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Gamification to Increase User Interaction

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Gamification to Increase User Interaction

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Dedicatory

First of all, I would like to thank the professors of the Instituto Superior de Engenharia do Porto, my classmates and also to all those who helped me along the way to carry out this work. I would also like to thank all the people from *Hitachi Solutions* who helped me to finish this thesis and dissertation and for providing me with a pleasant environment for carrying out the same.

Abstract

Companies across the world use multiple ways and frameworks that try to lead their employees to feel more motivated and productive on work hours. Nowadays, with the increase success stories within the concept of gamification, it has been a great push for most international companies to look at said gamified solutions as an alternative to solve most of the issues found within the workplace.

With that in mind, the main objective of this project will be to answer to an identified user interaction problem within Hitachi Solution's employee's hub, through the use of gamification.

Throughout this thesis process, with the help of the framework Design Science Research Methodology (DSRM), there has been identified and demonstrated all aspects surrounding the problem, the design, the development and the evaluation metrics to assert the success of said solution.

Initially, an analysis of gamification is done so to understand what drives people to use and interact with this type of systems. After, many frameworks are put on show and compared to each other so to better understand the pros and cons of the different methods. Lastly, there is a display of success cases where this type of solutions are currently massively adopted.

Later on, many solutions are created based on the innovation process and then put to the test based on their value to this thesis. With that in mind, the solution chosen on the previous step, got to be designed and implemented on Hitachi's system. This implementation was based on a agile methodology with recurrent scrum meetings at the end of short sprints (2 week sprints) and developed mainly in JavaScript, with the help of the Veu framework.

As a last step, the gamification was deployed to the production environment where it got to be used/tested as a pilot version of the system. Posterior to this, some of the users underwent a semi-structured interview with the objective of gathering feedback and understand their feelings towards the new features.

Concluding, after the tests were done, these were analysed and a slight improvement on interaction was observed. These findings allowed the business to green light further development on the project so to be able to increase even further the interaction level.

Keywords: Gamification, Employee Hub, User Interaction, Problem Solving

Resumo

Empresas em todo o mundo utilizam diversas formas e frameworks para tentarem levar os seus funcionários a sentirem-se mais motivados e produtivos no horário de trabalho. Atualmente, com o aumento de casos de sucesso dentro do conceito de gamificação, tem sido um grande impulso para a maioria das empresas internacionais estudarem estas soluções gamificadas como uma alternativa para resolver um grande número dos problemas encontrados no ambiente de trabalho.

Com isso em mente, o objetivo principal deste projeto será responder a um problema de interação entre o utilizador e o website para funcionários da Hitachi Solution, através de gamificação.

Ao longo desta tese, com a ajuda da framework Design Science Research Methodology (DSRM), foram identificados e demonstrados todos os aspectos que envolvem o problema, o design, o desenvolvimento e as métricas de avaliação para afirmar o sucesso da referida solução.

Inicialmente, é feita uma análise da gamificação para perceber o que leva as pessoas a utilizarem e interagirem com este tipo de sistemas. Depois, muitas frameworks são demonstradas e comparados entre si para entender melhor os prós e contras dos diferentes métodos. Por último, há uma exposição de casos de sucesso onde este tipo de soluções são atualmente adotadas.

De todas as frameworks avaliadas, a que se destacou mais foi a Octalysis, uma framework que se baseava principalmente no utilizador e nos seus motivadores para usar sistemas de uma forma rotineira.

Mais tarde, muitas soluções são criadas com base no processo de inovação e, posteriormente, postas à prova com base no seu valor para esta tese. Logo, a solução escolhida, uma solução baseada principalmente na criação de um sistema de pontos que dão poder aos utilizadores de escolher como ganhar e gastar os mesmos, teve, então, de ser desenhada e implementada no sistema da Hitachi. Essa implementação foi baseada numa metodologia ágil com reuniões de scrum recorrentes no final dos

sprints (sprints de 2 semanas) e desenvolvida principalmente em JavaScript, com o auxílio da framework Veu.

Como última etapa, a gamificação foi enviada para o ambiente de produção onde passou a ser utilizada/testada como uma versão piloto do sistema final. Posteriormente, alguns dos utilizadores foram submetidos a uma entrevista semiestruturada com o objetivo de arranjar feedback e entender os sentimentos dos jogares em relação as novas características.

Concluindo, após os testes realizados, estes foram analisados e observou-se uma ligeira melhoria na interação com o sistema. Estas descobertas, mesmo não atingindo por completo os parametros inicialmente estipulados nas hipoteses, permitiram com que a empresa promove-se o desenvolvimento adicional do projeto para poder aumentar ainda mais o nível de interação.

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List of Acronyms

AHP	Analytic Hierarchy Process.
CI	Consistency Index.
CR	Consistency Ratio.
DSRM	Design Science Research Methodology.
FFE	Fuzzy Front End.
GUI	Graphical User Interface.
MDA	Mechanics, Dynamics, and Aesthetics.
NPD	New Product Development.
PCF	PowerApps Component Framework.
QEF	Quantitative Evaluation Framework.
RI	Random Index.
RPG	Role Playing Game.
SPA	Single Page Application.
SWOT	Strengths, Weaknesses, Opportunities and Threats.

Chapter 1

Introduction

1.1 Context

Technology companies, like many other multinational sectors, have always the need to deploy expansive and comprehensive communication networks/platforms for their employees to achieve a faster response to any possible problem that may arise on their projects. These problems that are tackled through these systems are, usually, big code pieces that require a lot of effort to be reworked for every project. For this purpose, many companies create in-house solutions in order to respond to the ever expanding globalization of work.

Hitachi Solutions Europe has been chosen for its expansive and diverse environment around Europe. This consultancy firm mainly focuses on software solutions, working hand in hand with Microsoft tools and technologies. This company is a subsidiary of Hitachi Solutions, which was founded in 1970. Hitachi Solutions being a company with employees and customers worldwide have the need to be fast and uniform with their approaches on different projects.

After all that has been described, the target of this thesis will be a a platform that was created internally by the technology consultancy firm and it goes by the name of Solution Centre.

The Solution Centre is a website lets the user, in addition to some other functions, to submit source code snippets created by the them to be used by colleagues in future projects. Although some employees already contribute and regularly use the internal website, the percentage of users that interact and utilize the platform is still quite low.

Therefore, it is observed that new mechanisms are needed to be able to involve a greater number of users in order to create a more extensive code project library.

Taking into account the above problem, it is necessary to create one or more mechanisms that promote the code sharing system found on Hitachi's internal website and increase its use.

1.2 Objective

This project seeks to solve the problem that was identified and referred to above, through the implementation of a gamified solution that, expectantly will increase the interaction on the employee hub, by using the principles of software engineering following a competent pattern of learning, designing, developing and lastly data collection to identify the success of the solution:

1. **Data Capture**: Capture traffic and interaction data from the website prior to work. This data will be very valuable to understand if the gamified solution made any impact on the interaction factor of the employee hub;
2. **Study and Research**: Study the use of Gamification mechanics in different companies. By doing so, it will be easier to understand, from both the success and fail cases, what works and what does not to motivate the different individuals that will be using the platform on the daily;
3. **Preparation**: Prepare a Gamification strategy. After studying various frameworks, there will be a deliberation on which will work best to create this particular gamified solution;
4. **Development and Implementation**: Develop Gamification methods and mechanisms to increase interaction on the website. During this building phase there will be several two week sprints that will end with a show and tell with the business that will work to delineate the focus of the solution;
5. **Publish**: Create a campaign to promote the new system to notify the company of changes performed on the platform;
6. **Evaluating Data**: Capture final data and compare them with the initial one to detect the change in interaction with the Web site;

All these objectives will be explain in more detail below in the Preferred Approach section of the Analysis and Design chapter.

1.3 Research Questions

During this thesis there are a couple of questions that are going to be researched and figured out, in order to achieve a justifiable and fully understood result and thesis. With this said the questions that will be in review during this thesis will be the following: How to increase interaction through gamification? ; How will gamification be able to bring the necessary satisfaction to the users?

1.4 Expected Results

Gamification is, as an area of study, difficult to predict as it takes into consideration the needs and wants of the various users that will utilize the platform on a daily basis. That being said, the objective of gamification is firstly to try to appeal to the majorities needs, following a pyramid of needs similarly to Maslow's theory of motivation. Following this theory, the motivation to use certain aspects of the application will grow and inevitably create more usability for the website as a whole (McLeod 2020).

That being said, the expected result is, by studding the potential users and putting their needs in perspective, that there will be a bigger affluence of users after the creation and implementation of elements of gamification that cater to their needs.

In order to observe this result, there will be a few tools put into place, that will allow the business to understand, through raw data snapshots, the increase of user logins and navigation inside the platform. That being said, the expected from this project is a positive outcome, therefore a visible increase in user logins and interaction.

1.5 Preferred Approach

In this section there will be a small presentation of what type of approach was preferred to tackle the problem at hand.

Throughout this thesis document their will be exploration, experimentation, evaluation and implementation of a selected solution. With that in mind, the framework Design Science Research Methodology (DSRM) will be used to enforce a more complete demonstration of all aspects surrounding the project and to ensure that the thesis will keep on track for a better final result.

This framework consists of the following steps:

- **Problem identification and motivation**: The first phase of the framework is to identify and define the problem and what was the principal reason behind the need to solve the issue at hand. This was initially described by section 1.1 and further on, in more detail, by section 2.3 .
- **Objectives for a solution**: Following the identification there is a need to define the solution and break the problem down into goals/objectives that are more easily analysed and achievable throughout the project cycle. This will be shown in section 1.2 .
- **Design and development**: Moving to the design and implementation of the solution, there will be steps to take to develop the right approach analysed previously on the state of art. This step will hold the full life cycle of development of a software. This will be described by chapters 4 and 5.
- **Demonstration**: This phase includes the demonstration of the solution to the stakeholders of the solution and the deployment of the solution to the production environment, making it available to the broader audience of the project. This will be related to chapter 6.
- **Evaluation**: One of the last steps of the process will be, taking in consideration the evaluation steps explained and set in previous chapters, the success of the solution and understand why it does or not relate to the expected result. Chapter 6 will cover this.
- **Communication**: Lastly the final step will be communication between the developer and the various stakeholders, in order to, understand their feelings towards the solution and their feedback so it keeps growing the platform in the right direction. Throughout Chapter 6 there be a self analysis about the project and its future.

1.6 Document Structure

The report is divided into seven chapters. Each has a set of sections in order to organize the information for an easier and more pleasant reading. The chapters will be the following: Introduction; State of the art; Value Analysis; Analysis and Design; Implementation; Evaluation and Experiment; Conclusions.

Initially the report has an introduction phase to the project, where it was documented the personal and project frameworks in detail and where the problem was described. Where the description of the key elements of the project are detailed like the objectives of the proposed solution and its approach.

After an introduction phase of the solution proposal, the technology is introduced, in a chapter called "State of the art", this is the highest level of development that describes and documents in detail what is currently being done in the chosen development sector and other similar existing technologies.

The next chapter is the value analysis, on this one, a few solutions are identified, measured and related to the main problem and research questions, in order to understand which solutions work best to achieve both the best results and maximum user satisfaction.

Succeeding the value analysis, comes the analysis and design chapter, this will be the place where the solution previously chosen will be analysed, refined and put into a position where the developer can pick it up and implement it. In an effort of making that possible both functional and non functional requirements are created.

Following that, comes the implementation chapter, in this chapter the development is explained and desiccated in a way that will show how each of the user story were developed with the assistance of development pictures and code snippets of the more general parts.

With the implementation of the solution completed, a new chapter appears called evaluation and experiment, in this the author creates thorough tests that will serve to assess the success of the gamification on both a quantitative and qualitative point of view. Here the tests also have their dimensions and criteria detail so for a better testing experience.

Lastly, the conclusions chapter will summarise all that was made, created and tested during the construction of this project, looking at both the results and what will be the future of the solution created.

Chapter 2

State of the Art

In this chapter, there will be a main focus on the explanation of what Gamification is. Through a few sub-chapters that state how it came to be, what it is used for and some studies that will help with its implementation in form of frameworks that need to be followed. Later, there is a presentation of a few examples of what has been done in this area of study.

This chapter ends with a section that summarizes the main information shown throughout its entirety.

2.1 Gamification

During this section there will be a few subsections that will focus on what gamification is and why it is important for this project to solve the issue of user interaction. Also, throughout this section, there will be a few examples of gamification frameworks that will be possibly used to develop the gamified solution.

2.1.1 Introduction to Gamification and its Elements

There is a need to explain and relate what exactly is gamification and why was this the preferred approach to increase user retention and increase of population on this website.

As a first step, by dissecting the word gamification we can analyse that it is a derivative form of the word game, this being a direct connection to how the concept in study borrows many of its roots from popular games and game design directives. On a concise explanation, gamification is the act of bringing game mechanics to environments that would normally not have them, this can be, for example, in meaningful tasks in the workplace. By doing so, its theorized that the employee/workforce will

increase their productivity while still having more enjoyable experiences and possibly, depending on the gamification framework used, gain rewards and awards to push them to do better in their tasks. This is normally best implemented on day to day tasks that involve a lot of repetition and might get tedious to the user.

Now on a more extensive note, Gamification by definition is a homage to the gaming genre and their mechanics, that being said there is still a lot of differences between the two. In this subsection these differences and similarities will be put in display to be studied.

To start this study, lets point out the mechanics and dynamics used by each side, as per definition gamification tries to clone and re brand many mechanics and dynamics initially created and tested on gaming environments, yet the developers that reuse these try to bring it to a brand new audience and ecosystem, by doing so their main objectives get shifted from bringing enjoyment to the player, to increasing, in many cases, the productivity and initiative of the various employees that use the solution. In this matter, gamification is better represented by serious games than the more classic meaning of the word game.

Besides the aforementioned angle, when looking at rewards that both can bring to the player, we can find similarities as both award the user by doing challenges or tasks, even though gamification and games are found in diverging environments, they reward the user in very homogeneous ways. While on a game you normally get awarded with a tool that will help you complete your objectives, same, normally, happens with gamified solutions, as per example of a loyalty system, the customer per action gets granted currency that in future can be used to get discounts and products that the player longs for.

Concluding, by looking at the pair, even though the two come from the same origins doesn't mean that they can have the same impact on the human emotion or the same defined objective.

Now with the understanding of what gamification is based on, there is a need to point out three main aspects that make an implementation of gamification successful, this aspects are the mechanics (i.e., goals, rules and rewards), the dynamics (i.e., how players enact the mechanics) and lastly the emotion (i.e., how players feel towards the implemented experience) (Robson et al. 2015). The use of the three elements is extremely important for a gamified experience to flourish and achieve success.

Moving on to explaining them, firstly, the mechanics need to be implemented accordingly to the objective of the task, as an example, for a corporate ran grocery business that needs their clients to stay loyal to their company, they will not implement a very complex and thorough process for the customers to achieve goals and rewards, but instead create simple mechanics that will take very little effort from the clients part, for example implementing a point system that is automatically linked with the customer's payment method, making them instantly bound with the business and pressuring them to come back to get the rewards.

Secondly, the use of dynamics is equally important for the competent development of the solution, as the players, or customers, will always dictate how they will use the rules, so to achieve their goals in a way that is easier and faster for them. As an example, we can state an online question board, that rewards their users for every answer they write, this might be a good implementation if used correctly, but when customers start to misrepresent the system by giving out wrong answers the dynamic of it starts to crumble, that being said, boundaries and guidelines need to be set to direct users to the vested interests of the company that is implementing the gamified solution.

Lastly, there is emotion, this one being perhaps the easier to comprehend, all humans react to emotion based content, so by utilizing this as a part of the gamification it will greatly improve the positive reaction to the system. This can be achieve in a solution by utilizing and exploiting the employees needs, if, for example, on a consultancy company such as Hitachi Solutions, an collaborator has the need for a promotion or bonus, the system should give ways to help him achieve a bigger utilization so to achieve a bigger bonus or to look better on its promotion phase.

2.1.2 Historical Examples

In this section it will be explain and shown how gamification has grown over the years of its existence. This is a very interesting section for this subject because the past successful executions may and very often generate the development of various new implementations within the space that bring success to the desired company. That being said, this is going to try to summarise the past of gamification so to bring a new light upon some of the decisions made when implementing gamification mechanics on Hitachi Solution's solution.

Although gamification only got its mainstream traction during the 21st century its early stages can be traced back to the early 1900's where it was designed and implemented by a company called Sperry and Hutchison Co., they developed a system that would reward their users for being loyal to the company's partners drawing them to make more purchases and therefore increasing the profits and reputation among their peers. This system worked in a way where customers would get green stamps from buying on certain chosen shopping centers, and, in the wake of that, they would trade their winnings for items on Sperry and Hutchison's catalog. This example was able to show that, mechanisms should always try to entice an ecosystem where both the client and the company can profit from.

Succeeding this success story, many decades after, around the 1980's, gamification, although not yet mentioned by that name, started picking up steam and many companies across a different and wide spectrum of areas started using similar loyalty based systems to entice customers to use their establishment, this was the example of American Airlines, with their airline miles that would benefit the customer with discounts the more miles he traveled, or Holiday Inn, which would bring customers to their hotels because they would offer rewards that other hotels wouldn't. This was the start of many companies seeing benefit in, not only getting new users, but, also, the recurrent, loyal, customer.

Skipping a few years, to the early 2000's, with the increasing popularity of games and with the exponential growth that the industry was having, many studies and researches were created around the concept of introducing the ever so popular video game mechanics in the daily routine. So, by 2002, through the Woodrow Wilson International Center of Scholars the word serious games was coined, that is, games that would focus more in bringing knowledge to the user, rather than mindless entertainment, and so it was initiated the idea that games would push users to do something that they wouldn't normally do and increase their productivity.

Some years after, in a convention at the Warrent School of University of Pennsylvania Ian Bogost raised many issues and concerns about gamification stating that it doesn't normally work. He's made various accurate and valid points as to explaining that gamification wouldn't function on certain types of scenarios, which is a veracious argument when looking at companies that didn't understood the needs of their collaborators and employees. Therefore, there is a need to create a correlation between the maslows pyramid of needs and the users, where companies would explore the primary needs of their employees and create a system around them (Christians

2018).

Concluding on today's date, after this brief historical context we can observe through many examples that gamification is already a mature concept that, when implemented correctly on the right environment, can create a very good effort to increase productivity, company loyalty and recurring use, all aspects that were identified and chosen as objectives on the gamification plan done for Hitachi Solution.

2.1.3 Gamification Frameworks

Frameworks are very usefully to plan out a way to strike at a problem with the upmost precision and carefulness. A framework, in this sense, is very similar to the intended definition in a programming sense, as in programming we have a frameworks as generic and abstract works that help us build more complicated solutions, by developing on top of those and enhancing our code by getting it to be called by the implemented framework.

These normally are built very generic and abstract to be compatible with a broader spectrum of projects, thus providing a standard way to build and deploy applications. Frameworks are universal and reusable environments that help develop a certain part of implementation process.

Considering the aforementioned information, in this subsection many frameworks will be presented and evaluated so to understand which one would benefit more the creation of the gamification solution for the resolution of the problem at hand.

Octalysis

As a first and foremost presentation of a framework, an investigation was done on *Octalysis*, a gamification framework developed by Yu-kai Chou, a gamification, expert and behavioral design consultant that was rated number one among the *"Gamification Gurus Power 100"*, in 2020 (Chou 2008).

Yu-kai Cho in order to create this framework started by digging into the human behaviour and analyzing what made them play games, and by doing so, he was able to built a framework that would help him and everyone that was trying to build a gamified solution.

With this investigation some light was shed on strategies for developing gamification solutions and therefore created *Octalysis*. An octagon shape with 8 core drives representing each side of the figure.

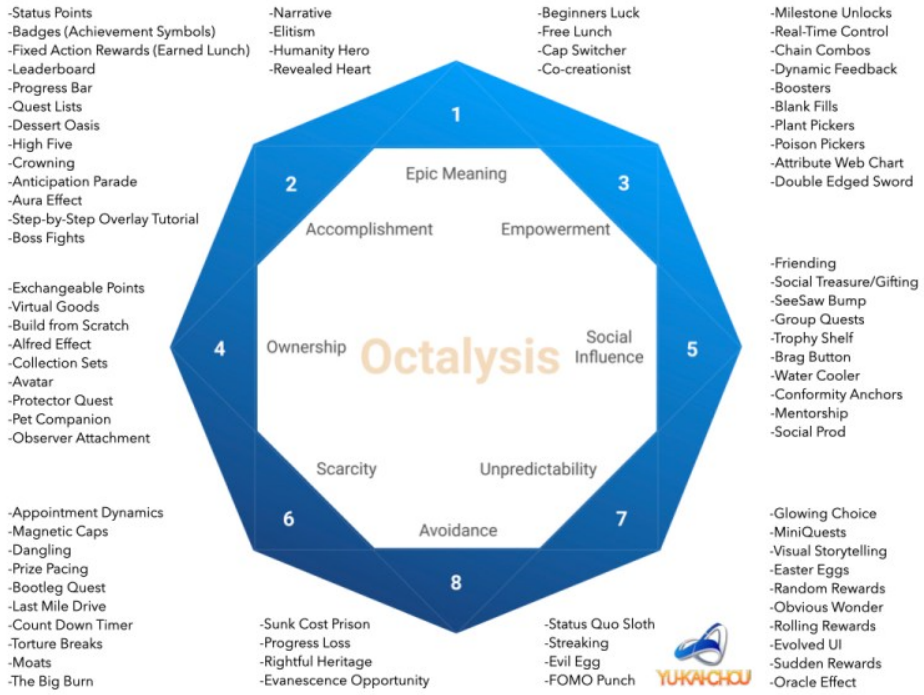

Figure 2.1: *Octalysis* Framework graphical representation (Chou 2020)

On this framework, Core drives are explored, such as the **Epic Meaning** behind the reason of each action, for example, this is when a player believes he is working towards something bigger than himself, this is the drive that pushes people to maintain an open source forum/project like Wikipedia.

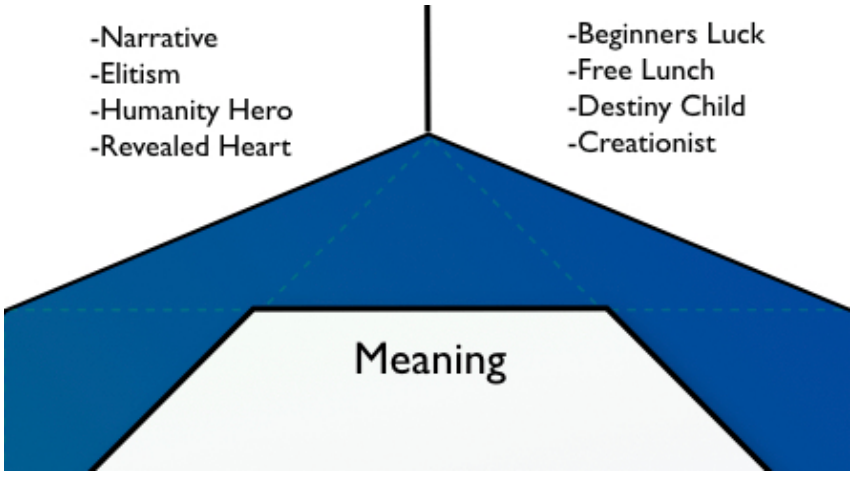

Figure 2.2: First core drive - Epic Meaning (Chou 2020)

The second drive represented on the octagon would be the **Accomplishment**. While playing certain types of games, usually, the player has to gather points or badges to move forward, yet those are often gotten through the completion of challenges and obstacles, which enhances the felling of accomplishment that the player gets when collecting them. From a design point of view this point is normally easily implemented through the use of points, badges or leader boards.

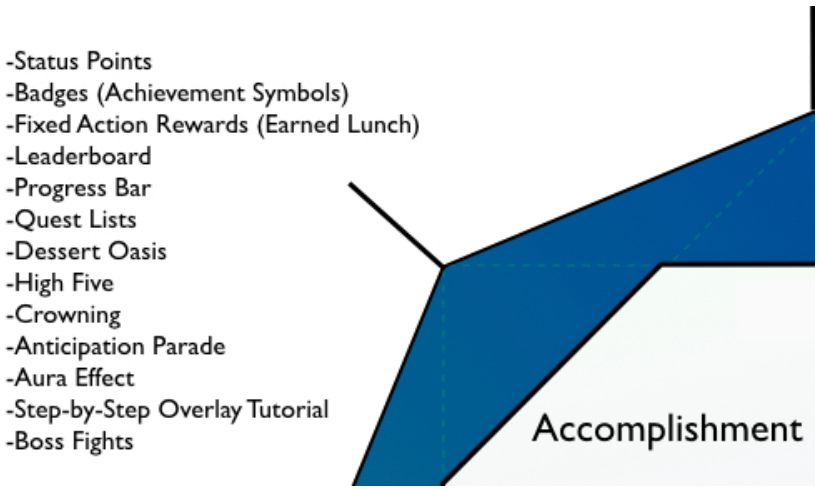

Figure 2.3: Second core drive - Accomplishment (Chou 2020)

As a third drive, there is **Empowerment**, this drive is all about giving the player a feeling of power, when they will be able to be part and engage on the development and creative process of their adventure. This is why RPG games are so famous because they let the players choose their own adventures, while still giving them instant feedback when some action they have done has triggered something positive or negative throughout the game's virtual world. Therefore, there is two main points that need to be incorporated in gamification - let players explore and figure out the different mechanics and give them instant feedback on their experiments.

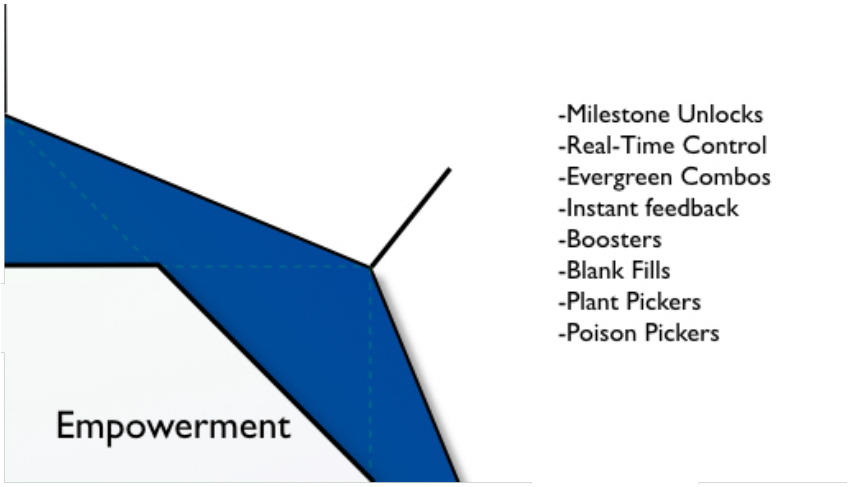

Figure 2.4: Third core drive - Empowerment (Chou 2020)

Another core drive represented on the octagon would be, for instance, the **Ownership**, as in a game that allows you to collect and create virtual goods and currencies, increasing, this way, your wealth, this can happen for example, when a user is allowed to create and customize in depth their profile and picture.

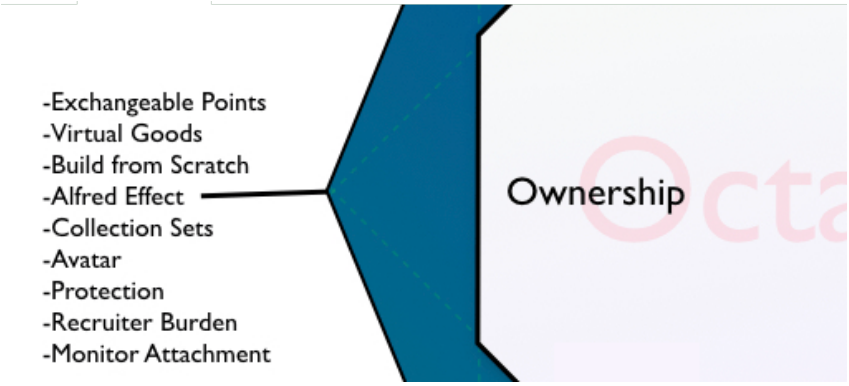

Figure 2.5: Fourth core drive - Ownership (Chou 2020)

On fifth place in the list of drives there is **Social Influence**. As a main reason why games are having a rapid increase in popularity nowadays is mainly because of the community that it creates around the different titles in this interactive media, which has been helping people around the globe during the pandemic (Clement 2021). Ergo, to increase the popularity of a gamification solution it requires to have elements of social interaction like, for example, a point leader board that will serve as *bragging rights* for the user.

Figure 2.6: Fifth core drive - Social Influence (Chou 2020)

Scarcity is seen as the sixth core drive, as this is the desire of wanting something because you can't have it. In today's gaming ecosystems there are a fairly few mechanics that do this, for example, the selling of limited edition in-game items or digital skins, which spikes up their, sales due to the fact that people do not want to wait for it to be available again or feel like they missed an opportunity.

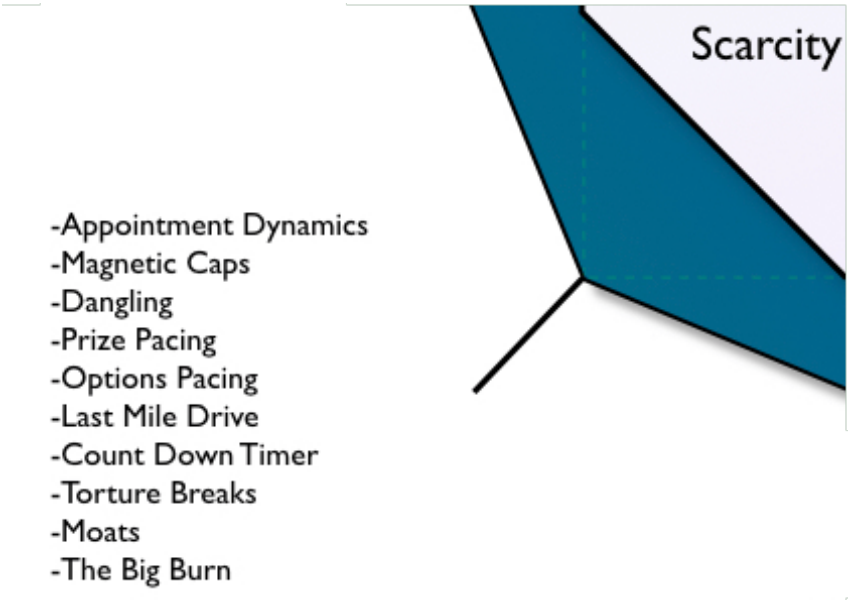

Figure 2.7: Sixth core drive - Scarcity (Chou 2020)

One more core drive is the **Unpredictability**. This is the drive that is behind most of the gambling games. The desire to know and see what will be the next outcome only because of its unpredictability pulls a lot from the pure curiosity of the human being.

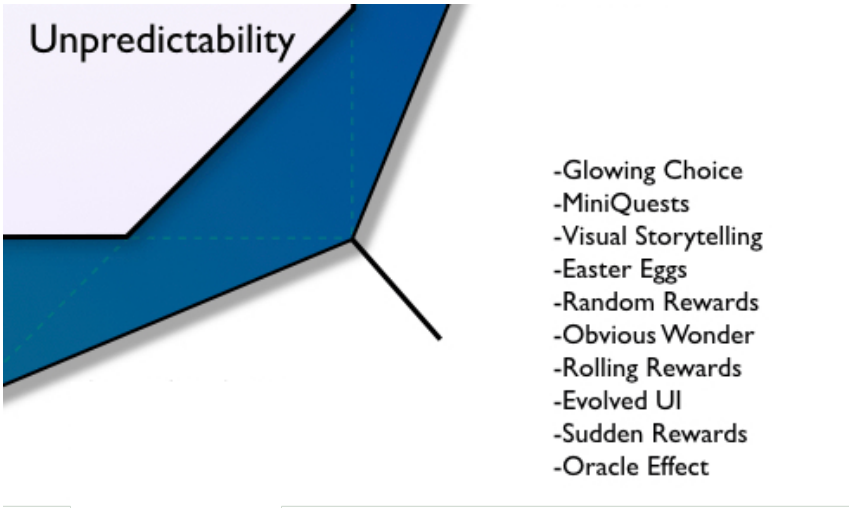

Figure 2.8: Seventh core drive - Unpredictability (Chou 2020)

Last core desire is **Avoidance**. This is based on the human impulse to avoid the feeling of loss or of a negative outcome. The reason why games have evolved to have checkpoints and save states where the game would go back to when the player lost, is due to users apprehension of losing progress and having a lasting feeling of time wasted.

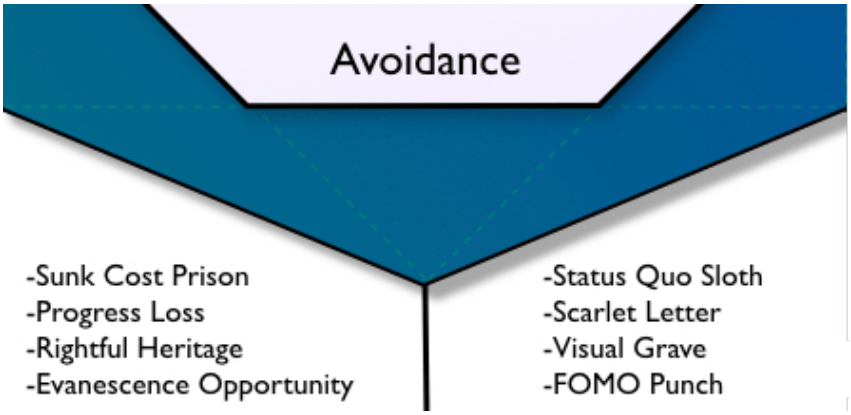

Figure 2.9: Eighth core drive - Avoidance (Chou 2020)

6D Framework

Similarly to the previously mention framework, this one tries to give and define a plan to design a gamification solution. In this specific framework, we are given six phases and steps to always remember when doing the blueprint of the project.

As the name alludes, this frameworks revolves around the utilization and experimentation with the six phases that start with the letter D, therefore the name

6D. These are: *Define Business Objectives; Delineate target behavior; Describe yours players; Devise activity loops; Don't forget the fun; Deploy appropriate tools* (Borderless Technology 2018).

The framework tries to focus itself on the initial exploration of the gamified system, which is the replication of gaming experiences into the real world. As an example of this, we can focus on the phrase *Describe yours players*, here it advises the division of the user base into four player types that can be then focused on and categorized. These are the *Achievers*, those who are interested on the rewards; the *Explorers*, people who want to learn and discover; the *Socializers*, users who play to interact with the rest of the player base; lastly the *Killers*, players who look to complete, fight and win over the opponent (Martes 2013).

By doing this separation, we are then able to understand what type of player the gamification is focus towards and how to point the development and implementation for their satisfaction.

Figure 2.10: Amy Jo Kim diagram of type of players (Kim 2014)

Mechanics, Dynamics, and Aesthetics

This framework was developed in 2001 to 2004 as part of the Game Design and Tuning Workshop at the Game Developers Conference in San Jose. MDA framework

is an approach to understand games design and game research, in order to create an easy to dissect platform that would help the different parties to learn from the various game designs and game artifacts (Hunicke, LeBlanc, and Zubek 2004).

Although this framework, unlike the aforementioned, does not create a scaffolding to build a gamified platform upon as it is not directly related with gamification and their design principles. Nevertheless it can be a very good and valid tool to have while planing the development. As explained above, per definition gamification is the action of using mechanics, dynamics and designs from tried and successful games, hence the usefulness of having a framework capable of capture said features.

In contrast to other forms of media and entertainment, games are an interactive product, so, by definition, they are much more unpredictable than static occupations, so their design needs to create a strict set of rules and systems that leads the player to the desired outcome.

Therefore the MDA framework formalizes the consumption of games by breaking them into their distinct components and establishing their design counterparts (Hunicke, LeBlanc, and Zubek 2004)

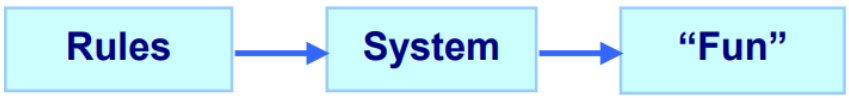

Figure 2.11: Consumption Components (Hunicke, LeBlanc, and Zubek 2004)

Figure 2.12: Design Counterparts (Hunicke, LeBlanc, and Zubek 2004)

The design counterparts are described by the following:

- **Mechanics**: Component at the lowest level of the game design that show and defines the information of the game, such as representation and algorithms.

- **Dynamics**: Component that transcribes the and translates the players intentions to the mechanics of said system, in real time.
- **Aesthetics**: Component that tries to consolidate the system into the right emotional responses that are evoked by the player, when they are creating inputs and receiving outputs.

2.2 State of the Art in Existing Approaches

Gamification is the process of developing game like aspects, features and mechanisms to a non gaming environment, this can be, for example, for education purposes like adding a leveling system that allows the students to understand how much they have studied and if they are ready or not for more advanced learning.

This concept is not new for the 21st century, however it came into popularity around this era because of the mass transformation of media into digital media which made it more easily accessible to a major audience. The newer generation, that grew up with the internet and all the information on their finger tips, have developed short attention spans, which made all new media and advertisers develop ways to keep the user involved and entertained - this mechanisms are normally heavily based on gamification.

That being said, it is concluded that, nowadays, the biggest problem that needs to be resolved is how to keep users entertained and how to keep them coming back to the website or application.

As a solution to the proposed problem many companies have created mechanisms to try to challenge and combat this situation.

2.2.1 Microsoft Learn

The first example, is Microsoft with their platform Microsoft Learn. This platform developed by Microsoft was created as a way to help/teach users how to work with first party tools, in this website those users could develop new skills, find certifications, and do learning paths - features that would help the user consolidate its study by giving them a quick course that would end with a few questions that would challenge their previous study. Lastly, this platform was also a hub for Microsoft employees to find specialized learning resources (Microsoft 2020).

In a way to increase popularity amongst its target audience and user return ratio, a mechanism, that was taken from entertainment and popular video games, was implemented. This gamification was, in its most basic form, adding a leveling system similar to those on role-playing games in which the users would be able to level up according to their ability to do challenges and learning paths, rewarding them with more or less experience depending on the success on those web resources.

Lastly, Another feature that was implemented was the possibility that these users could do online certifications that awards the users with achievements and badges that could be displayed on the user's personal page.

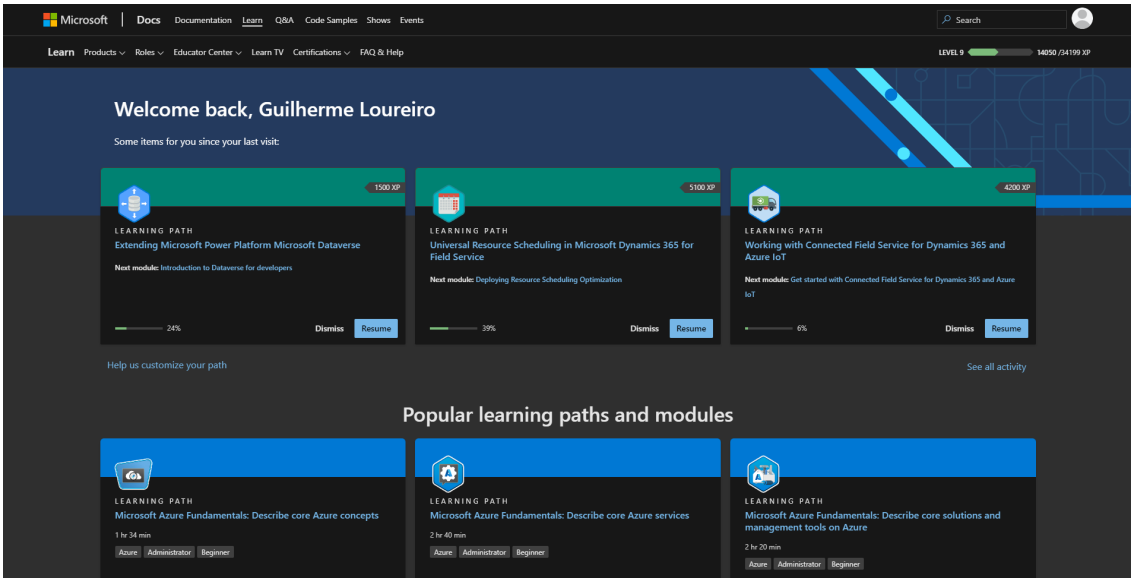

Figure 2.13: Microsoft Learn Home screen with examples of gamification

2.2.2 Google Badges

For many years now Google has employed many different game elements on their implemented features. Google is most well known for being the biggest and more in depth search engine that is used everyday by millions of users, and for that reason it understands that people need the latest information on the tip of their fingers, and so for that reason it becomes impossible to cover all possible subjects on the internet.

As a way to answer that problem Google created a badge system, similar to many achievements in games, that are awarded to the users that complete certain requirements, instigating the user base to be self sufficient, as some users would

upload most of the recent information needed, and other users would review its veracity, being both users awarded for their service in contributing to a ever expanding web of knowledge (Google 2017).

2.2.3 Samsung Employee Productivity

Samsung being a very successful company for years understands that keeping employees happy and engaged would increase their productivity, and therefore the profit of the enterprise. By utilizing powerful game mechanics they were able to transform and bring forward the ideologies, cultures and strategies that the company believes and is after on every employee making the current employees happier and being able to attract new talent through those mechanics (NewsCred 2018).

2.2.4 Gamipress

WordPress was released in 2003 as a blogging software developed by Mike Little and Mike Mullenweg, this solution is available for free for any user, so that anyone, even without a technical background, would be able to create their own website/blog on the internet (WordPress 2003).

Following the success of *WordPress* and with the ever growing concept of gamification, in 2016, a team of two, Ruben Garcia and Irene Berna, released a plugin, called *GamiPress*, that would work in tandem with *WordPress*, to increasing interaction within the developed website due to its gamification features.

These gamification features range a cross a big spectrum of game dynamics and mechanics. At the moment it gives the user the ability to rack up points, that works as virtual currency to buy and exchange for digital rewards, it allows the blogger to receive badges upon completion of certain requirements and lastly they also have ranks for users that have meet a certain criteria (GamiPress 2016).

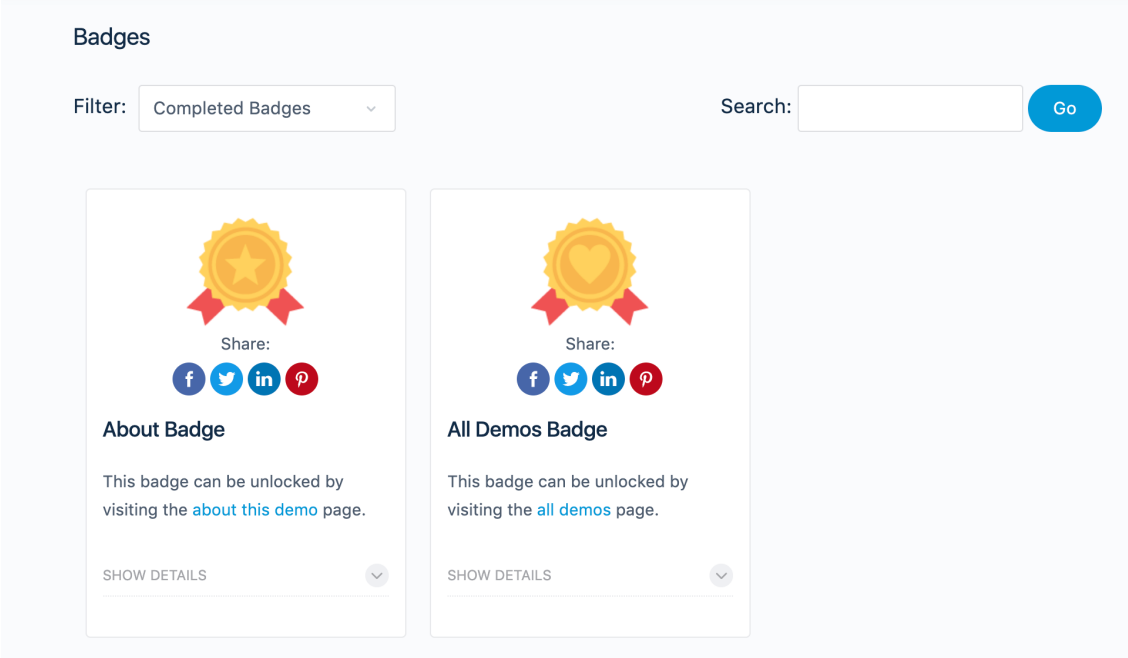

Figure 2.14: *GamiPress* Achievements (GamiPress 2016)

2.3 Summary

The problem that Hitachi Solutions has identified is attached to the way that a technology consultancy company, with the size of Hitachi, structures its workflow.

The business's way of work is very dependent on their resource management, where employees are rotated around to work on active client projects and to be on hold, also known bench time. When an employee is on a client project he is expected to attend its meetings and fully focus on making value for that client so to develop and deliver the best solution possible to the client.

On the other hand, the collaborator that finds themselves on bench time, will have a lot of downtime as they do not have any type of client obligations, so this time is, normally, based on self-study time that is very hard to be monitored by the company as a whole.

Understanding all of this, the Business jointly with the IP team have came up with a code repository, fitly named as *PCF Gallery*, which is manly composed of *PCFs*, short for *PowerApps Component Framework*. These components are front-end solutions, done with the use of various *JavaScript* front-end libraries (*vue, angular, react, etc...*), that have unique interactions with Microsoft's fairly new technology called *Power Platform*.

A few months after the deployment of the code repository on the employees hub, the IP team observed that very few solutions were being added and the interaction with the system was very limited and scarce, and that's how the plan to implement new mechanics and dynamics to that system started to appear. Concluding, with this work, the business expects that the code repository gets a boost of new users and new solutions. Making this chapter ever important due to its knowledge base on how to implement and develop gamification solutions.

This chapter started by describing what gamification is, how it came to be and how to successfully achieve a good implementation and development of the gamified solution, through the various methods shown in the frameworks presented.

Furthermore on the chapter, there was a presentation of success cases and solutions created by the different renowned tech companies, where the main attributes of their success was identified.

Chapter 3

Value Analysis

This topic will focus on the value analysis of the gamification solution that will be implemented in Hitachi Solution's employee system. This evaluation will start with a presentation of the innovation process which will identify the innovation of this project. Then moving forward to a value analysis, where the merit of this approach will be studied and compared against success use cases done in the same area of study. Subsequently to that, there will be a value proposition where the gains and pains of said solution will be weighted and analysed, so to start to create ways to better the approach and circumvent possible show stoppers. Lastly, it will be presented a Canvas Model that will go in depth on the strategic model of the solution to help visualize the future of the project and how to overcome possible obstacles that will appear when developing it.

3.1 Innovation Process

This approach aims to reduce the ambiguity/fuzziness of ideas before maturing the project. According to Koen, the innovation process can be divided into three distinct phases: The Fuzzy Front End (FFE), the New Product Development (NPD) process, and Commercialization. These can be viewed in the following figure (Koen et al. 2002).

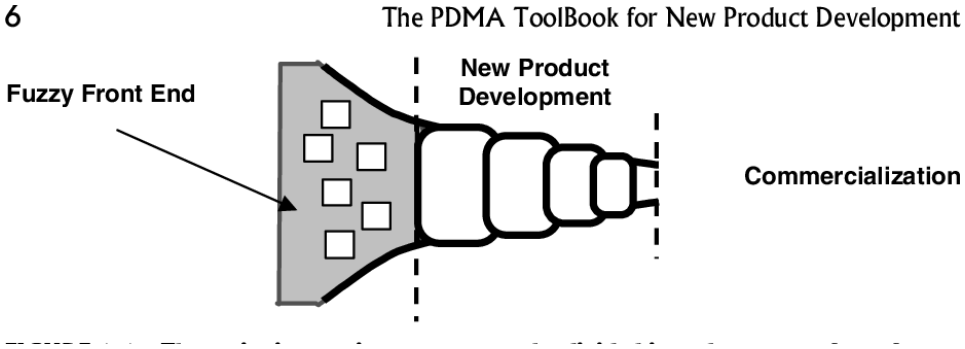

Figure 3.1: Division of the Innovation Process (Koen et al. 2002)

- **Fuzzy Front End (FFE)**: This phase is, normally, the beginning of the innovation process, and represents an environment of low organization and unstructured ideas, where there is still a lot of uncertainties variables related to the commercialization and financing of the project. In this phase there is a focus to search and upgrade the business requirements and concepts.
- **New Product Development (NPD)**: The second phase, finds itself on a privileged position where the plans are concrete and oriented towards specific objectives. In this phase the dates and objectives are defined accordingly and there are structured teams focused on continuous development and implementation of the product.
- **Commercialization**: Lastly, on the third phase, this shows the final product of the development done on the two previously mentioned phases. In this phase the product is ready to be commercialized and realized to its fullest on the market.

3.1.1 New Concept Development

This technique developed by Peter Koen and his team, has the objective to create knowledge and concepts of the ideas. New Concept Development was developed, in order of answering, in a more methodical way, the issue of fuzziness that these have during the first phase of the process (Fuzzy Front End) (Koen et al. 2002).

This model is a non-linear way of innovation that depends, as shown on the following figure, on three main parts: the Motor; the Wheel; the Rim.

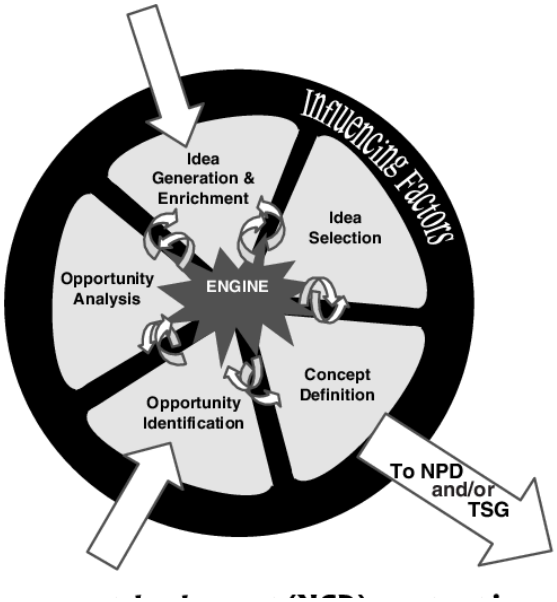

Figure 3.2: New Concept Development (Koen et al. 2002)

- **The Motor**: At the center of the model, the motor, is related with the strategic plan and the culture existent on the company and will influence and power directly the inner wheel.
- **The Wheel**: The inner wheel finds itself divided in five influencing factors of the front end: opportunity identification, opportunity analysis, idea generation, idea selection, and concept definition.
- **The Rim**: As the outer part of the model, it represents the exterior, non controllable factors, that affect and influence the process of innovation as a whole. Some of examples of these can be the law, politics or economy.

Opportunity Identification

The first influencing factor to be realized is, usually, the opportunity identification due to it giving the company a good idea of what opportunities need to be pursued. This phase is heavily supported with the showing of future scenarios and discussions about the future needs of the company.

In this case, the issue was identified by the IT team during a data meeting where they noticed that certain pages and features on the employee hub were being abandoned and not used. Therefore this was communicated to the stakeholders that contemplated a possible opportunity of using gamification to improve the level of interaction within the system.

Opportunity Analysis

As a second step, there is opportunity analysis, in this stage the previously identified opportunity gets evaluated and analysed in depth, in order to, understand how much value can be extracted from investing on it. To this end many detailed methods to identify opportunities can be used.

Having the opportunity identified by the company, now it needs to be analysed to understand the value that it may bring to a potential customer. In this case a SWOT diagram was drafted to more easily evaluate the opportunity. A SWOT diagram is a method used by companies to organize the internal, external, positive and negative factors. This is divided by four parts:

- **Strength**: Represents the positive internal influences that add value to the proposition.
- **Weakness**: Negative internal characteristics that push back and creates fallacies and disadvantages for the opportunity when related to others.
- **Opportunities**: External situations that bring value to the opportunity and push it to move forward, this may be any outside force that helps the development or success of the solution.
- **Threats**: Points out the external negative forces that may grind the project to a halt.

Strengths	Weaknesses
• Focus of the opportunity is to increase employee collaboration • Promotes company culture • More useful downtime in between projects	• Increases employee possible workload • Small development team • Increased website maintenance
Opportunities	**Threats**
• Implementation of external successfully developed gamification solutions • Increase of Gamification market awareness	• Extensive list of failed gamified solutions

Table 3.1: SWOT Analysis

- **Strength**:
  - Focus of the opportunity is to increase employee collaboration - In a globalized and international company like Hitachi Solution having a team that work together towards a common goal is extremely important, as it leads to more innovation, efficient processes, increased success, and improved communication.
  - Promotes company culture - With the creation of this ecosystem of collaboration between team members it will be easier to get more employees that are looking for this type of work environment.
  - More useful downtime in between projects - Through a gamified solution the employee's will be empowered and it will be easier to keep employees motivated and working.
- **Weakness**:
  - Increases employee possible workload - Due to the gamified solutions playing into the needs of the user, the employee might feel the need to be always working even when he has other work to do.
  - Small development team - As this solution is being built with a thesis in mind the development team is essentially just the author of the thesis.
  - Increased website maintenance - With the implementation of this feature there will be the need of increasing storage capacity and therefore the maintenance cost will increase.
- **Opportunities**:
  - Implementation of external successfully developed gamification solutions - Some competitors have implemented similar solutions that has worked to increase population within their internal website.
  - Increase of Gamification market awareness - With the increase of popularity of games across all the world there is a need to bring these addictive mechanics and dynamics to the workplace in order to better optimize the productivity.
- **Threats**:

  - Extensive list of failed gamified solutions - Team was apprehensive of creating a gamified solution due to its track record within some other consultancy companies.

Idea Generation and Enrichment

The process of generating ideas its where ideas are created, developed and implemented, yet before the that process starts, the idea first needs to be enriched, with the knowledge and solutions that were created on the previously steps.

In this particular project, after analysing the idea, it was identified that it needed to value the employee's time above all, as the overwork of the workforce was a serious concern from the business side. To solve this, there was a meeting to understand what sort of rewards the employees could get, and to make sure that they were balanced accordingly with the time used by the employee.

Moving to the development of the ideas, there were developed four gamified ways to achieve the solution of the issue:

- Creation of a badge and achievement system that would prompt users to do certain actions with the promise of them being able to receive something for doing so. This badge would then be attached to the users profile making him more desirable for project and client work, this would then increase the employee's chances of receiving bonuses or promotions.
- Creation of a level-up system that would generate skill matrices for users and then allowing them to be improved over time through the actions that these individuals do inside of the system. The users that would rack up a lot of skills by doing the prompted actions would therefore be able to use those as a show of work and knowledge when asking for a promotion or raise in salary.
- Creation of a point-reward system that would allow users to gain points by performing actions inside of the employee hub and then these could be cashed out for rewards like discounts for partnered stores or other monetary awards. This would also require the development of a solution that would have leader boards and weekly challenges that would inherently generate points for the user to gather. On one side, the creation of a leader board, that would show the consultants that were more involved with the community and that were more proficient in creating code components, therefore receiving points for being in the top three for a whole month. On the other, the creation of Weekly

challenges, that would award the fastest to complete them an opportunity to gain points.

Analytic Hierarchy Process (AHP)

With the aforementioned generation of ideas process completed, there is a need to analyse, evaluate and pick the most valuable idea. To execute this process a framework, by the name of Analytic Hierarchy Process (AHP), was chosen, due to its capability of using both quantitative and qualitative criteria on the evaluation process. The main idea of this framework, is dividing a decision problem in hierarchy levels, thus, facilitating their understanding (Nicola 2022).

As a first step of this process, there is the need to create a hierarchy tree that will specify the criteria that will be used and the three previously mentioned idea proposals.

The criteria used on this process will be the following:

- **Acceptance**: The Acceptance will qualify the possibility of users positively perceiving the solution and accept it into their day to day life.
- **Flexibility**: The Flexibility will determine if the solution is agile and easily adaptable to other features.
- **Reliability**: The Reliability will mainly focus on the technical debt that will be left by constructing the solution.
- **Longevity**: The Longevity gives evaluates the solution on its capability to stand the trial of time and keep it self updated and useful to the users - determining if the alternative creates a long term solution.

The alternatives that will be used, will be categorized throughout the process as:

- **Alternative 1 (A1)**: Creation of a badge and achievement system that would prompt users to do certain actions with the promise of them being able to receive something in return.
- **Alternative 2 (A2)**: Creation of a level-up system that would generate skill matrices for users and then allowing them to be improved over time through the actions that these individuals do inside of the system.

- **Alternative 3 (A3)**: Creation of a point-reward system that would allow users to gain points through features like leader boards and weekly challenges and then use the points to buy rewards.

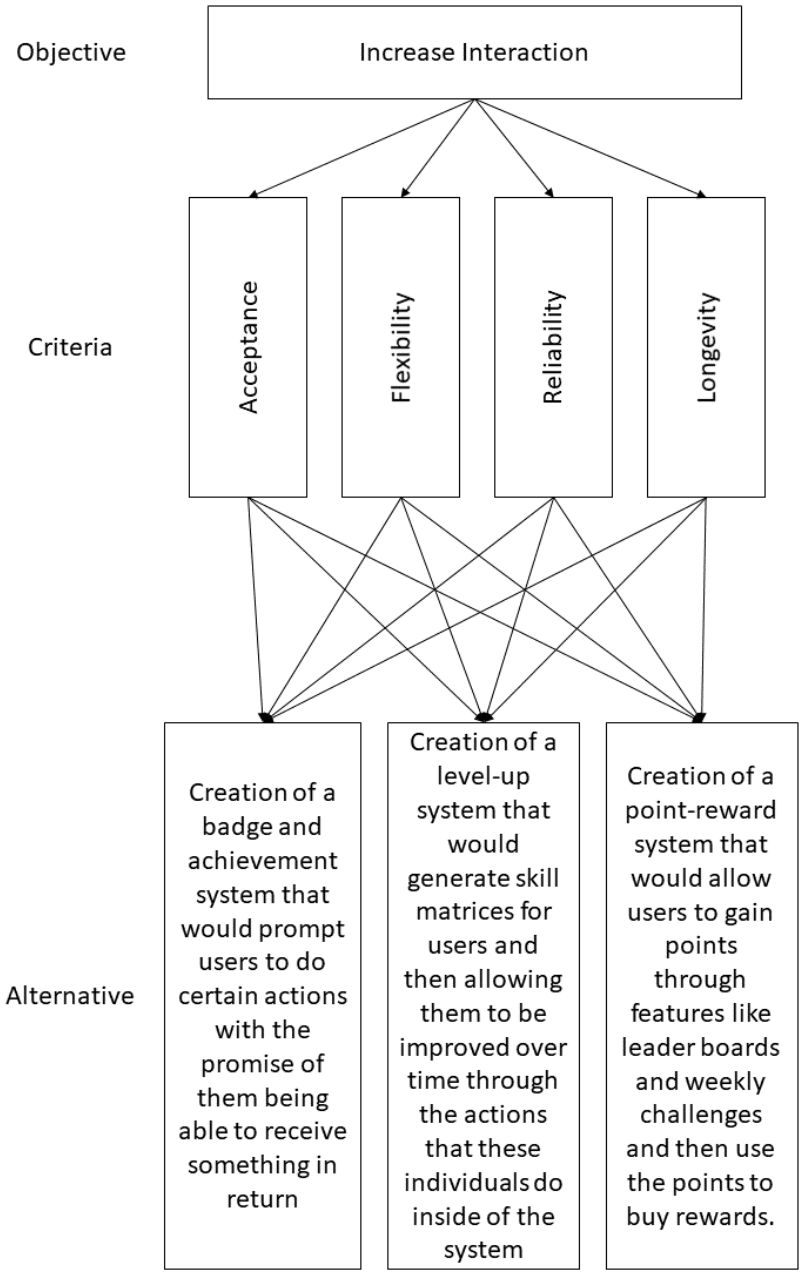

Figure 3.3: Hierarchical Decision Tree

Posterior to the creation of a hierarchical decision tree, the criteria had to be divided and compared based on their importance within the project. This comparison, seen in the table below (Table 3.2), puts all the criteria against each other two by two to understand what kinda of quantitative relationship these would have based on their importance in the project.

This can be read from left to right, where the values above one (1.000) mean that the row is more important as a criteria, while the values below one (1.000) mean the opposite.

Table 3.2: Comparison Matrix between Criteria

	Acceptance	Flexibility	Reliability	Longevity
Acceptance	1.000	3.000	2.000	3.000
Flexibility	0.333	1.000	0.333	1.000
Reliability	0.500	3.000	1.000	2.000
Longevity	0.333	1.000	0.500	1.000

After the comparison matrix of the criteria, the values get normalized by dividing each value by the sum of the column in which it appears. Then the value which is then characterized as the priority vector will serve to easily observe what are the more and less important criteria, this value is calculated by using the average of the normalized values from each row (Table 3.3).

Table 3.3: Normalized Comparison Matrix And Relative Priority Vector

	Acceptance	Flexibility	Reliability	Longevity	Relative Priority
Acceptance	1.000	3.000	2.000	3.000	0.447
Flexibility	0.333	1.000	0.333	1.000	0.127
Reliability	0.500	3.000	1.000	2.000	0.288
Longevity	0.333	1.000	0.500	1.000	0.138

Analysing the matrix, it can understood that the criteria can now be ranked from most important to less important, starting with **Acceptance** with the value of *0.447*, to **Reliability** with *0.288*, to **Longevity** with *0.138* and ending with **Flexibility** with *0.127*. This can be explain due to the fact that the main object of the project is to empower the user so it needs to have its approval as main and central point to its solution.

Now with the understanding of what criteria is more important, the next step centers itself on the Consistency Ratio (CR) value. This is the value that states the consistency level of the previously observed values, if the value is below 0,1 it is considered reliable (Nicola 2022).To calculate this value there is a list of steps that need to be followed.

First there is a need to calculate λ_{max} using the succeeding formula:

$$Ax = \lambda_{max}x \tag{3.1}$$

Here A is the criteria comparison matrix and x the relative priority value (Table 3.3), the result of this multiplication can be seen on following table (Table 3.4). In this case, λ_{max} is approximately *4.046* - the medium of the multiplication values.

Table 3.4: Consistency Matrix Comparison

	Consistency Value
Acceptance	1.818
Flexibility	0.510
Reliability	1.169
Longevity	0.558

With the $lambda_{max}$ now calculated, there is a need to calculate the Consistency Index (CI) through the formula:

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{3.2}$$

the n in this context is the number of criteria used. The result of CI is approximately *0.0153*.

Lastly the CR is calculated like with the next formula:

$$CR = \frac{CI}{RI} \tag{3.3}$$

The RI in this context is the Random Index for the matrix. This value is a constant and can be determined through Table 3.5.

Table 3.5: Random Index Values for square matrices

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

As there are four selected criteria for this evaluation, the matrix created was four by four (4x4), with that in mind, the RI for order 4 matrices is *0.90* as seen on table 3.5. Finally the calculated value for CR is approximately *0.0170*.

With the knowledge that the AHP process is reliable, the next step is to create a comparison matrices for each criteria, assessing the best alternative based on these criteria. These tables will have a very similar creation as the previous ones (Tables 3.6 / 3.7 / 3.8 / 3.9).

Table 3.6: Comparison Matrix between Acceptance in Alternatives

Acceptance	A1	A2	A3
A1	1.000	0.500	0.200
A2	2.000	1.000	0.333
A3	5.000	3.000	1.000

Table 3.7: Comparison Matrix between Flexibility in Alternatives

Flexibility	A1	A2	A3
A1	1.000	3.000	0.333
A2	0.333	1.000	0.250
A3	3.000	4.000	1.000

Table 3.8: Comparison Matrix between Reliability in Alternatives

Reliability	A1	A2	A3
A1	1.000	3.000	1.000
A2	0.333	1.000	0.333
A3	1.000	3.000	1.000

Table 3.9: Comparison Matrix between Longevity in Alternatives

Longevity	A1	A2	A3
A1	1.000	0.500	0.500
A2	2.000	1.000	1.000
A3	2.000	1.000	1.000

Applying the same calculations as before to obtain the relative priority each criteria, the following is done to each alternative in each table (Tables 3.10 / 3.11 / 3.12 / 3.13).

Table 3.10: Normalized Comparison Matrix and Local Priority for the comparison between Alternatives regarding Acceptance Criterion

Acceptance	A1	A2	A3	Local Priority
A1	0.125	0.111	0.130	0.122
A2	0.250	0.222	0.217	0.230
A3	0.625	0.667	0.652	0.648

Table 3.11: Normalized Comparison Matrix and Local Priority for the comparison between Alternatives regarding Flexibility Criterion

Flexibility	A1	A2	A3	Local Priority
A1	0.231	0.375	0.210526	0.272099
A2	0.077	0.125	0.158	0.120
A3	0.692	0.500	0.632	0.608

Table 3.12: Normalized Comparison Matrix and Local Priority for the comparison between Alternatives regarding Reliability Criterion

Reliability	A1	A2	A3	Local Priority
A1	0.429	0.429	0.429	0.429
A2	0.143	0.143	0.143	0.143
A3	0.429	0.429	0.429	0.429

Table 3.13: Normalized Comparison Matrix and Local Priority for the comparison between Alternatives regarding Longevity Criterion

Longevity	A1	A2	A3	Local Priority
A1	0.200	0.200	0.200	0.200
A2	0.400	0.400	0.400	0.400
A3	0.400	0.400	0.400	0.400

For a last step, the previous results are compiled into a new matrix along with an added column named Composite Priority. This column is calculated using these values multiplied with the previously calculated priority vector, indicating, this way, the importance of the alternative (Table 3.14).

Table 3.14: Criteria/Alternatives Classification Matrix and Composite Priority

	Acceptance	Flexibility	Reliability	Longevity	Composite Priority
A1	0.122	0.272	0.429	0.200	0.240
A2	0.230	0.120	0.143	0.400	0.214
A3	0.648	0.608	0.429	0.400	0.545

Analysing this final table (Table 3.14) it can be stated that A3 is the most relevant alternative for this problem.

Idea Selection

Following the creation and development of the previously mentioned ideas, there is now a need to choose which ideas can solve the problem more efficiently. With that in mind, the choice of a good idea is fundamental for a success implementation.

On this project, after a lot of deliberation, using the previously shown framework (AHP), and discussions with the stakeholder, the chosen idea was to go for the generation of points through the use of weekly challenges and leader boards (Alternative 3 - A3).

3.2 Value Analysis

Taking the example of many multinational companies around the world, most of them use gamification systems on their apps to increase, not only interaction between users, but also to attract new users to their systems. That being said, gamification has been evaluated in many different environments and has seen its fair share of successes and failures, as it is, normally, created with a certain demographic of users in mind.

As a first example, looking at the technical giant Microsoft, to increase the number of recurring users that use their learning tool, known as Microsoft learn, they have create a system that would show your knowledge level based on courses finished an attended. This was a huge success, not only among Microsoft employees that would want to refresh their knowledge of their first party tools, but also amidst other users that aspired to be able to use and create projects using Microsoft tools.

Concluding, after analysing the external social environment it can be evaluated that by enhancing the user experience meaningfully with gamification mechanics the website will have an increase in its population.

3.3 Value Proposition

The work proposed is around the creation of a code solution, that will try to enhance the user experience, increase the popularity and upgrade the old employee system that the IP team from Hitachi Solution had put in place.

This will involve, not only programming value, but also the creation of various diagrams and user stories to keep the business updated and notified of the latest improvements done in the branch of the gamified system. In addition, this will involve, also, the creation of a publicity and marketing strategy to peak the employees interest and attention to the newly added features

The aforementioned project will try to bring value to two center bodies of the organization:

- **Business**: Firstly it brings value to the company, as their employees will have a bigger and more in depth code repository which will make the consultants faster to act and react in opportune situations.
- **Employee**: On the other hand, this project will also bring value to the employees, as they will be able to use the developed features to be empowered for the actions that they perform inside of the code repository, making use of their bench time in a more meaningful way.

Concluding, a main point of this proposition will be to create, through code, a self sufficient environment that will bring the employees to use, per their own volition, the application.

3.3.1 Customer Profile

Starting this evaluation off with the customer profile, on this subsection it will be explain in what ways will the customer gain value with the solution, and what pains may this create to the aforementioned individual. In this case, as the project will be a first party system that will be launched exclusively to other employees of Hitachi Solutions, we will categorize the customer as the business and their workforce. With

that knowledge, the Ideal customer of this project is a employee that has downtime and needs work to do, so feels compelled, by the gamification, to work on code projects to enhance the code repository.

Starting on the **gains** side of this exchange, we can quickly identify the positive aspects of this development as being, first and foremost the solution of the problem at hand, this being, a significant increase in user interaction and collaboration, inside of the platform where the code repository resides. This gain is for both of the sides of the customer, as it would greatly benefit the consultant as he would have more support material, and the business as they would have a quicker reaction time to recurring problems.

The second gain that can be identified, is more on the companies side as they would have, as virtue of the gamified employee hub, a more encouraged and problem ready workforce.

To end the gains, we can identify one more gain on the employees side, again, as virtue of the this solution, the user will be motivated to work on this platform on their down time and by doing so they will be awarded with a plethora of rewards that depend on the quantity and quality of the work done, quickly enriching the more knowledgeable consultants

Moving on to **pains**, as is to expect when implementing a software solution there are always some pains to be accounted for and this one is no different. As a first point, it can observed as a possibility that the framework put into place might not be recognized and cherished by the organization, which will possibly lead to only benefit those who were already going to use the application without the new features.

As a second pain, we can take into account the possibility to be over complicating the process of uploading the code resources, which could lead to the opposite of the expected result and decrease the number of users using the platform.

Concluding with the customer jobs, we can evaluate the customer as two being different types: **the business**, the higher ups at Hitachi Solution that want to promote a higher quality of work for the least amount of time which will help them get more consultancy projects in a smaller time frame; **the employee**, the consultant that works at Hitachi that gets periodically sent to client projects and requires code repositories as a helping tool for common errors/issues that might appear.

3.3.2 Value Map

After the identification and recognition of the gains and pains that this solution might bring on board of the previously implemented software, there is a need to move to identify aspects known as pain relievers and gain creators, that will show how to decrease and create, respectively, the aforementioned pain and gain points.

Starting with the **gain creators**, it will be explained and described how products and services create customer gains. As a first gain creator, on the business side, they will have more capacity for more contracts with other companies that need consultancy jobs, therefore not needing to refuse work, as doing so is, normally, not a good idea, as it removes future project options from that enterprise.

As a second gain creator, now on the employees side, they will be able to show work on their downtime. Demonstrating effort is always a great plus for promotions as this will be a way to show the higher ups at Hitachi that they can create extra value to the company.

On other side, with the **pain relievers**, this will describe how the service will alleviate the customer's pain. Starting with the business point of view, they will have less capacity issues, where they would have to refuse business propositions.

While as a second pain reliever, now on the employees side, they will have a bigger and robuster code repository that will help them, when working on client projects, to solve common issues and errors.

3.3.3 Value Proposition CANVAS

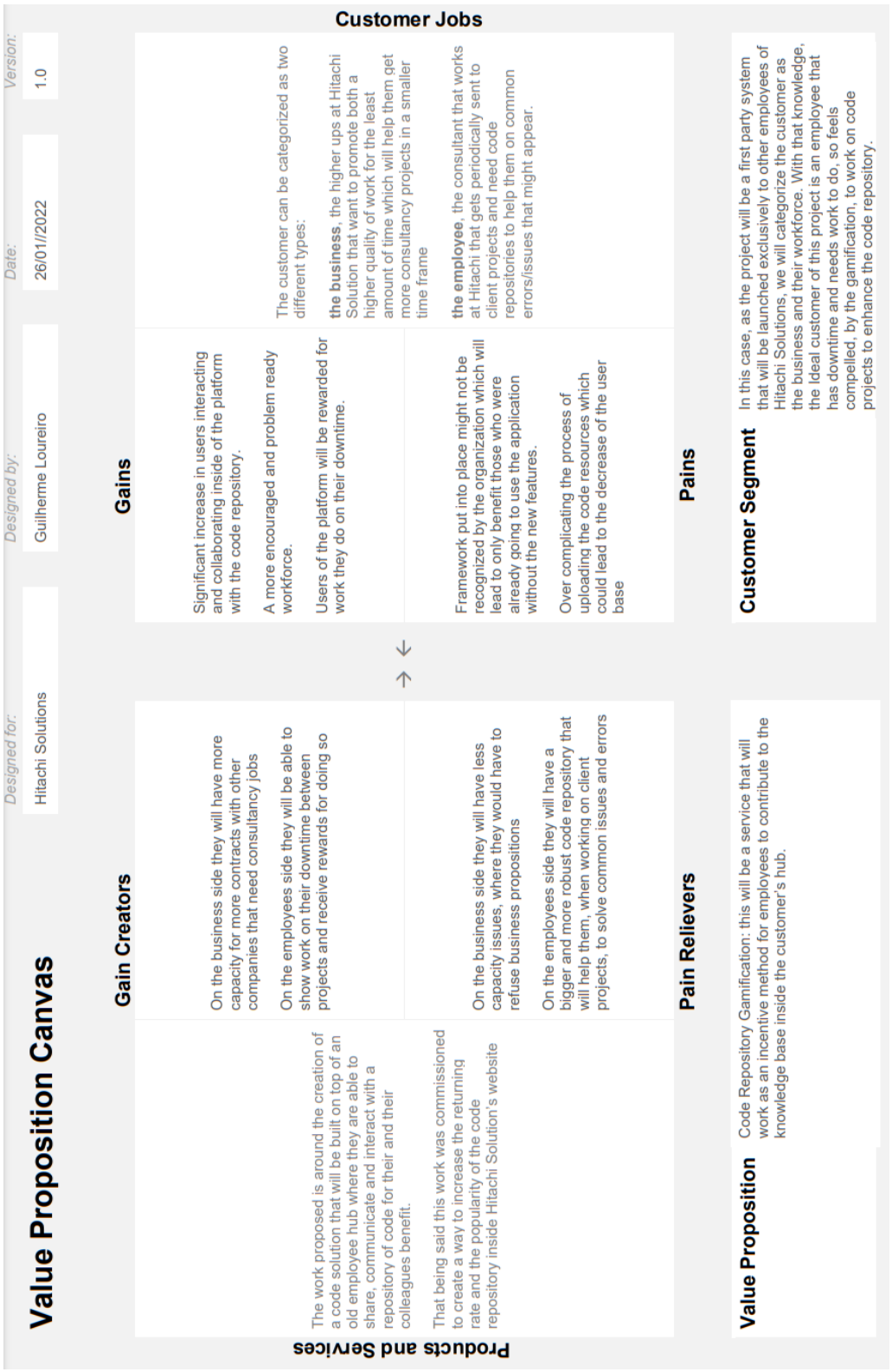

Figure 3.4: Value Proposition Canvas

3.4 Canvas Model

On this section, there is going to be a explanation of the few strategic management steps that need to be taken in order to create a successful solution, with the least pain points for the customer and with a high value creation for the business and their employees.

In an effort to increase the value output, nine building blocks are recognized to be discussed, so to create a big picture of what needs to be investigated and evaluated, in order to have a successful solution.

Business Model Canvas

Designed for:	*Designed by:*	*Date:*	*Version:*
Hitachi Solutions	Guilherme Loureiro	06/02/2022	V1.0

Key Partners

There are, usually, two types os stakeholders, the externals and the internals. As this solution is a first party project, the stakeholders will be, in its majority, internal.
The Stakeholders in this project fall into two major groups:

- the business, which encompasses the IP team and the higher ups at Hitachi. These will help with the development's quality control and with the extraction of data needed for said implementation;
- the employee, the focus point of the solution. Group that will provide feedback on the gamified solution.

Key Activities

The solution will be at home in Hitachi's employee hub, known as solution centre. This will be the place where most of the activities towards the solution will happen.
The gamification project will empower the customer to get their needs satisfied by contributing to the community's code repository.

Key Resources

The key resources needed will be storage space on the company's database and diversified rewards to satisfy the users.

Value Propositions

The project will try to bring value to two centre bodies of the business, firstly it brings value to the company, as their employees will have a bigger and more in-depth code repository which will make the consultants faster to act and react in opportune situations.
On the other hand, this project will also bring value to the employees, as they will be able to use the developed features to be awarded and rewarded for the actions that they perform inside of the code repository as a possible gamified aspect and incentive for it.

Customer Relationships

The customer expects an informal relationship created between peers. With that in mind, as this solution will be created with the customer's needs as a main focus, they will be able to provide feedback through a manner of channels that will let them be empowered with the tools to help and change the development and implementation of the solution.

Channels

The main channel for this solution will be the employee hub where they will be able to both contribute to the gamified code repository and give feedback on the gamification project.
For one-on-one messages the customer will prefer to be contacted through teams.

Customer Segments

As an internal project the customers will be the employees of Hitachi Solutions. This customer segment is constituted by a diversified group of individuals from across the world.
As part of the gamification framework, that will be done during the analysis and design of the solution, the user will have to be described and slotted into better manager their needs.

Cost Structure

The business, more specifically the IP team, will measure the costs of building the proposed solution. That being said, the key activities and key resources will be evaluated and the most expensive will be identified.
The main point of cost here will be, probably, the database space as, it will, most likely, have to be upgraded to a larger one, due to the expected increase in population interacting with the platform.

Revenue Streams

As it is an internal project this will not generate any revenue

Figure 3.5: Canvas Model

Chapter 4

Analysis and Design

Within this section there will be an explanation of what the problem is, the concepts and work ethic that make this project needed and the approach that is going to be used, this strategy has been previously studied and chosen on the last chapter based on important business criteria.

In the following chapter there will be a lot of concepts that are directly related to both consultancy and technological ways of working.

To understand the problem on hand, there is a need to understand the work life cycle in Hitachi Solutions, that being said the following description will be based on only technical consultants as those are the main focus group of this thesis. The consultant after entering the company and undergoing induction and training is then positioned on bench, this is where approximately thirty percent of the consultants of the company are, while the other seventy percent of employees are working on client projects building out technical solutions. This works through a rotation status of different consultants so to not overwork a particular individual.

While on bench the collaborator keeps himself busy by working on their personal skills and taking certifications (Microsoft certifications that increase both the employee and the company's status within Microsoft's partnership program), yet the practice still feels that a lot of this work is usually not very well monitored and sometimes not rewarding enough to push the employees to give their all on their self study time.

4.1 Methodology

In before identifying and analysing the components of the various functional and non-functional requirements on the following sections of this chapter, there is now

a need to organise and construct a plan using the knowledge acquired on the State of the Art chapter by applying the more adequate framework to draw up designs alternatives.

The Framework chosen for that job was the *Octalysis* due to its extensive work surrounding the player, its needs and also due to being the more complete of all other analysed methodologies.

4.1.1 Octalysis

During this step there will be first a evaluation of the core drives (or motivators) that are more important for the future user base of this application. Later, these motivators are used to create mechanics that will be developed and therefore brought to the users during the test phase of project.

Main Motivators

In here the motivators were put to the test and balanced based on the sentiments of the users and their reactions to a few features already implemented throughout the system. Another point, that was taken into account, was the expected user's salary and rank within the company.

In the following graphic (4.1) it is possible to see the most valuable motivators that will push users to use the solution, these were very heavily based on the company where this is being implemented, Hitachi Solutions being a technology consultant it highly promotes the collaboration within the company in order of winning clients and projects. With that in mind it is believed that for an employee to feel like he is working towards something bigger he requires to feel in power and that his actions actually matter within the system.

With all this in mind it was decided that the following four (while still varying in importance) are the main core drivers for the expected user: **Meaning**; **Empowerment**; **Social Influence**; **Unpredictability**

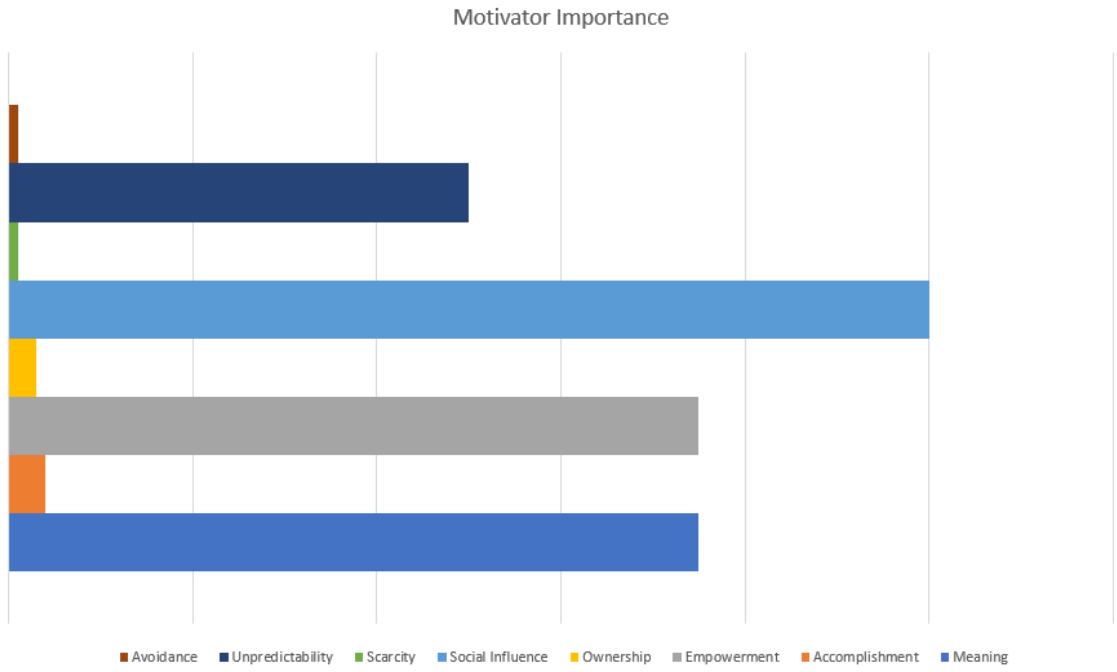

Figure 4.1: Main Motivators

Features based on Motivators

- **Meaning**: The epic meaning that can be found on this solution will be the same as is found in the value of maintaining a forum for a certain community. The player will feel like he is building to create something and towards something bigger. This will be translated by their possibility to upload code pieces against the system.
- **Empowerment**: In a way to empower the players, they get placed in a gamified system that encourages them to get involved with its mechanics, by giving them control of how a major part of the system will work, this being the creation of challenges for other users. On this solution users will have the possibility to create challenges, code pieces and rewards which allow players to feel like in charge of the whole ecosystem of the solution.
- **Social Influence**: The social impact on this gamification will be of higher importance once that it will require for all users to work in an closed environment where some users will create challenges and download/approve the code solutions while others will be creating them and uploading them to the previously created challenges.

- **Unpredictability**: As a side effect of this solution being built around a social/human environment, this will implement unpredictability due to how the player can promote more or less the use of the platform in different periods of time (e.g. the amount of challenges available in a given week).

4.2 Domain Model

On this project there will be a need for four tables that will allow the user to create challenges, upload files against them and then receive points and rewards based on the amount of points that they have accumulated.

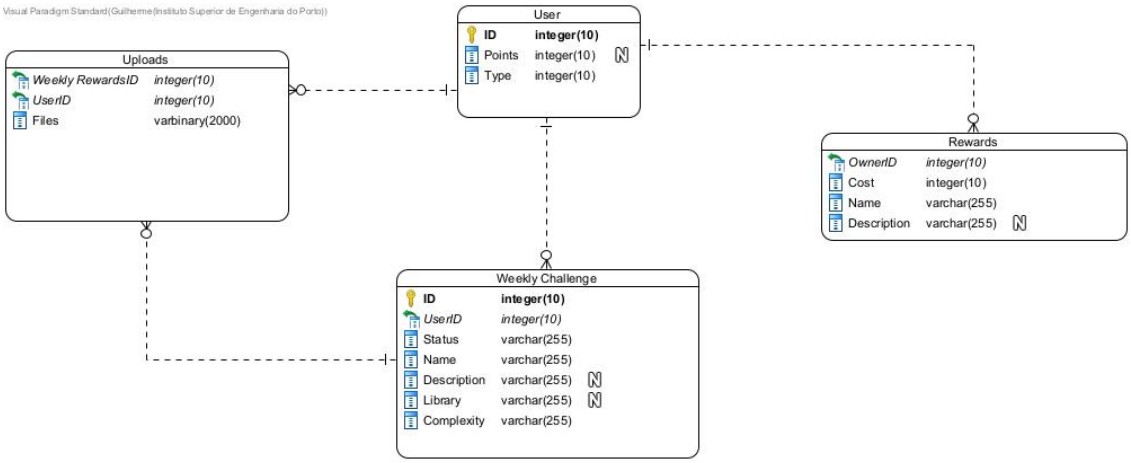

Figure 4.2: Data Model of the Azure Storage

4.2.1 Preferred Approach

To approach this problem and create a successful web solution, having in consideration the good practices of computer science and engineering, it was decided that there are few steps that should be followed to achieve positive results.

Firstly, for reporting purposes a query should be ran against the database system that the web solution is utilizing so that the initial interaction data can be stored and later compared with the information at the end of the process.

Secondly, to follow good practices, a process of identification and design of user stories and user paths will be accomplished, this will include also the creation of mock-ups as well as various diagrams to state what tables and screens will require changes to achieve the Gamification on already implemented solution.

After having all the preparations for the development fulfilled, the implementation should kick off on Hitachi Solution's system. This solution uses Vue and VuePress as JavaScript library for the front-end, Node.Js as a back-end JavaScript run-time environment, Azure as a Database structure and DevOps as a tool to both organise the git repositories and user stories. The development will be achieved through a system of "sprints" guided by user stories created and estimated previously.

In order to maintain code quality and functionality, all code will have to go through test phases, which will first go through the approval of the in-house product team and then, later, by the QA test teams.

Lastly, the system will be reinstated and promoted to the firm's consultants to demonstrate the changes that were created as result of this Gamification project. After a couple of weeks the same collection of queries that were ran on the database initially will be ran again to understand if there was a new influx of users interacting with the system.

4.2.2 Usability

To create this solution there will be done a development in the JavaScript library known as Vue, as one of the three biggest front end libraries and due to being created on top of JavaScript it has many useful connections with other systems, which creates a very dynamic and fast development. Along these connections there is one that can be highlighted such is the connections to the back end in Azure, this is very important for its usability as Azure is a Microsoft technology that helps the developers maintain, edit and query very easily as it has a very comprehensible graphical user interface increasing the speed of development.

4.2.3 Interface

For this project the interface is one of the moving parts that is most important for its success. By analysing today's trends in both graphical user interfaces and graphical design it can be shown that most users desire a minimalist and quick interface that would help them get from the start position on the website to their final destination in the less amount of clicks and pages.

Taking this into account the desired interface must be populated with less crowded text and with popup dialog boxes instead of changing pages that would disorient the user when using the application.

4.2.4 Stakeholders

This being an internal project makes most of the stakeholders internal, individuals that come from within the business. Inside Hitachi Solutions, the team that is tasked and employed to produce this type of internal projects is their intellectual property (IP) team.

The IP team, which is the team that, normally, identifies and builds features and improvements on the internal website, will be the main stakeholders of this project and will partake in the bi-weekly meetings to understand the development and construction flow of the overall solution.

4.2.5 Restrictions

As the solution will be built on top of a preexisting website the technological improvements will need to follow a development pattern already designed. Also the technologies that are able to be used to build this solution will have to be coherent and compatible with the previously built solution.

4.2.6 Relevant Technologies

Over the development of this project, a set of technologies will be used to achieve the preferred solution. As this project will be an enhancement of a already built solution, and not a brand new project, many of the software choices needed to be aligned with the previous team that developed the base code repository. The following list will identify and define the technologies that are going to be used for the implementation phase:

- **Vue**: *front-end* framework that focus on helping developers build professional and dynamic user interfaces. This technology works by combining the power of JavaScript and HTML, making constructing responsive interfaces easier then with pure *HTML* and *CSS* (Vue 2022). Adding to this technology, the solution also resorts to using VuePress, a static site generator that was built to support the documentation of Vue projects. Websites powered by *VuePress* are, normally, single page applications (*SPA*) that, during build, generates, on the server's side, a routing table for the whole website (VuePress 2022b).
- **Azure Storage**: This platform build by Microsoft is a *NoSQL* database that will work as the backbone of the application. The core storage services of

Azure Storage are, a massively scalable object store for data objects, disk storage for Azure virtual machines (*VMs*), a file system service for the cloud, a messaging store for reliable messaging, and a *NoSQL* store (Microsoft 2021). Having that in mind, as Azure Storage is a *NoSQL* database it means that it doesn't support *SQL* queries, which means that most of the support and report done on Azure databases is through the website *Azure Portal*. On a last note, the *NoSQL* design is, normally, done due to the need of a simple design and a finer control over availability.

- **Node.JS**: As a support for the *back-end* of the website, Node.JS is a framework that is, usually, created to build servers to hold the various *front-end* solutions built on top of it. As an *asynchronous event-driven JavaScript runtime, Node.Js* is designed to build *scalable* network applications (Node.JS 2022). This framework helps the developer with creating solutions without the need of threads, the possibility of callback functions, and a protection against possible deadlocks on the system.
- **App Insights**: Similarly to the Azure Storage, this technology is also created and developed by Microsoft, having, that way, built in compatibility with the database of choice. *App Insights* is a tool used for collecting, analyzing, and acting on telemetry data from the used Azure environments. This helps the developer to have a notion of the activity and traffic inside the different website pages and their respective interactions/features.
- **TailWind**: This framework built on top of CSS is a powerful tool to better maintain and manage the CSS classes created along the development of the solution. This software is a great help for the developer, so to easily access previously created classes and apply those directly inside HTML tags for a easy code reading experience.

4.3 Functional and Non-Functional Requirements

In this section there will be a presentation of requirements that were identified by both the developer and the business. This requirements will be function and non-functionals, the first will be demonstrated through the form of user stories that represent each requirement, while the second one will be evaluated through the use of a methodology known as FURPS+.

4.3.1 Functional Requirements

After much discussion with the business and the stakeholders, many functions were identified as a sort of a skeleton of the solution that was needed by the business. Following that, user stories were build around the features, these were the following:

User Story 1 - Setup Rewards

- **Persona**:

  Administrator

- **Description**:

  As an Administrator I want to be able to setup different rewards, this may include deletion and addition of new rewards.

- **Acceptance Criteria**:

Given I am an Administrator **When** I want to setup the rewards **Then** I will be click a button that will prompt a dialog box **And** I will be able to choose between adding or deleting a reward **Given** I am an Administrator **When** I choose to add a new reward **Then** I will be shown a screen that will ask me to enter the following information: - Reward Name; - Reward Description; - Reward Cost; **And** I will be able to confirm and create a new reward **Given** I am an Administrator **When** I choose to remove a reward **Then** I will be shown a screen that will ask me to confirm if I want to delete that item **And** I will be able to confirm delete it

- **Sequence Diagram** :

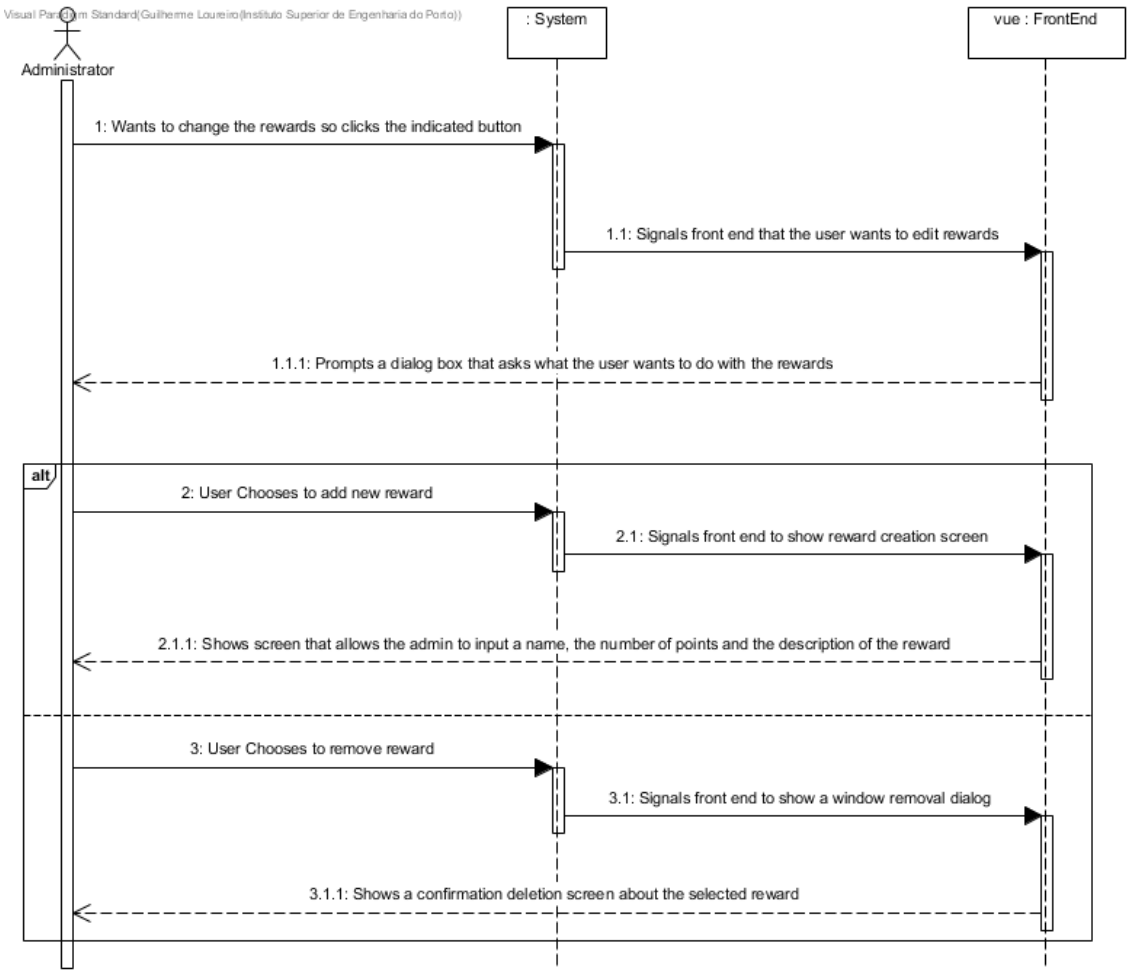

Figure 4.3: US1 Sequence Diagram

User Story 2 - Setup Point Values

- **Persona**:

  Administrator

- **Description**:

  As an Administrator I want to be able to setup different point rewards for different actions

- **Acceptance Criteria**:

Given I am an Administrator **When** I want to setup the point rewards for the different actions **Then** I will click a button that will prompt a dialog box will all the point related actions **And** I will be able to change the values accordingly

- **Sequence Diagram** :

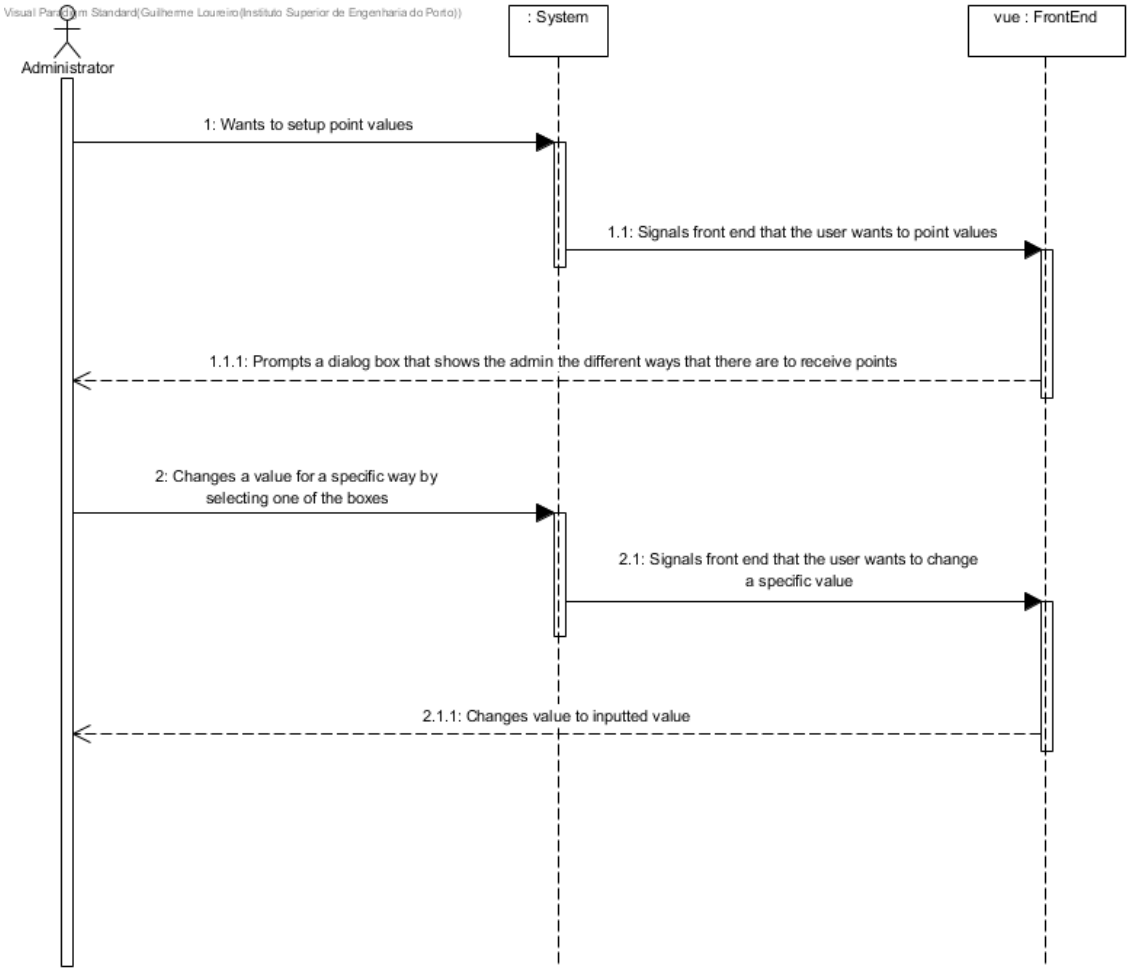

Figure 4.4: US2 Sequence Diagram

User Story 3 - Add Weekly Challenges

- **Persona**:

  PCF User

- **Description**:

  As a PCF User I want to be able to add weekly challenges to show the contributor community what types of PCFs I require for my projects

- **Acceptance Criteria**:

Given I am a PCF User **When** I choose the add a new weekly challenge **Then** I will be shown a dialog window with the following information that needs to be filled in: - Challenge Name; - Front-End Library; - Week Picker; - Complexity of the work; **And** I will be able to confirm and create the new Challenge that will be posted on the PCF Gallery

- **Sequence Diagram** :

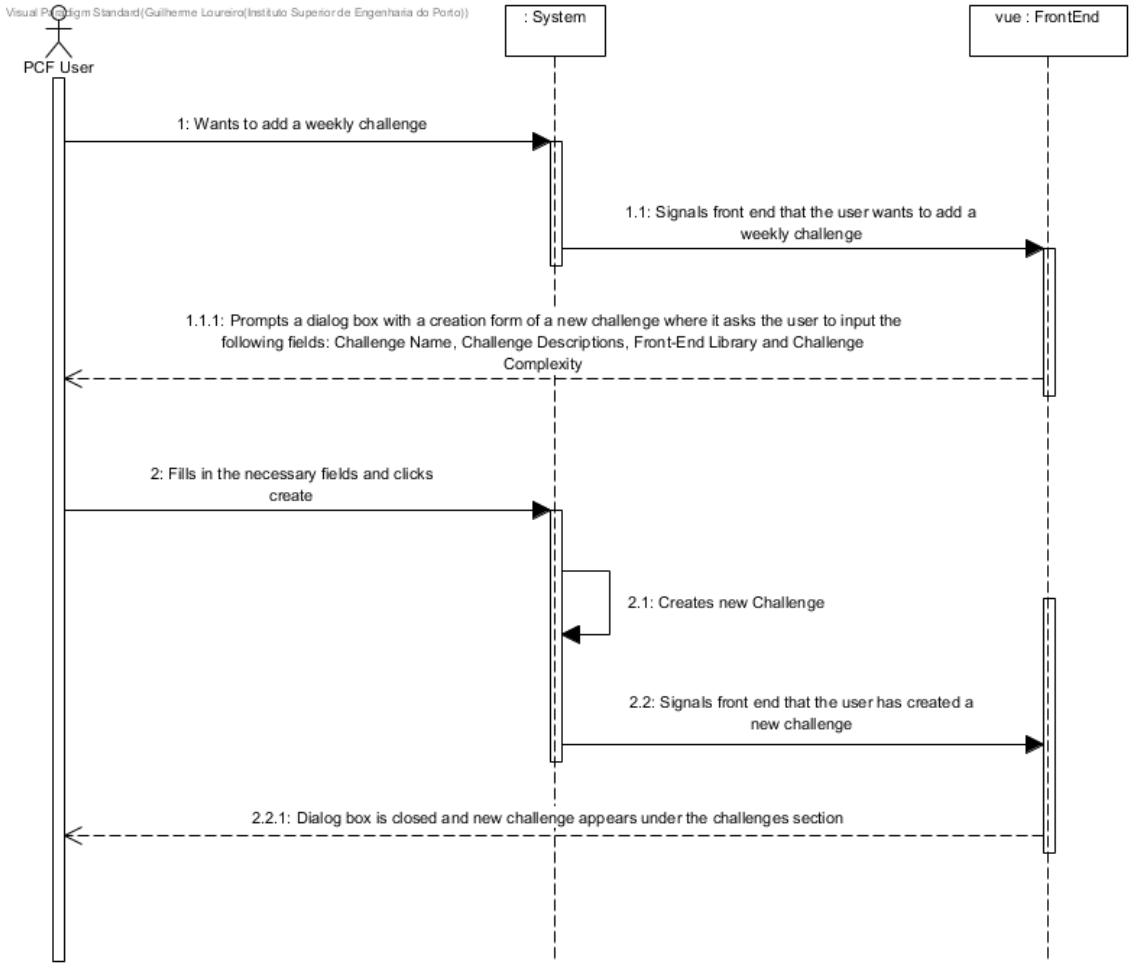

Figure 4.5: US3 Sequence Diagram

User Story 4 - Like a PCF

- **Persona**:

PCF User

- **Description**:

  As a PCF User I want to be able to like the PCFs that I enjoy and use the most that way giving extra points to the Contributors and driving them to create more PCFs like it for the Gallery

- **Acceptance Criteria**:

Given I am a PCF User
When I see a very useful PCF I want to be able to like it to reward the creator
Then I will click the Like Button
And I will give the contributor extra points for its creation

- **Sequence Diagram** :

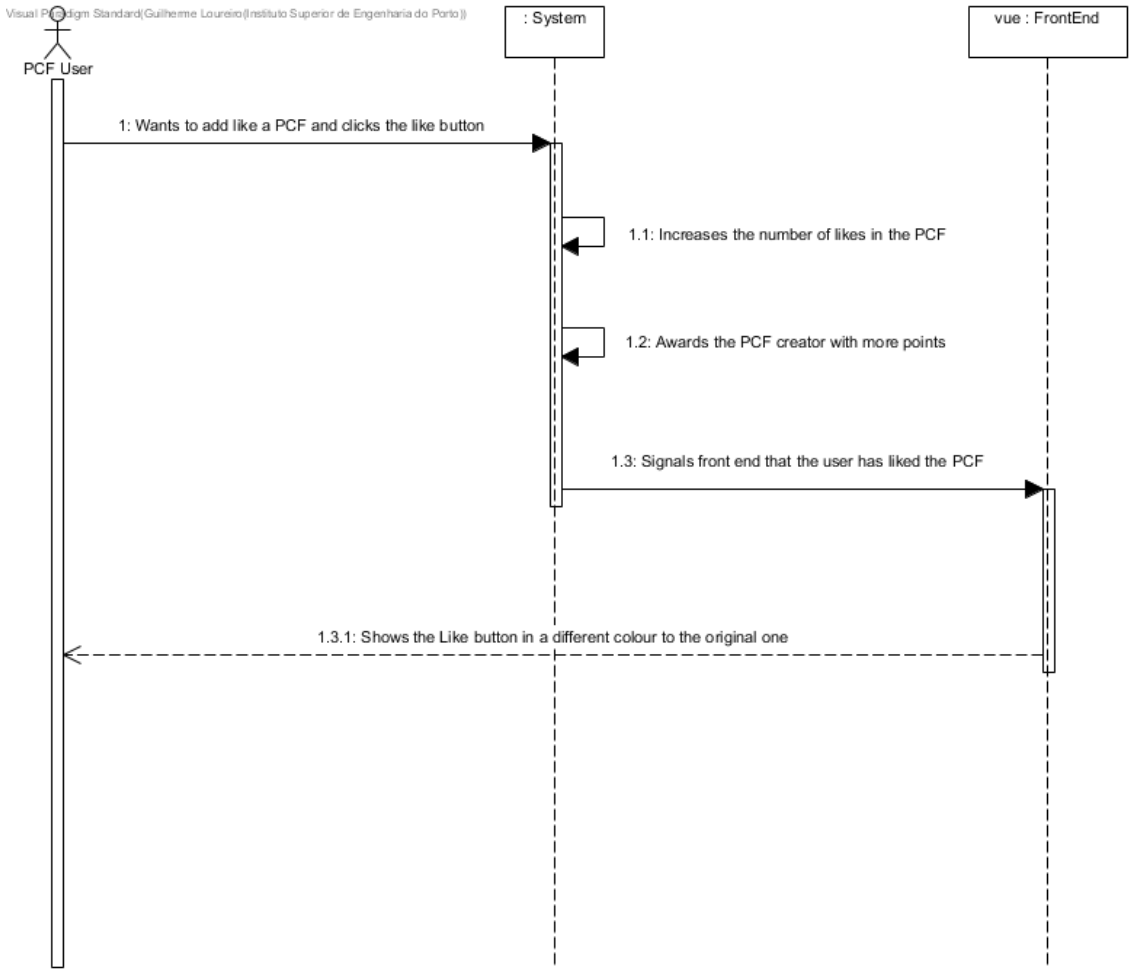

Figure 4.6: US4 Sequence Diagram

User Story 5 - Upload PCFs against weekly challenges

- **Persona**:

  Contributor

- **Description**:

  As a Contributor I want to be able to upload a PCF solution against a weekly challenge so that it would notify its creator that he has a PCF readily submitted and awaiting approval

- **Acceptance Criteria**:

Given I am Contributor **When** I click the submit against button on a challenge **Then** I am shown a screen where I will have to fill the following fields: - PCF Name; - PCF Description; - PCF solution (.zip format); **Then** after submitted it will ping the Creator of the Challenge **And** I will await its approval

- **Sequence Diagram** :

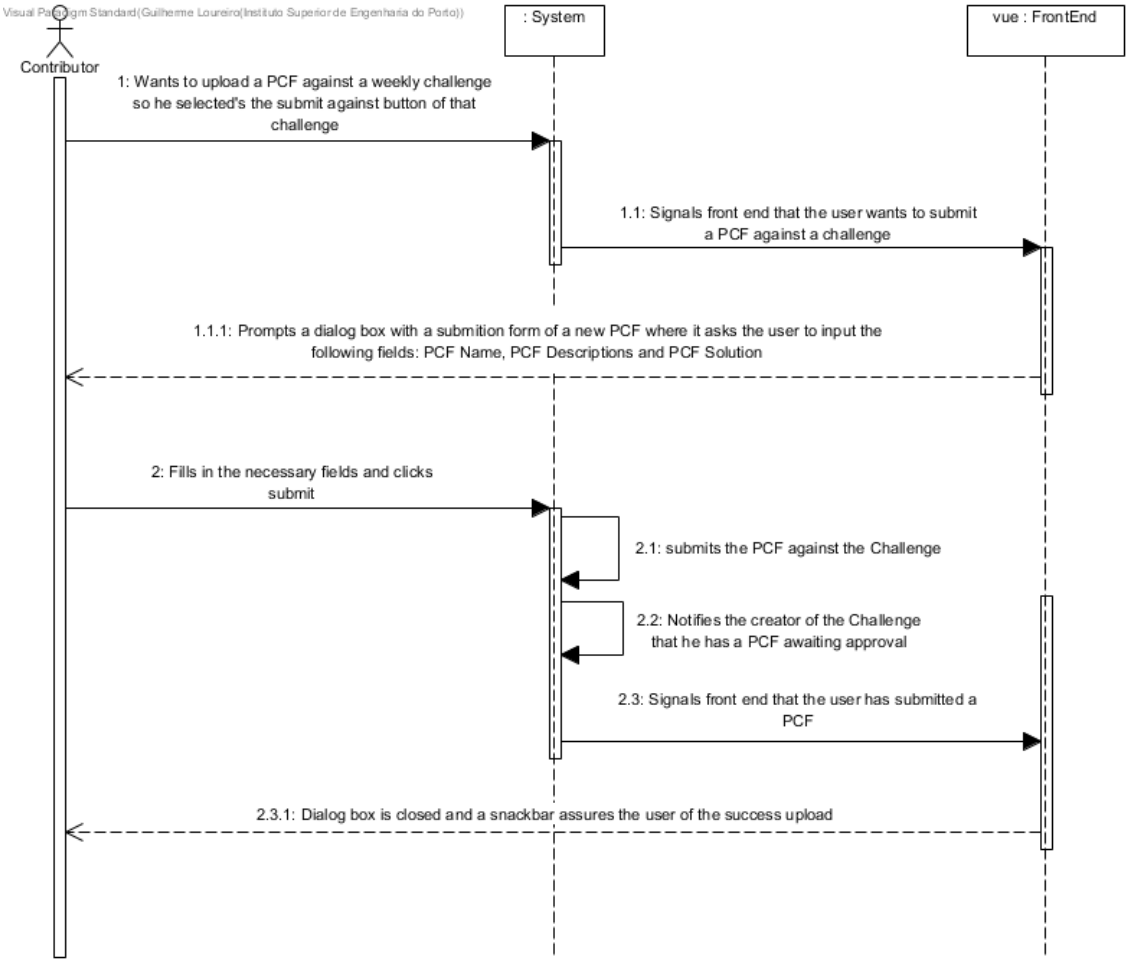

Figure 4.7: US5 Sequence Diagram

User Story 6 - Use Points to redeem rewards

- **Persona**:

  Contributor

- **Description**:

  As a Contributor I want to be able to use the points that I have been awarded by completed various actions on rewards

- **Acceptance Criteria**:

Given I am a Contributor
When I click on the rewards section
Then I will see various rewards where I can spend my points
And I will be able to select one and have it purchased with my point balance

- **Sequence Diagram** :

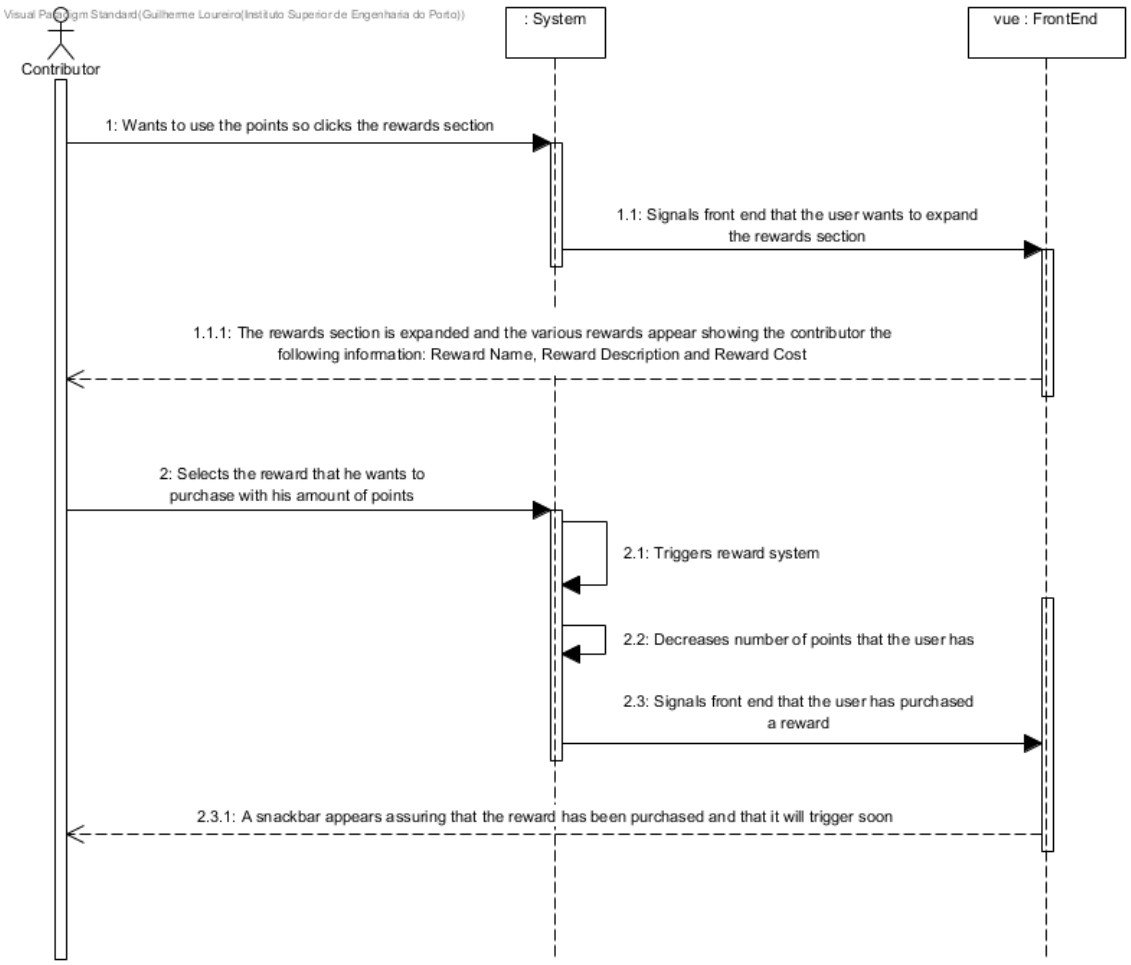

Figure 4.8: US6 Sequence Diagram

User Story 7 - Approval of the weekly challenge PCF

- **Persona**:

  PCF User

- **Description**:

  As a PCF User I want to be able to confirm and approve/reject PCFs that are submitted against my challenges

- **Acceptance Criteria**:

Given I am a PCF User
When I get notified that a PCF was submitted against my challenge
Then I will be able to download it
Then I will be able to test it
And I will be able to approve it and close the challenge or reject it and keep it going

- **Sequence Diagram** :

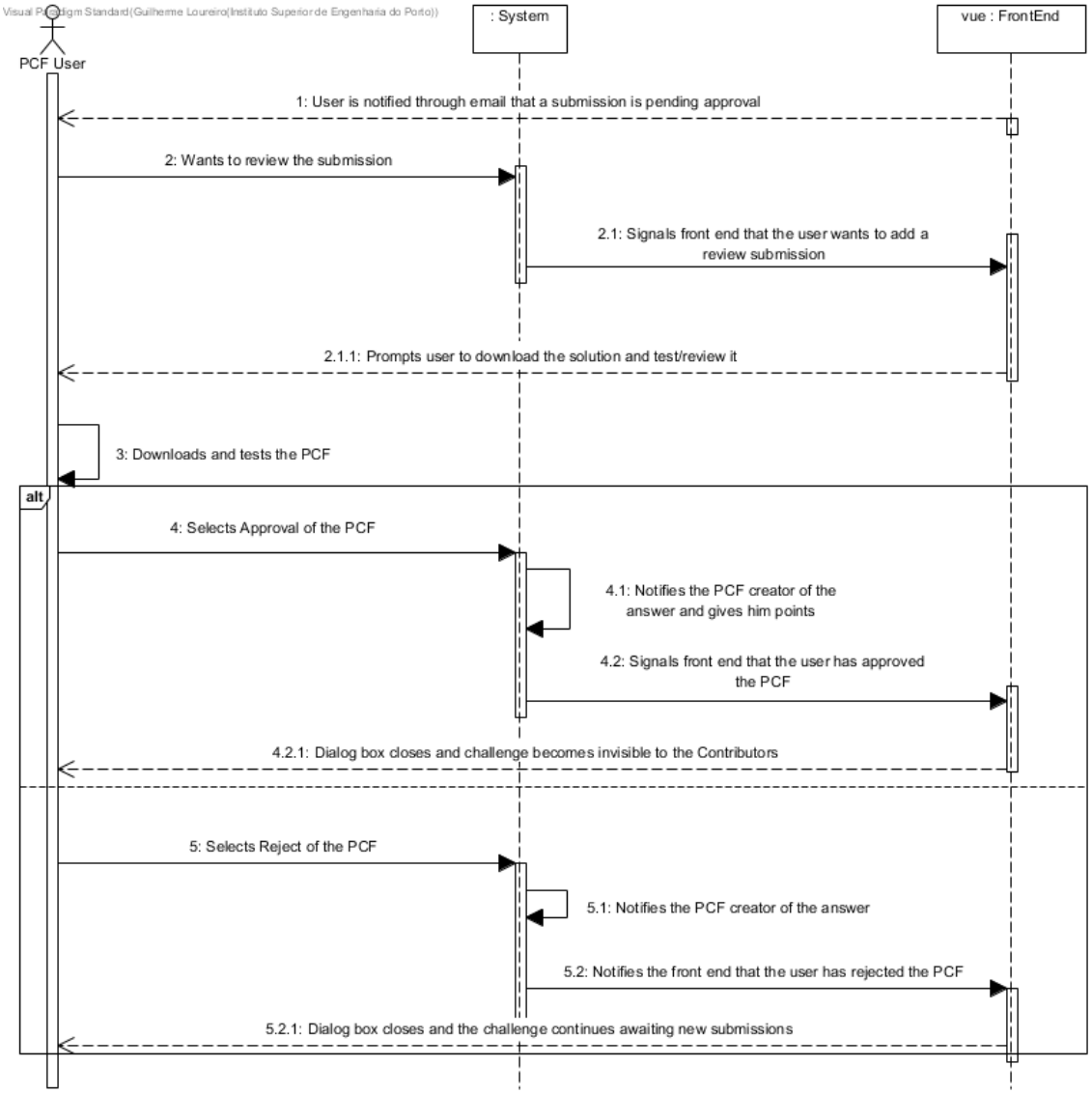

Figure 4.9: US7 Sequence Diagram

4.3.2 Non-Functional Requirements

On this section the non function requirements will be identified and explained through the method *FURPS+*, this framework helps software analysis and design as it helps distinguish the various elements that need to be taken into account and evaluated while designing a solution to a problem. *FURPS*, is an acronym that stands for functionality, usability, reliability, performance and supportability. The plus sign on *FURPS+* alludes to the constraints of the solution.

Functionality

Functionality represents all the features that weren't stated on the functional requirements due to its system wide impact that couldn't be separated and isolated on a single user story. The identified requirements are the following:

- The solution must integrate all the previously built systems on the employee hub;
- The gamified solution must be integrated with the already implemented data base;

Usability

Usability represents the requirements that involve user interaction with the system. The identified requirements are the following:

- The interface must be simple and quick to understand;

Reliability

Reliability represents the requirements that are associated with the system keeping its performance and precision. The identified requirements are the following:

- All errors must be taken cared of with understandable error messages;

Performance

Performance represents the requirements related with response, recovery and startup times of the software. The identified requirements are the following:

- All added features must respond accordingly within the maximum accepted time (less then 10 seconds);

Supportability

Supportability represents the requirements associated with the capacity of the system to be configured or compatible with other systems. The identified requirements are the following:

- The solution must work on any majorly available browser;

Restrictions (+)

Restrictions represents the requirements related with impediments, may this be physical or digital related with the solution. The identified requirements are the following:

- The technologies will have to be coherent and compatible with the previously built solution;

4.3.3 User Diagram

Based on the previously described user stories and personas that will work with the user stories, this user diagram (4.10) was created so to show what each type of user was in charge of.

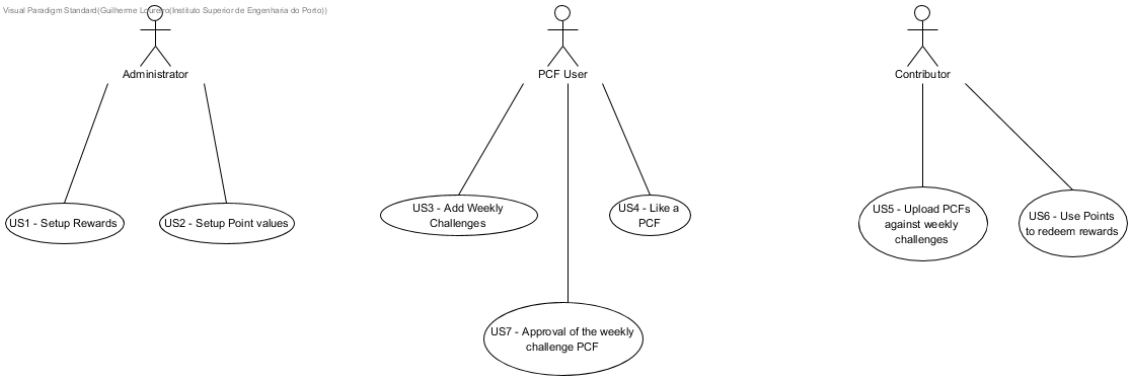

Figure 4.10: User Diagram

4.4 Design Decisions and Alternatives

Based on previous planning with both methodologies and frameworks the following alternatives and user interfaces were chosen as the more appropriate to get the job done on a good and professional matter.

Represented here on this section are also Mock-Ups of the interface. Mock-ups are a way to draft up a Graphical User Interface (GUI) without any development or implementation to show the stakeholders what the future look and feel of the application will be (4.11).

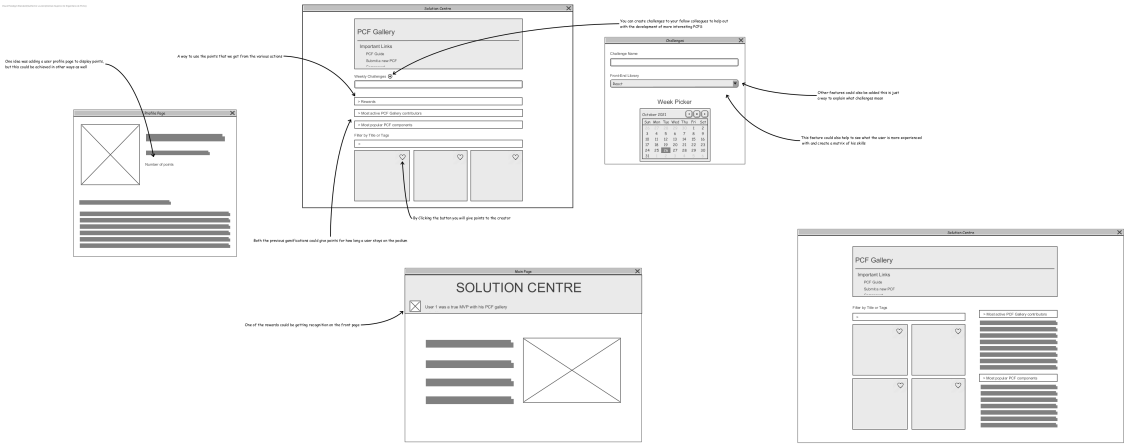

Figure 4.11: Mock-up of the Graphical User Interface (GUI)

With that in mind, moving now to the designs decisions, at a first point after analysing the various user stories there was a point that stand out, that being the empowerment of the user and how this would be able to play into the gamified solution. That being said a User menu was mocked so to mainly show the users information and the amount of points they had accumulated (4.12).

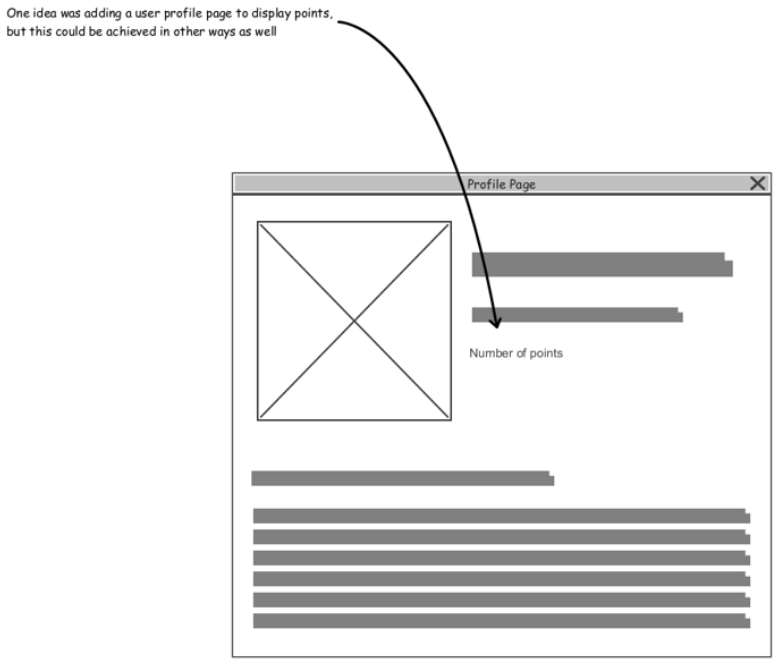

Figure 4.12: Mock-up of the Profile Menu

Yet this design later fell through due to deviating and taking focus off the main piece, that being the gamification, by moving the user away from the gamified solution he would have to click back to get on track which noticeably would break the flow of the process. As sum, the point system is now displayed on the main menu and most of the interaction will be done through dialog boxes.

As an example of this premise the following Mock-up, of a dialog box, was created to help the user create new challenges, this draft would allow the user to fill in a form and create a challenge that would be posted against a section or board on the main repository page (4.13).

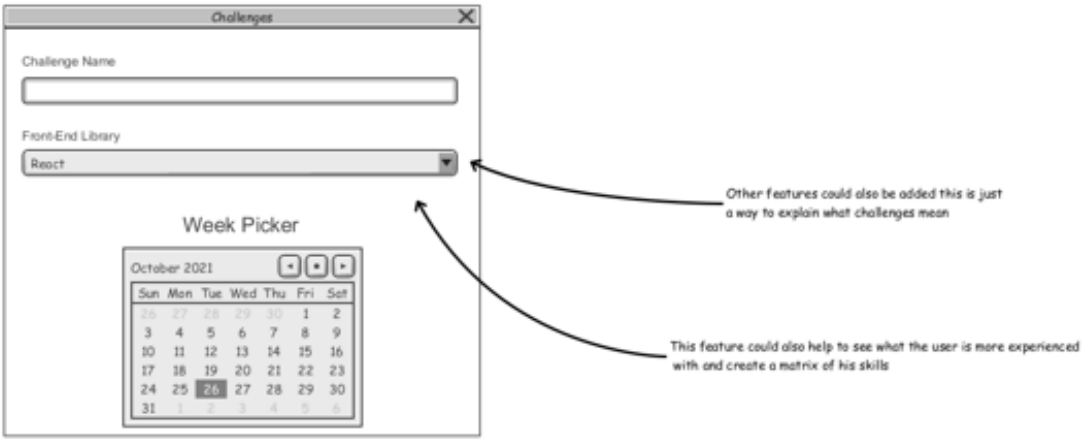

Figure 4.13: Mock-up of the Create Challenge Dialog Box

After that a new Mock-up was created to represent how one of the rewards could come across to the rest of the company, this reward would involve changes on the main application screen where the employee that purchased the reward would able to promote himself and his achievements to the rest of the company, making him better known and more prompt to be invited to client projects (4.14).

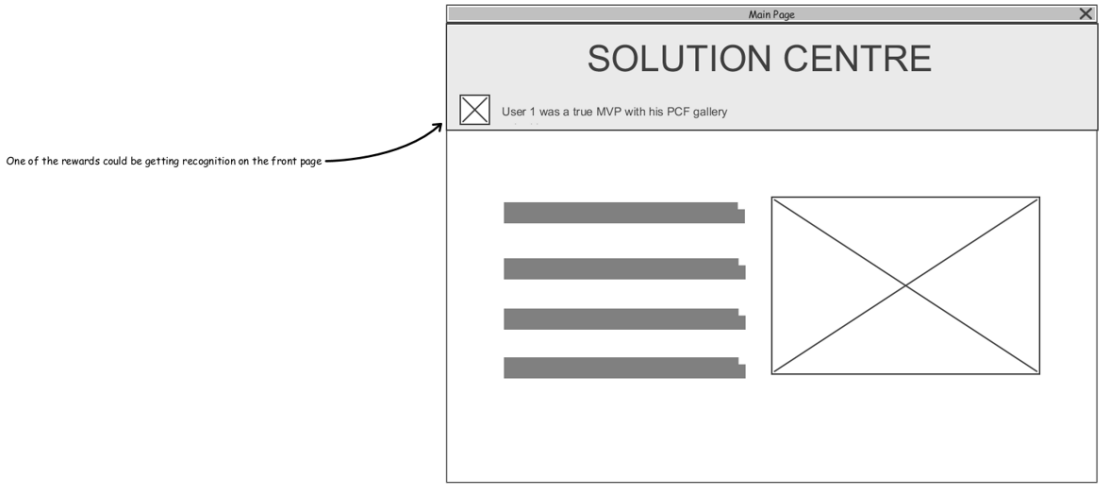

Figure 4.14: Mock-up of a possible Reward

Lastly, the main aspect of the main page that would house leader boards, sections and tabs of the gamification needs to be created and evaluated, for that purpose two designs were presented to the business, design one which would work on a horizontal fashion (4.15) and design two that worked more like a scroll-able single page application (4.16). Through discussion with the business, design two was chosen due to it being able to hold more information and promoting the gamification to the user as it would be the first feature that is showing to the user instead of a more compact / complex user interface like shown on design one.

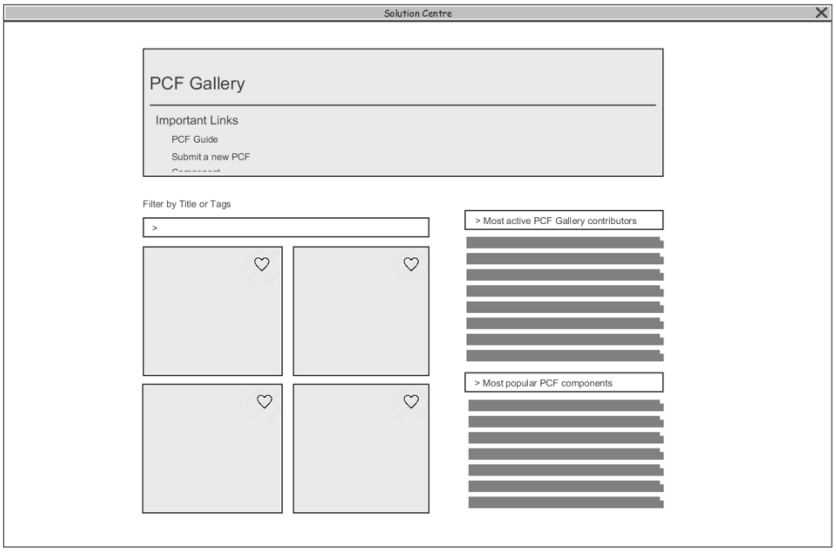

Figure 4.15: Mock-up of design one

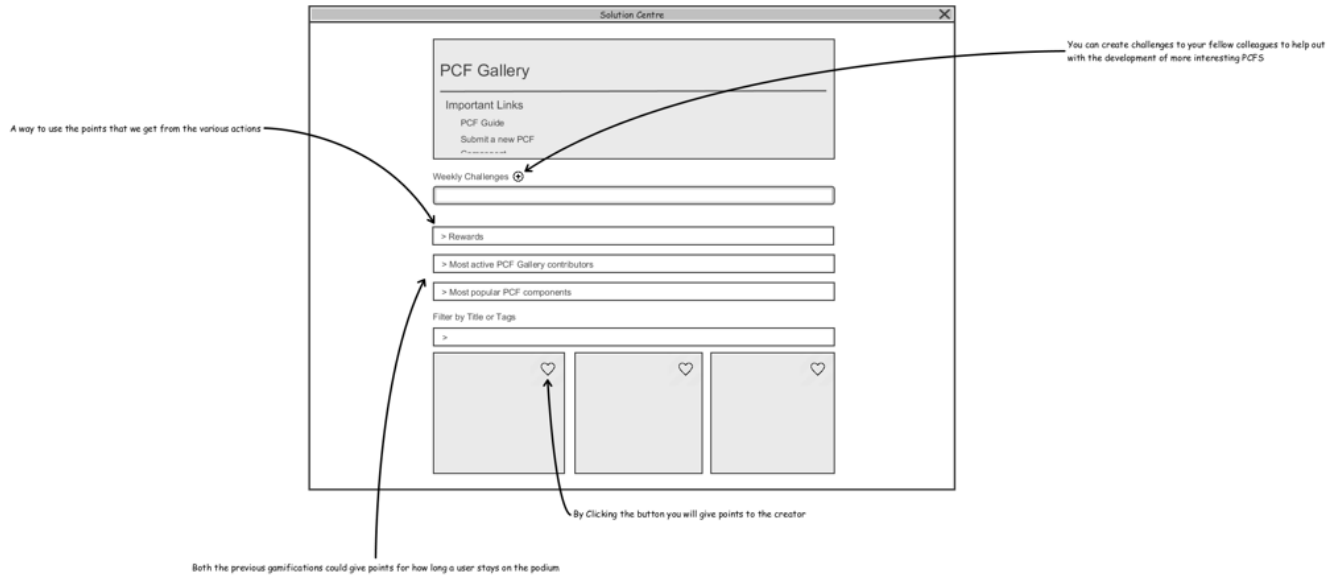

Figure 4.16: Mock-up of design two

4.5 Architecture

Since this work was an addition to a previously built solution of an employee hub there were architecture rules that had to be followed. That being said, the main architecture concept that was followed was based on the *VuePress* for the reason that this technology was responsible for generating the website and reading the *Vue* templates that were created.

Hence, the architecture of the system has two main parts, the **Node App** which generates the temporary files (layouts, pages, routes, etc.) and the **Client App** that reads the previously generates files and turns them into Single Page Application (SPA) (VuePress 2022a).

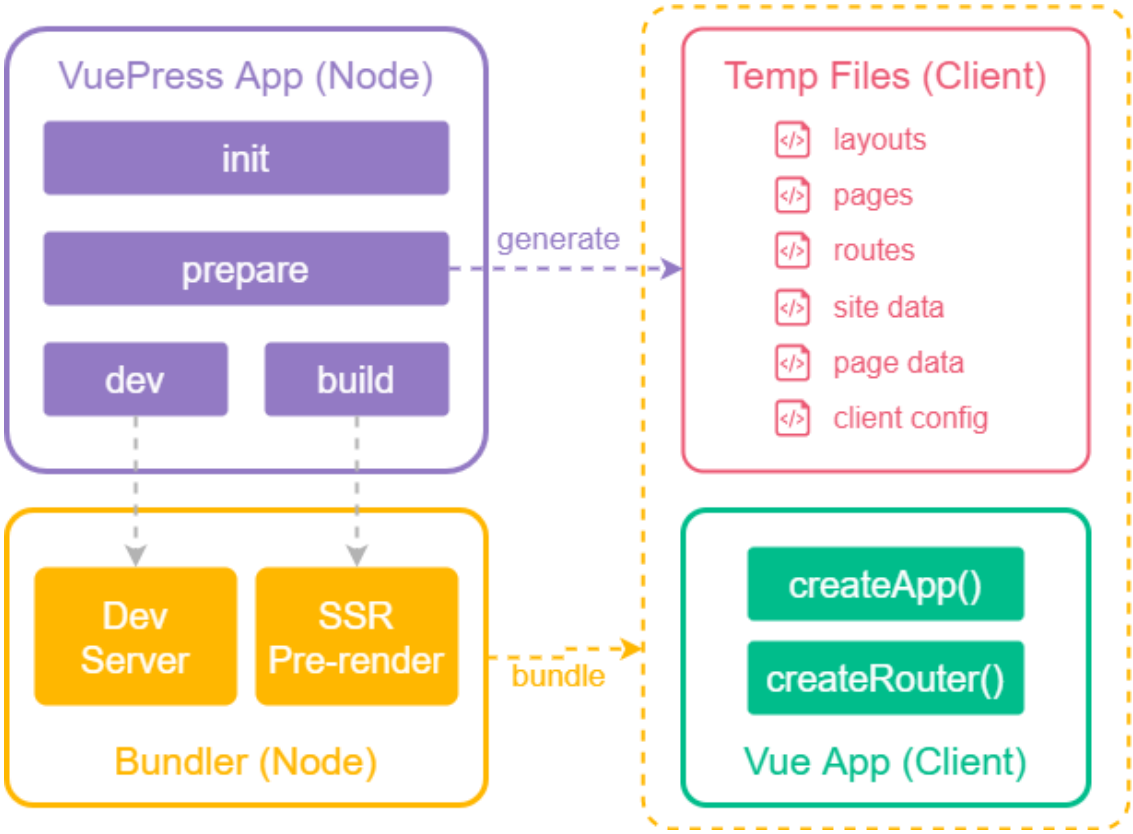

Figure 4.17: VuePress Architecture Overview (VuePress 2022a)

Chapter 5

Implementation

5.1 Component structure and Prototype

Throughout the development of this solution there have been a lot of structural changes to the initial website and in the following subsections there is going to be a focused explanation of each development change done through the various user stories previously presented.

5.1.1 Setup Rewards

In order to attend to the requirement of the admin being able to create rewards and the user to be able to see them a tab (clickable section that servers the purpose of hiding and showing content) was created.

By taking advantage of this new section the user is able to navigate and observe its possible rewards, the amount he needs to purchase it and the amount of points he has (5.1). In addition, by clicking on the name of the reward the user can then open up the reward, in form of a dialog box (graphical control element in the form of a small window that communicates information to the user and prompts them for a response), to read its contents.

On the other hand, the admin is granted permission to two new buttons, besides the ones already described that are also shown to the normal user. These are the button to add new rewards, which prompts a create rewards dialog box and the button to edit said reward (5.2 and 5.3).

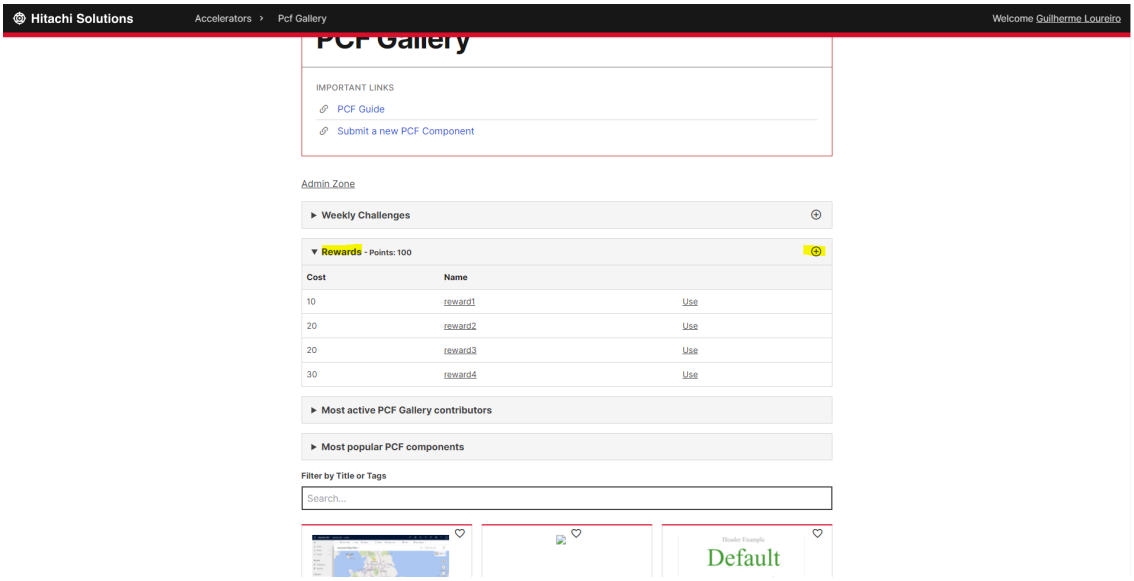

Figure 5.1: New tab on the system to accommodate the rewards section

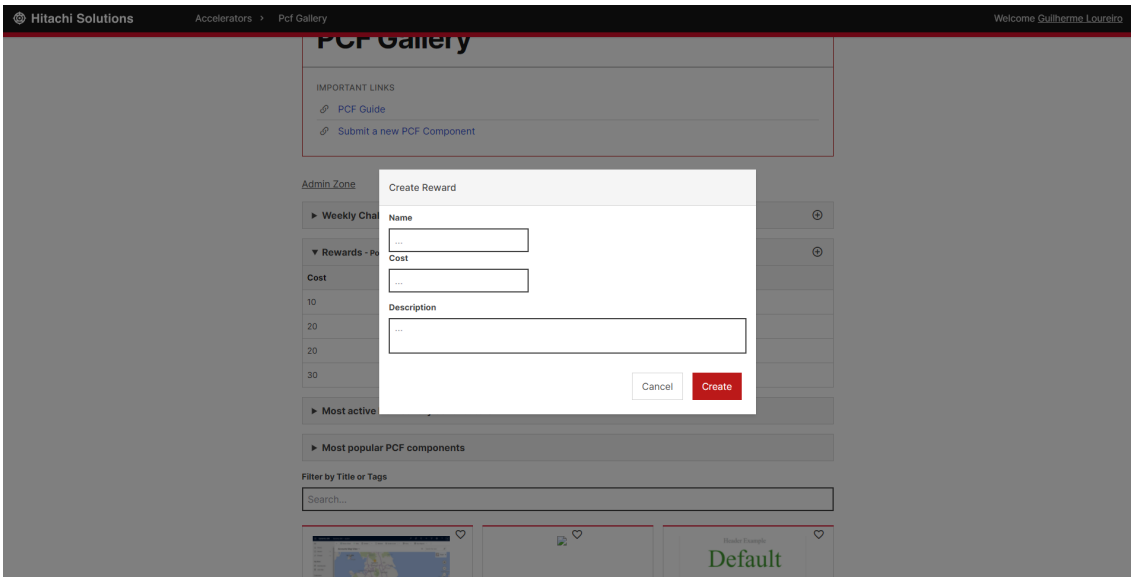

Figure 5.2: By clicking the add button a dialog box will appear to create rewards

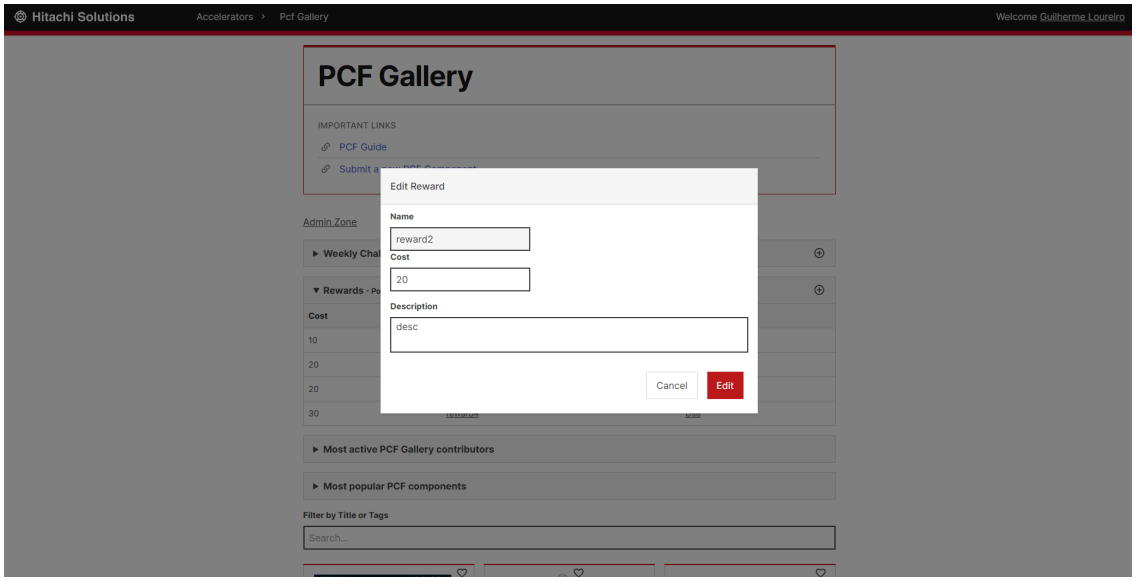

Figure 5.3: Added an edit feature that works by clicking on the reward's name

5.1.2 Setup Point Values

With the rewards now added to the system and available to be purchased by the users, there was a need for the admin to be able to control the economy of gained currency throughout the web application. As such, an admin zone was created as a dialog box, where the admin is able to decide how many points are awarded for each of three actions (5.4).

Through this panel the admin can setup the points gained by the user. At the moment, the user can gain points for having their post (code project) liked, for being able to successfully complete a weekly challenge and lastly for being able to stay on the top of the leader board at the end of the month. All the values for each of these actions can be modified and updated per the admins choosing.

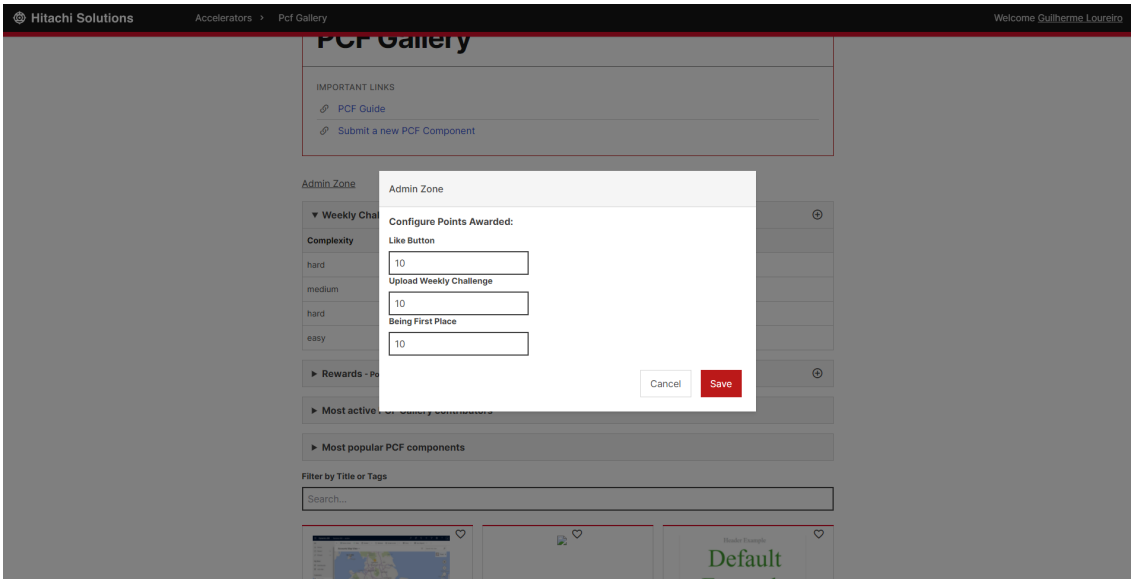

Figure 5.4: New dialog box on the system for the admin configure the point system

5.1.3 Add Weekly Challenges

In order to maintain consistency throughout the system, to setup challenges, the same principle as the rewards was followed.

As such, three elements were developed, one tab to show the various challenges and to serve as a launching pad to the other two elements (5.5). One element appears when clicking on the add button that would let the user create challenges through a dialog box (5.6) and the other element shows up when clicking the name of the challenge that would allow the user to edit (if he was the owner of said challenge) or upload a code project against it (if he did not create the challenge) (5.7).

While very similar to the rewards, the challenges are able to be created not only by the admins but by the PCF Users as well, a persona which relates to a user that contributes to this code repository in both downloading the projects but also creating and approving the projects against their challenges.

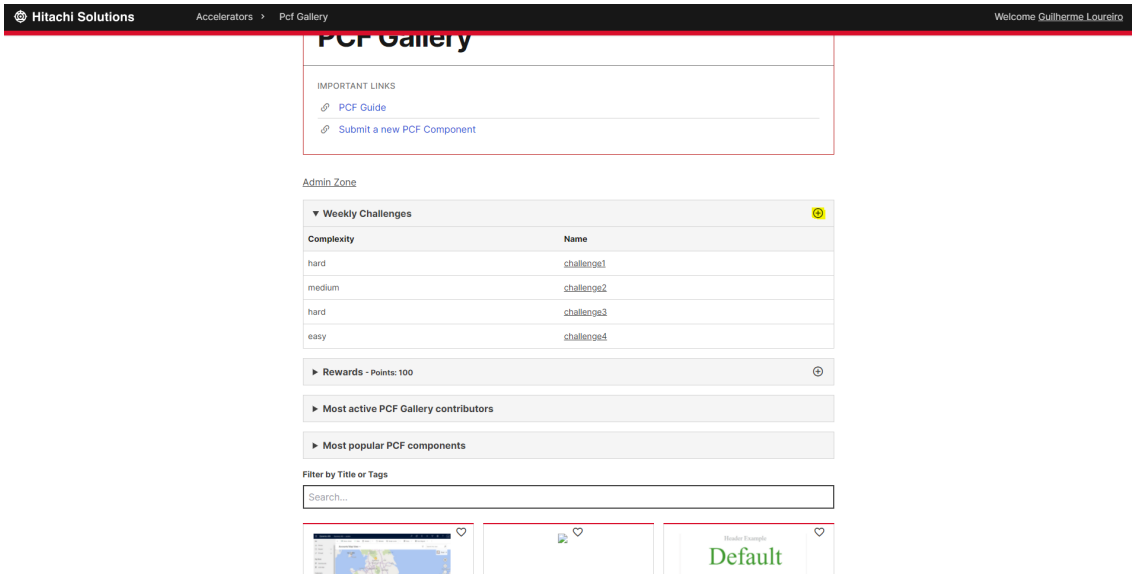

Figure 5.5: New tab on the system to accommodate the challenge section

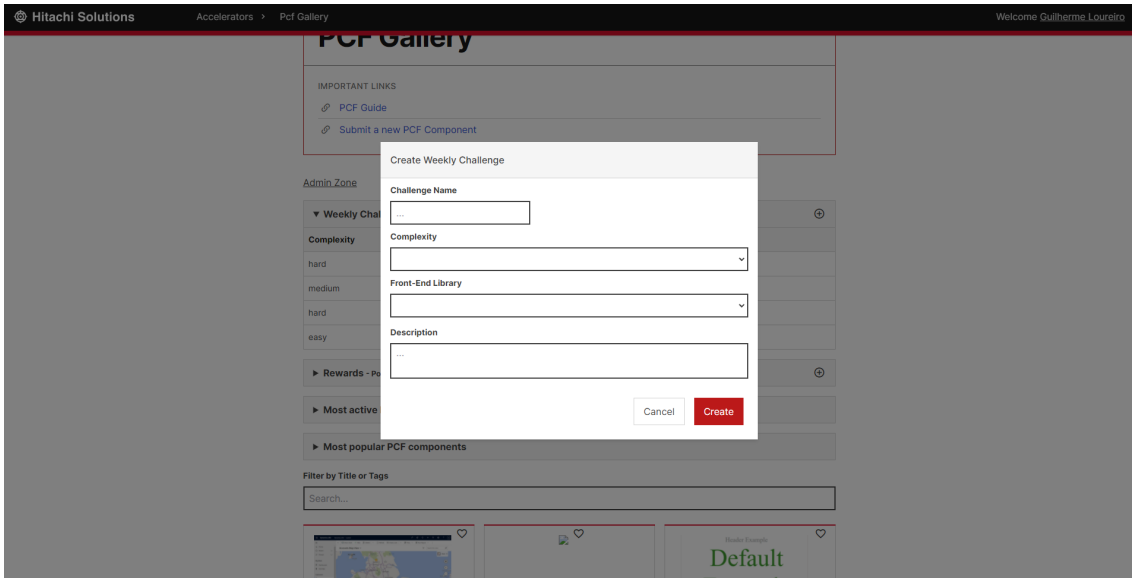

Figure 5.6: By clicking the add button a dialog box will appear to create challenge

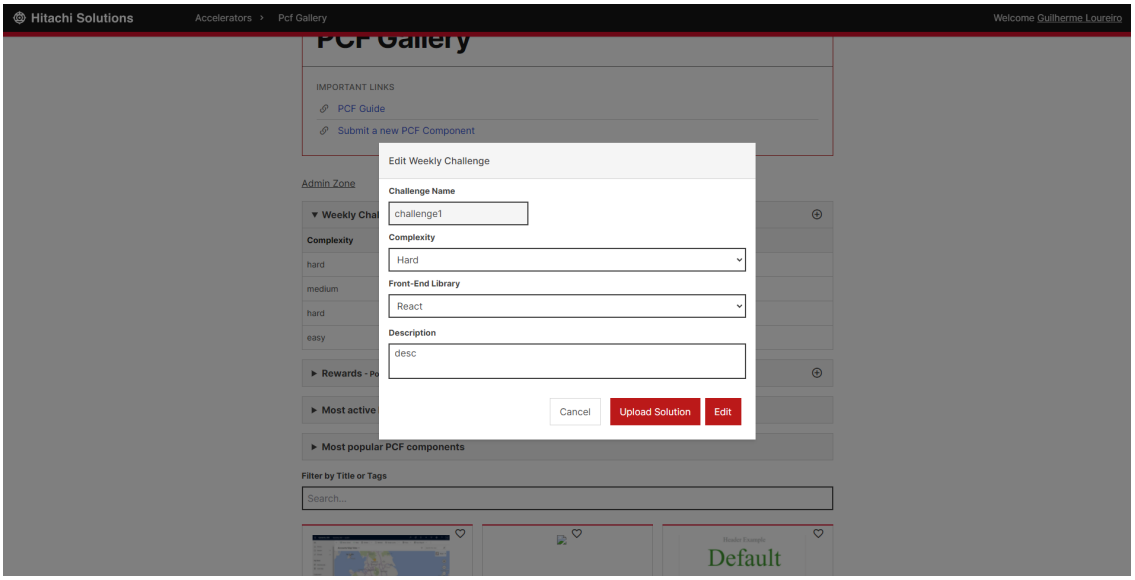

Figure 5.7: Added an edit and upload feature that works by clicking on the challenge's name

5.1.4 Like a PCF

As one more way to increase interaction between users that create code projects and those that do not, a new button was added to the main gallery in the page (5.8).

This button will increase the amount of likes the chosen projects have and as such give points to the creator of said PCF accordingly.

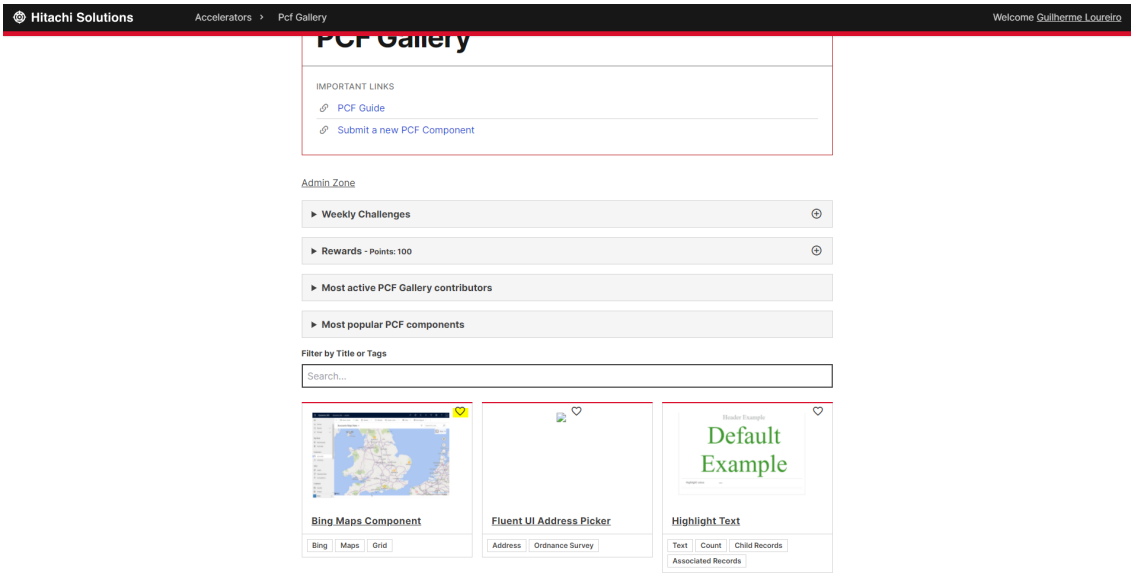

Figure 5.8: Feature to like a Code Component by selecting the heart icon

5.1.5 Upload PCFs against weekly challenges

As explained previously on the *add weekly challenges* subsection when editing a weekly challenge that the user does not own he is able to upload a file against it (5.9).

This action will then trigger a approval process that will notify the owner of the challenge to review the code project and accept it or refuse it depending on its own requirements. The outcome of the upload will then trigger or not a call to the database to change the users points, if the verdict is positive.

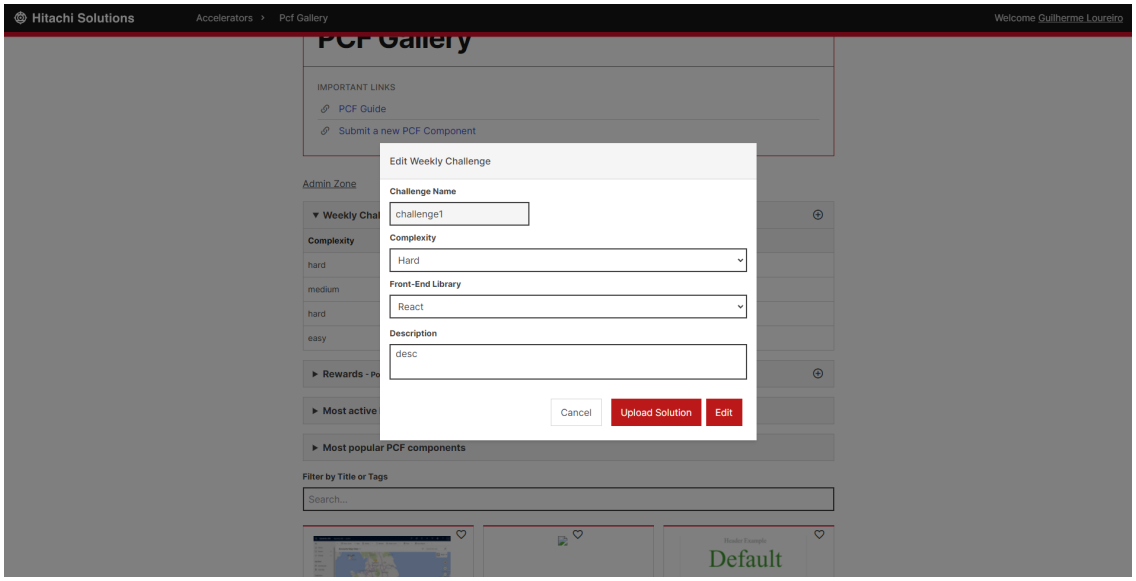

Figure 5.9: Upload feature that works by clicking on the red upload button

5.1.6 Use Points to redeem rewards

With both the rewards and points in the system a feature where the user could use their earned points to purchase rewards was built (5.10).

This system had various levels of development, some purchases of rewards worked through a notification process that would send an email to a group system admins, for those that needed manual involvement like give out monetary gains (e.g. amazon gift cards), and others through automation systems that would trigger a azure function to resolve the purchase (e.g. create a post promoting the user to the company).

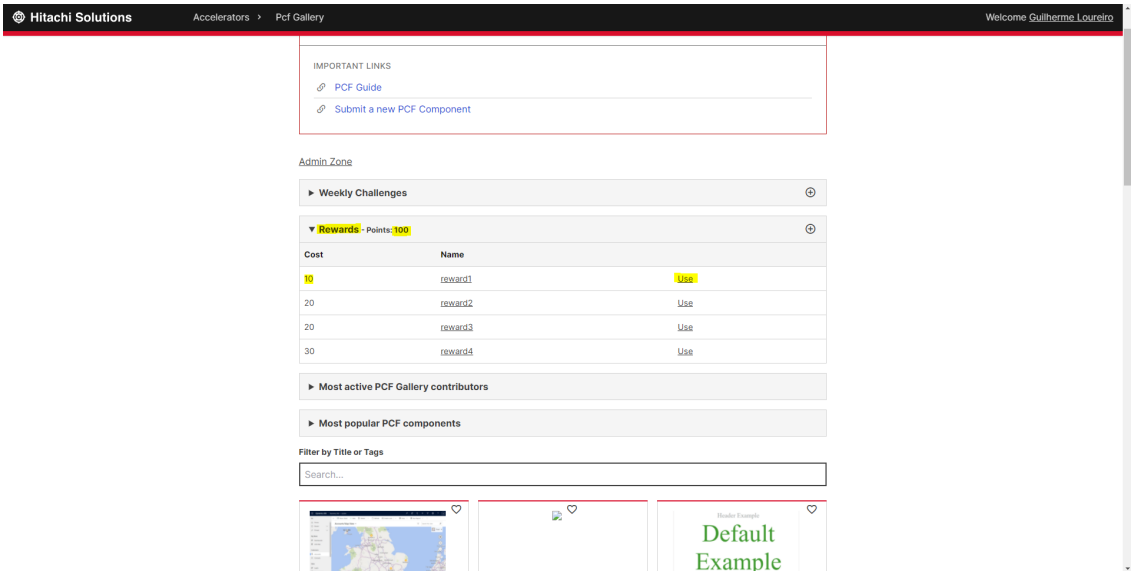

Figure 5.10: Tab where the user is able to use its points on by clicking the use button

5.1.7 Approval of the weekly challenge PCF

After the user uploads a solution in a zip format this solution is brought to the database and a automatic email is sent to the owner of that challenge, to warn him that a PCF was uploaded. With that in mind, the owner required a way to access the uploaded files and approve them as successful or not (5.11). For that purpose a new dialog box was created with a grid that had information about the upload and three buttons, one to download the solution, one to approve it and one to reject it (5.12).

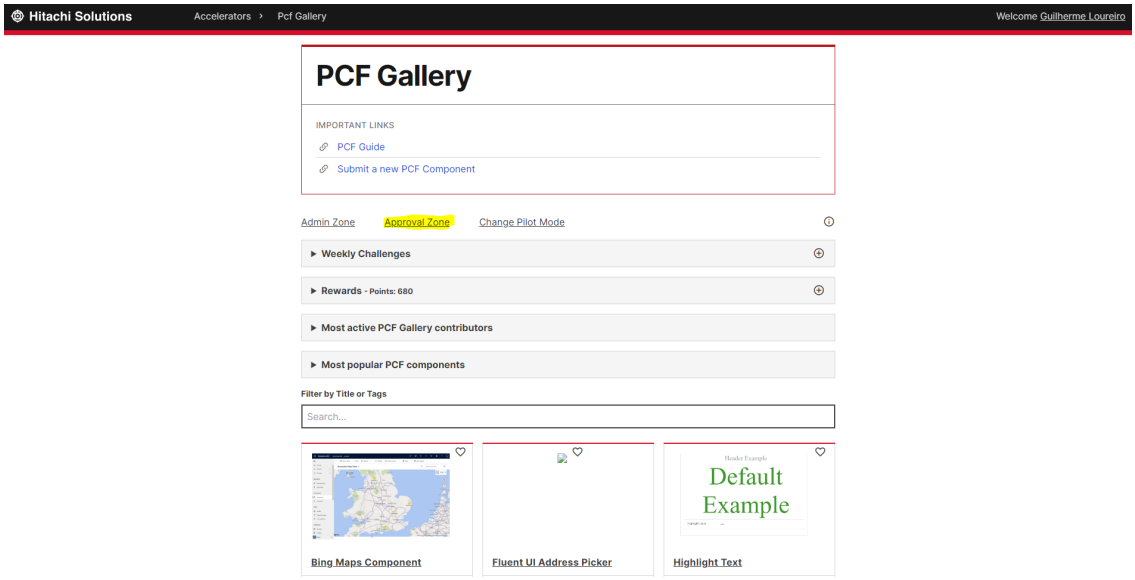

Figure 5.11: Button that the user would use to open the approval dialog box

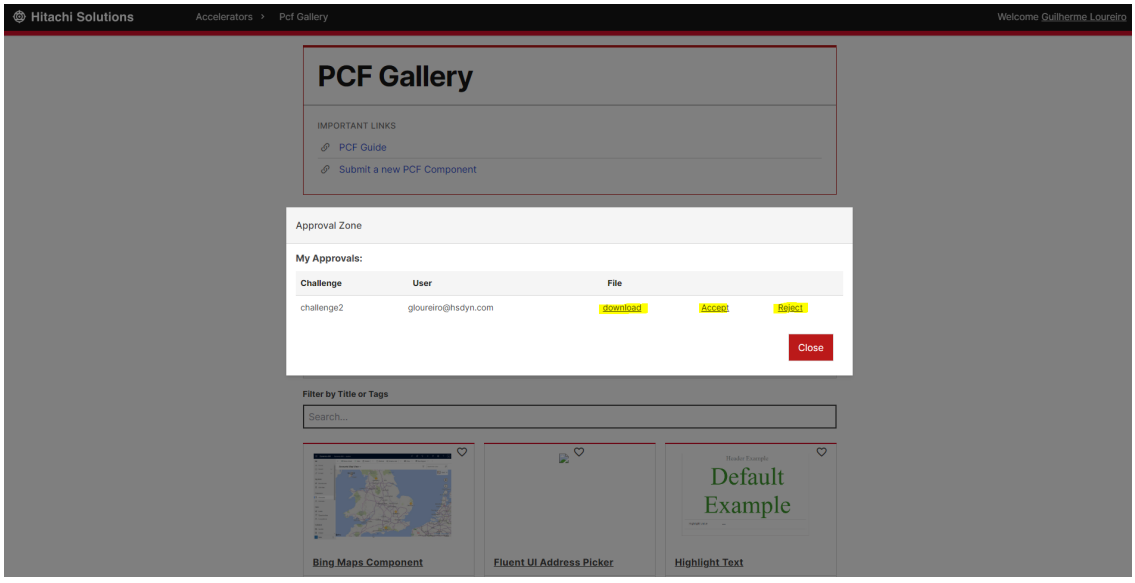

Figure 5.12: Dialog box used for approvals of submission

5.2 Data Base Connection

The database in use, as mentioned on the analysis and design chapter, is Azure Storage, a *NoSQL* database and as such it has a very fluid and malleable way of navigating through its tables and records.

For this application, in order of creating a faster and uniform development, a few methods were created that helped create, update and search records on the

database. These methods were built in *JavaScript* and stored on a helper class (named *azureTableHelpers*), like it can be observed on the following code examples:

- **Get Table Data** - Get the records of a given status from the current environment's Azure Table :

```
export async function getTableData(
    tableService,
    statusValue,
    site,
    filter,
    count = 1000
) {
    let resource;
    if (
        document.location.hostname === 'myportal.hsdyn.co.uk' ||
        document.location.hostname === 'uk-ipwebsite-webapp-staging.azurewebsites.net'
    ) {
        resource = site.themeConfig.prodTables[statusValue];
    } else {
        resource = site.themeConfig.devTables[statusValue];
    }

    return getRecords(tableService, filter, resource, count);
}

```

- **Create Record** - Create a new record on a given table given the partition key and values of that new record:

```
export async function createRecord(
  partitionkey,
  values,
  tableService,
  tableName
) {
  let uuid = '';

```

```
9         if (values['RowKey']) {
10          uuid = values['RowKey'];
11        } else {
12          const nanoid = customAlphabet('123456789
    BCDFGHJKLMNPQRSTVWXYZ', 17);
13          let id = nanoid();
14          let firstPart = id.substr(0, 4);
15          let secondPart = id.substr(4, 4);
16          let thirdPart = id.substr(8, 4);
17          let fourthPart = id.substr(8, 5);
18          uuid = firstPart + '-' + secondPart + '-' + thirdPart
    + '-' + fourthPart;
19        }
20
21        var insertEntity = {
22          PartitionKey: { _: partitionkey },
23          RowKey: { _: uuid.toString() },
24        };
25        for (var attribute in values) {
26          switch (attribute) {
27            case 'partitionkey':
28              insertEntity.PartitionKey = {
29                _: values.partitionkey,
30              };
31              break;
32            case 'rowkey':
33              insertEntity.RowKey = {
34                _: values.rowkey,
35              };
36              break;
37            case '$state':
38              //State is not stored in the tables.
39              continue;
40            default:
41              let value =
42                typeof values[attribute] === 'object'
43                  ? JSON.stringify(values[attribute])
44                  : values[attribute];
45              insertEntity[attribute] = {
46                _: value,
47              };
48              break;
49          }
```

```
    }
    return new Promise((resolve, reject) => {
      tableService.insertOrReplaceEntity(
        tableName,
        insertEntity,
        function (error, result, response) {
          if (error) {
            reject(error);
          }
          console.log('Data inserted successfully');
          resolve(uuid);
        }
      );
    });
  }

```

- **Delete Record** - Delete a record on a given table given the partition key and values of that record:

```
  export async function deleteRecord(
    partitionkey,
    values,
    tableService,
    tableName
  ) {
    var deleteEntity = {
      PartitionKey: { _: partitionkey },
      RowKey: { _: values['RowKey'] },
    };

    tableService.deleteEntity(
      tableName,
      deleteEntity,
      function (error, result, response) {
        if (error) {
          // Delete table entity error
          console.log(error);
        }
      }
    );
  }
```

```
23
```

5.3 Automation Work

For the automation work on this system the power of azure functions are leveraged. This technology was chosen due to, first being already implemented in few places on the system and second because it is a technology on the same platform as the database so it has a lot of built in compatibility.

The code for this is written in JavaScript with a support of a Json file that identifies the solution on the system.

As an example of this automation here is scheduled workflow that will give out points to the person who is on top of the leader board at the end of a given month:

```
1  const AzureTables = require('../libs/azureTable');
2
3  const gamificationTable = 'GamificationDev';
4
5  const main = async function (context, req) {
6    let svc = AzureTables.getTableService();
7
8    const gamificationDev = 'GamificationDev';
9    const pcfTable = 'PCFGallery';
10
11   let pcfRecords = await AzureTables.getRecords(svc, pcfTable,"
      PartitionKey == 'pcf_gallery'");
12
13   let contributors = {};
14   pcfRecords.forEach((pcf) => {
15     if (!contributors[pcf.hsl_emailaddress]) {
16       contributors[pcf.hsl_emailaddress] = {
17         email: pcf.hsl_emailaddress,
18         contributions: [],
19         total: 0,
20       };
21     }
22
23     contributors[pcf.hsl_emailaddress].contributions.push({
24       email: pcf.hsl_emailaddress,
```

```
25        id: pcf.RowKey,
26      });
27
28      contributors[pcf.hsl_emailaddress].total++;
29    });
30
31    contributors = Object.values(contributors).sort((a, b) => {
32      return b.total - a.total;
33    });
34
35    console.log(contributors[0].email);
36
37    let Users = await AzureTables.getRecords(svc, gamificationDev,"
       PartitionKey == 'User'");
38
39    let insertUser = {};
40
41    var found = Users.find(function(post, index) {
42      if(post.RowKey == contributors[0].email)
43        return true;
44    });
45
46    if(found != null){
47      found.Points = found.Points + 50;
48      insertUser = found;
49    }else{
50      insertUser = {
51        PartitionKey: "User",
52        RowKey: contributors[0].email,
53        Points: 50,
54      };
55    }
56    console.log("here");
57    AzureTables.writeToAzureTable(svc, 'User', gamificationDev,
       insertUser);
58  };
59
60  module.exports.main = main;
61
62  main();
```

Chapter 6

Evaluation and Experimentation

6.1 Hypothesis

In this section the initial research questions, discussed in the introductory chapter of this paper, are remembered and brought forward to be analysed and evaluated, as a way of creating possible hypothesis.

There are three possible outcomes with this solution, first the user interactions increase, second they decrease and third they remain the same. For this thesis the chosen hypothesis of this investigation is that by adding new gamified elements to a code repository solution that was previously built, the users interaction within the employee hub will increase in number. These interactions would mostly happen within the new gamification mechanics.

To evaluate the interaction, it is considered a success if the users logins and navigation increase more than 50% than the previous analysed values.

6.2 Assessment Metrics

In this section there is going to be a description of the metrics that were put into place to be able to test the successful status of the project after the deployment of it to the general public.

The **first assessment metric**, that was stipulated for this project, is based on data analysis where the values of navigation evidences will be examine to determined if there is a significant increase in user interaction with the gamified solution than there was previously. This data is composed of signification information of what pages the employee uses on a regular basis, when does the user login to the internal page and how many contributions to the code repository there was. Concluding the

first evidence, the data is collected at the beginning of the development process and later will be collected a month after the deployment of the gamified solution.

As a **second metric**, a semi structure interview that will be done after the deployment of the solution to both the employees and the business to understand and evaluate their satisfaction level towards the developed features, as well as their experiences while working with it. The pair of interviews will will take into account what was previously defined on the value proposition, with questions purposefully questioning the level of success of the pain relievers and gain creators.

Concluding, these two metrics will be able to evaluate the solution on two levels (quantitative and qualitative). A quantitative measure, where raw data will be studied to learn if there is or not a concrete increase in user population. A qualitative measure, where the developer team is going to understand the feelings of their users towards the new implemented features.

6.2.1 Metric Dimensions

This subsection will state the dimensions that will be taken into consideration on both of the two metrics that were above mentioned:

1. On the **first metric**, since it is directly derived from the systems inner workings, its dimension will be as big as the initial system. Therefore the system will be first released on the Europe region of Hitachi Solutions, which encompasses over seven hundred employees, yet close to half of these employees are functional consultants (employees that don't work with code related jobs), hence due to the technical nature of the gamified solution these wont be counted as sample population of the data analysis.

   As a result the sample/dimension of this metric will be around ninety employees, this number was achieved after a study within the company to understand the maximum number of possible technical consultants within the company that may be on bench at once. Accordingly with companies metrics only about thirty percent of the approximately three hundred technical consultants may be on bench at the same time.

2. On the **second metric**, the employee interview will try to have at a sample size of fifteen employees from different offices around Europe to ensure that the responses are representative of the project's target audience, these employees will mostly be technical driven employees due to the characteristics of the

gamified element, as its main focus is to get code solutions into a common repository.

The business intended interview will have a dimension of three elements, two from the IP team, which was the team that initially built the employee hub and one from the high management of Hitachi to understand if the new implemented mechanics meet their expectations.

6.2.2 Metric Criteria

This subsection will explain the criteria taken into consideration on both of the two metrics that were above mentioned:

1. On the **first metric**, the criteria for the data analysis will be the following:
    - **How Much**: This criteria evaluates through a study of how many users login into the website per day compared to how many users actually use and interact with the newly implemented gamified features.
    - **Where**: This criteria defines the various geographic zones/offices that have interacted with the gamification solution, to understand which office interacts the most. This criteria will take into account that some offices are more populated than others, by doing the evaluation through percentages per office capacity.
2. On the **second metric**, the questions for the employees, that will appear on these forms, are mainly be based on two main factors: the employees satisfaction level and the motivation behind their actions. While the questions that are going to be asked to the business surround the increase of productivity within employees and if the solution meets the expectations.

6.3 Methodology

Firstly, diving more on a the technical side of the project, to guarantee the success of the different functional requirements that are built along the project, an agile method will be put into place, where there will be five stages that need to be completed for each user story, producing this way an assurance of its working status after being deployed.

The previously mentioned steps to construct and evaluate the functional requirements will be the following:

- **Analyses**: Study of the user story, opportune moment to question the business on any uncertain aspects and steps where user diagrams and user paths are created to help better align the development with the acceptance criteria
- **Development and Implementation**: Creation of the users stories features through code, while using all the good practices previously learnt and adopted.
- **Developer Testing**: This will take into account the developer's skill in creating automatic testing, these will range from unit tests (tests created around single classes or small algorithms, normally tested in isolation), integration testing (tests with a broader range that will evaluate the connections around the different classes) and lastly end to end tests (testing of the full user story connecting all the implemented features).
- **Quality Assurance Testing**: Stage to identify possible issues and problems with the process, create corrective actions and implement them.
- **User Acceptance Testing**: User testing is the moment where an user behaviour is taken into account and the user story is tested with the various personas. This phase is heavily based on the previously written and agreed acceptance criteria.

On another note, to evaluate the success rate of the whole solution the Quantitative Evaluation Framework (QEF) method will be used.

6.3.1 Semi Structured Interview

The interview that will be conducted to the users of the new features and the involved business will be shown and analysed through the following table that will first index the questions, second state the open ended questions that were planned for the interview and lastly a summary of the interviewees responses/answers.

Table 6.1: Semi Structured Interview Analysis

Index	Question	Summary

1	What is your background?	Overall throughout the interviews most of the interviewees were technical consultants that wanted to share their solutions but there were a small number (3 people) that worked on the functional side of the company. During this question, in some of the interviews, the ones that were technical people were asked about if they had every used the previous system to share code solutions, the answers for this were very mixed yet the majority said that they didn't while the ones that stated they did only did it once and never thought of coming back to it.
2	Did you know what Gamification was? If so, what were your feelings towards Gamification previous to this experience?	Due to most of the users that accepted answering this interview being fairly new to the work environment and that this was their first work experience, they stated that they never had any major interaction with Gamification so they could not inform the interviewer on any feelings towards it. Yet, the other smaller group, that did have previous experience and knew what Gamification was, were able to answer affirmatively to the first question but stated that they mostly felt disappointment and disinterest when it came to Gamification, when asked why they simply stated that it didn't correlate with their needs.
3	What do you think about the weekly challenges?	When asked about the weekly challenges they were able to understand what they needed to do and believed that the system was intuitive, yet they also were able to provide very interesting pieces of feedback. When testing the weekly challenges some of the interviewees identified that a week period for a challenge was a too small validation time frame for both the one that created the challenge and for the one that was trying to create a solution for said problem.

4	Which emotions do you have towards the available rewards?	In this question the feelings were very homogeneous since most, if not all, felt that the rewards presented were both satisfactory and had a wide variety from monetary to internal self-promotion rewards. This way the interviewer was able to justify that the rewards were built in a correct manner to please a greater number of employees that could be found on the target group.
5	Would you continue to use this system? If so, what is the main reason that pushes you to do it?	This was the most polarizing question from all the others asked during the interview, this because of the second question, while all stated that they wanted to continue to play around with the system many demonstrated different feelings as reasons to continuing to do so. This was later analysed as a divergence in both rank and work experience of the test group which was justified by the users with more experience to be more pulled to the rewards they could gain through playing with solution and the newer ones just wanting to be part of something bigger that would give them more work to do while on bench.
6	Do you believe that this point system will bring more users to the platform? If so, why?	Overwhelming positive answer from the part of the interviewees and the main reason for them to want to continue using the Gamified solution was the ability to be more productive when on bench waiting for other projects and the possibility to buy into bigger and better rewards while also being part of a bigger community working towards faster delivery of solutions within the company.
7	Do you think that this gamified solution is justified?	On this question all users agreed with the statement and most said that they were excited to be able to utilize it further when it gets deployed on a bigger scale as there would be a lot more challenges and rewards for them to play with it.

6.3.2 QEF

This method is a quick and valuable way to understand if the solution takes into consideration all the functional and non functional metrics previously stipulated

through the initial talks with the business. Therefore the QEF method has as a basis the objectives (functional or non functional) of the solution that will be developed and implemented. This is a accurate framework that will help the evaluation of digital media(Escudeiro and Bidarra 2008).

The method will frame the success factors on a three dimensional space in order to determine the level of performance of the system. Concluding, this method will help, throughout the development, to understand if the solution is going on the right direction accordingly to the defined metrics (Escudeiro and Bidarra 2008).

Yet with all of this in mind, the QEF in this thesis will only be done in a developers scope which will only include the objective and functional requirements and how these were implemented within the last version of the system.

This decision was taken due to the previously presented Interview working already as a way to evaluate the non functional elements of the deployed solution.

On the first picture (6.1), it can observe the evaluations of the different functions/features that were to be implemented during the development phase. In this figure we can obverse the different levels on what the requirements will be evaluated against.

On the second one (6.2), the fully evaluation of the functions can be seen. Here it can be observed both their titles and their evaluation. As most of the requirements were all successfully implemented and developed they have been given the full score of 100 points, which made the final score be 100.

Dimension	Functionality						
Factor	System						
			Wrk - Fulfilment (%)				
Requirement	Metric Evaluation	0	25	50	75	100	
US01 - As an Administrator I want to be able to setup different rewards, this may include deletion and addition of new rewards.	The Administrator will be able to edit, delete and add rewards	Not implemented	The Administrator is able to only add rewards	The Administrator is able to only add and delete rewards	Implemented with bugs	Fully implemented	
US02 - As an Administrator I want to be able to setup different point rewards for different actions	The Administrator will be able to edit the amount of points to be awarded	Not implemented	-	-	Implemented with bugs	Fully implemented	
US03 - As a PCF User I want to be able to add weekly challenges to show the contributor community what types of PCFs I require for my projects	The PCF User will be able to edit, delete and add challenges	Not implemented	The Administrator is able to only add challenges	The Administrator is able to only add and delete challenges	Implemented with bugs	Fully implemented	
US04 - As a PCF User I want to be able to like the PCFs that I enjoy and use the most that way giving extra points to the Contributors and driving them to create more PCFs like it for the Gallery	The PCF User will be able to like PCFs and through a background process give points to their creators	Not implemented	-	-	Implemented with bugs	Fully implemented	
US05 - As a Contributor I want to be able to upload a PCF solution against a weekly challenge so that it would notify its creator that he has a PCF readily submitted and awaiting approval	The Contributor will be able to upload a PCF against a challenge and submit it for approval	Not implemented	The Contributor is only able to upload the PCF	-	Implemented with bugs	Fully implemented	
US06 - As a Contributor I want to be able to use the points that I have been awarded by completed various actions on rewards	The Contributor will be able to receive points for: Having a PCF liked: Having won a challenge: Being in first place of the leaderboard at the end of a month	Not implemented	-	-	Implemented with bugs	Fully implemented	
US07 - As a PCF User I want to be able to confirm and approve/reject PCFs that are submitted against my challenges	The PCF User is able to see and approve/reject uploads	Not implemented	The PCF User can see the uploads	-	Implemented with bugs	Fully implemented	

Figure 6.1: Function Evaluation

q	D	qi	Dimension	qj	Wij (Factor Weight j in Dim i) [0,1]	Factor	rwjk (requirement weight k in Factor j) {2, 4, 6, 8, 10}	Requirement	wfk % requirement fulfillment k) [0,100]
100%	0.00	100	**Functionality**	100.00	1.00	System	10.00	US01 - As an Administrator I want to be able to setup different rewards, this may include deletion and addition of new rewards.	100
							10.00	US02 - As an Administrator I want to be able to setup different point rewards for different actions	100
							10.00	US03 - As a PCF User I want to be able to add weekly challenges to show the contributor community what types of PCFs I require for my projects	100
							10.00	US04 - As a PCF User I want to be able to like the PCFs that I enjoy and use the most that way giving extra points to the Contributors and driving them to create more PCFs like it for the Gallery	100
							10.00	US05 - As a Contributor I want to be able to upload a PCF solution against a weekly challenge so that it would notify its creator that he has a PCF readily submitted and awaiting approval	100
							10.00	US06 - As a Contributor I want to be able to use the points that I have been awarded by completed various actions on rewards	100
							10.00	US07 - As a PCF User I want to be able to confirm and approve/reject PCFs that are submitted against my challenges	100

Figure 6.2: QEF

6.4 Results

After a couple of weeks of a pilot solution being available to a small test group there was a lot of feedback, information and questions directed and given to the developer, as expected due to its innovation inside the company.

Although the testing phase had a lot of hurdles and issues to overcome, there was still ways of evaluating the solution on the two metrics that were initially stipulated. Yet the test population was greatly reduced from the initial expected number.

Starting with the **first metric**, after evaluating the data of both navigation and login to the system there is a slight increase of the user basis yet it did not increase past the success marker (50%) that was specified on the hypothesis. That being said, these results were a bit skewed due to a sharp increase in client project which took most of the active members of the employee hub away from bench, which decrease the size of population.

In terms of percentages, when the first data was taken there was around 55% of employees on client projects, so around 45% of possible employees to use and contribute to the code repository, yet when the pilot of the gamification was released, after a few delays of the date, the number of possible employees had reduced to 30% as a result of a surge of new clients.

Moving forward to the **second metric**, the number of answered questionnaires was, again smaller then expected, yet there was still a considerable amount of answers. The overall feedback was positive from both the business and the employees that were able to use the pilot version of the solution. The tone that was sent through the interviews was an overwhelming feeling of continuing to use the system and add it to their day to day work lives. Lastly, there was also good ideas sent through the feedback that will be analysed and if agreed by the whole team later on implemented.

6.5 Assessment Completion

With the aforementioned results being evaluated and investigated, based on the metrics dimensions and criteria, it is fair to say that the chosen hypothesis for this thesis wasn't able to be achieved on a first test, yet the business remains content and optimistic with the solution and believes that in the near future a bigger test should

be executed that would try to encompass all of the regions in Hitachi Solutions Europe.

Concluding, the outcome for now of the gamification piece developed and created for this thesis is that, due to the increase being ever so slight, that it can not be evaluated as a success but instead as a step in the right direction for a capable and functional gamification. When looking at the previously stated hypothesis this can be evaluated under the third outcome, that states that the users interactions have remain, in general, the same.

Chapter 7

Conclusions

7.1 Objectives Achieved

Starting this chapter, on this section there will be a review of the objectives that were proposed and which have been successful, unsuccessful and the reasons for such. At the start of the thesis, on the introductory chapter, six objectives were identified and noted down to give the work more of a structure.

During the creation and development of this thesis most of the objectives have been successfully complete, yet there was one that not completely and fully developed, mostly due to timing issues and required updates to the database of the employee platform that would potential skew the results.

With this in mind, the only objective that stand out as incomplete was the Publish goal (fifth objective). This is considered not complete on account of the promotion campaign of the newly implemented features been much shorter and with a smaller range than expected. Initially this was expected to ran during two weeks previously to the deployment from the development environment to the production environment, yet because of timings with needed updates to the database this campaign was cut short and became much simpler than expected.

In Sum, most of the objectives have been completed and documented throughout this thesis, while some had a few deviations from the initial plan due to unexpected hurdles yet this thesis can still be considered a success in terms of objectives achieved.

7.2 Limitations and Future Work

With the above mentioned objectives achieved, both the business that requested the work and the developer of the solution agree that this should be something to

pursuit on the next iterations of the solution centre development cycle.

This being said, with the solution centre having a new major release that will bring itself from version 2.0 to 3.0 a lot of new improvements will be able to be created and realised. This major upgrade will bring both limitations and future work opportunities to the gamified solution.

On one side, since a lot of the back-end and mainly the database platform is changing some of the previously implemented features will have to be reworked and slighted adjusted, one being that the automation will be limited to simpler tasks due to it still staying on the previously implemented platform.

On the other side, another major change that is being brought to the 3.0 is templates, these will help bring similar features that were previously only being used on one spot of the application to a whole new level of usability. This will help a lot on future work around bringing the gamified elements to most if not all of the employee website.

Concluding, even with the new release of the system having a few limitations and hurdles to pass through, the business also sees benefits on reworking a few features to better work with the templates so to create a bigger generalised interface.

7.3 Final Consideration

In a final reflection of the work that was done throughout this thesis, it can be seen as an overall success. During the first of part of this paper there was a lot of moments of growth and learning which could then be seen through all the second phase of the project.

Although there were hurdles to overcome, may those be few external factors or time constraints, the project is still seen as a major victory and a step on the right direction, that will later on be transformed and parsed into a full fledged international project with users not only from Europe but also from other sites around the world where Hitachi Solutions has their offices.

Concluding, this whole project, may it be the theoretical or practical work done within it, is seen as a enormous step for the student that grew not only academically but also in a personal level.

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