise Project Management Survey, *InformationWeek:reports, April 2014 edition*.
- Sull, D. (1999), Why Good Companies Go Bad, *Harvard Bussiness Review, July-August 1999 issue*.
- Yilmaz M., O'Connor R.V, (2016), A Scrumban integrated gamification approach to guide software process improvement: a Turkish case study, *Technical gazette, Vol .23, No. 1, (pp 237-245)*.
- Yilmaz, M., (2013), A software process engineering approach to understanding software productivity and team personality characteristics: an empirical investigation. // PhD thesis, Dublin City University, Ireland, (PhD thesis).
- Kniberg H., (2009), Kanban vs Scrum – How to make the most of both, *Enterprise Software Development Series*.
- Hunicke R., LeBlanc M., Zubek R.,(2004), MDA: A Formal Approach to Game Design and Game Research, *In Proceedings of the Challenges in Games AI Workshop, Nineteenth National Conference of Artificial Intelligence, San Jose, USA*.
- Ceska M, (2015), Gamification in the SCRUM Software Development Framework, Masaryk University, Faculty of Informatics, Masther Thesis, Brno, Czech.
- Cockburn, A., (2004), The end of software engineering and the start of economic-cooperatives gaming, *COMSIS 1(pp 1-32)*.
- Cockburn, A., (2007), Agile software development: the cooperative game, *Addison-Wesley*.
- Baskerville, R.L, Levine, L., Ramesh B., Pries-Heje, J (2004), The high speed balancing game: How software companies cope with internet speed, *Scandinavian Journal of Information Systems 16 (pp 11-54)*.
- Holeman, R. (1995) The software process improvement game, *Software Engineering Education (pp 259-261)*.