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Project for developing a project management simulation game for engineers

MASTER FINAL THESIS

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Abstract

The main objective of this project is to develop a game that serves to put yourself in the shoes of a Project Manager and acquire knowledge of this field in a more practical and entertaining way. It is mainly designed for students who aspire to work in project management. The responsibilities that players will take on throughout the game are mainly related to recruiting team members, assigning tasks, and managing the budget. These responsibilities will be affected by different occurrences that may occur during the game project, and players will have to employ strategies to cope with these events in order to finish the game project in the shortest in time and within the initial budget.

To achieve the result of the project, an analysis of the existing games in this field has been carried out, as well as an in-depth study of issues in the world of project management. The methodology for developing the game was also based on a trial-and-error model, in which different adjustments were tested in order to arrive at a game where the players, in addition to being entertained, learn project management concepts. With these components, the player will have to develop the established project.

The result is a board game, consisting of a Kanban board, cards representing tasks, employees and occurrences, a budget tracking sheet, a calendar and a dice.

In conclusion, these types of games have great potential as they allow you to learn while you entertain yourself, as well as allowing the player to put themselves in the role of a manager and thus have a more realistic view of what it is like to have a position of this kind.

Resumen

El objetivo principal de este proyecto es desarrollar un juego que sirva para ponerse en la piel de un Project Manager y adquirir conocimientos de este ámbito de una manera mas practica y entretenida. Está principalmente pensado para estudiantes que aspiran a dedicarse a la gestión de proyectos. Las responsabilidades que tomaran los jugadores a lo largo del juego están relacionadas sobre todo con el reclutamiento de miembros para el equipo de trabajo, la asignación de tareas y la gestión del presupuesto. Estas responsabilidades se verán afectadas por distintas ocurrencias que pueden ir ocurriendo a lo largo del proyecto del juego, y los jugadores deberán emplear estrategias para hacer frente a ellas y poder finalizar el proyecto del juego a tiempo y sin sobrepasar el presupuesto inicial.

Para poder alcanzar el resultado del proyecto, se ha llevado a cabo un análisis de los juegos que existen de este ámbito además de profundizar en temas del mundo de la gestión de proyectos. La metodología para desarrollar el juego también se ha basado en un modelo de prueba y error, en el que se ha ido probando diversos ajustes para poder llegar a un juego donde los jugadores, además de entretenerse, aprendan conceptos de gestión de proyectos.

El resultado consiste en un juego de mesa, compuesto por un tablero Kanban, cartas que representan tareas, empleados y ocurrencias, una hoja de seguimiento presupuestario, un calendario y un dado. Con estos componentes el jugador deberá desarrollar el proyecto establecido.

Como conclusión, estos tipos de juegos tienen un gran potencial ya que permite aprender mientras te entretienes, además de que permite al jugador actuar como si fuera un manager y de esta manera tener una visión mas real de lo que conlleva tener un puesto de este estilo.

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1. Introduction

1.1 Object

The following project has been developed with the purpose of offering a fun and different way of learning how to manage a project through a simulation game. Its objective is to put the players on the shoes of a Project Manager and be able to complete a project from start to finish while experimenting certain constraints that will put them in situations that will make them change their strategy. The main duties that players will assume throughout the game are mainly related to team recruitment, task allocation and budgetary planning. Players will have to complete the project in time and without surpassing the initial budget.

1.2 Scope

The final objective for this thesis is to develop a game which can be used for students that want to pursue a Project Management career, especially those that are cursing a master in this ambit since it will be used in classes related to the topic.

In order to achieve the desired result for the game, several Serious Games and Project management concepts would be analysed. This will give an idea of how to implement features from these areas in the game. These types of games will be studied closely for inspiration, and it is also likely that a search for games from other fields will be carried out in order to acquire more ideas for the final result. A lot of time will be spent on the design of the game components so that it can be both attractive and simple at the same time. This will be implemented in a working prototype in order to test what works and what needs to be improved. At the same time, an eye-catching packaging will be designed, together with a game manual where both the components and the game instructions will be explained.

1.3 Requirements

Regarding the specifications of the game, it has to be a board game that can be played in groups so that it involves group working. Its duration must not exceed one hour, so that it can be played multiple times changing strategies during a 2-hour class. Understanding of the game should be simple and follow a *Poka-yoke* mechanism, to prevent any mistake or errors while playing the game. The game should address at least three aspects of Project Management so that players can acquire different skills in this discipline. Lastly, it should consist of an Open Access game so that anyone can print it and enjoy it.

1.4 Rationale

This topic has been proposed by the Director of thesis, Vicenç Fernandez, since he has found that open access serious games about Project Management are lacking at the moment. Giving the opportunity to students to train themselves through this type of learning is something that can help them gain new skills that maybe they would not acquire through other learning methods. In addition, viewing the popularity that these types of games are

gaining during the last years, it will be a product that will be well received in the market, and even more if its free to play.

2 Background and review of the state of the art

This section consists of a general explanation on what serious games consist of, a more detailed of these types of games related to project management, and lastly a market research analysing these games that are currently available.

Serious Games

There are many ways to define *Serious Games*, but basically all of these definitions define these games as those that offer a learning purpose in addition to entertainment. The term was first introduced in 1970 by a researcher called Clark Abt in his book called "*Serious games*" (Djaouti et al., 2011). He designed both digital and non-digital games for several purposes, such as military uses or school usage.

In recent years, much research has been done to find new ways of acquiring knowledge to replace traditional methods of learning. In addition, with all the technological advances, corporations need to continuously form their workers, and there is no better way than learning while having fun. Therefore, *Serious Games* are gaining popularity among companies. This type of education is also becoming more and more popular in universities, where traditional learning is quite common, and professors decide to use this training to break out of the conventional study routine and keep students entertained while they learn and encourage their participation in the activities.

Serious Games has been achieving an exponential growth from its beginnings, and there is no doubt that it will continue to grow. According to a *Serious Game Market* report, this market in 2020 was valued at $5,94 billion, and it is forecasted to reach up to $32,72 billion by 2030, which means an annual growth of 18.47% (Serious Games Market Size, Share | Industry Forecast - 2030, n.d.). This growth of interest can also be reflected in terms of the number of research articles that have been published over the last few years. According to a study published in the *International Journal of Computer Games Technology*, there has been an exponential increase in *Serious Games* related articles in the late 1990s, but especially since 2004-2005 as it can be seen in the following figure (Laamarti et al., 2014).

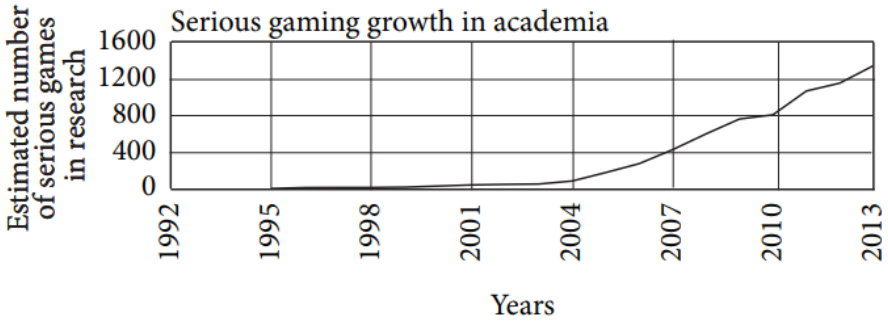


Figure 1. Serious games growth in the research field

Depending on the field these games will be used, it is possible to use some types or another and they can also be rather digital or non-digital. It is possible to find many

varieties of serious games, but with many common characteristics. According to an article from *Designing Digitally* (All About Serious Games: Types and Purposes | DDINC, n.d.), Serious Games are divided into two categories, the process-oriented type of game and the outcome-focused one.

It is possible to differentiate up to three different procedures for the *process-oriented* kind of serious game, which are the following ones (Types of Games | Serious Games at Work, n.d.):

Discovery games

Provides new awareness and insights. These types of games are commonly used in market research, team improvement and political research.

Decision-making games

These types of games are an alternative to the traditional decision-making techniques. They are for improving team efficiency, ideation, and citizen participation.

Simulation games

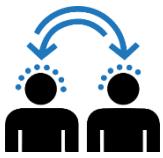
These games simulate real-life stages and can be divided into different types depending on the autonomy degree (*Free-form* simulations or *Algorithmic* simulations).

Figure 2. Process-oriented procedures

The three types of focus for the outcome-focused are the following ones:

Education

Focused on training core skills to people, such as managing teams or learn how to drive a car. These games perform like simulation games (free-form or algorithmic).



Persuasion

This type of game tries to make people view things in another way, by making them think outside the box. They are commonly used for advergames and political games.

Motivation

These games offer some extrinsic motivation by earning a reward in the real world, so that it players have a higher engagement on the game.

Figure 3. Outcome-focused procedures

As it has been mentioned previously, *Serious Games* are used in a wide variety of fields. In the following section this type of games related to project management will be discussed.

Project Management serious games

These types of games have been quite popular in Project Management studies. Since this topic could be difficult to teach in a theorical way, being able to work as a project manager in a game environment is ideal. It can be easy to represent complex project problems in a game and make the team members try to find all the possible solutions.

Project Management involves a handful of knowledge areas, which can difficult its learning process, making educational games perfect for it. For example, the Project Management Institute (PMI), has listed up to ten areas, being the following types of management: integration, scope, time, cost, quality, Human Resource, Communication, risk, procurement and stakeholder (Westland, 2019). So, a game in which all these areas are brought together is ideal for training your project management skills.

The majority of Project Management Serious games focus on two phases: planification of the project and its control (Rumeser & Emsley, 2018). They mostly try to punt the players in complex situations that must be resolved by applying strategic actions.

These games can have different methods to rely on. A study carried out by Rumeser, David & Emsley, M. (2018), analysed what learning method was the most adequate for Project Management Serious Games. The analysis consisted in dividing students from a Master's Degree in Project Management from the University of Manchester in two groups, in which they had to participate in two *Project Crashing Game* (PCG) and on a *Project Crashing Simulation Exercise* (PCSEL). The main difference between them was that the PCG involved both competition and communication between the teams, and the PCSEL was a more narrowed exercise with not many issues. Once each group finished their games/simulations, they were asked to answer a series of questions. Some of the conclusions they obtained are the following ones:

- There is not much difference regarding preference of learning method (PCG vs PCSEL).
- Those who preferred PCG was because it was more fun and entertaining, in addition to it gives the opportunity to cooperate with other players.
- Those who preferred PCSEL was mainly because it was easier to operate, and that it is much more accessible and flexible.
- The students prefer more complexity in games.
- Depending on the student learning style, he/she will prefer one method or another.

Regarding these points, what is clear is that both games and simulations are good ideas to use as learning methods, and that they can be both implemented as additional teaching resources. In the next section various Serious Games that are currently available and can be used as a way to gain Project Management skills will be discussed.

Market research

This section will show serious games related to the theme of the project. They have been used as inspiration for the development of the project result.

Kanban EV

This game corresponds to a board game that simulates an electric vehicle production plant. The players manage several tasks related to the management of suppliers and supplies and will therefore help them to acquire skills in resource and time management.

Each player has an employee in charge and must assign tasks from all the departments that make up the production plant. The game also has a boss who will be making the work of all the employees more difficult, as well as scoring the performance of each one.

Players will learn concepts related to R&D, parts assembly, logistics, design, and management, since they will take actions in all these departments. Some of these actions consist in electing a car design, order car parts, assembling them, test the vehicles, etc.

This game is differentiated by other PM serious games because of its complexity, but it is one of the most realistic games because you truly get hands on the whole process of a project, in this case the production of an electronic vehicle. It also contains many add-ons so that there are many ways to play it (Smith, 2021).

Figure 4: Kanban EV game

The project Management Game

This game consists of an online game based on the planning of a Gantt chart. The goal of the game is to assign workers to different tasks on the Gantt chart and completing the project with the less use of budget and without delays (The Project Management Game, n.d.).

Players will count with an initial budget and a staff in which each worker has different characteristics related on how fast they finish tasks and their costs. These workers make use of the budget in each task they perform.

It's a game that can be played rapidly, so this will give the possibility to the players to take different strategies in order to obtain the best results. It's a good way to learn in a simple way how a Gantt chart works and to improve time and budget management skills.

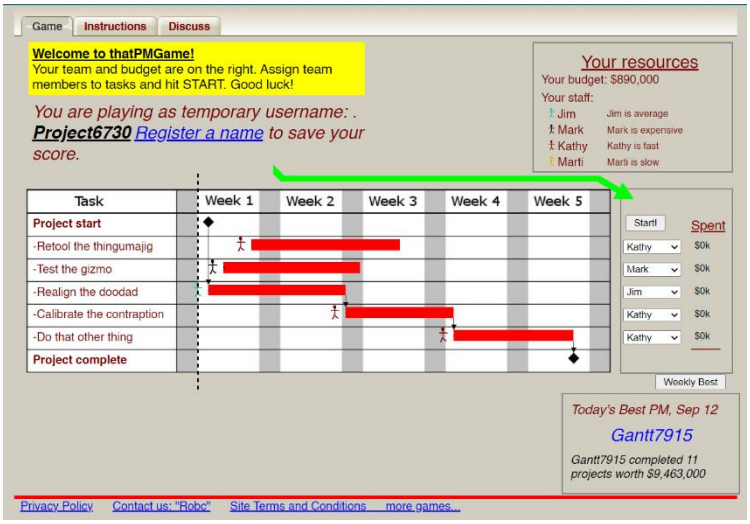


Figure 5. The Project Management Game

The Get Kanban Board Game

The main components of this game consist of a Kanban Board and cards that represent tasks that must be completed. Its goal is to gain as much profit by attracting subscribers for the project, which consists of a subscription-based web application. This will depend on the features the work team is capable of delivering (The getKanban Board Game - About the Game, n.d.).

Each tasks contains stages – Analysis, Development and Testing- with the respective amount of work involved in carrying them out represented by dots. There is also different type of tasks, differentiating them into tasks that are urgent, tasks that have a flexible delivery date, tasks that represent new product features and lastly those which don't create any major business value. To complete each one of them, it will be necessary to roll the dice and sum the quantity of dots contained in each task.

Players will have to use different types of charts to keep track of how the project is going. These graphs include a cumulative flow chart, a run chart, and a lead time distribution

chart. Each chart should be managed from a member of the team, which should be assigned depending on the skills of each one.

Throughout the game events will occur that will make them change strategies in different aspects of project management.

Figure 6. The Get Kanban Board Game

The Pmzone Project Management Board Game

During this game players will experience various situations and participate in actions that a project manager goes through, in order to face its challenges.

Activities that players will engage in throughout the game include adding value to their project, set a project plan, performing both known and unknown tasks that might contain constraints and risks, and all this operating within a fixed budget and resources. Players will have to think outside the box and work in groups to complete the project with success.

The game includes cards that represent tasks, constraints, risks, and delays. It also has figures that represent employees and tokens that represent money. The teams will have sheets that contain the tasks to be completed with its features. They will have to plan these tasks to make good use of the budget and be on time. For example, another feature of the game is that to obtain bonuses players will have to complete acts such as *Tell your friends a 20-word story when each player adds one word to the story*, and if it is done correctly, players will extra budget for the project (PMZONE, 2021).

This game is played in workshops and is meant to improve decision-making skills and bringing new perspectives on how to manage projects to participants, which can then be implemented on their daily tasks at their job position. Something to remark of the game, is that at the end of it the players must discuss about the strategies they have adopted throughout the game so that everyone can consider the different approaches that can be used.

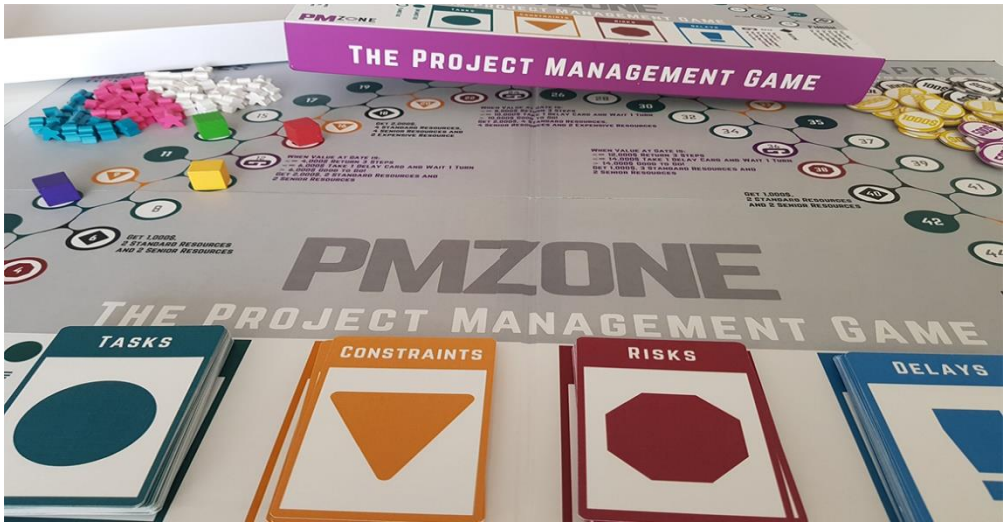


Figure 7. PMzone Board Game

MIT Project Management Game

This game was created by the MIT University and consists of a simulation in which players can choose to manage a construction, a hardware or a software project. This project can also be customized if wanted. Each one of them contain different features but are played in the same way.

The three projects require the player to make decisions on actions such as scheduling the project, setting staffing levels, putting pressure on workers, adding new features to the project, reducing the scope of the project, or speeding up tasks.

Each project involves two main phases, which the first one consists of the high level design phase that mainly consist of detailing all the project specifications with the relevant departments. The second phase in when the all the specifications are converted into a final working product with all that it involves. The player will oversee everything that happens in these stages.

As it can be seen on *Figure 8*, the game consists of a dashboard with various information concerning the project. The player will set the adjustments week by week to pursue the success of the project and will be able to see its progress on several charts that can be visualized on the right side of the dashboard. In addition, the players may receive messages that contain information about how the project is going on and some recommendations to consider (MIT Management Sloan School, n.d.).

This simulation is a great option since it can be played online, and it involves practicing many aspects of project management.

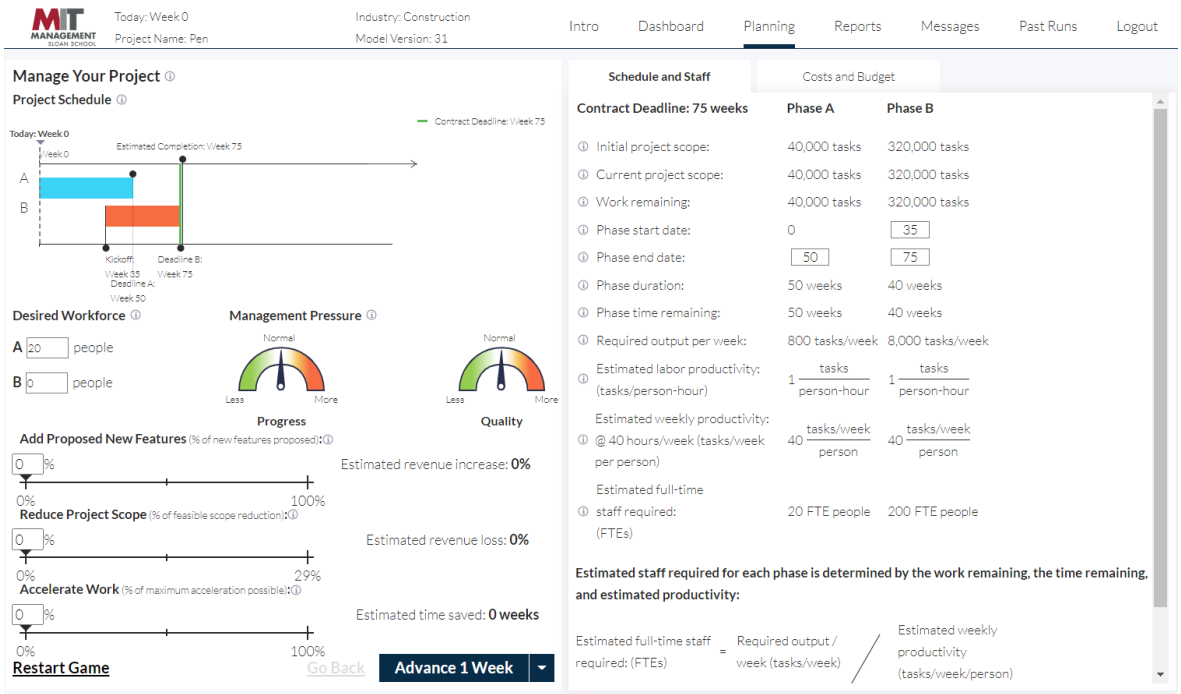


Figure 8. MIT Management game

As it has been shown, serious games can be done in several ways, from an online platform to a traditional board game. Some of them can be played individually but others must be played in groups, having certain advantages one from another. Other point to consider is that some of them gets more in depth into the project, and others have a simpler concept. What is clear is that all of them will help the players improve their management skills and acquire new perspectives in a more entertaining way than the traditional learning.

These games have been used as inspiration for the development of this project. The next pages will show the result of the game and how it has been reached.

3 Methodology

The completion of this project has been principally based on three steps, being the first one the research phase, then the conceptualization phase, and finally the test phase. Here below they will be explained how they were carried on.

Figure 9. Methodology implemented

Research Phase

Card games have a long history, and we can find many different types of them. Most of them are for entertainment uses only, but they also exist those which have an educational purpose behind them. These games can also be played on a virtual format, making them more accessible for all. Since the game that has been developed throughput the project has an educational intention, the research has been based on *serious games*, specifically those related to Project Management.

The research also involved playing these available games, to acquire inspiration on possible designs of both the cards and game flow.

Another important key of this research was looking at the reviews and final thoughts of people who played them, by getting notes on those negative reviews to not repeat what they had done incorrectly, and those with better reviews to try to follow what can be best for the game. Lastly, the visualisation of videos in which Project Management games are being played has also helped to obtain possible ideas.

Some of the games that have been analysed are those that are shown in the previous chapter.

The investigation has also been based on different topics related with the theme of the game, being Project Management. PM is a topic that covers many points, so it has been necessary to comprehend each one of them so that they could be reflected on the game. The focus of the game has been related with employee selection, task designation and strategic reorganization due to occurrences that can happen during a project.

Regarding the aim of the game that have been mentioned in the previous paragraph, it has been contemplated to include workers who can perform tasks in projects related to the one carried out in the game. For this reason, most of the employees will be engineers or product designers. At the same time, research has been carried out into possible events that may occur during the development of any project.

Conceptualization Phase

Once all the information related to Project Management and serious games was gathered, the ideation of the game could be started. During this process, the inspiration from the investigation of the other games was key.

Before starting on making a brainstorm to obtain ideas for the game, it was necessary to make a full comprehension on what was the true objective of the project.

The objectives could be resumed into three main ones:

- Easy and fun to play.
- Possibility to take different paths so that the game can be replayed in order to test different strategies.
- Acquire knowledge from a Project Manager point of view.

Once all the objectives were clear, it is time to start brainstorming possible ways to carry out the game. This process was very important since many ideas for the game were displayed. Here below can be found a small list of ideas that were provided during the brainstorm:

- Employee has a specialty
- Task must be done by an employee with certain specialty
- Roll dice to complete tasks
- Task should have subtasks
- Division of tasks into milestones
- Kanban Board
- Monthly salary for permanent contracts
- Hourly rate for temporal contracts
- 5 employees per team
- Events affect tasks or employees
- Event cards without nothing happening
- Winner is whoever remains with more budget
- Etc.

As might be expected, many of these ideas were modified, but most of them were applied on the game as first stated. The difficult part was getting all of them and putting them together to obtain a game that its flow was logic and worked.

Sketching possible designs for the different components of the game was also a very important process for the development of the game. The different elements of the game were designed in a way that made them as simple as possible and had all the necessary information. Making them good looking was also key so that the game looked more entertaining.

Testing Phase

Once there was a possible final design for the game, it was time to test it. This phase mainly consisted of a trial-and-error process. This phase involves having a functional prototype, so all the components of the game were printed. This helped to have a better perception on how the game worked. With each print, there were many tries on the game to find attributes to improve.

Once a viable solution was achieved, the testing was made by others besides me (as it can be seen in *Figure 10*), to obtain insights from someone who has not been involved on the development of the game, as the future players who will play it. The intention of this was also to see if they enjoyed playing the game and if the game was intuitive. The feedback from these testers was that they had an enjoyable time playing the game, since it made them change strategies, especially because of the occurrences that were happening. Each one of them took a different plan of action. The first tester decided to be more budget-conscious in recruiting the employees, but the other tester decided to hire those employees with higher costs, but better with better features. At first, both of these strategies could have been successful, but while playing the game, the player that had spent more money on the team started to have several problems, principally because of the occurrences she was experimenting, and that she couldn't spend more money on hiring temporary employees. This could have been because of bad luck, but what was clear is that the gameplay will have a big dependency on hoy the budget is spent while hiring the employees. Both of the testers retested the game using a different recruitment plan, and they both had better results than in the first try.

Once this phase was finished, by making the corresponding changes that arose from the tests, a final result was obtained. This result is shown in the following pages.

Figure 10. Tester playing the game

4 Theorical background

This section is intended to explain what theorical knowledge has been considered to develop the game. The features that appear during the game are those which may happen while managing a project, and they have been represented as real as possible so that the players can put themselves in the shoes of a project manager.

Project management can be divided into three pillars: time management, budget management and scope definition. These pillars were identified as the *Iron Triangle* and can be considered a basic criterion for the success of the project (Atkinson, 1999). All of them can be affected by different events that may occur throughout any kind of project, and this will affect directly on the quality on the final product. Therefore, this game aims to make the players, through different events, change the way they manage the project. In the following, it will be explained how they have been applied in the game.

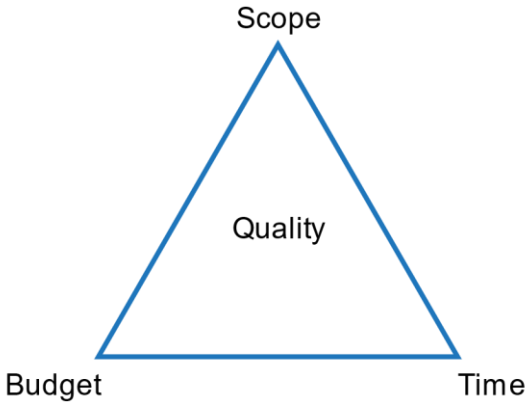


Figure 11. Iron triangle

Scope definition

The project scope refers to the tasks are necessary to carry out to achieve the project goals. This also implies to specify the total amount of work involved in each task.

Setting tasks and comprehend what is involved in each one of them is very important, since they have a direct impact on the costs and timing of the project. A good strategy to plan the tasks and setting its implications is to analyse which subtasks must be carried out to complete each task. Defining the scope also helps to set what tasks are not meant to be work on, since many times happens that tasks are done without any reason and could have been avoided. Another idea could be dividing all the tasks into milestones, so that you can keep track of the work that has been completed.

This has been implemented in the game in a way on which players will view all the tasks that are meant to be done to complete the corresponding project, since each task are composed by some subtasks, and are divided into milestones. In addition, the subtasks count with a factor that indicates the difficulty of it. For this reason, the players will have to do strategic

planning on allocating workers to tasks, since some of the tasks are more difficult to complete than others, and these should be performed by the best employees to ensure that it does not take too long to complete and that the project is completed on time.

Time management

In all projects, there is a delivery date in which it is necessary to hand in the result, and due to uncertainties or occurrences, projects can take longer than expected and this can cause problems. This schedule is allocated by the client, so it should be respected as much as possible.

The scope analysis has a direct impact on this constraint. Planning tasks and estimating the duration of completing them is truly important if managers don't want to have any surprises related to delivering the project on time. Time in projects can be affected by many factors: difficulty of task, employee work skills, task dependencies, absenteeism by employees, etc. Thus, in the game the players will be confronting the situations previously mentioned and take decisions so that the project timeline is not affected.

Due to the problems that can affect the project schedule, players might have to hire temporarily other employees to arrive to the delivery date, because if not they will be charged penalties, as might happen in real projects.

Budget Management

Projects count with initial budgets that must be used wisely so that there are more profits and that the result can be carried out as first estimated. A part of the budget goes directly to the salaries of the employees, and if there is any unused budget at the end of the project, it can be distributed to the team as a reward. Therefore, it is important to make good decisions about the recruitment of staff for the team, considering their salaries, to stay within budget and to be able to have a greater financial benefit.

At the same time, at certain moments along the project, it will be necessary to hire more employees, but this will affect directly to the budget use, so this should be also done wisely. This can mainly be caused by occurrences as the other constraints previously mentioned.

As it has been shown, players will take part in many actions that comes with having good analytical and decision making skills, to be able to make the best moves and obtain the best result. The experience they will gain from the game will help them to have a better handling when faced with project management. As indicated in the object of the project, players will experiment all the constraints previously mentioned.

5 Consideration and decision regarding alternative solutions

During the conceptualisation phase, many ideas were brought to mind regarding the design of each component, specially related to the characteristics that each one of them had to have. The initial idea for the game has been about making cards that represented tasks, others that represented employees and lastly ones that represented occurrences, and that everything must be displayed on a Kanban Board was maintained during all the design process. Although this idea has been maintained throughout the development of the game, the attributes of each card have been modified overtime. The process to obtain the final result has been long, but it was necessary so that the game had a logistic flow and could be easy to understand.

While developing the first ideas, the concept of making a simple game for the player was not truly taken into account. At first, the idea was that the groups formed by players were given three projects, and they had to choose one to develop. The three of them were similar but counted with different features that affected directly on budget and timing. The following shows the different projects that would have been proposed to the players.

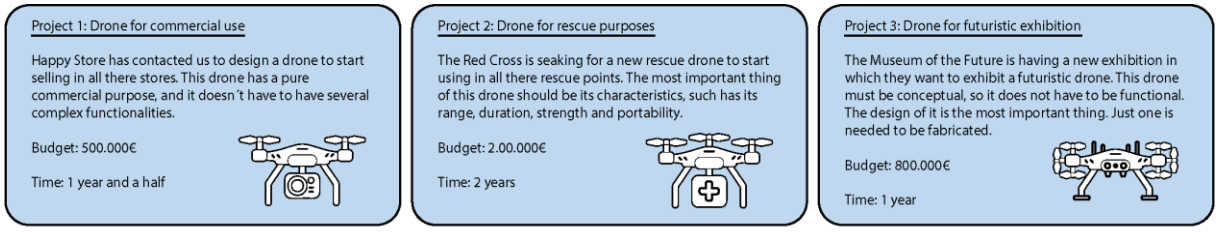


Figure 12. Proposed projects for initial game design

This could have been a good idea, since players had the possibility to choose between the project that they were more into. The teams would have been in charge in setting the different tasks involved in each project, so depending on the project, certain tasks would be more important than others. These tasks should display its difficulty and timing that they would suppose to have, as it can be seen here below.

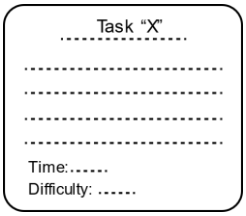


Figure 13. Task definition for initial game design

At first, this sounded as a good idea as it left the players free to plan the whole project. This also could be a problem since the players could find themselves lost while setting all the necessary tasks. Games must give clear directions to ensure that its flow is not affected. Thus, as this game method could cause problems to the players, it was finally changed.

Regarding the employee cards, each one of them had a set of points in different characteristics. These characteristics included teamwork, communication, innovation, organisation, and leadership. Their salaries depended on the points they had on these attributes. Each employee also had a description of who they were, that justified the points they had. The following figure is an example on how this card was designed.

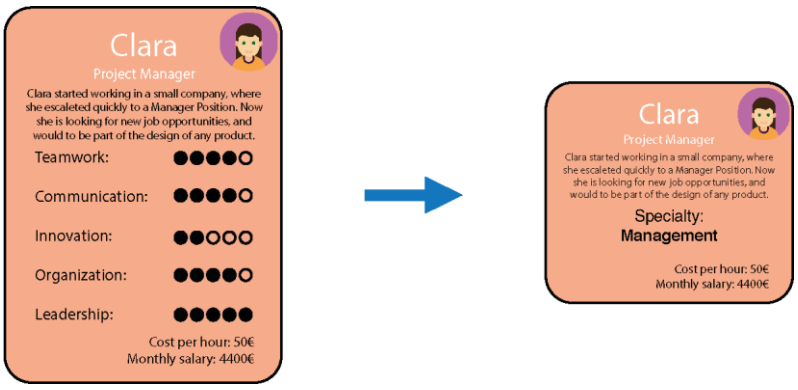


Figure 14. Employee card first designs

The characteristics were mainly devised with the intention that, in order to get the necessary points to complete the tasks, employees had to be put together. In other words, if a task needed 7 points of Teamwork and 4 of Innovation, this task should be performed by a set of employees that would add up to these points in the corresponding characteristics. This could result confusing since tasks can be difficult to calculate the necessary points of each attribute and might not make sense the fact that these characteristics were needed to complete tasks. So, considering that the aim was to make a simple game, these attributes were removed, and the employees only counted with a specialty, as it can be seen in *Figure 14*. Although this design is not the final design, it has a simpler look and feel and allows the game mechanics to make more sense.

Another component that received many changes was the event card. Although the occurrences represented on these cards has been maintained, the concept on how they function has been changed. These cards, in addition to the description, it counted with a condition regarding the event, meaning that on some occasions, the player had to roll the dice and depending on the outcome, the action will be one or the other, as it can be seen in *Figure 15*.

Figure 15. Event card first design

At the first instance, this was a good idea and functioned well regarding game dynamics. On the other hand, the fact that the player would have to roll the dice and depending on the result one thing or another would happen, could become tiresome as the final game design already has many uses of the dice, and this could become repetitive. For this reason, the dice dependency on events was not considered for the game. All these changes were done thanks to the testing that was conducted. Many things were added to add value to the game and to achieve a better game mechanism.

All these adjustments were specially made to make a logic mechanism and to improve the experience. These changes also have been made with the idea that the game must be simple so that the players wouldn’t have any problems while playing, and that they would not need a game master to direct the game.

6 Discussion of the solution

This section is divided into three parts, the first being an explanation of all the different components that are included in the game, then comes the instructions for the game, including its flow and some important reminder, and lastly the packaging from the game is shown. All the components to be printed to full scale are shown in the annex document.

Game components

1. Presentation Card

Figure 16. Presentation card

This is the card that shows the relevant information about the project that must be accomplished throughout the game. It displays information about the budget, duration, start and end of the project.

2. Kanban Board

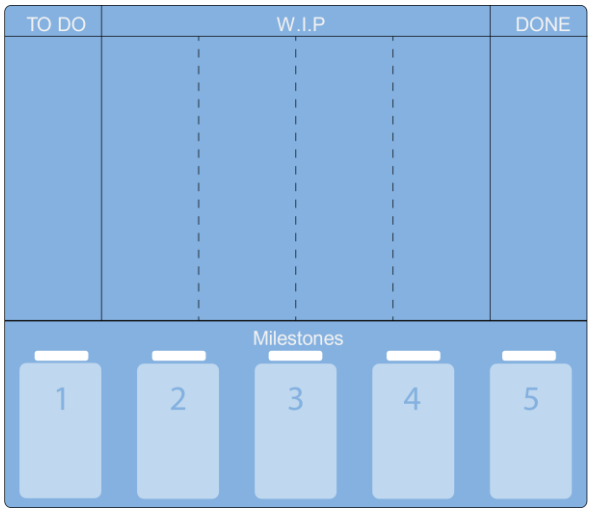


Figure 17. Kanban Board

The players will have to display the tasks on the Kanban Board. Tasks that are not yet started must be placed in the *To do* column, those tasks in which the employees are working on must be on the *W.I.P.* columns and once they are ended, they must be in the *Done* column. After all tasks of a milestone have been completed, the tasks should be stored at the bottom in the corresponding slot.

3. Game calendar sheet

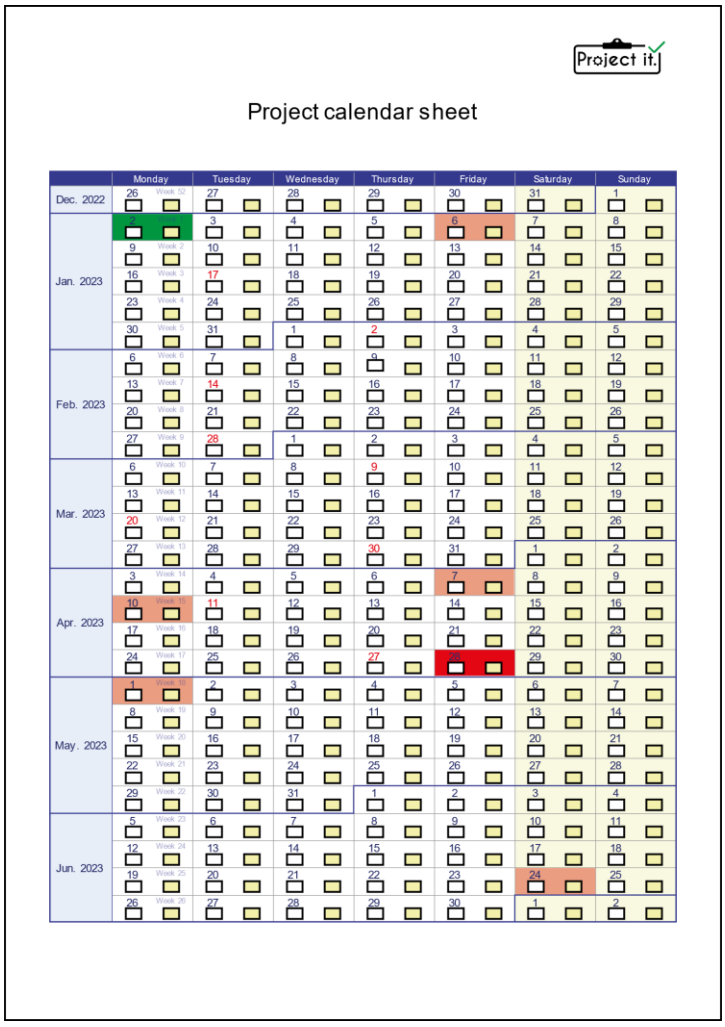


Figure 18. Game calendar sheet

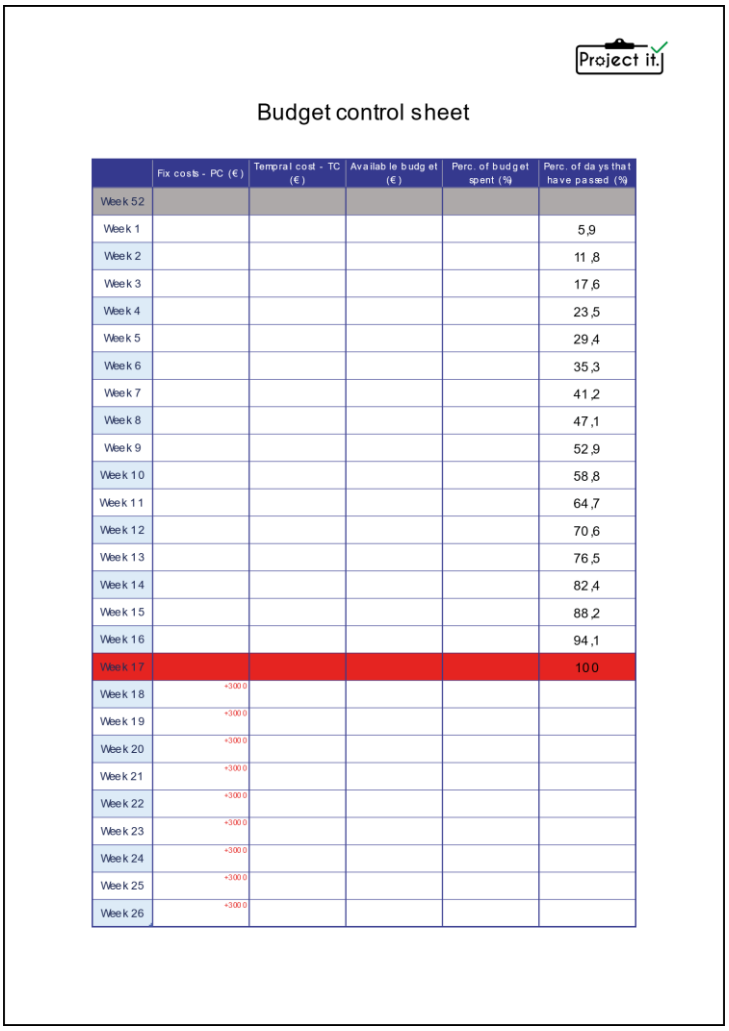
This calendar is used to keep track of the days that are passing during the project. It will have to be filled with each passing day.

The green cell corresponds to the start date of the project, the red cell corresponds to the delivery date of the project and the orange cells correspond to public holidays, so that no work can be done on these days.

The days marked in red correspond to the occurrence of an event. There is a total of 9 that have been introduced randomly.

The small white cells inside each day are used to mark that the date has passed. The small yellow cell is used to mark the days affected by an event. Above this date you can write the name of an employee who is hired on a temporary basis, to count the number of days he/she works.

4. Budget control sheet



	Fix costs - PC (€)	Temporal cost - TC (€)	Available budget (€)	Perc. of budget spent (%)	Perc. of days that have passed (%)
Week 52					
Week 1					5,9
Week 2					11,8
Week 3					17,6
Week 4					23,5
Week 5					29,4
Week 6					35,3
Week 7					41,2
Week 8					47,1
Week 9					52,9
Week 10					58,8
Week 11					64,7
Week 12					70,6
Week 13					76,5
Week 14					82,4
Week 15					88,2
Week 16					94,1
Week 17					100
Week 18	+3000				
Week 19	+3000				
Week 20	+3000				
Week 21	+3000				
Week 22	+3000				
Week 23	+3000				
Week 24	+3000				
Week 25	+3000				
Week 26	+3000				

Figure 19. Budget control sheet

This budget sheet is used to keep track of how much of the budget is being spent and must be filled in each time a week has concluded.

It is divided into 6 columns. The first one corresponds to the current week that the employees are working on. The next column refers to the amount of money that has been spent on permanent contracts, which means the weekly salary of the whole team. The next one is for adding the sum of money spent on the temporal employees during that week. The fourth column is for keeping track on how much of the budget is remaining, and the following one refers to the percentage of it that has been spent. The last column counts the percentage of days that passed until the project delivery date.

As it is shown on the sheet, on the second column starting on week 18, the team will have a penalty of 3,000€ each week the team is delayed with the project.

5. Tasks card

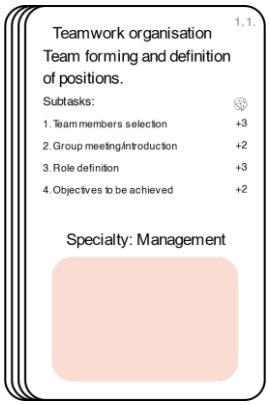


Figure 20. Task cards

These cards correspond to the tasks. There are a total of 22 tasks distributed in 5 milestones. Each task shows at the top right the number of the milestone to which it corresponds and its task order within the milestone. It also displays a brief description of the task and the subtasks that the worker will have to perform. To the right of it there is a number that corresponds to the result that must come up when rolling the dice to complete each subtask. There is also a slot where the worker must be placed, who must have the speciality mentioned above this slot.

6. Employee card

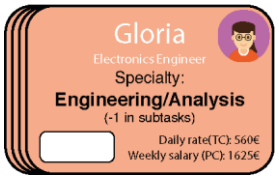


Figure 21. Employee cards

These cards correspond to employees (total of 23). On each card you can see what each employee does or has studied in addition to his/her speciality. Below the speciality, a characteristic related to the performance in each subtask is shown, which will be related with their salary. There is also a cell where the player will have to write the ID of the employee (001, 002, etc.). At the bottom right it displays the daily rate that it would cost to hire him if he/she was hired on a temporary basis, and then the weekly salary for those employees that are hired permanently.

7. Event card

Figure 22. Event cards

Event cards correspond to occurrences that may occur during the game. Some of them affect tasks, some affect certain employees, some affect the whole team, and some do not contain any occurrences at all. There is a total of 21 event cards.

8. Dice

Figure 23. Dice

Simple dice which must be thrown to complete subtasks.

Game instructions

Introduction

The goal of the game is to remain with the highest quantity of the initial budget. This means that the players will have to make good decisions in task planning and employee designation to finish the project on time.

It is recommended to play the game in groups of 3 to 4 players, where each person can be responsible for one function (e.g. one rolls the dice and moves the tasks, another fills in the calendar and another fills in the budget sheet).

During the game, the players will have to choose between a handful of employees with different salaries, characteristics, and specialties, and designate them to the different tasks. These tasks are divided into 5 milestones and contain certain subtasks that must be accomplished. Therefore, to complete a task, all its subtasks must be done. And to get a subtask done, it will be necessary to roll the dice and obtain the same or a higher number that corresponds to the subtask. This number can vary depending on the employee.

They will have to follow a calendar in which some days they will encounter events that will force them to change their strategy.

Game flow

1. First, the players will have to read the project description to have an idea on what the project consists of and obtain relevant information about. (2 minutes)

2. Next, the players must choose 5 employees from among all of them who will work on the project. Things to considerate:

    a. *Specialty* – Employees may only work on those tasks that match their specialty. Some employees count with more than one specialty, meaning they will be able to work on more than one type of task.
    b. *Weekly Salary* – The money that you will spend each week by having him/her on the team.
    c. *Daily rate* – Money that costs each employee if you decide to hire him/her temporarily. They can be hired at any time during the project.
    d. *(-1 in subtasks)* – This means that this employee can accomplish the subtasks by getting one number less when rolling the dice in each subtask.
    e. *(+1 in subtasks)* – This means that this employee can accomplish the subtasks by getting one number more when rolling the dice in each subtask.
    f. Those employees that have no information below the *Specialty* will have to obtain the number it shows or higher on each subtask.

    It is important to ensure that the team is multidisciplinary and that salaries do not exceed the budget. Throughout the game you will be able to hire temporarily an employee paying their corresponding daily rate. Writing down and calculating the salaries can help during the game. In addition, the work team must be composed of

at least one employee with a specialisation in management, as he/she will be the project manager. (5 minutes)

3. Players must write down the employee ID in the white cells. the purpose of the IDs is related to the events that may occur, since some of them will only affect certain employees of the team. It doesn't matter what ID is assigned to each employee. These numbers must go from 001 to 005 as it is shown in the example below. (1 minute)

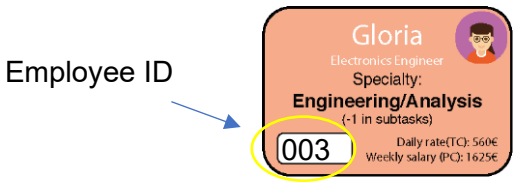


Figure 24. Employee card with ID

4. Once the employees are chosen, the players can get the task cards and organise them. Each task card contains a number that is shown on the top right part of the card, and it corresponds to the milestone to which it belongs and its order within it.

   The card also shows its title with a brief description about the task. The subtasks are displayed below the description, and on the right part of each subtask there is a number that corresponds to the number that the player must obtain to accomplish the respective subtask. In addition, each subtask has a number indicating the column in the *W.I.P.* part of the Kanban Board it belongs to.

   As it has been mentioned before, each task can have one or more specialties, which means that the tasks can only be completed by an employee that matches with one of them. Employees must be placed on the cell below the specialty while it is being worked on. (4 minutes)

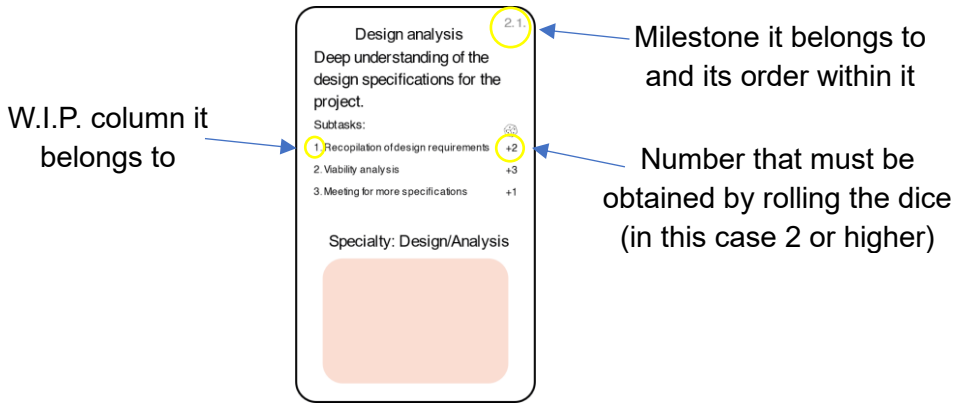


Figure 25. Task card explanation

5. From this point the players will play by their own. Once the cards are organized, the game can start. First, the tasks cards from the first milestone must be placed on the *To*

do column in the Kanban Board, as it is shown below. The rest of the task's cards can be placed on the side. You can also place the chosen employees on the side of the board. The event cards must be also placed next to the board and turned upside down.

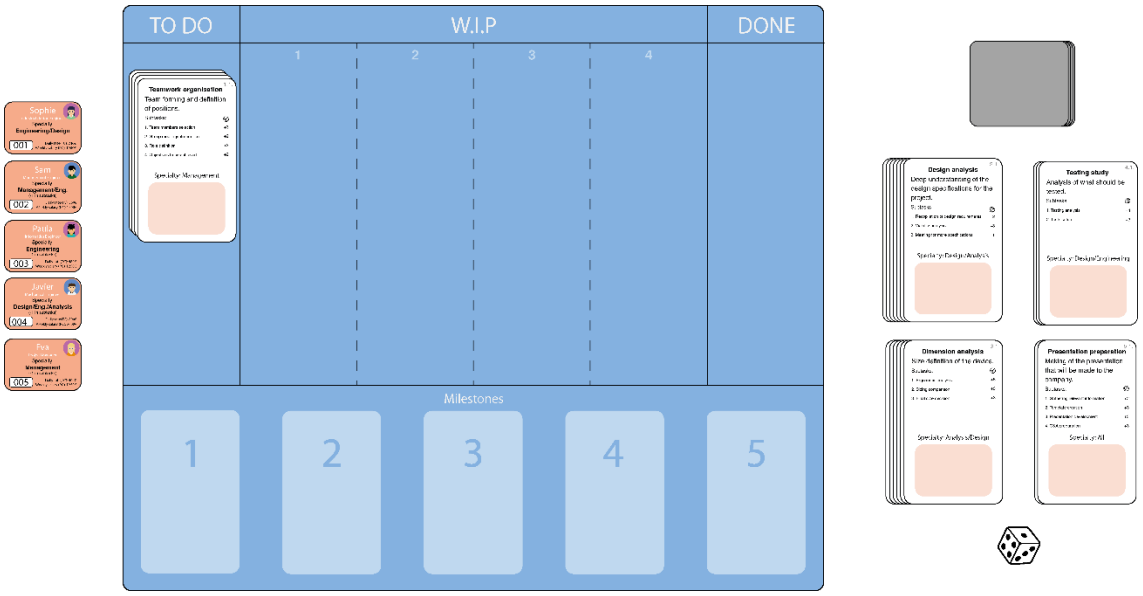


Figure 26. Game flow illustration 01

Once they are all placed on the *To do* column, the first task should have to be placed on the first column on the *W.I.P.* part of the Kanban Board.

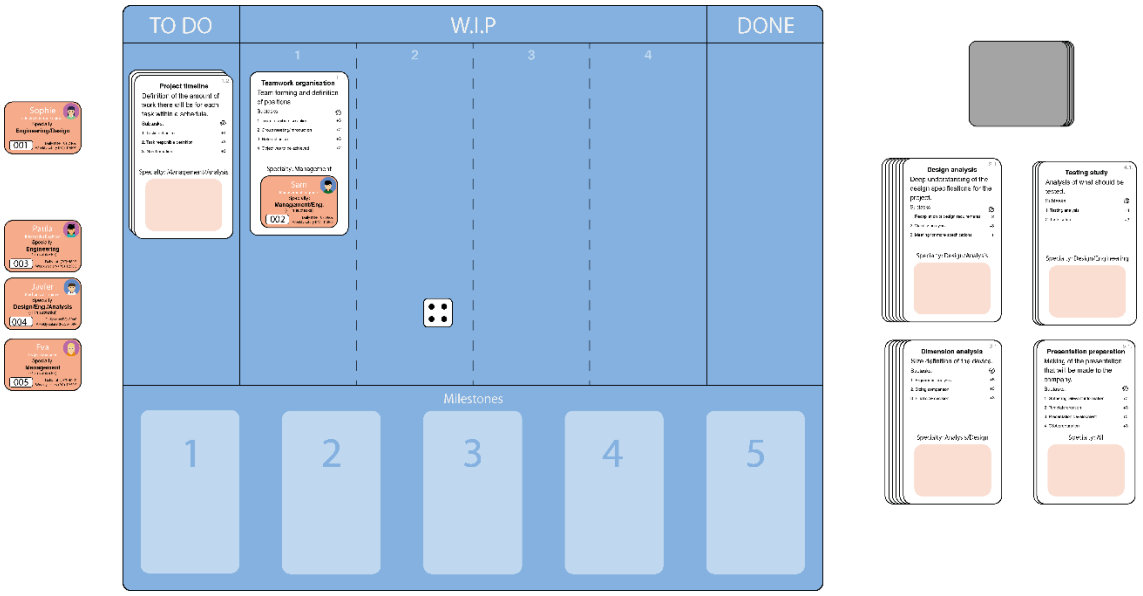


Figure 27. Game flow illustration 02

Then, the players will have to roll the dice. If the number obtained on the dice is the same number or higher than the corresponding number, the subtask will be completed, and the card be moved to column number 2. If not, it will have to stay on

the same column. Once the dice is rolled, the player must mark on the calendar that the day has passed. Players can only roll the dice once per day and task, meaning that if there is more than one task on the board, the dice must be rolled once per task, and that will mean that a day has passed.

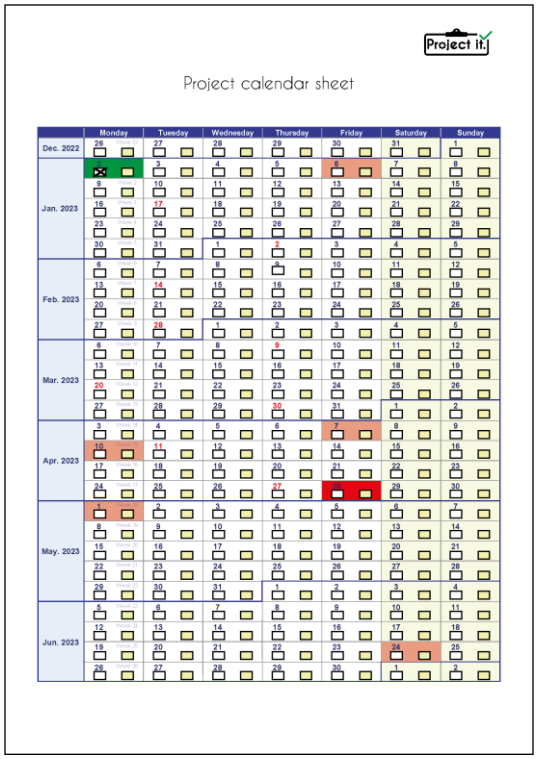


Figure 28. Game flow illustration 03 - Calendar sheet

Once the day has been marked on the calendar sheet, the game can continue. As it has been mentioned before, if the number that has been obtained by rolling the dice is lower than the one mentioned in the subtask, the task must stay in the column. If it is equal or higher, the task can be moved to the next column to start working on the next subtask. As the first column has been freed, the next task in order can be moved to this column. The image below represents as if the number obtained with the dice is higher than the one that the first subtask from the first tasks, so it has been moved to the next column and a new task has been added to the first column.

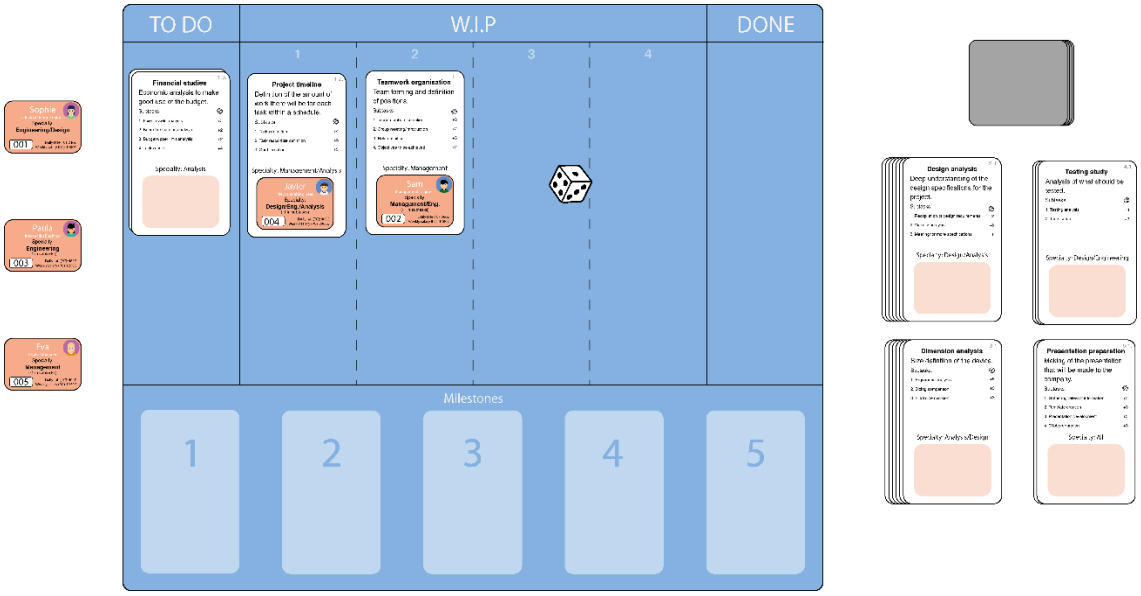


Figure 29. Game flow illustration 04

Once both tasks are correctly placed, the next day on the calendar must be marked and the dice can be rolled out to start the second subtask from the first task. If the obtained number is equal or higher, this task can be moved to the third column. The dice must be thrown again for the first subtask of the second task, and it will be moved or not depending on the result.

This must be repeated until all the tasks from the first milestone reach the *Done* column. Once this happens, the cards must be put on the bottom part of the board on its corresponding milestone.

It is important to keep track on the days passed on the calendar sheet and fill in the budget sheet as it is shown below. Players must take care that the column for the percentage of the budget spent does not exceed the percentage of days that have passed.

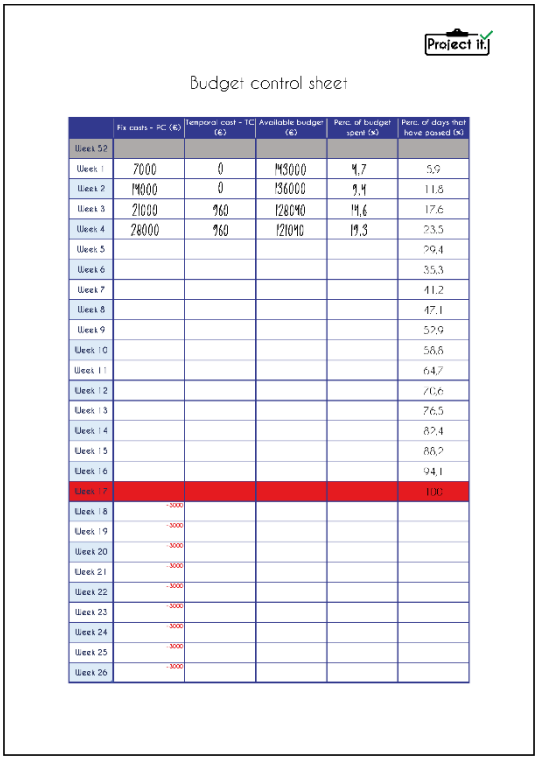


Figure 30. Game flow illustration 05 - Budget sheet

As mentioned above, there are certain days on which events occur. These days are those that are coloured in red on the calendar sheet (e.g. 17 January). So, when the current date is one of these days, one of the event cards should be taken before rolling the dice. The occurrences that appear on the cards start on that same day, meaning that, for example, if it happens that a worker cannot work for the next 5 days, the first day he/she cannot work is that same day. Another thing that can happen is that an employee leaves the team. If this happens, another employee can be recruited to fill the position.

The following represents what the game should look like when all tasks are completed.

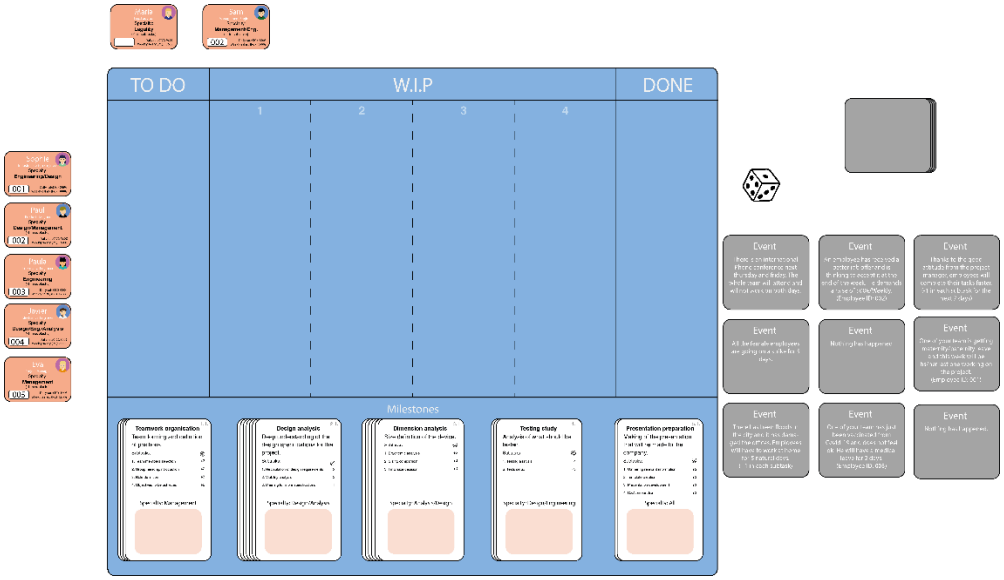


Figure 31. Game flow illustration 06

As it can be seen on the image, the employees from the team are placed on the left part of the board and on top those employees that have been hired temporarily or that have left the team. On the right-hand side of the table, the event cards that have been released during the project are displayed. There is a total of 9 since there are 9 dates involving occurrences. In addition, the task cards are placed on their respective milestones.

Below is what the budget and calendar sheets could look like at the end of the project.

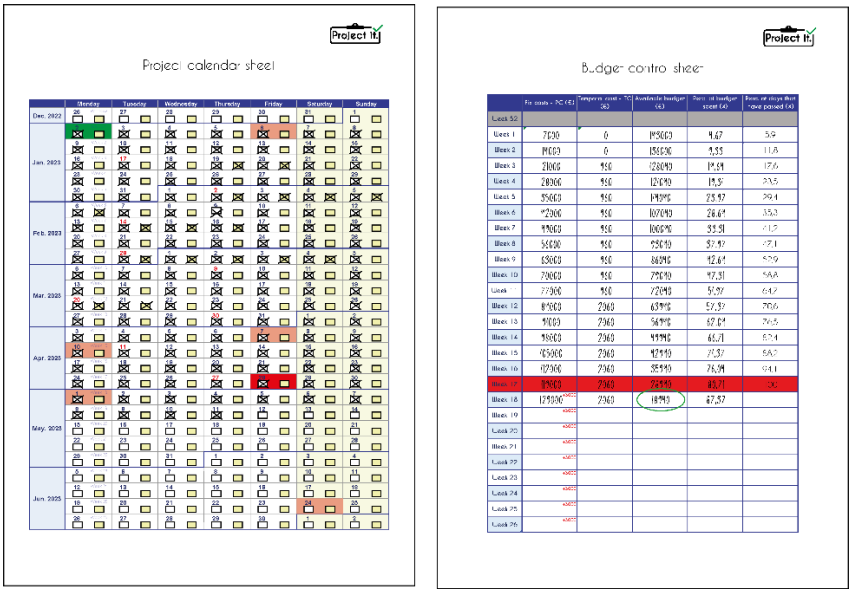


Figure 32. Game flow illustration 07 - Sheets filling

As it can be appreciated on the sheets, each day has been marked in addition to those days when events were taking place, and the budgetary content has been filled in for each week. In this example, the remaining budget has turned out to be 18940€. This amount should be compared to the one the other teams had to see who won. The game can be repeated by using other strategies to try to improve the result.

Compilation of points to remind

- The goal of the game is to obtain the largest amount of remaining budget.
- The work team must always be composed of 5 workers.
- An employee can be changed only if an event states it.
- Employees can be changed between tasks.
- Employees can be hired temporarily (TC) at any time.
- The start date of any event is the day in which the card has been picked up.
- Some employees must get a higher or lower number when rolling the dice to complete a subtask.
- A task can be placed on the first column of the *W.I.P.* part only if there is no other task on it.
- A task cannot overtake another, meaning that, if there are more than one task on a same column, and if the result of the dice for the corresponding subtask from the first task is not achieved, the subtasks from the other tasks cannot be performed. This cannot happen on column 1 since there can only be one task each time as it has been mentioned before.
- All the tasks from a milestone must be completed to be able to work on the tasks of the next milestone.
- The tasks of the last milestone must be performed by all employees of the team as it is stated on the card, meaning that they will only be able to work on a task at a time. The tasks can still be performed if there is an employee that is not available during the days they are being carried out.
- Tasks must be moved to the *Done* column once all its corresponding subtasks are completed. Therefore, if a task contains 1, 2 or 3 subtasks, their last column from the *W.I.P.* part will be columns number 1, 2 and 3 respectively.

Packaging

Here below is the packaging that will have the game.

Figure 33. Packaging of game

Game manual

The packaging includes a game manual in which all the previous information is shown.

Figure 35. Game manual cover

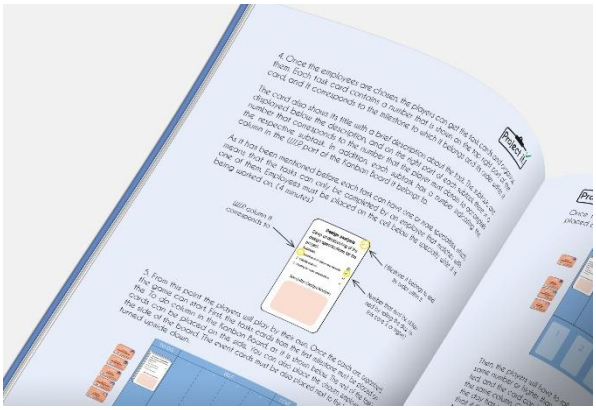


Figure 34. Game manual page

7 Budget summary

The total cost of the project has been 16,683.28€, in which 14,400€ corresponds to the working cost, and 2,283.28€ to the additional costs. The detailed cost will be found on the Budget document, which also includes a Gantt diagram according to development of the project.

8 Analysis and assessment of environmental and social implications

As this project has no environmental or social implications, this section has not been carried out.

9 Conclusions

The result of the project is a game that will help several students pursuing a career as a Project Manager to gain skills that they may not have gained through traditional apprenticeships. This game will allow players to put themselves in the role of a project manager and experience various types of situations they may go through, especially in situations involving issues related to budget management, time management and task planning. Along the game the players will have to use different strategies to try to achieve the best result as possible, that will be based on delivering the game project on time without exceeding the budget.

There are no limits related with the usages of Serious Games, since it can be applied in all type of ambits and it can involve a wide variety of scenarios. The research conducted in the project has demonstrated that there is a big interest in these types of games, and its popularity is increasing exponentially.

Regarding the game limitations, this game should be printed to play, thus you will need to have a printer to print the different components. In addition, currently it is only available in English, so it can only be played by people who understand English.

In terms of the project's future vision, the aim is to make the game available online and to keep it open access, without the necessity of printing it out. In this way, it will be possible to reach a large number of players, especially students. The game is meant to still be improved overtime by adding new features, and this will be easier with the feedback from those who play. In addition, the game will be also offered in more languages, so that people that don’t understand English can also play.

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Packaging and game manual References:

The image from the packaging and the cover has been designed has been designed on the basis of an image of Vecteezy.com

"Figure 31: Packaging of game". This packaging has been designed using images from Freepik.com

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The icons that appear along the report have been developed by myself using Adobe Illustrator.