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Specialization: distributed applications and internet services

MASTER'S THESIS

Title of thesis: Enhancing Scrum with collaborative games

Title of thesis (in Polish): Usprawnienie metodyki Scrum poprzez gry zespołowe

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ABSTRACT

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If the thesis is written by more than one author, the **Abstract** must specify what each author has prepared and contributed. Moreover, the particular authorship of each chapter and subchapter must also be specified (see **Table of Contents**). If a writer is named as the author of a particular subchapter it should be assumed that all the items in the subchapter are the work of that particular writer. For example, if the thesis is co-authored by writer A and writer B, in the Table of Contents it may be stated that writer A co-authored chapters 1 and 7, individually authored chapter 2 as well as subchapters 3.1 and 4.2, etc. A writer B, on turn, may be named as the co-author of chapters 1 and 7 as well as the individual author of subchapters 3.2 and 4.1, etc.

Keywords:

Field of science and technology in accordance with OECD requirements: <field>, <technology>,. . .

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1. INTRODUCTION

1.1. Context and motivation

The Scrum is a methodology can be traced back to 1986, where in article "The New New Product Development Game" [1, 2], published by Harvard Business Review. Back in 1986 companies such as Honda, Canon and Fuji-Xerox were using producing word-class results using all-at-once product development method, which was a scalable, team-based technique and emphasized the matter of having teams that are self-organized and empowered, what is more they outlined the role of management in the development process. The name "Scrum" is not an acronym, its name derives from sport of rugby, where the way of restarting a game after an unintended infringement or in case the ball has gone out of play. In the eighties, large companies creating defense and IT projects were failing due to growing frequency, which headed to numerous books how to create a better process. The growth of the companies and technological progress led to creating in 2001 agile manifesto [3, 4]. The agile manifesto contains rules as follows:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more." [3]

A game can be seen, accordingly to Miguel Ehécatl Morales-Trujillo in his article "Improving Software Projects Inception Phase Using Games", as an activity which leads to learning new skills and applying them to overcome challenges, getting rewards or punishments. In the article serious games are distinguished as those which can entertain, even though it is not their primary purpose, and may be played seriously. The serious games might be used as a strategy to address different kind of challenges and sorting obstacles [5].

In this thesis, the main purpose of the serious games is to verify, whether it is possible to enhance the Scrum using collaborative games.

1.2. Problem statement

The goal of this research work is to propose and implement a set of collaborative games for improving communication, motivation, creativity, involvement and introduce a innovate approach in Scrum teams.

1.3. Research method

The research design is an action research method deployed in Intel Technology Poland site in Gdańsk in collaboration with its teams. The company was experiencing issues in particular fields using Scrum methodology. We cooperated with one the main Scrum Masters in the corporation, Grzegorze Reglinski. Grzegorz is a certified scrum master (Professional Scrum Master), has over 10 years of experience of working in Agile environment as a developer, product owner and scrum master. He gained practical knowledge, while working on agile projects and solving problems. His experience was built in Scrum, Kanban and Scrumban teams. Grzegorz currently manages and supports, from the agile side, over 50 people working together in a project based on microservices. The practical aim of action research is to enhance performing retrospective meetings. Moreover, the research goal is to examine whether the games are positively influencing cooperation and motivation of the participants. What is more we aim to verify if creativity of team members was increased using the proposed techniques and if their are more involved, while being both entertain and while extract valuable results using serious games.

1.4. Related work

Miguel Ehécatl Morales-Trujillo wrote a paper on "Improving Software Projects Inception Phase Using Games" and his work was focused on all the Scrum meetings, this master aims to improve only the retrospective meeting. Miguels goal was to help understand customers, market, business opportunities and to improve everyday issues in the organisation. This work is strictly focused on human relations enhancement and retrieving valuable outcome in case of the project in the retrospective meeting.

The Synergy-Analyzer introduced is a innovate web service which is able to retrieve a game based on simple question. The participants of the retrospective meeting are obliged to fill a form and basing on their answers the system will retrieve a best, suitable game for their issues in the team. The solution has no related work, this a first kind of system.

1.5. Outline of the thesis

The work contains 7 chapters, the first one describes the aim of the work and is an introduction to the topic. The next chapter contains knowledge from the literature, books, articles and publications. It is focused on how does scrum looks in theory, the process, what kinds of roles do we distinguish in this methodology and what meetings are required. In the second section of chapter two the practical scrum has been described. The third chapter contains description of fundamental and supplementary games, what are the requirements and rules. In the following chapter games deployment has been elaborated, the results of the teams meeting, the outcome from the participants' feedback and what was observed while implementing the game. Moreover the chapter has been divided into two sections, using two different sets of questions for feedback retrieval. The chapter five includes web service detailed description of the architecture and the way it works. The next chapter contains collected data about how the system was evaluated and the outcome of the deployment. The last chapter summarizes all the work that has been done in this master thesis.

2. SCRUM OVERVIEW

The concept of agile development was proposed in 2001. Agile Manifest was elaborated by 17 developers, the purpose of it was to gather all important rules how to properly produce a good quality product:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more." [3]

The Agile Manifesto is based on following twelve principles:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity–the art of maximizing the amount of work not done–is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.[3]

Scrum is the most popular agile methodology for developing products and services [6]. The Figure 2.1 shows, in a simplified way, how agile development works [2]. The main rule in development using Scrum methodology is that after each iteration (2-4 weeks of implementing planned features) the customer is able to get a usable product. The principle artifact in Scrum is product backlog, which is a list of features based on customer requirements, it should be prioritized from the most important functions to "nice to have" features or just less urgent. The backlog contains user stories, which is a form of expressing business requirement in Scrum, it is created in a way that can be understandable for both sides, business and development. There are a few templates with different structure, but the most popular and commonly used is:

1. Basic User Story structure [2]
   (a) As <who, a role in system>, I want <what, a need> so that <benefit, goal> e.g.:
      i. As *a company owner*, I want *the company logo to be visible on the welcome page* so that *customers are able to see it*.
2. Mike Cohn's User Story Structure [7]
   (a) As <a role>, I want <goal/desire> e.g.:
      i. As a *user*, I want *the company logo to be visible on the welcome page*.
3. Chriss Matts's User Story Structure [8]
   (a) In order to <receive benefit> as a <role>, I want <goal/desire>
      i. In order to *increase the number of sales of our print consumables* as a *marketing manager*, I want *customers to register their e-mail addresses*.

A user story is created to store it in Product Backlog and in the future divide it to tasks, but in order to do it developers should know the requirements, so the main purpose of user story is to start conversation, it is a catalyst to talk about requirements.

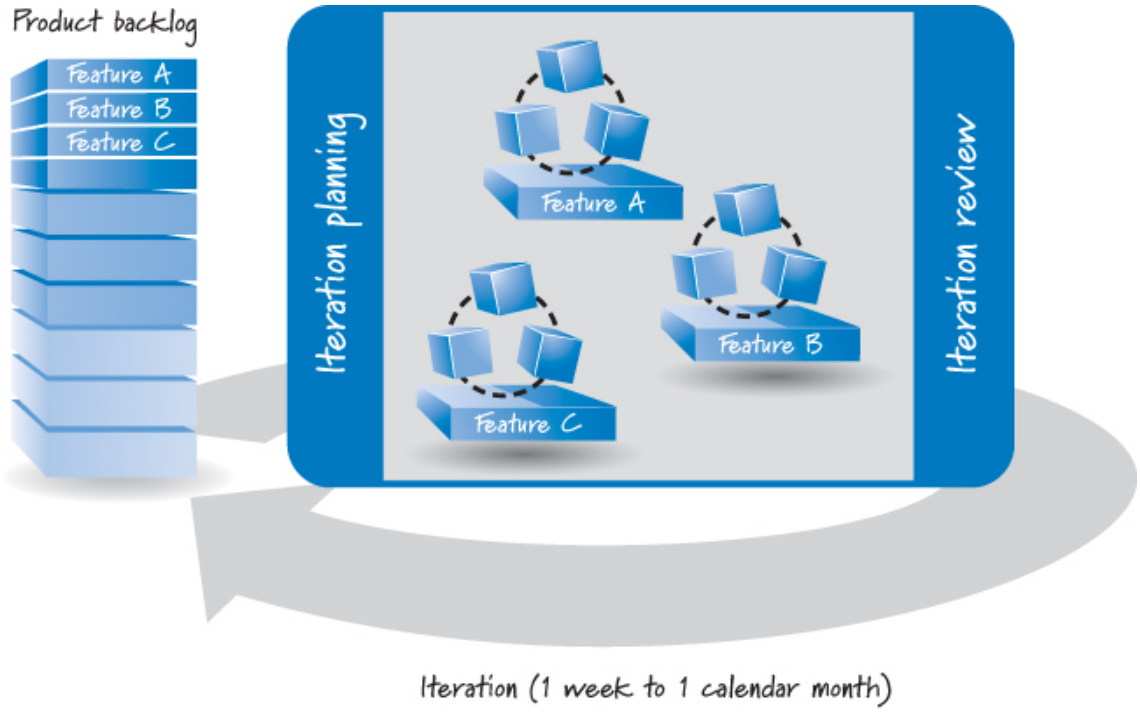

Fig. 2.1. Agile development overview [2]

2.1. Scrum in theory

In this section we will focus on scrum in theory, how it works, what are the required elements - who is required and what meetings. Often scrum in theory differs from scrum in practice and it is said that Scrum is just a tool and it should adjust to the team, not the other way.

2.1.1. Process phases

Scrum is a methodology based on incremental and iterative model of product development cycle as showed on Figure 2.2.

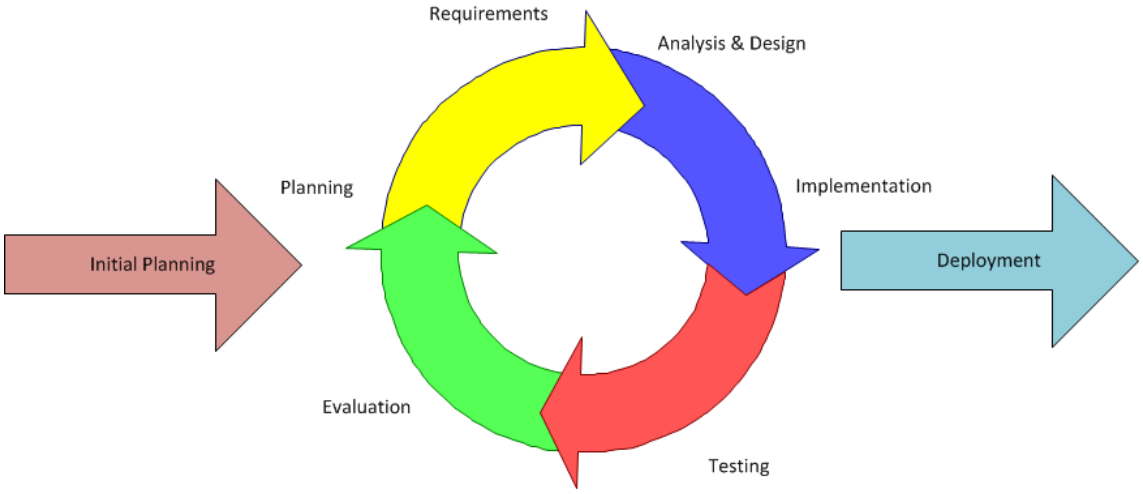

Fig. 2.2. Scrum cycle development
Source: https://www.inflectra.com/Methodologies/Waterfall.aspx

The incremental-iterative model is divided into stages, one whole cycle is called sprint, it is suggested that each sprint should be 2-4 weeks long. Every cycle contains planning, gathering requirements and deciding, what and how should be done, analysis and design, implementing what was planned on the particular iteration, in this moment of cycle we have two paths, we can decide to deploy our product if it is done or continue to next stage which is testing. The last element of the cycle is evaluation, if everything what was planned was actually implemented. The cycle is actually straight-forward and is very effective [2].

2.1.2. Roles in scrum

Scrum has determined each team member included in the project a particular role Figure 2.3, each role has it's own responsibilities.

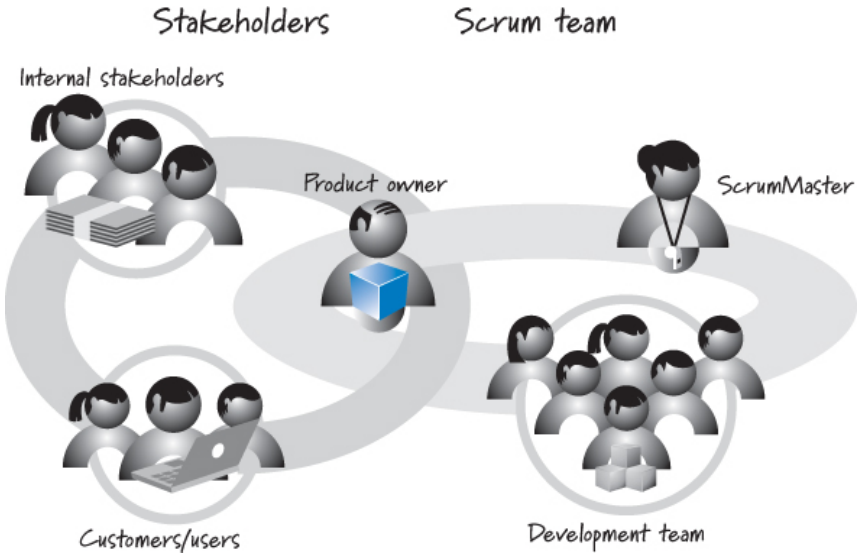

Fig. 2.3. Roles in scrum [2]

Product owner is a person that need to look in at least two directions simultaneously [2]. This role is responsible for communication between stakeholders and the scrum team. The principle

obligations are shown in the Figure 2.4.

Fig. 2.4. Product owner responsibilities [2]

Product owner represents scrum team outside and is responsible for product development, decides which feature should be included in a particular sprint, adds user stories and features to the backlog, defines acceptance criteria and verifies whether they are full filled after the sprint.

Another important person in Scrum Team is Scrum Master, whose responsibility is illustrated on Figure 2.5. Mainly his role is to superintend the process and help development team to adapt to the agile methodology. This role is responsible mainly for removing impediments that inhibit team's productivity, protects team from outside interference so that they can remain focused on delivering good quality business value every sprint, servant leader of the Scrum team and team's process authority [2].

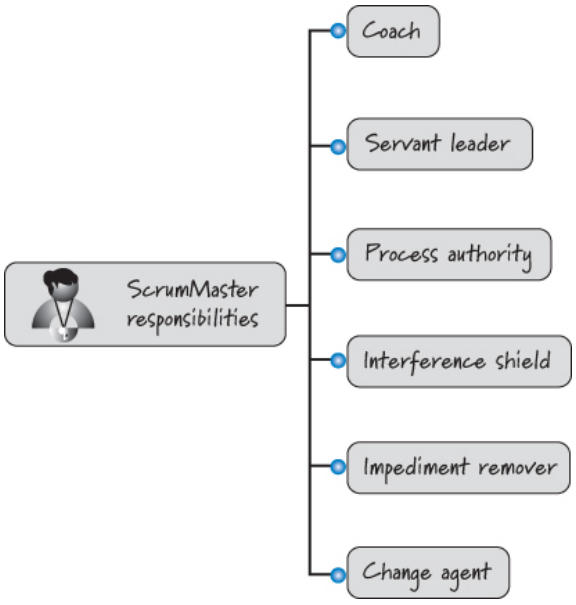

Fig. 2.5. Scrum master responsibilities [2]

The last, but without which there would be no product and which is essential, is development team, also called delivery team, design-build-test team or just team. Types of jobs in a develop-

ment team for example are: architect, programmer, tester, database administrator, user interface designer and many more. Development team is responsible for product implementation, testing, integration and design. The team should include people of various specializations and skills, who can fulfill project requirements. Delivery team is obliged to perform sprint execution, which means performing actions that will result with a ready functionality. Each member of the team is expected to participate in scrum meeting such as described in subsection 2.1.3. On this group this work will be mainly focused on [2].

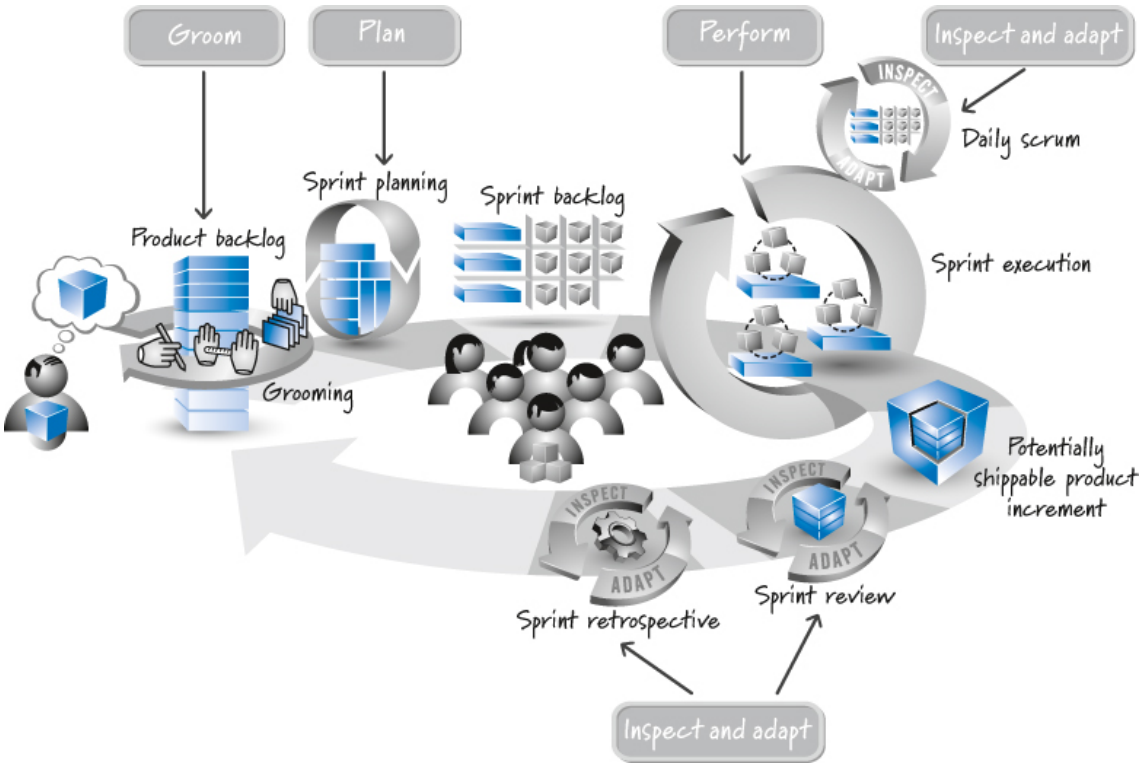

Fig. 2.6. Development Team responsibilities [2]

2.1.3. Meetings overview

A product development is composed of multiple sprints, which can last 2-4 weeks [2] and each iteration should deliver a usable product to a customer, which does not mean ready or fully functional implementation, just a product that can be potentially shippable. As presented on Figure 2.7, before sprint execution there should be a Backlog Grooming meeting, each iteration starts with Sprint planning and ends with Sprint Review and Retrospective, what is more every day begins with Daily Scrum. The next sections will describe all the meetings separately [2].

This Backlog grooming meeting is focused on maintaining the product backlog, it should be executed before next sprint planning. The main aim of this meeting is to [9]:

- remove user stories that are no longer relevant,
- creating new user stories in response to newly discovered needs,
- prioritizing the user stories,
- assigning or correcting estimates to user stories,
- splitting user stories which are high priority but too big to fit in an upcoming iteration.

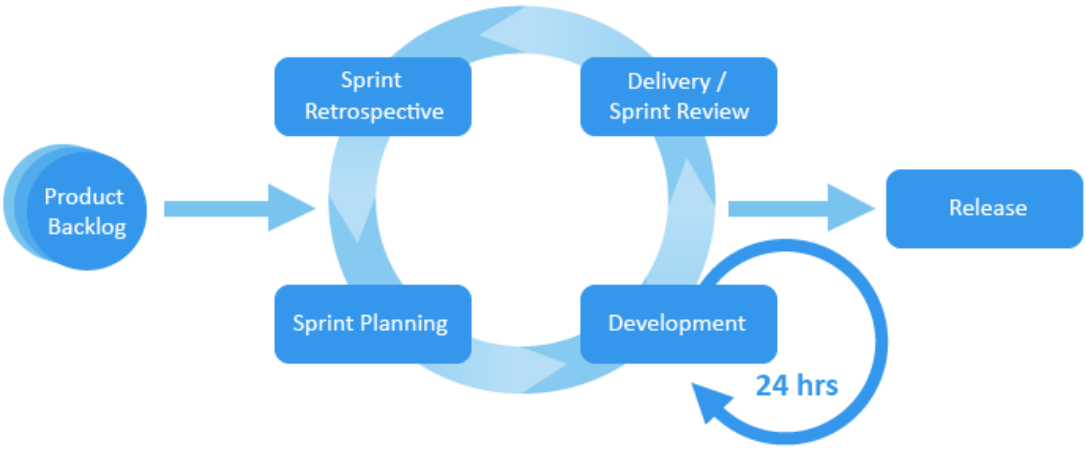

Fig. 2.7. Scrum meetings and process
Source: http://blog.fluidui.com/design-is-changing-agile-for-the-better-heres-why/

On the Backlog Grooming it is mandatory that the Product Owner is present, Developments' Team and Scrum Masters' presence is optional [2].

The Sprint Planning is a meeting on which Product Owner shares initial sprint goal and answers questions regarding product backlog items. The initial requirements should be accomplished in order to start the meeting [10]:

1. Prioritized backlog after backlog grooming.
2. The highest-priority stories should be estimated.
3. Prepared definition of done.
4. The capacity of the team should be known, for example the team has a meeting outside working place that might affect the sprint, this should be included in the capacity field.

Two distinct objectives might be retrieved from the Sprint planning. Firstly, we must ensure that each team member understands what is expected to do in the particular user story and secondly divide user stories into tasks and determine what can they deliver and makes a realistic commitment. Each team member might select one of the tasks, which is willing to own and complete, but it is not a required action, which must be performed. Thereafter, the team estimates, taking all the factors into the consideration, the risk, developers experience, the difficulty of the task and estimate in hours how long it might take to complete a task. From the Sprint planning we have two primary outputs, first is the goal of the iteration, which means, what users stories should be delivered, second is the sprint backlog with list of created tasks [2, 10].

The Review is a meeting in Scrum which takes place at the end of an iteration. The product owner, scrum master and development team should be present, on the list of invited people might customers and managers may be included. The review meeting is a demo of a product that has been delivered after a sprint and also a chance for the customers to provide feedback. Quoting the agile manifesto "Working software is the primary measure of progress." and "Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage." those rules are fulfilled thanks to the review meeting [11].

The Daily Stand-ups is a short meeting which is held every day during the sprint and its purpose is to discuss issues that are preventing work from being done and how is the work progress. The

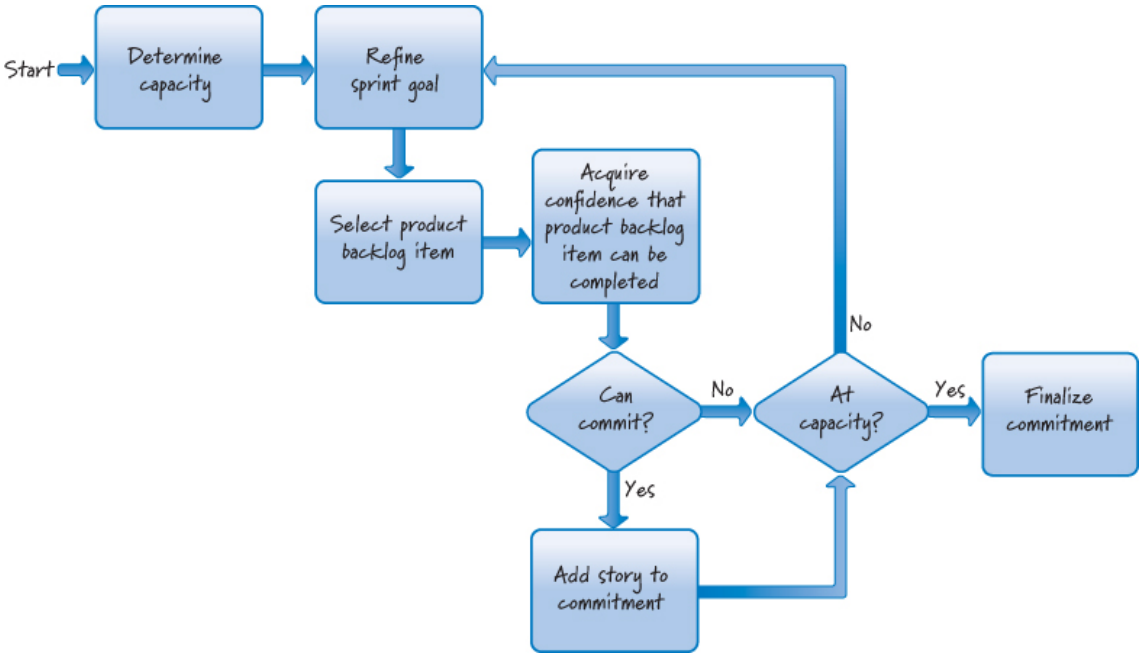

Fig. 2.8. Scrum One-part sprint-planning approach [2]

Daily Stand-ups are time boxed to no longer than 15 minutes and the participants are obliged to stand. The team members stand in the circle and and answer the following questions [11]:

1. What have you done since yesterday?
2. What are you planning to do today?
3. Do you have any problems preventing you from accomplishing your goal? What progress has been made on existing impediments? Can the blockage be removed or must it be escalated?

It is indicated that in order to keep the meeting short, the major issues which were discovered during the Daily Stand-up will be discussed afterwards [11].

The Retrospective meeting takes place at the end of the meeting and is strictly focused on reflection of team members on the sprint that has passed. The encounter provides the participants a chance to congratulate each other on the things that succeeded and discuss once that went wrong [11]. The purpose of the retrospective was summarized by Norm Kerth, by quoting a fragment from "Winnie the Pooh" [2]:

> Here is Edward Bear, coming downstairs now, bump, bump, bump, bump, on the back of his head, behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels that there is another way, if only he could stop bumping for a moment and think of it.

The Sprint Retrospective allows the participants to stop bumping and have a moment to think. The target is to examine what is happening in the team, analyze the way the team is working, identify the problems and ways to improve. The areas that the team should focus on and which are up for discussion are processes, practices, communication, environment, artifacts, tools, internal and external issues within the project and the development group [2].

It is said that the Sprint Retrospective is one of the most important and least appreciated practices

in the Scrum and this is because there are people who think that it takes time away from doing "real things" such as developing, testing, designing. Its importance comes from fact that using this approach the team members are able to customize scrum to theirs needs and it is a crucial contributor, as written in Agile Manifesto [3], to continuous improvement [2].

2.2. Scrum in practice

3. RETROSPECTIVE DEDICATED GAMES

Communication inside any team can be difficult especially when it involves revealing your own personal opinion which might differ from others. Speaking out loud about problems even in small group might be shameful and most of people do not like to open up in front of others, which might cause layering issues not only in communication between people, but also in developing good quality software. Based on experience that we learned from Scrum Masters and Technical Leaders in company Intel Technology Poland, most people have enormous knowledge about technology, new frameworks or developing with good standards, but they are not used to share it, because they are afraid of criticism, so they rather sit quiet and let other, more brave, sometimes less experience, people talk. The following games are invented for the situations, which were mentioned before to minimize the shyness and fear and to maximize awareness of possible problems and to enforce team to discuss them.

3.1. Fundamental games

To start with, we should be aware of existence of a standard procedure mentioned in subsection 2.1.3. The 3-statement method which contains "Good things", "Bad things" and "Things to improve" is the most popular and the most frequently used by teams, based on Grzegorz Regliński knowledge and experience, technique of conducting Retrospective. Games presented in this chapter are an innovative approach to this meeting, which often changes users' point of view, shows a problem, both inside and outside of the team, from a different angle and entertains, while retrieving interesting and impressive results.

3.1.1. Speedboat game

"Speedboat" (also known as Sailboat) is a game which changes the perspective of looking on retrospective and problems. Team members do not focus what problems they had in terms of ordering them into three columns using 3-statement method, but thanks to change of view they start to think creatively and might retrieve more valuable issues. Figure 3.1 shows what should be drawn on a blackboard. Every item represents different statement [12]:

1. The cloud which is creating the wind symbolizes things that were successful, things that are pushing forward our team and product, for example good code reviews in previous sprint, members of the team share knowledge and help others.
2. The anchor symbolizes things which could have been done better, because the idea is good but the execution is not being done well, for example crowding pull request reviews because only one person is doing them, bad communication in the team caused e.g. solving problems that someone already had and did not share with others the solution, wasted time.
3. The rocks symbolize statement things that we wish did not happen again, something that may cause our product major problems now or in the future, those are things that we need to lose, for example planning did not go well, so many people were without tasks because of bad division or dependency.

The game should start with describing people what is game about. The main aspect is that people understand what is required from them during "Speedboat" game. The Table 3.1 below shows

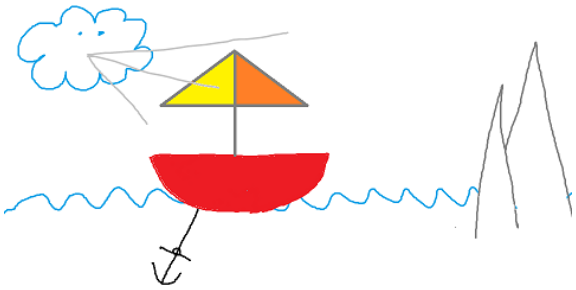

Fig. 3.1. Speedboat

what is required to start with this improvement game.

Table 3.1. Requirements to start Speedboat game

Target	Improve creativity in the team and maximize solving problems
Required	1. Minimum 3-people scrum team 2. Blackboard 3. Sticky Notes 4. Pencil/Pen
Time	About 45 minutes

After description the leader draws the picture, like on Figure 3.1 and team members should stick sticky notes where think they belong. The next step, if everybody already is out of ideas, is to discuss the results displayed on blackboard, maybe a particular issue is for one person positive and for another is negative, they should clarify and talk about it. This approach is not only productive for the team, but also for project, and might retrieve interesting outcome.

3.1.2. Glad/Mad/Sad game

The Glad, Mad, Sad game, also known as Happy, Sad, Angry is a game in which the manager or scrum master is able to observe teams mood, which is definitely a useful factor to retrieve from a retrospective meeting. Figure 3.2 visualizes how the scrum master should draw in order to conduct "Happy/Sad/Angry" game. The board should be divided to three spaces, where each space has its own meaning and purpose [13]:

1. Happy Face symbolizes successful things which occurred in current iteration, accomplishments and valuable effects for the team and project, things that we learned and you are thankful for.
2. Sad Face symbolizes things that made a team member not satisfied of his/hers work, an action which could be done better.
3. Angry Face symbolizes things which caused problems that made team members annoyed, issues which were the source of iteration failure or the work harder than could have been using e.g. other tool, framework etc.

To start with the leader, who is responsible for retrospective should describe the rules of described in this subsection game. Required equipment for this approach is presented in Table 3.2.

The next steps, after team members understands what is the purpose and what are the rules of described game, are the same as in Speedboat game, filling sticky notes and discussion.

Fig. 3.2. Happy/Sad/Angry

Table 3.2. Requirements to start Happy/Sad/Angry game

Target	Retrieve teams mood and maximize solving problems
Required	1. Minimum 3-people scrum team 2. Blackboard 3. Sticky Notes 4. Pencil/Pen
Time	About 45 minutes

3.1.3. Starfish Game

The next game I would like to describe shows a totally different approach for conducting retrospective. The game is called "Starfish" [14], because this shape divides board to five areas like on Figure 3.3 :

1. Keep doing - this area describes things which are being done well by the team and they should continue doing them because they are valuable for the project and team members.
2. Stop doing - things which are "not bringing value, or even worse, it is getting on the way"[14].
3. Start doing - things which were working for you in the past in other team/project or new ideas, approaches which might help team in delivering product and in general are beneficial for the team.
4. Less of - things which are being done already and they bring value, but should be reduced.
5. More of - things which are being done already and they bring value, but they would bring more value if done more [14].

This game shows a different perspective than is in usual 3-statement method and thanks to that, leaders are able to retrieve problems and issues in nonstandard fields. The requirements are presented in Table 3.3.

Table 3.3. Requirements to start Starfish game

Target	Retrieve problems, increase creativity and maximize solving problems
Required	1. Minimum 3-people scrum team 2. Blackboard 3. Sticky Notes 4. Pencil/Pen
Time	About 60 minutes

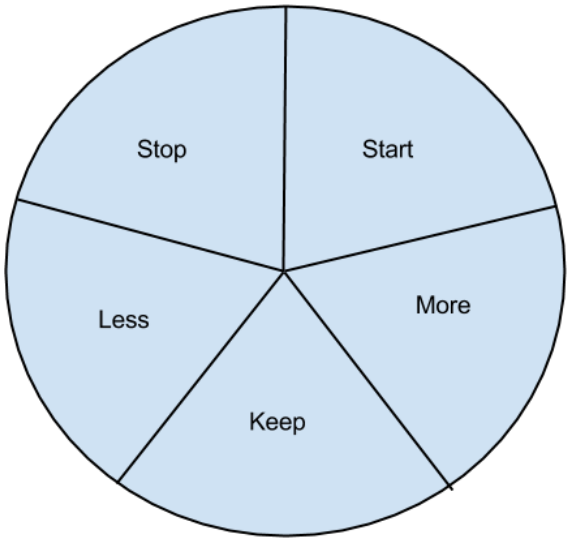

Fig. 3.3. Starfish

3.1.4. 360-degrees of appreciation Game

Another team building game is called 360-degrees of appreciation and is an activity that fosters open appreciation feedback within a team. The game is useful in case of increasing team moral and improving people relationship. The Table 3.4 presents requirements for the game and the rules are as follows [15]:

1. Gather all participants around the table.
2. Write appreciations on your paper for each member of the team gathered around the table.
3. If everyone is ready, ask the participants to sit in a circle.
4. Chose one person that will sit or stand in the middle of the circle.
5. Everyone in the circle should read theirs appreciations toward the person sitting in the center.
6. Repeat steps four and five for everyone in the circle.

Table 3.4. Requirements to start 360-degrees of appreciation game

Target	Motivates constant feedback, strengthens relationship and trust
Required	1. Minimum 3-people scrum team 2. Paper or Sticky Notes 3. Pencil/Pen
Time	About $\tilde{2}$ minutes for each participant for the item 2 of rules and about $\tilde{1}0$ minutes for item 5

3.1.5. Mood and improvements Game

During the cooperation with Intel Technology Poland teams, the "Mood and improvements" game has been created. The activity is a merge of two approaches, both of them were already described, first in the subsection 3.1.2 and the second one has its roots and has been inspired by the game from subsection 3.1.4. The goal is to retrieve as valuable as possible feedback from the team about the project and simultaneously increase the trust, strengthen the relationship between team members and retrieve from the team ideas how to improve the project or the team. As presented

on Figure 3.4 the game has five areas that need to be filled. The first three fields on the top are described in subsection 3.1.2, because the upper part of the picture is the exact reflection of Glad, Mad, Sad game. The lower area of the Figure 3.4 presents:

1. Flowers - representation of statement "Appreciations", in this section we thank people for things that they have done for us, the team, the project in the past iteration, e.g. quick and upright code review, help in the task etc.
2. Light bulb - is the representation of expression "Ideas", in this area we stick the papers with concepts how to improve the team or the project, e.g. estimate more carefully on the planning, dedicate some time in the iteration to increase code coverage etc.

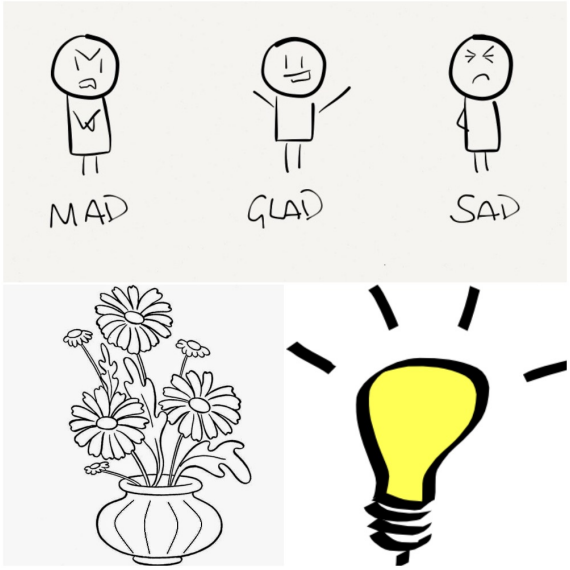

Fig. 3.4. Mood and Improvements

Before implementing the game in the team requirements presented in Table 3.5 must be completed and the team needs to be aware how to play the game.

Table 3.5. Requirements to start Mood and Improvements game

Target	Retrieve teams mood and maximize solving problems
Required	1. Minimum 3-people scrum team 2. Blackboard 3. Sticky Notes 4. Pencil/Pen
Time	About 60 minutes

3.1.6. 5L's game

The second game created, thanks to the collaboration with the Intel Technology Poland teams, is 5L's Game. The activity has not been developed from scratch, there is an existing solution called 4L's [16], which we have improved, by adding one additional element. The initial version of the game is shown on Figure 3.5 and it contained four fields:

1. Liked - things that the participants liked about the past iteration, considering project and team.
2. Learned - things that the team members learned in the past iteration, new language, used new

framework or tool, this might also be things not connected to the project like for example while being on a integration with the team the participants learned how to windsurf or make sushi.

3. Lacked of - things that have been done in the past iteration and you do not want to stop doing them but you have an idea how to do it better, how to improve the action, or just wish that it could be done, for example more efficiently.
4. Longed for - things that you wish would have been done, for example more attention on code quality, rather than focusing just on the delivery.

Fig. 3.5. 4L's

While implementing the game the team that we were currently working with (team B) suggested that there should be an area where you can describe things that the team disliked in the past iteration. After a discussion we developed the 5th "L" which was "Loathing". The last "L" included in the initial 4L's game was created in order to retrieve negative feedback from the team and, if possible, improve the area where the problem occurred or even dispose it.

3.1.7. Candy-Love Game

Another game, which may be valuable to focus on, is more a team building game rather than solving problems in case of project, but in order to maximize performance and product quality it is advisable to have strong and integrated team [17]. Harvard Business Review claim that "Research shows that when people work with a positive mind-set, performance on nearly every level—productivity, creativity, engagement—improves. Yet happiness is perhaps the most misunderstood driver of performance.". [18] "Candy Love" game integrates team members by letting them speak up and talk about their life beyond work [19]. In order to deploy the game and show it to your team, necessary requirements presented in the Table 3.6 are needed.

The participants need to sit at the table, without laptops and other distracting things. One person

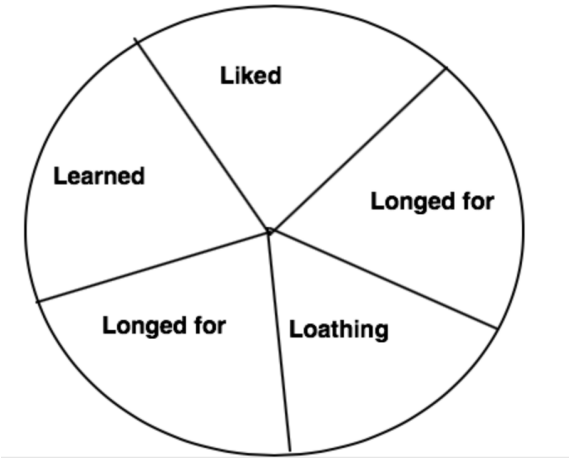

Fig. 3.6. 5L's

Table 3.6. Requirements to start Candy-Love Game

Target	Increase trust in the team, help people to speak up and get to know each other
Required	1. Minimum 3-people scrum team 2. Pack of MM's, Skittles or other colourful candies 3. Jar for candies 4. Meanings of colors (rules)
Time	About 2-4 minutes per person

picks the candy out of the jar and shows it to the team, than checks the candy color meaning. The others need to focus on what the person which picked the candy is talking about. The meanings of the colors are necessary to have in order to properly perform the game, because it's hard to remember all the meanings of the colors, which are as follows:

1. Red - share one thing that you like about your job, this color retrieves positive emotions, especially on people that are not satisfied or happy with what they do.
2. Yellow - share your life goal that you are working on, this color illustrates others what is important for that person and can inspire.
3. Green - share your favorite movie or/and book, this shows person from different angle, maybe this might start a conversion later with people that we usually have nothing to talk about.
4. Purple - share your favorite way of reviving yourself on a regular workday, this color shows what the person thinking about to decrease stress and might be also a great catalyst for a conversation.
5. Blue - share one stressful thing in work that you wish you could improve, this color shows what stresses person out, maybe someone has a solution that can share, this can also convert a negative thing into a positive.
6. Orange - share what is your favorite food, maybe later you can share a meal with someone from the team and it is a topic that everyone likes.

The participants should pass the jar to each team member and end the game when all the candies are gone, when all the team members picked one sweet or when the time of the meeting has ended [19].

3.2. Supplementary games

The techniques that are going to be described in this section are or were probably used by major number of the teams working in information technology, most of them are not aware of its existence and how valuable they are. These approaches are just supplementary games to fundamental ones described in section 3.1. In order to properly and effectively implement a retrospective meeting the team should chose one of the fundamental games and as an additional value add one or more supplementary game, which may increase number of valuable opinions and feedback from the team.

3.2.1. Anonymous

Based on our work in Intel Technology Poland site in Gdańsk and also on Rui Miguel Ferreira [20], who wrote his article based on Hiren Doshi article, which was posted on Practice Agile Software Development blog, we can discover power of anonymous retrospectives. According to the article [20] no matter how supportive, open and transparent the company is, there will be always individuals that are not eager to share their thoughts with others [21]. They suggested the anonymous technique to encourage introvert individuals to also share their point of view on the project. The following model was presented:

1. All the participants of the meeting must be involved and take part in this activity.
2. The data should be anonymous, untraceable to the writer, for example decide that everything will be written using blue pen and capital letters.
3. Collect the papers into an empty container and mix them.

Using this technique all the team members are comfortable to share their thoughts and opinion without the feeling of shame or embarrassment. According to our research we learned that most of team members do not like retrospective meeting, because they do not like to expose and talk about theirs feelings, opinions and thoughts. Using this approach it might change retrospective into a valuable meeting without forcing participants to talk and what we also discovered once something is told by an extrovert its stops being "taboo" and even introverts add something to discussion [21].

3.2.2. Safe Room

The retrospective is a meeting strictly focused on a team or project and the managers or product owners, if not directly invited to discuss specified problems, should not be present [21]. The safe room techniques is also commonly used in such meetings, but as we mentioned before. The retrospective meeting should be always dedicated to the team and theirs issues and the participants should be comfortable to share their thoughts. We already described one approach how to encourage team to speak up, the second technique is to create a "safe room". To put the "safe room" theory into practice, the person, who is leading the meeting should inform the attendants that everything what is said in the room should stay in the room. This technique must be based on assumption that the team trusts each other that whatever is said during the meeting will not be repeated outside the team, it is a non-formal confidentiality agreement.

3.2.3. One-word-retrospective game

The "One-word-retrospective" is a game that is supposed to help team to deal with feelings. This technique is used to increase the collaboration, respect and improve the understanding in the team [22]. The rules of this supplementary game are as follows:

1. Gather the team and ask each participant to tell how does they feel, using just one word, about the past iteration.
2. Collect all the words, they might be written on sticky-notes using Anonymous technique.
3. Write all the words on the board, so everyone is able to see them.
4. Then start to ask the participants why do they feel that way, use the exact words from the board.
5. List the major issues and confirm them with the team.

The requirement to implement this supplementary game in the team is to have following things [22]:

1. Establish trust and openness.
2. Respect people and their feelings.
3. Be able to deal with the issues.

The most important thing, not only using one-word-retrospective technique, is to ensure that the team trusts each other, especially because you are dealing with peoples' emotions and feelings. The leader should make sure that in order for people to speak openly, he has to introduce, if necessary, depends on the team, rules like for example the anonymous or/and safe room techniques.

4. GAMES DEPLOYMENT

We deployed the games presented in chapter 3 in teams working on Intel Technology Poland projects, in Gdansk. The experiment was executed on three different teams, which are presented in Table 4.1, they differed in terms of members quantity, team maturity and whole group experience in scrum.

Table 4.1. Groups

Group	Number of members	Project Age	Scrum experience
A	9	Extremely mature (1.5 years old project)	typically 2 years
B	3	Immature (2 months old project)	at least 3 years
C	8	Mature (7 months old project)	at least 3 years

The process of deploying a game in a team was as follows:

- Describe a particular game to the team
- Conduct the game with the team (as a team member or an a coach)
- Collect the data and discuss the results with the team
- Collect feedback from each team member which participated in a game

Each team was asked for a feedback after game deployment, two different sets of questions were asked. After first iteration of deploying two games, Starfish Game and Speedboat game, we reflected on the results, the study group and supervisor, using research methodology, Action Research. We evaluated that the retrieved results should be improved, in order to retrieve more interesting and less generic characteristics. First set was as presented below:

1. How you evaluate influence of this method on results?
2. Did the discussions were successful?
3. Did any unique features were retrieved thanks to the game?
4. Do employees more willingly participate in the project when work is supported with this kind of game?
5. How do you evaluate work associated with games comparing to standard procedures?
6. Were the results better using games instead of standard procedures?
7. Would you implement that game permanently instead of standard procedures?
8. How would you evaluate preparation of the game?

The scale was 1-5, where 5-meant great, excellent and 1 meant bad, not satisfying.

The Table 4.2 presents the quantity of feedbacks retrieved, while playing Speedboat and Starfish Games, in each team, where the games were deployed. By the time, when first iteration was being deployed, team C was not cooperating with us.

Table 4.2. Number of feedbacks using old set of questions

Group	# of plays Speedboat	# of plays Starfish
Team A	1	1
Team B	1	1
Team C	0	0

The second set was improved in few different aspects, firstly and most importantly the questions in the new set are more specific and are focusing on not the general feeling of the team, but on the concrete problems. Secondly, members were asked to answer questions about specific characteristics, which are supposed to help team develop and improve, such as communication, motivation and creativity. Lastly, the questions were more clear and easy to understand, than the old set and also were presented as statement on which the respondent was suppose to answer how much does he or she agree on it. The second set was as presented below:

1. The influence of this method is greater than using standard procedures.
2. The game should be implemented permanently instead of standard procedures.
3. The game might complement standard procedures.
4. Thanks to the game the creativity of team members increased in the retrospective meeting.
5. Thanks to the game the involvement of team members increased in the retrospective meeting.
6. Thanks to the game the communication in the team increased in the retrospective meeting.
7. Thanks to the game the motivation of team members increased in the retrospective meeting.
8. The game is easy to understand and play.

Similarly as in the first set, the scale was 1-5, if we project the answers on numbers, but the participants of the experiments had five possible options to choose:

1. Totally disagree.
2. Disagree
3. Hard to say.
4. Agree.
5. Totally agree.

The Table 4.2 presents the quantity of feedbacks retrieved from the teams, while playing the games listed in the sections 3.1.1,3.1.2, 3.1.3, 3.1.5 and 3.1.6.

Table 4.3. Number of feedbacks using new set of questions

Group	# of plays Speedboat	# of plays Starfish	# of plays Glad/Mad/Sad	# of plays Mood & Improvements	# of plays 5L's
Team A	2	1	0	0	0
Team B	1	1	1	2	2
Team C	2	1	2	1	2

4.1. First iteration

4.1.1. Speedboat Game deployment

The game was implemented in a scrum team A. While we deployed the game, the team was ending its 31st sprint and was highly integrated. The estimated time of the game was 45 minutes, but the actual turned out to be 1 hour and 30 minutes, because of surprising discussions which was partly caused by the game. The results of retrospective are presented on the Table 4.4 and were quite impressive and the team was able to retrieve 10 things that push them forward, 2 things that could have been done better and 4 “bad things”. Most of the team members were willing to participate in discussion and the result was discovering new issues, new points of view

and solutions. The second group on which we tested Speedboat implementation was team B (group of 3 people), which, by the time, was new and had theirs first iteration and retrospective together. The estimated time of the game for this group was 1 hour, by the end the team was able to retrieve 14 things that push them forward, 7 things which pulls them down and 4 things on which they may crush. The team integrated by sharing thoughts with each other and all of the team members were willing to discuss, constructively argue in some cases. They were asked the same questions as group A and the result were satisfying.

Table 4.4. Results of the Speedboat Game

Group	Good Things	Bad Things	Things to improve	Time	Comment
Team A	10	2	4	1 hour 30 minutes	31st iteration
Team B	14	7	4	45 minutes	1st iteration
Team C	N/A	N/A	N/A	N/A	N/A

The chart on the Figure 4.1 represents collected results of this survey using old set of questions.

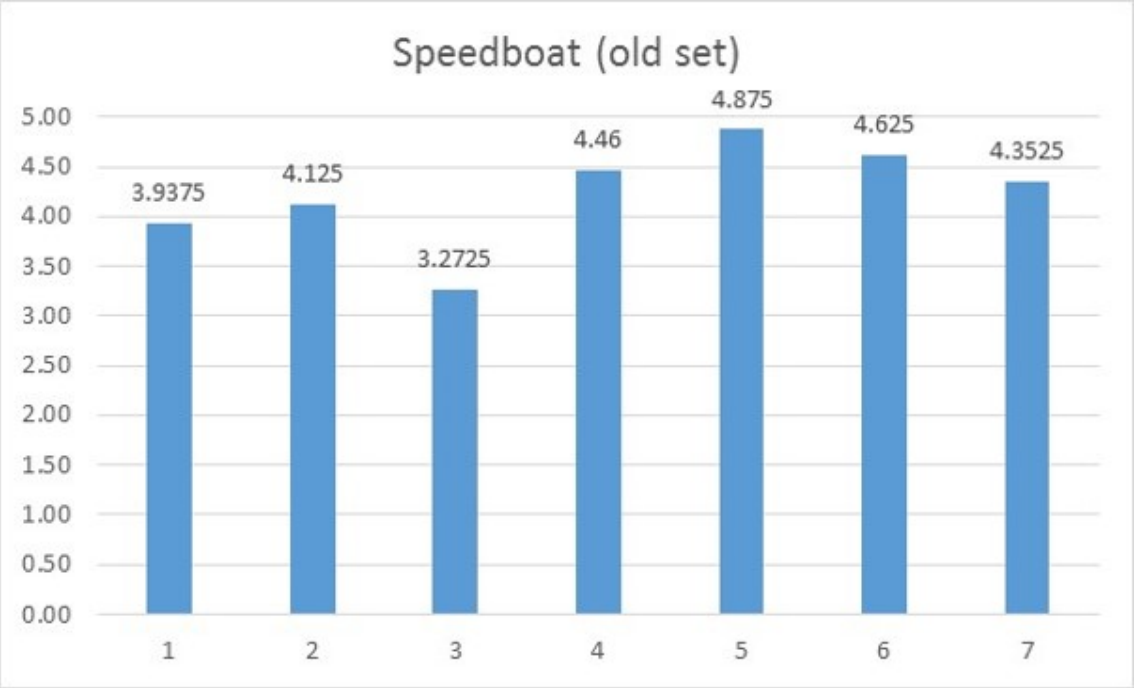

Fig. 4.1. Results of deploying speedboat game using old set of questions

As we can see on the Figure 4.1 the results are quite similar to each other and also the question "How would you evaluate preparation of the game?" was excluded from the chart, because in case of this study it does not give any interesting characteristics. In this case we are unable to actually retrieve any information, what we know is that the participants of the experiment agree on that the game has better results than the standard procedure. What is more, they think that discussions were successful, employees willingly played the game, work associated with the game has positive impact on the team members and most importantly they would strongly recommend to permanently implement the game instead of standard procedure. On the other hand they decided that it is rather hard to say, if they actually retrieved thanks to the "Speedboat" game any unique features.

4.1.2. Starfish Game deployment

"Starfish" game was also implemented using old set of questions in team A (while they were evaluating theirs 32nd iteration) and in team B (evaluation of 2nd iteration). The results for both teams are presented on Table 4.5 and the first team using this game was able to retrieve 8 things that should be started in order to make the iteration successful and ease the work, 1 thing that they should be immediately stop doing, 4 things that they want to continue doing, because they are verified and good for the team and project, they also found 4 things that should be made less and 3 things they want to make more. Team B retrieved 5 "start doing", 2 "stop doing", 2 "continue", 4 "less of" and 6 "more of". The game changed the perspective, so the participants were more creative and interested in a game.

Table 4.5. Results of the Starfish Game

Group	Start doing	Stop doing	Continue	Less of	Stop doing	Time	Comment
Team A	8	1	4	4	3	1 hour 45 minutes	32nd iteration
Team B	5	2	2	4	6	1 hour 10 minutes	2nd iteration
Team C	N/A	N/A	N/A	N/A	N/A	N/A	N/A

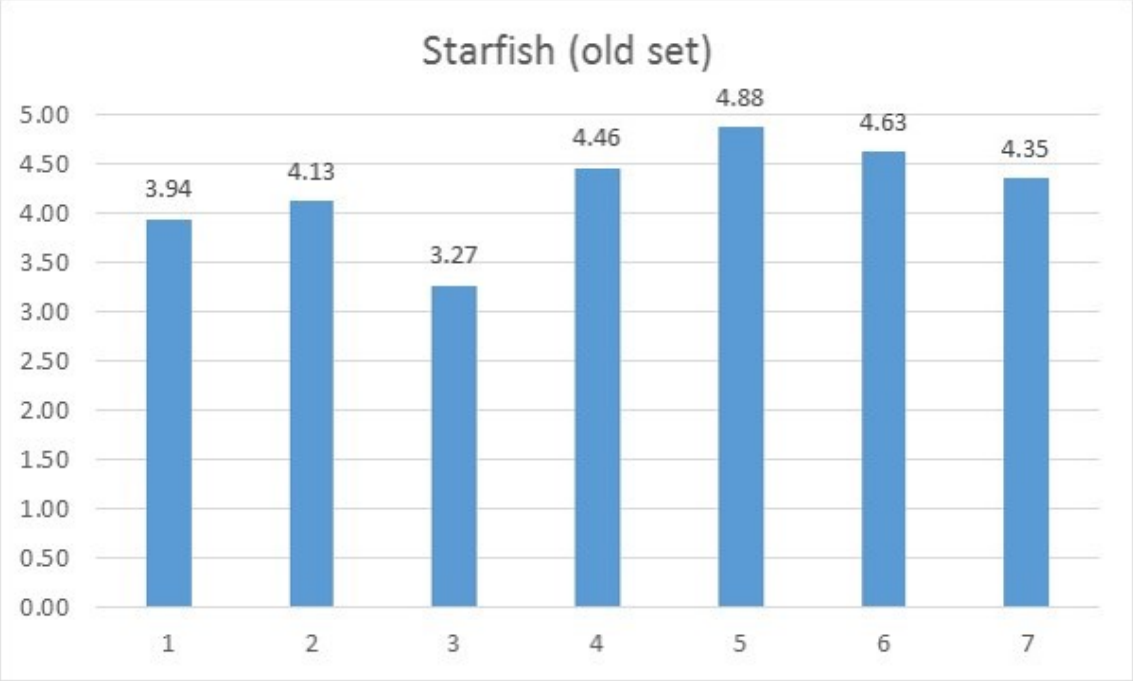

Fig. 4.2. Results of deploying starfish game using old set of questions

Figure 4.2 presents results of the "Starfish" deployment. As we can see, similarly like in "Speedboat" game results using old question set, it hard to retrieve useful data from this chart. The uniqueness of the features is hard to establish like in "Speedboat" deployment and the other results are more or less the same.

4.1.3. Comparison

The chart on Figure 4.3 presents comparison of deploying "Speedboat" and "Starfish" game, we can see that results does not differ that much, this was the catalyst of actually changing the set of questions to retrieve more valuable characteristics, ask more specifically to retrieve better features.

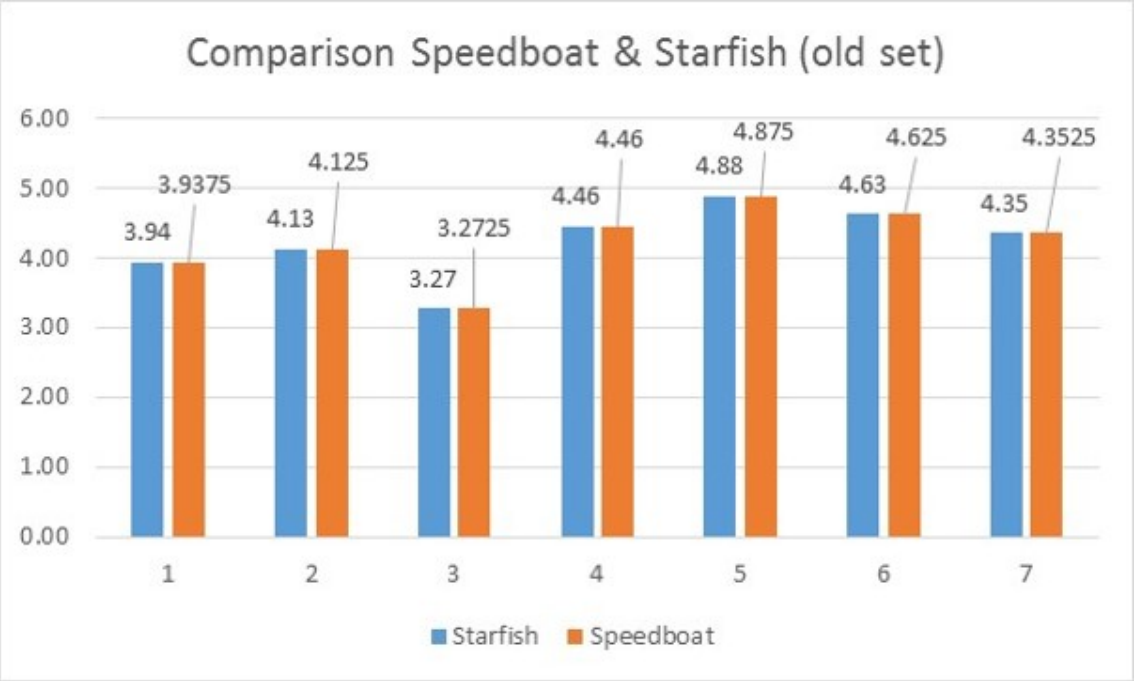

Fig. 4.3. Comparison of deploying starfish and speedboat game using old set of questions

4.2. Second iteration

4.2.1. Speedboat Game deployment

This test was deployed multiple times on every team that has been listed in Table 4.1. Using this game we are able to see that the change of perspective, not using standard procedures, looking at things differently, what will push our boat forward, what might crush us and what is pulling us down the teams more involved, motivated and eager to participate in retrospective game. The **??** presents the results that were retrieved using Speedboat technique of performing retrospective. in group B one time for 45 minutes and in team C ones for 50 minutes. While team A was in theirs 33rd iteration they were able to find 8 good things, 5 bad things and 3 to improve, two iterations later the results were as follows: 16 good things, 3 bad things and 4 things to improve and they played the game for 1 hour and 15 minutes on average. Team B played the game just once, while having a 3rd iteration and it took them 45 minutes to successfully get 8 good things, 5 bad things and 6 things that needed improvement. The last team, team C, played the game once for 55 minutes and they retrieved 17 good things, 8 bad things and 5 things to improve, while having theirs 19th iteration.

The Figure 4.4 presents "Speedboat" game deployment. Every single game described in this

Table 4.6. Results of the Speedboat Game

Group	Good Things	Bad Things	Things to improve	Time	Comment
Team A	8	5	3	1 hour 20 minutes	33rd iteration
Team A	16	3	4	1 hour 10 minutes	35th iteration
Team B	8	5	6	45 minutes	3rd iteration
Team C	17	8	5	50 minutes	19th iteration

chapter was documented with a picture and the feedback from the team.

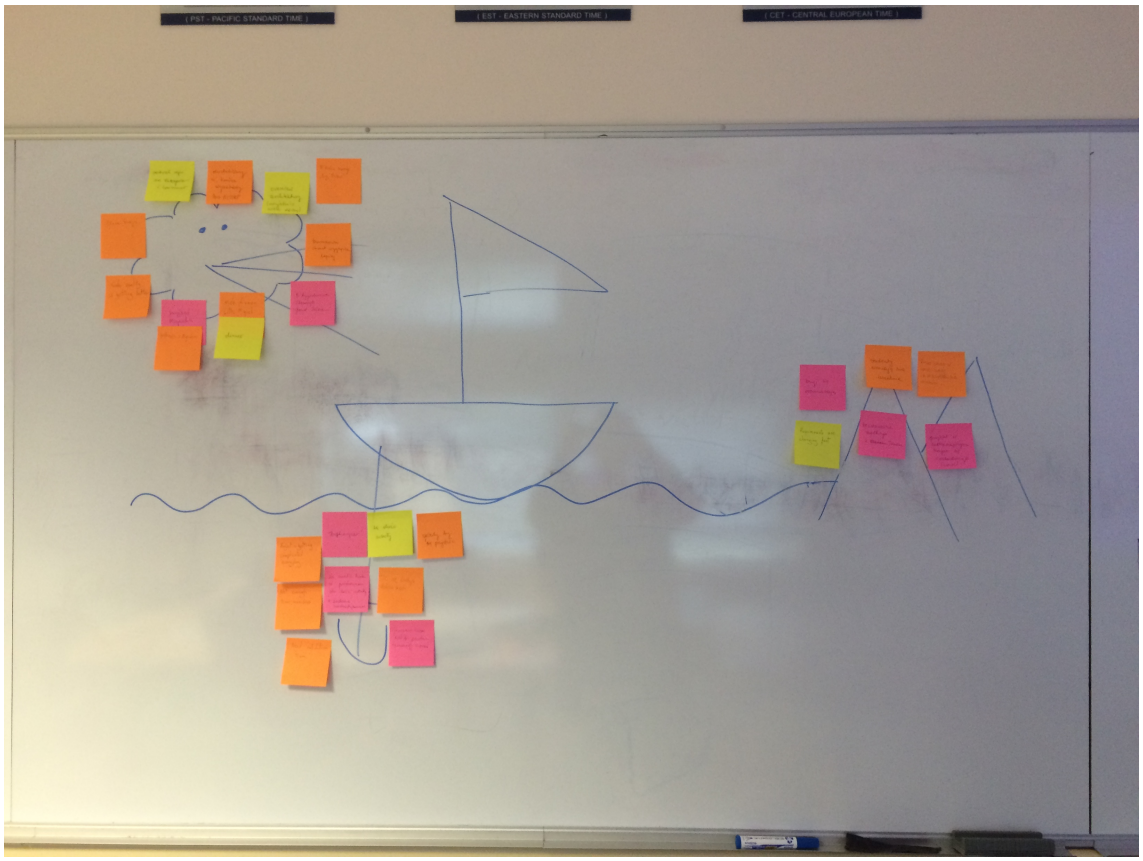

Fig. 4.4. Speedboat deployment

Analysing the results from Figure 4.5, we are able to retrieve that the team is seeing better influence on the retrospective meeting using this game, but surprisingly it was hard for them to decide whether they would like to play this game permanently during the next meetings. The probable cause is that the game is fun and good to know, but it should not be used on every retrospective, because of monotony, which we would like to dispose. They could not also decide definitely, but were more convinced than in the previous question, that this game might complement standard procedures. In case of characteristics they were almost definitely convinced that they agree on statements about motivation and involvement of participants while playing "Speedboat", a little bit less they thought that communication increased and they were not convinced in case of team members creativity. What is more and what is actually surprising they could not decide positively in case of ease of understanding the game.

Fig. 4.5. Results of deploying speedboat game using new set of questions

4.2.2. Starfish Game deployment

"Starfish" game was a big surprise for all the teams, the drastic change of perspective, five fields to fill created multiple discussions. The game was implemented in teams A, B and C, none of the participants known this game before, so because of the complexity the preparation of the game, explaining the rules and giving the participants the time to familiarize with the new approach, made the meeting much longer. The data presented on Table 4.7 shows the results retrieved by the teams in the retrospective meeting using the described in this subsection. In average team A finished the meeting after 1 hour and 45minutes, they played the game after theirs 36th iteration and the game resulted with 9 things that they should start doing, 3 stop doing, 3 continue, they should do less 5 things and more 2. The team B was in theirs 4th iteration and finished the game in 45minutes, they attained 6 things that may increase their effectiveness and are good for the team, so they should start doing them, 1 that is stopping them and they should dispose it, 7 things that are being already done in the team and they want to continue performing them, 6 things that the team should do less and 1 thing that should be done more often. While having 21st iteration, team C retrieved 6 start doing things, 4 stop doing, 2 continue, 3 less of and 2 more of, the game lingered for 1hour and 10 minutes for them. It was an interesting experience to work with teams which are so involved in the retrospective meeting.

Table 4.7. Results of the Starfish Game

Group	Start doing	Stop doing	Continue	Less of	More of	Time	Comment
Team A	9	3	3	5	2	1 hour 45 minutes	36th iteration
Team B	6	1	7	6	1	45 minutes	4th iteration
Team C	6	4	2	3	2	1 hour 10 minutes	21st iteration

Figure 4.6 presents live deployment of the "Starfish" game.

Fig. 4.6. Starfish deployment

The results in Figure 4.7 represent the feedback retrieved upon "Starfish" game from the team members of all the listed in Table 4.1 groups. The participants decided that they agree that the game should be permamently implemented in retrospective meetings, what is more based on their opinion the results using this approach is greater than standard procedures. In case of ease of the game, after preparation and discussing the rules, they decided that even though the game is complex, after proper introduction, they understood it clearly. Greater part of participants answered that involvement is a characteristic that could be retrieved from "Starfish". Motivation and creativity in case of this game are the features that can also be increased using this approach, probably because of the innovation of this game, increased using this approach. The groups would rather use this game permanently than as a supplement of standard procedures. Most of the team members were not convinced in case of communication, whether it was actually improved.

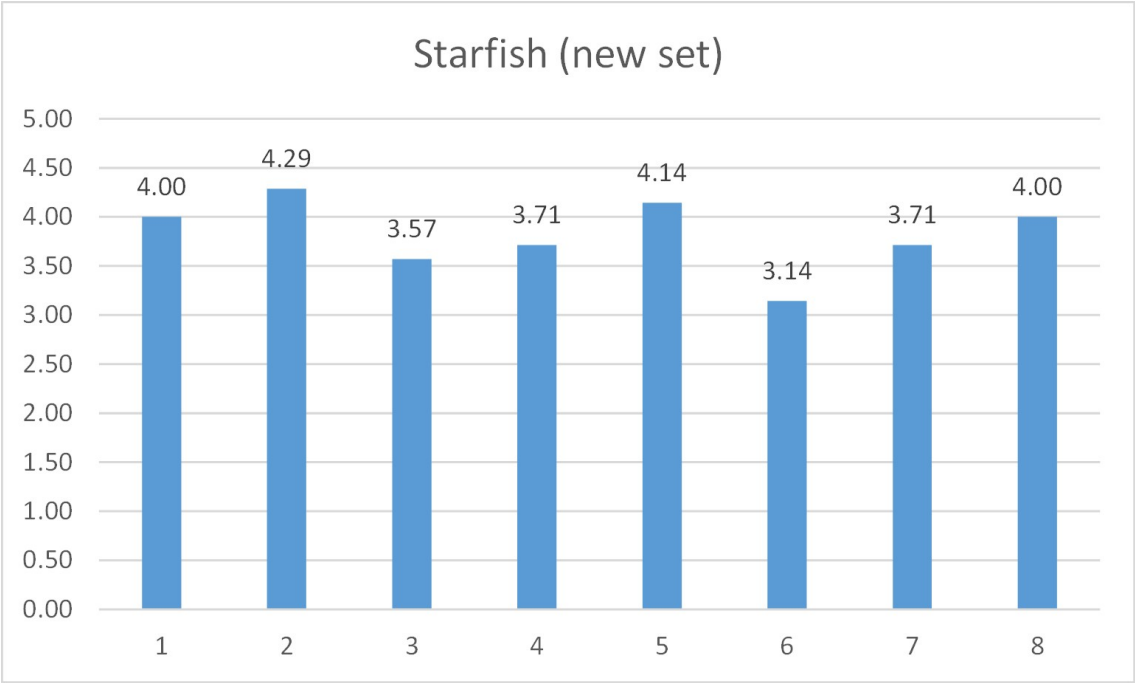

Fig. 4.7. Results of deploying starfish game using new set of questions

4.2.3. Glad/Mad/Sad Game deployment

Glad/Mad/Sad also known as Happy/Sad/Angry game, was deployed in groups B and C, because internal changes the cooperation with team A was not possible anymore. The Glad/Mad/Sad was not a surprise for the teams, this approach is very similar to the standard one, at the same time, if you have a choice, it is better to use the Glad/Mad/Sad technique rather than the standard Good Things, Bad Things, Things to Improve technique to diversify the retrospective meeting. Both teams played once having theirs 5th iteration, team B and 20th iteration, team C and they approximately for 45 minutes. The Table 4.8 shows the results which were retrieve by the teams. The team A was able to get 8 good things, 7 bad things and 2 to improve and team C respectively 10, 9 and 14.

Table 4.8. Results of the Glad, Mad, Sad Game

Group	Good Things	Bad Things	Things to improve	Time	Comment
Team A	N/A	N/A	N/A	N/A	N/A
Team B	8	7	2	40 minutes	5th iteration
Team C	10	9	14	50 minutes	20th iteration

On the Figure 4.8 we can see deployment of the "Glad, Mad, Sad" Game in Intel Technology Poland site in Gdańsk.

Fig. 4.8. Glad, Mad, Sad deployment

The Figure 4.9 presents the results of the Glad/Mad/Sad game deployment. The highest result was retrieved in third and eight question and indicates that participants agree on the fact that this technique might complement standard procedures and is easy to understand. The members of the experiment also are rather convinced that the game is increasing the creativity of the team, which

proves a previously presented thesis that it is better to use the Glad/Mad/Sad approach, rather than the standard technique. In case of the influence of this method on better results, whether the game should be implemented permanently and team members involvement in the retrospective meeting the participants claimed that it is hard do decide whether, in those fields, any influence exists. The attendees of the experiments agree on the fact that communication and motivation of team members is not influenced by this technique.

Fig. 4.9. Results of deploying Glad/Mad/Sad game using new set of questions

4.2.4. Mood and improvements Game deployment

On the Figure 4.10 is presented deployment of the "Mood and improvements" game that has been created in collaboration with Intel Technology Teams, merging "Glad, Mad, Sad" game and two fields to indicate ideas for improvements and appreciations for team members.

The Table 4.9 shows the results of Mood and Improvements Game implementation. The team B played the game twice for 45 minutes on average and retrieved in the 6th iteration 6 good things, 3 bad, 6 to improve, they had 3 ideas for improvement and 4 appreciations. In the 9th sprint they found 13 good things, 2 bad things, 2 things that need improvement, 3 ideas for the improvement and 1 appreciations. The second team that participated in the research was team C and in their 22nd iteration they were able to get 12 good things, 16 bad things, 4 things to improve, 4 ideas for enhancement and 1 appreciation, it took them 50 minutes to finish the game.

The Figure 4.11 presents the results of feedback received from the participants. The chart indicates that the game was easy to understand and might complement standard procedures. The participants also agreed on the fact that the game increases creativity, communication and involvement, what is more they agree on games better influence on the results comparing to standard procedures and are willing to permanently implement it into the retrospective meeting. The only characteristic that attendants of the experiment cannot decide on is, if the technique increases motivation.

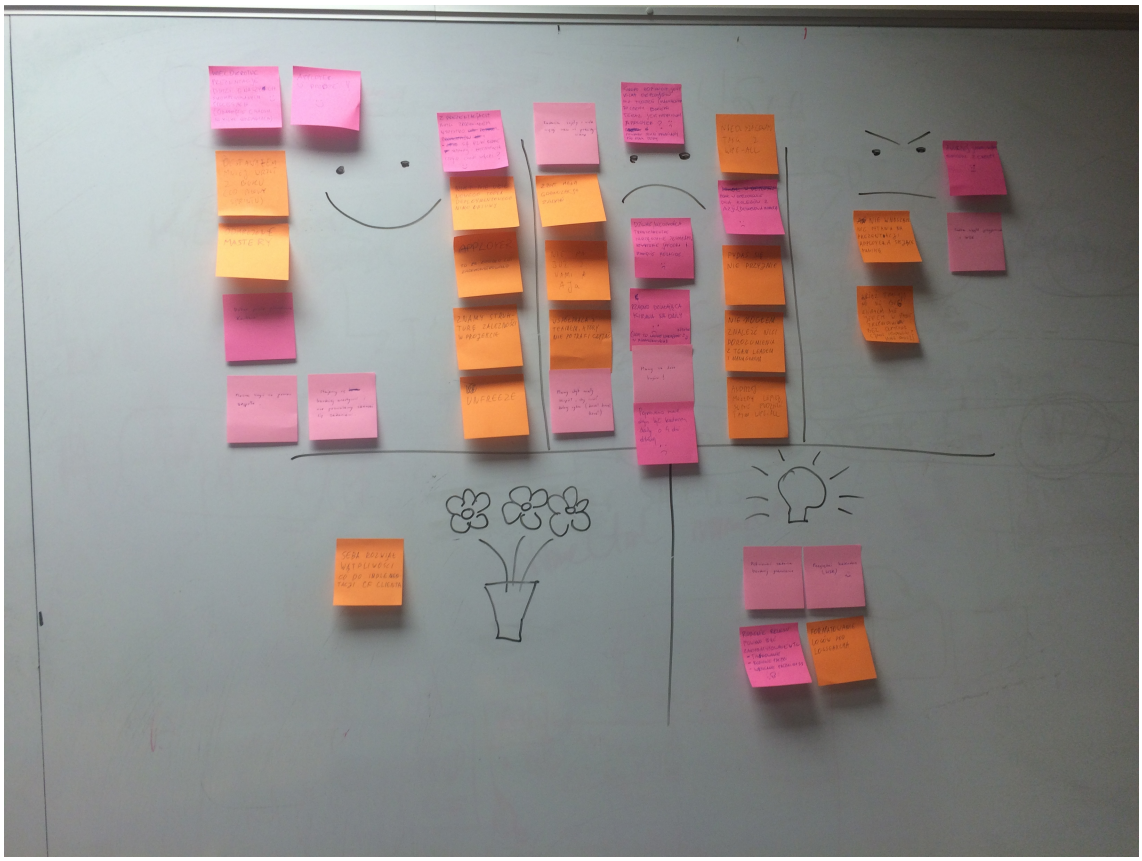

Fig. 4.10. Mood and improvements game deployment

Table 4.9. Results of the Mood and Improvements Game

Group	Good Things	Bad Things	Things to improve	Ideas for improvement	Appreciations	Time	Comments
Team A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Team B	6	3	6	4	4	35 minutes	6th iteration
Team B	13	2	2	3	1	55 minutes	9th iteration
Team C	12	16	4	4	1	50 minutes	22nd iteration

Fig. 4.11. Results of deploying Mood and improvements game using new set of questions

4.2.5. 5L's Game deployment

The "5L: Liked, Learned, Lacked, Longed for, Loathed" has been created in collaboration with Intel Technology Poland teams, using as a archetype game "4 L's". This approach changes the perspective, shows the participants a different point of view and enables them to learn more about other team members, for example what they learned in the past iteration or what was actually important for them what was done, but they have an idea to improve the current technique used in the project. There are two ways of playing the game that were deployed in the teams. The first one is shown on the Figure 4.12, the areas are arranged in the circle.

The second one is presented on Figure 4.13 and in this approach we arranged the fields in columns, what is more we assigned sticky-notes colors to particular area, this way we were able to see a clearer picture, where the most features are condensed.

Using the 5L's game the participants were involved in the retrospective meeting and especially using the technique with colors they even started to be competitive, who has more pink sticky-notes, or in some cases who has the most diverse pile of papers. In both teams, B and C, the game was deployed twice and was played, responsively for 50 and 65 minutes on average, as presented on Table 4.10. Team B retrieved after finishing their 7th iteration 18 things they liked, 4 learned, 2 lacked, 2 longed for and 6 they loathed, and upon the 8th iteration they discovered 8 likes, 6 learns, 7 lacks, 3 things that they longed for and 8 that they loathed. In contrast, team C retrieved 15 things they liked, 4 learned, 3 lacked, 7 longed for and 10 loathing in the 24th iteration and respectively 14, 4, 2, 5 and 6 in 25th iteration.

The Figure 4.14 presents the results retrieved from the participants' feedback. The results were positively surprising, because all the bars are equal or above the "Agree" statement. The participants feel the most that the involvement was increased by this technique, what is more they also agree on the fact that communication and motivation was improved by this technique and

Fig. 4.12. 5 L's game deployment

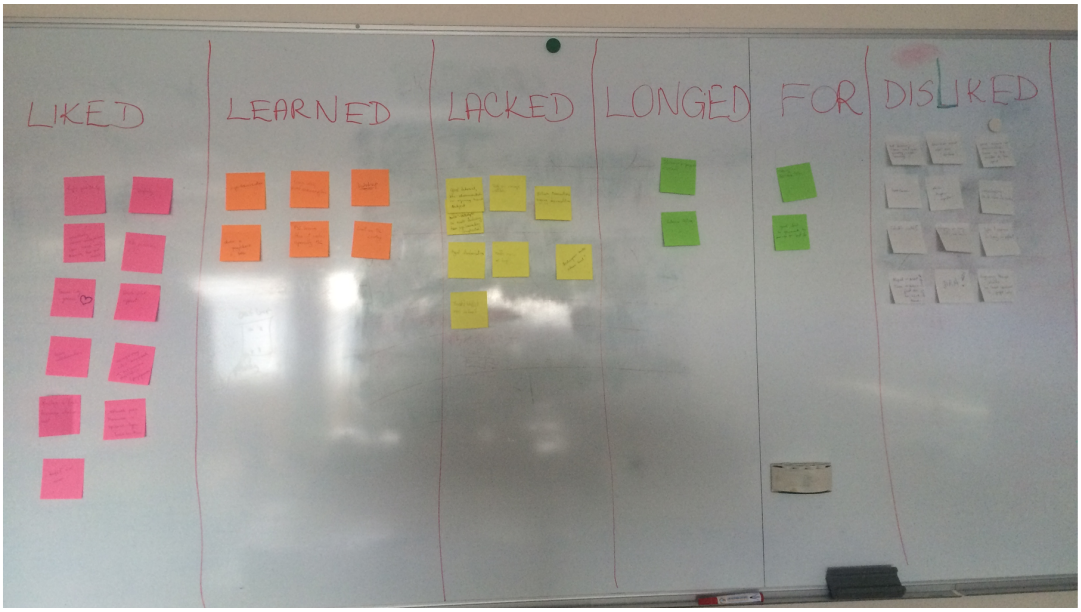

Fig. 4.13. 5 L's game deployment different representation

Table 4.10. Results of the 5L's Game

Group	Liked	Learned	Lacked	Longed for	Loathing	Time	Comment
Team A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Team B	18	4	2	2	6	55 minutes	7th iteration
Team B	8	6	7	3	8	45 minutes	8th iteration
Team C	15	4	3	7	10	50 minutes	24th iteration
Team C	14	4	2	5	6	1hour 20 minutes	25th iteration

also they think this game should complement standard procedure in the retrospective meeting. The lowest result, but still very high, because exactly equal to "Agree" statement, the participants gave to the statement about whether 5L's method influence is better than using standard approach, they would also permanently implement the 5L's to the retrospective meeting, moreover they discovered increase in creativity and think that the game is easy to understand.

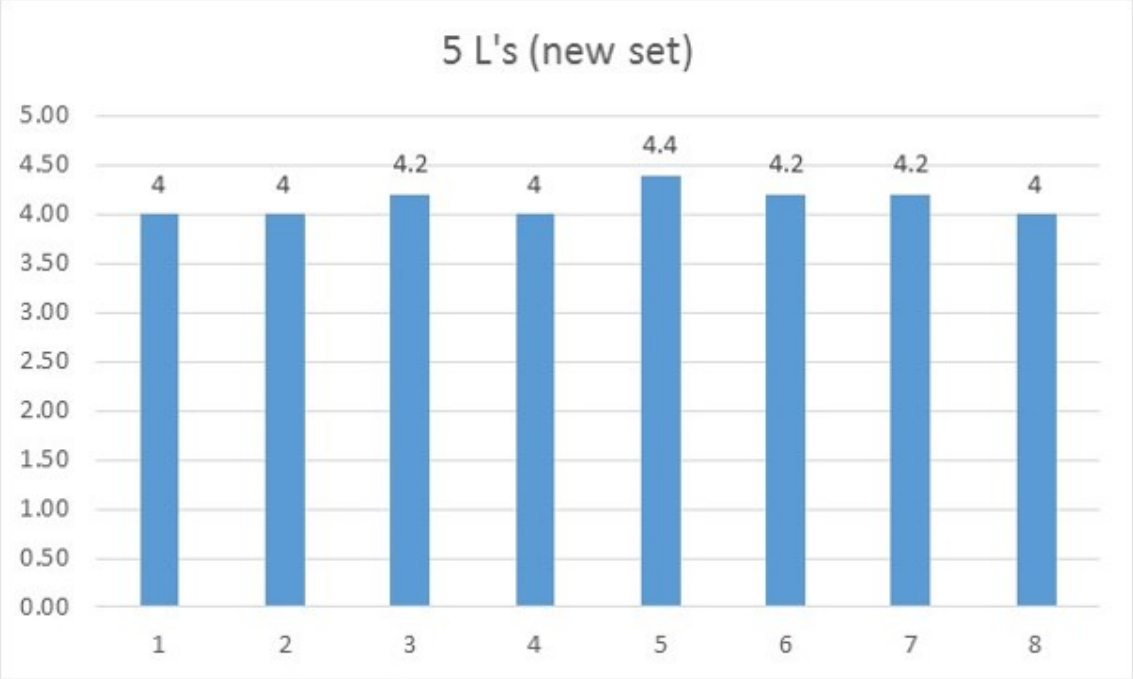

Fig. 4.14. Results of deploying 5 L's game using new set of questions

4.2.6. All Deployed Games Comparison

Described in sections Second iteration games were deployed in Intel Technology Poland site in Gdańsk with collaboration with teams listed in Table 4.1. Thanks to them two games were created or improved. Moreover we were cooperating with Certified Scrum Master, Grzegorz Regliński, who also helped us in order to properly implement the games in the teams.

The overall description of deployment is presented on Figure 4.15. The figure points out, when in time the particular game were introduced, what is more in which team, while which sprint or whether it was first or second iteration of the question set. To summarize the chart, each category responds to described games and what is more:

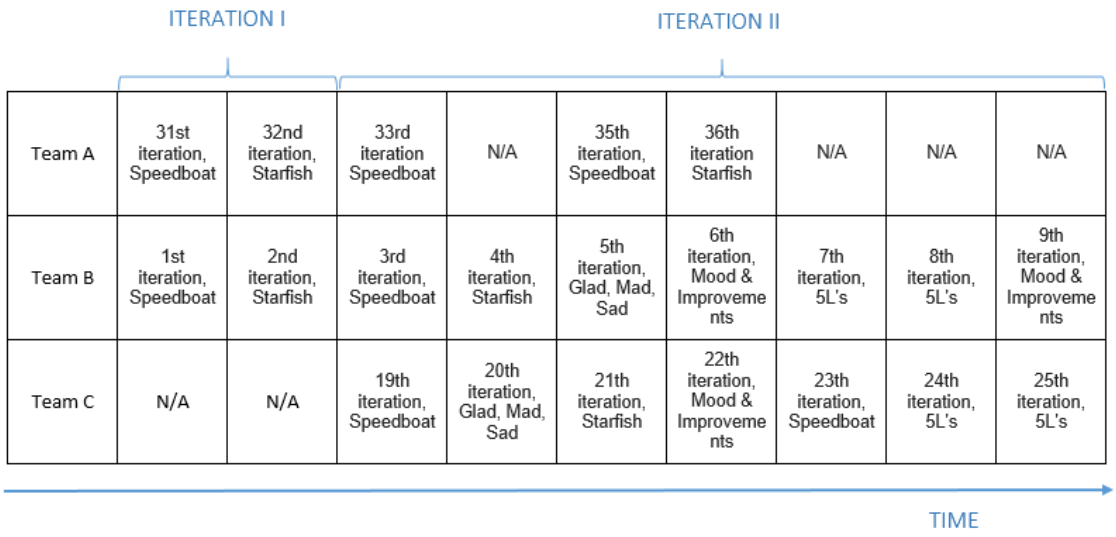

Fig. 4.15. Overall timeline of the games

1. The influence of this method is greater than using standard procedures.
   - The participants agreed that games: Speedboat, 5L's and Starfish impacts positively on the results.
   - Not as strongly, but still closer to "Agree" statement, they think that Mood and Improvements influences the outcome of retrospective comparing to standard procedures.
   - It is hard for the members of the experiment to decide in case of Glad/Mad/Sad approach.
   - Best games: Speedboat, 5L's and Starfish
   - Worst game: Glad/Mad/Sad
2. The game should be implemented permanently instead of standard procedures.
   - The participants definitely agree in case of implementing Starfish Game permanently.
   - They have also a positive feeling in case of 5L's game in this field.
   - The attendants of the experiment rather bow to statement "Agree" in case of Mood and Improvements.
   - In case of Glad/Mad/Sad and Speedboat it was hard for them to decide.
   - Best game: Starfish
   - Worst game: Speedboat
3. The game might complement standard procedures.
   - In case of complementing standard procedures with the introduced new approaches the Glad/Mad/Sad and 5L's had almost the same results.
   - The result which equaled exactly "Agree" statement retrieved the Mood and Improvements approach.
   - In case of Starfish they rather bow to "Agree" statement in case of complementing the standard procedure with the presented technique.
   - In this category Speedboat has the worse result, it is hard for the participants to decide whether the approach should complement the standard procedures.
   - Best game: 5L's
   - Worst game: Speedboat
4. Thanks to the game the creativity of team members increased in the retrospective meeting.
   - The exact value of "Agree" statement and what is more the best result in this category is

assigned to 5L's technique.
- The game creativity in Starfish, Mood and Improvements and Glad/Mad/Sad games is also influenced, but the results are below the "Agree" statement, but heavily above the "Hard to say" opinion.
- The worse result was assigned to Speedboat, for the participants it was hard to determine if the influence in the creativity happened.
- Best game: 5L's
- Worst game: Speedboat

5. Thanks to the game the involvement of team members increased in the retrospective meeting.
   - Based on data collected from the feedback from the teams the 5L's game is the best in case of involvement of participants increment, slightly worse results performs Starfish technique.
   - Both, Speedboat and Mood and Improvements are below "Agree" statement but significantly above the "Hard to say" opinion, so it is reasonable to claim that they likewise increasing the involvement.
   - The Glad/Mad/Sad approach, accordingly to opinion of the team members, does not impact the involvement.
   - Best game: 5L's
   - Worst game: Glad/Mad/Sad
6. Thanks to the game the communication in the team increased in the retrospective meeting.
   - The best results achieved the 5L's game in case of increasing the communication in the team.
   - Slightly below the "Agree" statement are placed the "Mood and Improvements" and "Speedboat" games, moreover we can assume positive influence in the team communication using these approaches.
   - On the Starfish technique has been decided, by the attendants of the research, that it's hard to indicate whether communication has been improved.
   - In case of Glad/Mad/Sad game it has been established that it does not have influence on the communication increase.
   - Best game: 5L's
   - Worst game: Glad/Mad/Sad
7. Thanks to the game the motivation of team members increased in the retrospective meeting.
   - The team was motivated and eager to participate especially using 5L's method.
   - In case of Starfish and Speedboat it has been decided that, even though the bar is slightly below the "Agree" statement, we can still establish that those methods increase teams' motivation.
   - For the Mood & Improvements game, the participants determined that is hard for them to decide whether the motivation was increased using this technique.
   - The Glad/Mad/Sad game, in case of motivating the team to be involved in the retrospective meeting, rather failed, but it is closer to the "Hard to say" statement, rather then "Disagree" opinion.
   - Best game: 5L's
   - Worst game: Glad/Mad/Sad
8. The game is easy to understand and play.
   - In this category most of the games are above the "Agree" statement, which arises the conclusion that the Starfish, 5L's, Mood & Improvements and Glad/Mad/Sad games were easy to understand by the attendants.

- Only one out of five approaches was for the participants hard to define whether it was easy or difficult to understand.
- Best game: Glad/Mad/Sad
- Worst game: Speedboat

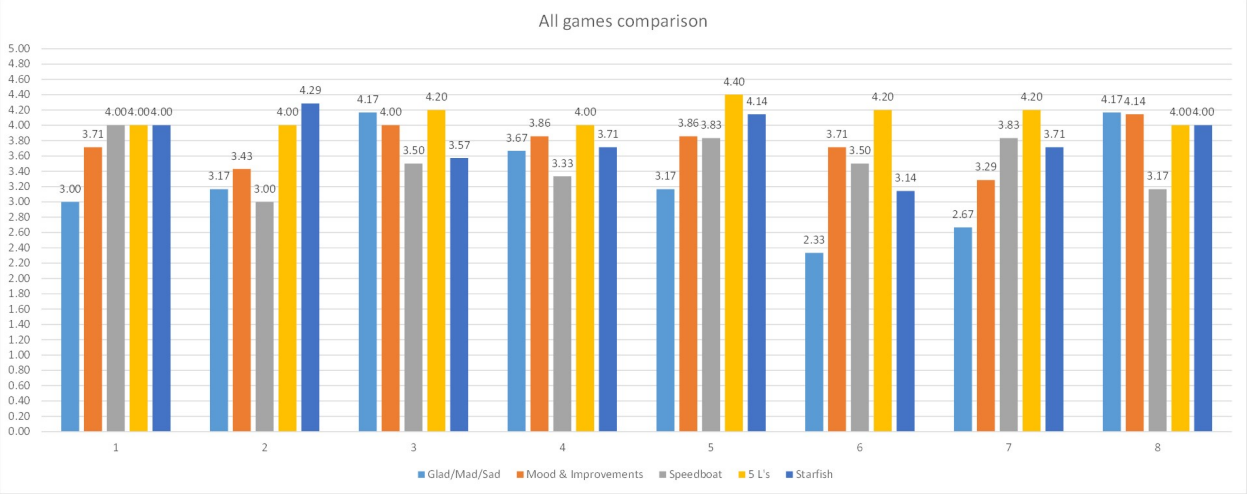

Fig. 4.16. Comparison of deploying all the games using new set of questions

To conclude the feedback obtained from the participants, the presented Table 4.11 indicates, how many times a game transpired to be the best and the worse. In summary, the best game for all the scenarios, on the basis of attendants of the experiment opinion, is 5L's, it works well in six out of eight categories. The worse technique turn out to be the Glad/Mad/Sad, probably because of the major similarity to the standard procedures. It is not said that the Glad/Mad/Sad approach should not be used or that all the retrospective meetings should implement the 5L's method. It is advised, based on our research, to vary in case of how the retrospective meeting is being led, different techniques being deployed provides more valuable results.

Table 4.11. Overall results of the games from the feedback

Game	# of best results	# of worse results
Speedboat	1	4
Starfish	2	None
Glad/Mad/Sad	1	4
5L's	6	None
Mood & Improvements	None	None

The additional Figure 4.17 presents a table of grouped results, green color indicates whether the threshold equal 4 or more, above "Agree" statement, was reached. The cells appointed with red color denote, where the result value was less than 3, which means "Disagree" statement. The yellow color presents results above and equal 3.5 threshold, which were also classed as "Agree" and the blue once which are above 3 and below 3.5 threshold, classified as "Hard to say" opinion. As presented in the table the 5L's game reached, as the only game, all the cells marked as above 4. The Starfish Game also retrieved almost, beside one, positive results higher than 3.5. On the other hand, the Glad/Mad/Sad is the only approach in which the less than 3 level has been obtained. In case of the other games, they perform successful outcomes in particular situation and should be used as a solution to a dedicated problem, for example for problems with the communication in the team you the Scrum Master might try the "Mood & Improvements" approach. We can observe that the major number of results are yellow and green, which confirm the thesis, that the games increase positive factors in the retrospective meeting. The blue and

the red cells are in minority. What can be also classified as a success is the fact that in the "All games together" column all the values are yellow colored, which means that in general games increase results. In the "All questions summary" column the situation is less satisfying especially for "Glad/Mad/Sad", but in the major number of games reached the threshold higher than 3.5.

	Glad/ Mad/ Sad	Mood & Improve-ments	Speedboat	5L's	Starfish	All games together
The influence of this method is greater than using standard procedure.	3.00	3.71	4.00	4.00	4.00	3.74
The game should be implemented permanently instead of standard procedures.	3.17	3.43	3.00	4.00	4.29	3.58
The game might complement standard procedures	4.17	4.00	3.50	4.20	3.57	3.89
Thanks to the game the creativity of team members increased in the retrospective meeting.	3.67	3.86	3.33	4.00	3.71	3.71
Thanks to the game the involvement of team members increased in the retrospective meeting.	3.17	3.86	3.83	4.40	4.14	3.88
Thanks to the game the communication in the team increased in the retrospective meeting.	2.33	3.71	3.50	4.20	3.14	3.38
Thanks to the game the motivation of team members increased in the retrospective meeting.	2.67	3.29	3.83	4.20	3.71	3.54
The game is easy to understand and play.	4.17	4.14	3.17	4.00	4.00	3.90
All the questions summary	3.29	3.75	3.52	4.13	3.82	

Fig. 4.17. Grouped results of all the games

5. PROPOSED APPROACH

5.1. Game-based retrospective

5.2. Synergy analyzer system

5.2.1. System overview

5.2.2. Backend architecture

5.2.3. Frontend structure

5.3. Open sourcing

6. EVALUATION

6.1. Overview

Based on observation and surveys we would recommend the “Speedboat” and “Happy/Sad/Angry” games especially for teams with communication and creativity issues. This approach allows team members which are not that open and talkative to also participate in retrospective. Using standard procedures mostly extrovert people are taking control over this meeting, what makes the introvert part of the team less appreciated and may cause a feeling of not belonging which makes hard for the team to integrate and lowers morale of the less talkative and open team members. This method also increases the creativity by changing the point of view. Team members are asked to answer three questions “what may cause a crash of our project? what pushes us forward and is good for the project? and what improvements should we introduce to sprints so nothing would slow us down?” by answering on them and looking on the project differently we were able to retrieve more ideas. What is more, after the sticky notes are on the board we are able to establish the mood of the team. On the other hand “Circle” game also increases communicability and creativity, but do not show teams’ mood, we are able to establish what to do in the next iteration (start, stop, continue) and which actions should be reproduced or reduced (less of, more of), but the general mood is being hidden.

6.2. Results of deployment

7. SUMMARY

Every diploma thesis must include a chapter entitled **Summary**. It should appear before the **Bibliography** and include a review of the main points of the thesis and/or obtained results. The chapter should also state what should be realized if research into the subject of the thesis is continued.

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LIST OF FIGURES

LIST OF TABLES

APPENDIX A. TITLE OF APPENDIX A

Appendices should be consecutively denoted with letters of the alphabet. An Appendix should include necessary supplementary data, e.g. calculations or schematic diagrams.