Georgios Riskas

MACROMANAGEMENT IN RTS GAMES

Emphasizing strategy over tactics

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Abstract
Strategy games have been introduced to the public in many different forms and video game is no exception. Real-time strategy (RTS) has been amongst the most popular strategy subgenres. It has gone through many changes and has both borrowed and lent gameplay elements from and to other genres throughout time.

The most common criticism of modern RTS games is that they lack the strategic depth (macromanagement) and rather emphasize in the tactics (micromanagement). While the mentioned criticism is a generalization, it contains - depending on the game - a smaller or bigger fraction of truth. Strategy is arguably present but is many times overshadowed by the demanding tactics.

The purpose of the present thesis was to examine if RTS games could be designed in a way that encourages strategic thinking without relying on heavy micromanagement on the battlefield. The study was qualitative and the main methods that were used were formal gameplay analysis and comparative analysis.

Four of the bestselling RTS games of all time were put under the scope of the research to detect traceable design patterns that can answer the research question. The games were Command & Conquer, Starcraft, Age of Empires II: The Age of Kings and Warhammer 40,000: Dawn of War.

After the formal gameplay analysis exposed many of the games' patterns and mechanics, the comparative analysis pointed to the direction that should be followed. The analysis showed that specific mechanics have been used in the past towards the direction of emphasizing the macromanagement in RTS.

A strategy manual was produced to list the findings of the research, as instructions that can be used in future game development of RTS games. The manual combines old ideas with innovative ones that can be used for prototyping. Quantitative analysis might be used in the future to extend the results of the research.

CONTENTS

APPENDICES

Appendix 1. Mindmap

Appendix 2. Framework of reference

Appendix 3. SWOT analysis

Appendix 4. Manual contents

1   GLOSSARY

The present chapter contains the definitions of acronyms and game related terms that are mentioned in the text.

AI: Acronym for Artificial Intelligence. This term is descriptive of how smart CPU-controlled characters behave in a game. For example, if an enemy soldier runs for cover when he sees a grenade, it's an indication of AI. It's generally harder to defeat foes that display good AI (Videogamecritic 2011.)

Fog of war: You can see the entire map, but not what is going on. Once you scout the area, you temporarily see what is going on (Gamereplays 2014.)

Rock, paper, scissors: Crawford's term for game design where between three units or moves neither is the strongest (A beats B, B beats C, C beats A). Rock-papers-scissors is triangular (Halfreal.)

RTS: Acronym for Real Time Strategy game. Strategy game where players can move pieces continuously (Halfreal.)

Shroud: You won't see the map unless you scout it. Once revealed it stays revealed (Gamereplays 2014.)

TBS: Acronym for Turn-based strategy Game where players take turns performing actions (Halfreal.)

2   INTRODUCTION

A simple definition of strategy is a careful plan or method for achieving a goal, usually over an extended period ("Strategy" Def. Merriam-Webster. com. n.d). It is hard to find any activity that aims to an end, in which the concept of strategy would not be applicable. Evidently, video game is no exception.

It is easier to understand what strategy means to the respective medium, if its meaning is interpreted in two diverse ways. Firstly, most video games have a specific goal, which the players aim to achieve. The methods that are followed for that purpose can be viewed as the players' strategy. Secondly, strategy is recognized as a genre in video game which has its own distinctive characteristics, history and subgenres (Mott 2010.ed.)

With that said, the term "strategy game" is used to describe games that belong to the respective genre and not games that simply require planning as a necessary part of playing and succeeding in it. The subgenre of RTS (real-time strategy) is put under the scope of the present thesis, aiming to explore the dynamic relation between strategy and tactics and the result that they deliver as a gameplay experience.

While TBS (turn-based strategy) games inherited their gameplay elements from the preexisting war themed board games, RTS chose a different approach. As the name of the genre indicates, the decisions of the players, the actions and their consequences all take place in real time. The involvement of tactics is unavoidable as the players should give orders to each one of their units, usually by pointing and clicking their mouse buttons, to achieve their goal (Rollins & Adams 2003.)

2.1   Motivation

Even though the use of tactics seems to be one of the most recognizable traits of RTS, it has also been one of the biggest sources of criticism that the genre has received. According to that criticism, games that require heavy tactics, also require faster reactions, higher clicking rates and challenge players' multitasking abilities under time pressure rather than their strategic thinking (Toronto 2008.)

Even if the genre has not remained stagnant and is continuously evolving, the novel ideas that are proposed, usually revolve around micromanagement or "class based mechanics", as designer Sam Bass sets it in one of his interviews (Remo 2010). The present paper aims to examine if the mentioned criticism is valid and the possible ways to mediate the involvement of micromanagement.

The author's motivation for the project comes at first, out of his personal interest for the genre. A respected amount of time has been spent in playing video games in the past twenty years and RTS games have always been a big part of the experience.

Secondly, as mentioned above, developers have not taken many risks in the direction of reducing the micromanagement. On the contrary, it is usually the other way around. Tactics is considered as a synonym of the fun (Goodfellow 2008) that the game should offer and that comes both for players and developers.

Finally, the amount of risk that developers are willing to take on RTS games, gets less every year. This is of course justified by the tendencies on the market. As, Thirlwell states on his article about the decline, evolution and future of RTS "No one is green-lighting $40 to $60 million RTS projects anymore." (Thirlwell 2016).

The purpose of the present work, is to suggest solutions that can be used to mediate the power of tactics over the strategy. In addition, it aims to create a template that can be followed to design games that do not rely heavily on micromanagement, but allow players to emphasize on the strategy. The Mindmap, framework of reference and SWOT of the report can be found in Appendices 1-3.

2.2   Outline of the report

Chapter 1 is the glossary section that includes the required explanations of the terms that are used in the report. In their majority, they are terms used in games or game development in general.

The present chapter 2 is the introduction that offers basic information about the place of RTS on the field of video games. Additionally, informs the reader about the author's motivation and offers the outline of the report.

Chapter 3 aims to list the defining characteristics of RTS as they were developed throughout the history of the genre and then to clarify the concepts of strategy and tactics. That will improve the reader's insight about the game design patterns of RTS that are analyzed in the following chapter.

Therefore, chapter 4 contains information about the research methods that are used as well as the scope of the qualitative study. After the selected games are analyzed, they offer a conclusion about what affects and how the gameplay of RTS games.

Chapter 5 offers information regarding the contents of the instructions manual that was produced from the research and finally chapter 6 is the conclusion of the present paper.

Overall, the present paper tries to answer the following research questions: Can RTS games offer strategy oriented gameplay that does not rely on heavy micromanagement? Can macromanagement be emphasized instead, or is it against the engineering of the genre itself? If the answers to the previous questions are positive, then is there room for innovation or do all the answers lie on the already used recipes of the past?

3 DEFINING RTS

The broad meaning and the appliances of the term *strategy*, makes it occasionally easy to categorize many different titles under its wide range. The term *real-time* seems to also fit in the ensemble of games that take place in real time.

Figure 1 illustrates the range of games that can be categorized as strategy games. Bloons TD 5 is a Tower Defense game, while The Escapists is role-playing strategy game.
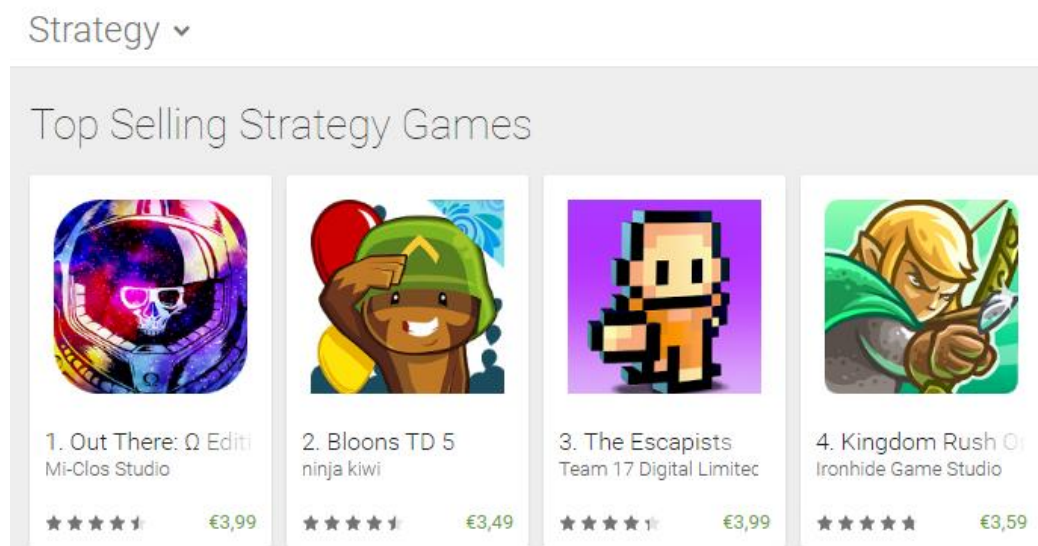
Figure 1. Top Selling Strategy Games on Google Play as of 10.4.2017 (Riskas, G. 2017)

The present chapter does not aim to offer in depth information about the history of the genre but to rather put a frame of reference that will make the research of chapter 4 easier to approach. Thus, the titles that are referenced in the present chapter are the games that encouraged the inception of innovative ideas rather than the complete history of the genre.

3.1 Brief history of RTS

The descriptions of chapters 3.1.1 and 3.1.2 are based on the lengthy article "The state of the RTS" by Dan Adams (2006) and the "1001 Video Games" edited by Tony Mott (2013). Additional sources are mentioned separately when necessary.

The titles that prepared the ground for what is nowadays considered RTS, had already made their appearance in the 1980's. However, it was during the 1990's that the genre took its distinctive form. The first game that has been recognized as an RTS title is admittedly Dune II, published by Westwood studios in 1992.

3.1.1 Strategy games before Dune II

The strategy games that are mentioned in this subchapter can be considered RTS games only retrospectively, since the term itself would not be established until 1992. It could be said that they worked as prototypes that served the further development of the craft.

Figure 2. Stonkers (1983) in game screenshot (Teamliquid.com)

In 1983, the game "Stonkers" was released for the 48K ZX Spectrum system. The game is one of the first to demonstrate strategy action in real time. As Figure 2 illustrates, both the player and the computer are provided with the same units. The units can be given orders to move on the map and attack enemy units. The biggest innovation of the game was the "rock, paper, scissors" system, on the unit counters. The game also featured a basic resources system in which, soldiers had to be provided with food to stay alive (Driver 2008.)

"Mega Lo Mania" was originally released for the Amiga system in 1991. The game featured building castles, technology trees, advancing epochs and a minimap system. The resources consisted of men and minerals. The twenty different minerals could be combined in diverse ways to unlock updated technologies and weapons. The player could order the units to move into different sectors, but unable to micromanage them after they were in place. If

hostile units ended in the same sector they would engage into a fight (Figure 3). (Blackwood 2015.)

Figure 3. Mega Lo Mania (1991) in game screenshot (Imgur.com)

The most important and influential example of a game for the evolution of the whole genre came in 1989 for the Sega Mega Drive system, with the title of "Herzog Zwei". It was the first time that a game resembled so closely what was later going to be the modern RTS genre. The basic elements such as base control, resource management, unit production and even split-screen multiplayer (Figure 4), set the base for other games to build upon later (Tomas 2005).

Figure 4. Herzog Zwei (1989) in game screenshot (Gamefaqs.com)

3.1.2 The dawn of RTS and its evolution

The foundation of the genre came in 1992 with "Dune II: The Building of a Dynasty", released by Westwood Studios. The game featured all the elements of a modern RTS such as, the on-map resources and the use of mouse for giving direct orders in real time. It should be noted that some of the systems were still in a rough shape. For example, no more than one unit could be ordered at the same time (Loguidice & Barton 2009, 65-75.)

Three years after the success of Dune II, Westwood studios released their next title, Command & Conquer. In addition to the already existing gameplay, the game added a more sophisticated user interface and made the units' selection more accessible. Figure 5 illustrates the sidebar that gave access to new structures and units.

Figure 5. Command & Conquer (1995) in game screenshot (Old-games.ru)

In the same year of 1995, Blizzard Entertainment released the sequel to the first Warcraft title, Warcraft II: Tides of Darkness. The novel element of the game was the use of fog of war instead of the shroud feature that was used that far. The game was also the first to put naval units under the control of the player (Dulin 1996.)

In 1997, Ensemble Studios put their signature on the RTS genre with their title, Age of Empires. Instead of a fantasy setting like the previous examples, Age of Empires used real history as its inspiration. The sophisticated resource

system and the progression through different ages of human civilization offered a new perspective to the genre. The complicated technology trees, the different winning conditions and even the aspect of diplomacy made Age of Empires a unique title upon its release (LGR 2016).

Total Annihilation was released in the same year by Cavedog Entertainment and immediately impressed, as its own name indicates, by its massive scale. The player was able in the later parts of the game to access the big picture of the battlefield via a long range top down camera view. The game used three dimensional models for the first time. Combined with the physics engine that was used and the advanced visual effects, Total Annihilation made its way among the best RTS games of all time (Dulin 1997.)

Blizzard Entertainment is known today as one of the most successful game companies and part of the reason lies in their RTS titles back in 1998 and 2002 when they released Starcraft and Warcraft III: Reign of Chaos respectively. Both were of the most polished titles of genre for the time that they were released and each one of them carried its own amount of innovation.

Figure 6. Starcraft in game screenshot (Riskas, G. 2017)

Figure 6 illustrates the factions of Terrans (left) and Zerg (right). Two out of the three entirely different but balanced factions in Starcraft. Warcraft III introduced the use of heroes as a special unit. While the idea of a player

avatar unit had been used before, that was the first time that the heroes could be upgraded by leveling up and by using different items (Adams 2002.)

Rise of Nations, developed by Big Huge Games was released in 2003 and while the game resembled Age of Empires in many ways, it offered its own innovations. It was the first time that the different factions had borders within which, they could establish their base. The game also featured some interesting late game mechanics. To prevent players from creating huge armies, the cost of the units would increase depending on how many of them were produced (Chin 2003.)

Relic Entertainment is recognized today as one of the most innovative studios when it comes to RTS games. The new economy system based on strategic points that should be captured put the focus of the gameplay almost entirely in the battle (Figure 7). The units, even though they moved and attacked in squads, could also behave as individuals when it was about upgrading them with new weapons. Finally, the addition of morale in the units added a new layer regarding on the tactics of the game (Adams 2004.)

Figure 7. Company of Heroes (2006) in game screenshot (Riskas, G. 2017)

After the mid-2000's the genre of RTS has not been as popular as it was in the decade before and that is the main reason why studios do not take big risks to establish new franchises. Grey Goo, developed by Petroglyph Games in 2015, is one of the few examples of RTS games that had a major release without being part of an established franchise.

3.2   The defining characteristics

The description of the present chapter is based on "Gameplay and Design" by Kevin Oxland (2004, 31-32). Additional sources are mentioned separately when necessary.

The way RTS games are controlled is with a mouse and a keyboard. The mouse plays the most important part, since this is the tool that is used for selecting the units and issuing commands. Many of the orders can be alternatively issued by the keyboard shortcuts. The mentioned feature is used by experienced players who want to take full advantage of the time that they are given. Most RTS games have been released on PC and some of them have been ported on consoles. In some uncommon cases, game consoles have had exclusive RTS releases. For example, Halo Wars 2 was meant to be played with an XBOX controller, since it received exclusive release for the XBOX ONE console (Figure 8).

Figure 8. Halo Wars 2 (2009) in game screenshot (Sosgamers.com)

Most RTS games usually feature one or more single player campaign, a skirmish mode that can be played against the game's artificial intelligence(AI) and multiplayer mode. The number of players that can participate in a multiplayer match is between 2 and 8, depending on the game. The players can reach each other either online or via a local network. The games offer more than one factions for the players to choose. Different factions should be approached differently and might have different learning curves.

The game sessions take place in different maps. They usually include different resources and feature different environments. The minimap, as the word indicates is a miniature of the map. It usually appears in the bottom of the screen, as part of the user interface and helps the players to keep track of the action in various parts of the battlefield. Specific maps might even affect the flow of the game depending on the way they are constructed (Dor 2014). Other maps can simply have two identical halves the offer equal opportunities to the players (Figure 9).
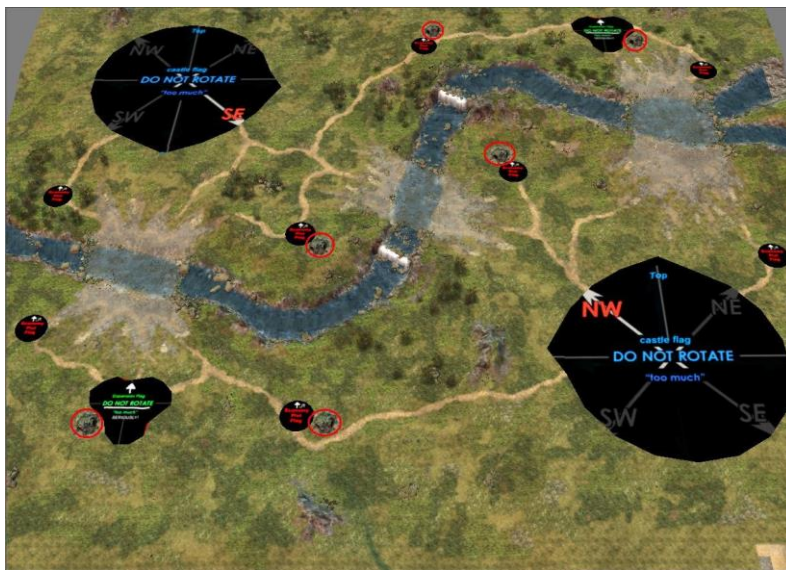
Figure 9. Battle for Middle Earth (2004), top-down view of the map "Fords of Isen" (Gamereplays.org)

Exploration of the map is another common theme on RTS games. In the beginning of each session the players can see a small part of the map. The rest of it is covered by fog of war, shroud or a combination of the two. Players are called to travel through the map to find resources and face their opponents. In specific games, special items that benefit the player can be found on the terrain, as well as NPC encounters with creeps. Getting information about enemy bases is usually critical as well. Many RTS games even feature scout units to highlight the need for exploration.

There have been exceptions throughout the history of the RTS genre, but it can be said that the prevalent theme of RTS has always been war. The players own their main base at the beginning of each session. The mentioned

building represents the center of their faction. The players are also able to build a plethora of different buildings for battle or economy purposes. Buildings can be destroyed by the opponents during the game. The building system might allow the players to build everywhere on the terrain, or apply various restrictions depending on the game.

The units that the players can produce are not always the same but they often follow similar logic in the relations between them. The phrase "rock, paper, scissors" is usually used to explain a balanced system in which every unit has strengths and weaknesses against different opponents. Not all games have adopted the system, and others have modified it, but remains one of the most prevalent balancing systems that have been put into use.

Technology trees refer to the macromanagement part of the game. They resemble the order in which different technologies should be researched and new structure should be built. Figure 10 illustrates the technologies that can be used in Age of Mythology (2002). The priorities that are given in every game can alter the outcome and define the result of the battle (Ghys 2012). In specific titles such as Command & Conquer: Generals and Lord of the Rings: The Battle for Middle Earth, the meaning of technology trees has been expanded into a system of power points that the players earn by fighting. They can then spend those points to obtain skills that will offer advantage over their opponents.

Figure 10. Age of Mythology (2002), in game view of technology tree (Ageofempires.wikia.com)

Micromanagement and macromanagement are two terms referring to the tasks that the players must maintain. Micromanagement refers to the smaller tasks that need the perpetual attention of the player, such as issuing orders in a real-time battle. Macromanagement refers to tasks that should do with long term future planning such as choosing which strategy should be followed to establish a strong economy. More information about the terms is given in the following subchapter 3.3.

3.3 Strategy and tactics

Military strategy is a set of ideas implemented by military organizations to pursue desired strategic goals (Gartner 1999, 163). Usually strategy refers to the combination of all the means one should use, to achieve victory. Strategy is the long-term decisions that are not judged immediately but in depth of time. The basic aspects of strategy include economy and diplomacy as much as military force.

Military tactics on the other hand, are by definition, the science and art of organizing a military force, and the techniques for combining and using weapons and military units to engage and defeat an enemy in battle (Clausewitz 1832). Tactics resemble the short-term decisions. They can be undoubtedly useful when in battle as in commanding the troops to move, evade or attack, or even decide what is the most beneficial formation that the units should take.

RTS games are based on the balance between the two. In theory, strategy/macromanagement is by default more important. The player who comes victorious out of a session is usually the one that could read the game more accurately. In a scenario of two players equally capable in micromanagement, the one who would apply the better macromanagement would win most of the times.

On the other hand, intensive micromanagement can distract players from macromanagement. The players should make long term decisions, but if they do not have the required speed to execute their moves faster than their opponents, then the strategic part becomes insignificant.

In conclusion, a rough outline of what are the defining characteristics of RTS are can be found in what the senior producer of Command & Conquer: Generals (Figure 11), has said. "The fundamentals of these games are pretty similar: they generally have maps or levels to explore and fight over, resources that can be harvested to build structures and units, armies that move and fight, and a technology or "research" tree that unlocks more powerful units and capabilities over time" (Bates 2004, 56.)

Figure 11. Command & Conquer: Generals (2003), in game view (Releasegamestudio.com)

4 FORMAL GAMEPLAY ANALYSIS

Qualitative research can be applied in video games in many ways. It can be used to examine their design patterns, their real-world relevance, or to describe the way they motivate players and challenge their way of thinking. In general, this type of research aims to unveil underlying patterns and their relation to the human experience (Wyse 2011.)

The ways that a game can be approached has been a subject of discussion amongst researchers and game scholars in the past. In search for methodological tools in game analysis, Konzack, in his book "Computer Game Criticism: A method for computer Game analysis" (2002, 89-100) argues that there are seven different layers that games can be looked upon, including hardware, program code, functionality, gameplay, meaning, referentiality and socio-culture.

The International Game Developers Association have included on their Curriculum Framework nine suggestions of themes that should be offered in game programs in universities. The topics are:

●   Game criticism, Analysis & History,
●   Games & Society,
●   Game Systems & Game Design,
●   Technical skills, programming and algorithms,
●   Visual Design,
●   Audio Design,
●   Interactive Storytelling, Writing & Scripting,
●   Business of gaming,
●   People and Process Management (IGDA 2008.)

Aarseth separates game analysis in three different dimensions, in his paper "Playing Research: Methodological approaches to game analysis" (2003): Gameplay, game structure and game-world. Gameplay stands for the players' actions, strategies and motives. Game structure is the rules of the game and the game world is indicated as the fictionalized setting, the topology and the visual part of it.

Consalvo and Dutton suggest interaction mapping, object inventory, interface study and logging gameplay as means of developing a methodological toolkit for qualitative study of games. The model that they have developed is broad, so it can be applied in different genres but it can also take genre specifics under consideration (Consalvo & Dutton 2006.)

In the present thesis, the main aim is to understand the design patterns of RTS games and to explore the genre specifics and reveal any cause-effect relation, between the design that is applied and the experience that is delivered. The details about the process are given in the following chapter 4.1.

4.1   Setting the scope

It becomes quite clear by reading the research questions, that the most important concern of it should be the gameplay. Studying the gameplay can offer insight about why specific design choices were made, how they were made and if the result was the desired one.

Studying other players' experience of games through critics, reviews, walkthroughs, playtesting reports, interviews or even plain knowledge of the respective genre are all methods that can be used to extract information (Aasreth 2003). The objective nature of one's opinion can render the results risky and in the worst case invalid.

According to Aasreth, there are many sources that can be used for non-playing analysis. On the other hand, it can be easily assumed that the researcher who has spent time playing a game can understand the mechanics of it better than a sole spectator who has never tried it (Conslavo, Dutton 2006).

The description of the present chapter is based on the "Game Research methods" by Petri Lankoski and Staffan Björk (2015, 23-36).

Qualitative game analysis can be done in a few diverse ways. Zagal and Mateas suggest that analyzing time in video games is one way to approach

qualitative research. Sköld, Adams, Harviainen and Huvila explain how games can be studied from the viewpoint of information. But in the present report the approach of studying games is that of formal analysis of gameplay.

Formal analysis is the procedure of breaking down the elements that constitute the experience of a game and trying to find the relation and the correlation between them. These elements in the case of video games are the rules and the goals, or in other words, the primitives of the game.

An effortless way to understand what primitives are, is to think of them as the building blocks of games. More specifically, the research is concluded around the components, the actions and the goals of the game. The components are the assets of the game that are controlled either by the player or the AI (Artificial Intelligence). The actions are the combination of decisions that the players make and can have some short term or long term results. Finally, the goals represent the desire of the players to reach achievements related to the games.

In conclusion, the chosen methodology for the research is that of formal analysis by playing the games. The aim of the analysis is to reach the core of the games' structure and find out what elements are emphasized and what results they yield.

4.2   Gameplay analysis

The games that are selected to be put under the scope are Command & Conquer (1995), Starcraft (1998), Age of Empires II: The Age of Kings (1999), and Warhammer 40,000: Dawn of War (2004). The main reason why the specific titles were selected, is the success that the mentioned games have enjoyed both critically and financially. All the titles that are examined have sold a minimum of two million copies (Mallinson 2002; Kalning 2007; Microsoft 2000; Remo 2009) and make their place to the list of the highest grossing PC games of all time.

4.2.1   Command & Conquer (Westwood Studios, 1995)

Command & Conquer is an RTS game where the player is called to pick a side and fight against another human opponent or against the game's AI. Global Defense Initiative (GDI) and Brotherhood of Nod are the two factions of the game and they both have their own separate campaigns.

The game has the following types of components: units, structures and resources. Of the mentioned components, units and structures have different versions while the only resource is the fictitious mineral, tiberium. Power could be considered as a second resource, since it is required to keep the structures functional. The game keeps track of the player's credits, which allow the player to purchase buildings and units.

The player actions, regarding the units consist of selecting, moving and attacking. Moving can be expanded to following and patrolling. The actions related to structures are building, repairing and selling while the generic action of purchasing can also be applied. The mentioned actions are issued by using the left mouse button. Buying, repairing and selling actions are all accessed through the game's sidebar.

The game ends when all the structures and all the units of one side are destroyed or captured. Engineer units can capture enemy structures. Specific buildings such as Obelisks and Turrets cannot be affected by the mentioned unit.

The environment of the game consists of a terrain where the action takes place, a sidebar, which the player can access to purchase assets and a minimap, which helps the player to keep track of the existing units and to issue fast commands. The sidebar opens automatically after a Construction Yard is built and can then be toggled between active and inactive by pressing the appropriate button named Sidebar, on the top right of the screen.

Figure 12. Command & Conquer (1995), in game screenshot (Riskas, G. 2017)

In Figure 12, the sidebar is activated but the map is not active yet. It replaces the eagle symbol on the top right when activated. The map is not enabled from start but becomes available when a Communications Centre is built. The amount of credits is displayed constantly on the top of the screen, on the left of the sidebar. The player has already built a Barracks on the left and a Construction Yard on the right. The player's credits are currently 5300. The power meter is located on the bottom left side of the sidebar showing how much power is available and the horizontal indicator show how much is currently used. In Figure 12, the power is quite low, because no power plants have been built yet.

The locations on the map that have not been visited by the player are covered by shroud. That initially prevents the player from seeing the terrain. Once revealed, the terrain can be viewed along with all the units or structure that are located on it. Scouting can be crucial, because once a location is revealed the players can then watch all the activity that takes place.

The units are produced as single individuals and not as squads. There is no population limit and thus the player can produce units, if they have resources in their possession. The formal analysis could not detect if there is some limit of allowed selected units but there were no restrictions for up to seventy units that was tired.

The unit components have a health, speed, range, armor and damage value. All the values can be realized while playing but they are never shown in terms

of numbers. The AI moves towards the opponent's base to get close and destroy it. If they find any resistance on their way, they can stop and engage in combat with the opposing units. They usually attack in groups.

The relation between the components is what adds complexity to the gameplay. First, tiberium is what gives the player the opportunity to purchase structures and units. After tiberium is collected, it is changed into credits in the tiberium refinery structure and so It can be used by the player. The power plant structures are necessary for maintaining the base functional.

Structures and units are closely connected since the units are produced via the structures. The Construction Yard is the center of the operations and all the other buildings must be constructed close to it after its deployment. Whenever the players are called to build a structure, it should be in the adjacent space of the already built structures. The combination of different buildings unlocks more advanced structures which, in their turn can produce more advanced combat units. Table 1 shows which units become accessible by building Barracks, Weapons Factory and Tiberium Refinery in different combinations.

Structure(s)	Unit(s) allowed			
Barracks	Minigunner	Grenadier	Rocketeer	Engineer
Barracks + Weapons Factory	APC (vehicle)			
Weapons Factory	Humm-Vee (vehicle)	Medium Tank		
Weapons Factory + Tiberium Refinery	Harvester (vehicle)			

Table 1. Structures and units' relation of the GDI faction (Riskas, G. 2017).

If two of the same structure that is responsible for producing units are built, the waiting time required for the specific unit is decreased. Additionally, the player can set one of those structure to the main building. This will prioritize the units' production from the mentioned structure.

When trying to deduce how much macromanagement is emphasized in the game, it becomes clear that part of the game design has been made, having that in mind. One of the first observations that were made during the gameplay analysis is the purchasing system via the sidebar clearly points to that direction. Building actions do not require a builder unit as it happens in many other RTS games. Creating units also, does not require the player to select the appropriate built structure to issue the command. The player can have control of the structures and units that they want to buy just by using the sidebar.

On the other hand, even if the player possesses more than one barracks structure they must wait for each one of the units to be produced. The lack of a production queue increases the micromanagement that is required and the same applies to the structures.

Controlling the units requires a fair amount of micromanagement. The units are produced as single individuals and not as squads. Different units can be made up to ten different squads by using advanced controls. This feature helps the player to issue their commands, but it lacks the flexibility that was developed in later RTS titles. If the army grows to big numbers, some technical problem of pathfinding become more obvious and the fact that the game allows the creation of oversized armies can create some serious issues.

The economy of the game is based on the tiberium mineral that must be gathered and the power that must be produced. Both procedures are automated and there is no micromanagement required. The minerals are gathered by the harvesters. This unit is produced automatically, whenever a repository is built. After the unit is produced it will start gathering minerals and returning to the base to turn them into credits.

After tiberium batches on the map are collected, tiberium starts spreading again in a slow rate. The power is produced by the power plant structures. In both cases, the player should simply build the correct structures without having to micromanage them afterwards.

The unit components have many different versions, with different range, armor, health and attack values. Even though, some units can easily defeat others, there are not hard counters. The game does not adopt the rock, paper, scissors battling system to achieve balance. The units have different pros and cons that make the encounters between them interesting because of their abstract nature. For example, the basic minigunner is not a particularly strong unit, but if gathered in big numbers they can cause severe damage. On the other hand, the grenadiers can deal more damage as individuals but they can also harm friendly units if used carelessly.

Micromanagement of units becomes more important in specific occasions. When a squad of units fights against a tank unit, the positioning and the maneuvering can make the difference, since the tank can crush units if it runs over them. If a grenadier unit is in play, as it was mentioned above, the outcome of a fight might differ depending on how well the unit was micromanaged.

The controls of the game can sometimes lead to additional micro actions. Unit selection and movement commands are both issued by clicking the left mouse button. This can potentially lead to unwanted situations that can slow down the deployment of the army. For example, if one or more already selected units are ordered to move close to another unit or structure the player can accidentally select the new unit or structure instead of issuing a movement command.

The general feeling of the formal analysis is that the macromanagement is more important for the outcome of the game. Even if the units are not ordered to attack, they will do it if an enemy unit approaches within their range. What is more important is the player's ability to read the game and create a balanced squad of different units, rather than their ability to execute complicated maneuvers in the battlefield.

The building order is an important part of the gameplay since the players should memorize which combinations of structures make updated technologies and units available. Once the players know what the combinations are, they should decide what is the right moment to build each

one of the structures. Naturally the macro element is prevalent when it comes to the building order that should be followed and this no exception in any RTS game.

In general, Command & Conquer is a game that emphasizes the macromanagement over the micromanagement. The game's automations regarding the economy and the battling help the players concentrate on the big picture of the game. Tactical choices can be satisfying but they do not usually make the difference in the long term.

4.2.2 Starcraft (Blizzard Entertainment, 1998)

Starcraft is a sci-fi RTS game that features three different factions: The exiled humans named Terrans and the alien factions of Protoss and Zerg. The game features three different single player campaigns for each one of the mentioned factions. Players can face each other on multiplayer game or fight against the system's AI.

The game's components consist of units, structures and resources. All the mentioned components have different versions. The game keeps track of the player's resources of minerals and vespene gas as well as the population limit.

The player actions regarding the units consist of selecting, moving and attacking. Movement can also be expanded to patrolling and garrisoning. Actions regarding the base building include gathering resources, building structures, producing units and upgrading. The basic player actions are executed with the mouse. Left click selects units and right click issues a command of either movement or attack. The cursor automatically changes to red if the mouse pointer hovers over enemy units with one or more of their units selected.

The game offers the option to attack an area instead of specific enemy. During that action, the selected units will try to move to the designated area and attack every enemy unit or structure on their way. In a one-to-one game, that

was tested for this analysis, the game ends when one of the opponents have no structures or units left.

The game's environment consists of the terrain view where the main game takes place, the minimap on the lower left part or the screen, the unit/structure view on the lower center of the screen and the unit/structure actions on the lower right. The unit/structure view is where the player can be informed of the selected asset's values. Figure 13 illustrates the selection of the Terran Barracks structure. It can produce two units which can be seen on the structure's actions view on the bottom right of the screen.

Figure 13. Starcraft (1998), in game screenshot (Riskas, G. 2017)

The units are produced as single individuals and not as squads. The maximum number of units that can be included in the same selection is twelve, but up to ten squads can be formed by using the game's advanced controls. Selecting one unit while holding the control key automatically selects all the units of the same type that are in the current viewport.

The population limit defines how many units can be produced and can be increased by building Supply Depots for Terrans and Pylons structures for Protoss. Zerg can do the same by creating an Overlord unit. The overlords can move but they are very slow and cannot attack. The population limit can

be increased up to two hundred but bigger units can add more points of population. For example, a Marine unit uses one point but a Battlecruiser uses six. Thus, the population number does not translate in the same number of units in the battlefield.

The components have values of health, armor (only for units), damage (for units and specific structures), rank (only for units) and kills (only for units). Protoss units have an additional value of shield. The mentioned values can be seen by the player. Units also have range and speed which can be realized while playing but not seen. Units can be separated into infantry and airborne. Zerg solely can burrow specific units underground to create ambushes, but they cannot move while in this state. Infantry units that deal physical damage, are unable to attack airborne units. Figure 14 illustrates the values of a Firebat unit. The selected Firebat unit has values of Damage and Armor that can be seen by the player. The value can be see when the mouse pointer hovers over the damage icon.

Figure 14. Starcraft (1998), in game screenshot (Riskas, G. 2017).

The game's components are related closely, since they are dependent to each other, as it is usually the case in RTS games. The structures are created by the builder unit of each faction. The mentioned unit is produced from the central structure of the faction's Command Centre, Hatchery or Nexus for

Terrans, Zerg and Protoss accordingly. Units are produced from the structures that they are linked with.

The units that a structure can produce, can be seen in the structure's view while selected, i.e. marines are produced from the Barracks, Vulture vehicles from the Factory etc. Zerg produce units in an analogous way, with the only difference that after building the correct structures, all units are created through the hatchery. Specific structures can create their own addons (upgrades).

The player should spend a specific amount of resources for creating any unit or structure. Minerals are used for producing the basic units and structures, while vespene gas is required additionally for the advanced units and structures. Resources are also used for upgrades which, can be bought in different structures.

The macromanagement of the game relies heavily on keeping track of the units that the opponent produces in each session and forming the army composition accordingly. The map view is concealed using fog of war, so that players must be present in an area to see it. However, the player must be aware of the opponents' units and upgrades throughout the whole session and thus, scouting is essential.

The game's combat system is based on a combination of hard and soft counters. Specific units counter others and the player is called to memorize the relations to achieve victory. The relations can get really complicated because combinations of units can change the balance. For example, a Terran Marine is stronger than a Zergling unit but Zerglings can attack in much bigger numbers. Upgraded Zerglings can damage Marines more, but if Marines use their Stimpacks skill they can counter them. Hydralisks are stronger than Marines but Marines grouped with Medics can counter them.

Additionally, the player is called to create structures and units timely to achieve a good production rate. Managing the economy, naturally gets harder on the later stages of a game session. The hotkeys of the game offer help if

memorized by the player, since they can then build structures and purchase upgrades only by pressing limited number of buttons.

One more aspect of macromanagement is the player's ability to queue up to five units on the production line of the same structure. The focus can then move to other actions instead of having to wait for each one of the units to be produced.

The optimal building and production order are important throughout the whole session but the way they are achieved is a mixed bag in terms of gameplay. Starcraft is fast paced game and big part of the fun comes from that aspect but the macromanagement does not stay unaffected.

From the conception of the correct strategy, to the execution, there is a specific amount of micro actions that take place. For example, if the player decides to increase the income of minerals by assigning a newly created worker, they would have to perform the following actions: navigate the view to central building, select the structure, left click on the action that creates a worker unit, wait for the unit to spawn, select it and right click on the minerals to issue a gather command.

The example above is one of the easiest and most common sets of actions that players familiarize with, but even the mentioned task can be delayed or omitted when other events are in play. The correct mindset might be enough for realizing what the next move should be, but the dependency on micro actions scales down its importance.

The unit controls require heavy micromanagement. The limited selection of twelve units makes it essential very early in the game to use the advanced selection hotkeys to use separate groups. Especially while playing with the Zerg which rely on sheer numbers to attack their enemies, the unit selection limitations feel to oppose the design of the faction.

On top of that, the path-finding in the terrain gets very problematic when the player tries to move separate groups at the same time. Units might stop moving or try to find a less optimal workaround, for the player's

circumstances, to reach the destination of their command. The units' hard counters make the tactics more important, since mistakes on positioning can cost.

The process of building structures requires a certain amount of micro actions. The player should manually select the builder unit, select the desired structure and then choose an applicable spot to place it on the terrain. Positioning of the structures is also important, since it is easy for the careless player to restrict the movement of their own units.

The worker units also should be assigned to gather resources, but other than that, no further micro actions are required. New instructions must be issued only if the specific deposit of resources is drained completely. There is no way of tracking unoccupied workers other than observing if they currently perform any task. This is an easy procedure in the beginning of a session, but gets progressively harder, the more units exist on the base.

Specific units have special abilities which might turn the outcome of a fight if micromanaged correctly. For example, as it was mentioned above, specific Terran units can use stimpacks, after the appropriate upgrade is purchased from the Academy structure. The mentioned ability, increases the movement and attack speed of the unit but decreases their health by ten units.

Overall, Starcraft is built around the relation of diverse units which makes it interesting to play and hard to learn. While macromanagement is naturally more important, it contains a surprisingly big amount of micro actions. The emphasis from the game design perspective is on the micromanagement where the intense and competitive spirit of the game emanates from.

4.2.3 Age of Empires II: The Age of Kings (Ensemble Studios, 1999)

Age of Empires II: Age of Kings is an RTS war game inspired by history. The game features thirteen different factions. Each one of them has a special unit and a unique technology bonus but other than that they are very similar. The only exception to the mentioned rule is the Vikings faction that has two special units. The game offers five different single player campaigns, based on the

historic figures of William Wallace, Joan of Arc, Saladin, Genghis Khan and Barbarossa. Multiplayer game that can be played against a human opponent or the system's AI.

The game's components consist of the following types: units, structures, resources and items. Of the mentioned components, all have different versions except from the items. The only item that is found in the game is the relic. The game keeps track of the player's resources, population limit and the current age/era which shows how much one has developed. The game also keeps track of the time that has passed when it becomes relevant, i.e. when the player is trying to achieve a victory by Wonder or by relics.

The basic player actions consist of selecting units, moving units simply or via waypoints, patrolling, guarding, following, grouping, attacking, attacking areas, terminating a unit or structure, garrisoning both units and items, building structures, researching technologies, advancing to new ages, converting enemy units and structures, healing friendly units, repairing structures, ringing the town bell, choosing between four combat stances, changing between four formation types, trading, offering tributes and finally changing the diplomacy status. All the action is executed with the use of the mouse. Both left and right mouse buttons are used depending on the action. Shortcuts are accessible via the keyboard but are not mandatory to use.

The standard victory conditions are the following three. At first, the player can win by destroying the enemy structures and units. Secondly, if the player collects all the relics and hold them for a specific amount of time. Finally, the player wins if they build a Wonder structure and prevent enemies from destroying it for a designated amount of time. The standard game was played for this analysis. Age of Empires II: The age of kings, supports many ways to play the game and the winning conditions may vary.

Figure 15. Age of Empires II: The Conquerors (2000) in game screenshot (Gamershell.com)

Figure 15 illustrates the Aztecan Wonder structure framed by the game's environment. The game's environment consists of the following elements. Four resources fields appear on the top left side of the screen, while the current age is displayed in the center of the top of the screen. The diplomacy button is displayed on the top right. The biggest part of the view is the terrain where the main game takes place. While a unit or structure are selected, their actions are accessed through the lower left side of the screen and the unit/structure avatar and attributes are on the center of the lower part. The right bottom part is where the minimap of the game is located.

The units are produced as single individuals and not as squads. The maximum number of units that can be included in the same selection is forty, but units can be grouped by using the game's advanced controls. Selecting one unit while holding the control key automatically selects all the units of the same type that are in the current viewport. The population limit defines the number of units can be produced and can be increased by building houses up to a maximum of seventy-five (five per house).

Scouting becomes relevant early in the game. In fact, one of the starting units is a Scout. The game uses a combination of shroud and fog of war. The terrain cannot be seen at all in the beginning. Once revealed, the player can

see what it looks like but cannot keep track of the activities in various places if they have no units there.

The components have values of health, attack strength and armor. Ranged units of both infantry and cavalry have an additional value of range. The structures have in their majority a value of health and a Garrisoning value which, indicates how many units can enter the structure to be protected. Few buildings also have an attack value when that is called for their purpose, for example guard towers with the ability to attack. The resources have a value of quantity and they stop existing when it is collected.

The relation between the components can be described in several ways. Structures, units and technologies need resources as a requirement to be constructed, spawned and researched respectively. All the structures require wood and a few of them require stone. The Wonder structures are the only ones that also require gold. Structures can be improved by purchasing technology upgrades primarily from the university structure.

Some of the most important upgrades that can be researched in the Town center structure are the new ages upgrades. More specifically, the player starts in the Dark Age and can later advance to Feudal, Castle and finally Imperial Age. The player ought to have built two structures of their current age and a specific amount of food (for Feudal Age) and gold resources (for Castle and Imperial Age), to advance to the next age. When the players advance to a new age, new structures, units and technologies become available.

The units require food, wood and/or gold separately or in different combinations of two. Technologies require food, wood and gold in a similar fashion but food and gold are clearly needed in more cases. The production rate of resources might change during distinct phases of the game, but in general, food is mostly required throughout the whole duration of the session.

Units are spawned from the game's different structures. Swordsmen and pikemen are spawned from the Barracks, archers from the Archery Range, cavalry from the stables, etc. The same structures contain technologies for upgrading the units that they spawn but additional technology research

regarding the units can be conducted in structures dedicated to it, i.e. the blacksmith and the university.

The villager unit can gather the four basic resources of wood, food, stone and gold. If the map allows it, fishing boats can additionally contribute in the food production by gathering fish. Trade carts can be used to earn gold in the land and trade cogs perform the same duties in the sea. In both cases, there should be an allied faction in play. The villager unit is also solely responsible for building and repairing structures. With that said, the villager can be easily categorized as the center of the economy and that becomes obvious from the beginning of the game.

The relation between military units is explained by their strengths and weaknesses when they collide in the battlefield. For the most part, Age of Empires II: The Age of Kings applies a rock-paper-scissors system in the relation between units. According to that model, all units are strong and weak against different opponents. But the game has more than three types of units which makes the list of unit counters to grow exponentially.

An example of the mentioned relations is explained below. Swordsmen are strong against skirmishers but weak against archers and archers are weak against skirmishers, which as mentioned above are weak against swordsmen. The relations become more complicated when new parameters are put into play.

On top of the previous example that explained the relation between a swordsman, a skirmisher and an archer, the next example explains the relation between a pikeman, a light cavalry unit, an archer and a siege weapon. Pikemen are strong against light cavalry but weak against archers and archers are weak against siege weapons. Finally, siege weapons are weak against light cavalry.
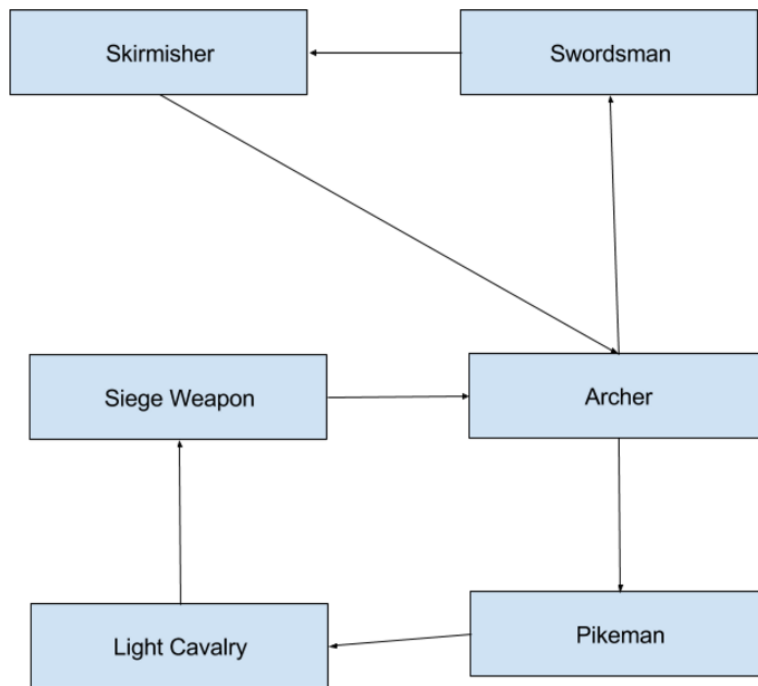
Figure 16. Age of Empires II: The Age of Kings. Unit counters (Riskas, G. 2017)

Figure 16 depicts the relations between the six different units that were mentioned above. The relations are in their majority clear to understand, since many of them have been established for a long time in players' subconscious minds and have passed to the stage of common knowledge. Of course, the complicated combinations of units that can take place in the battlefield require more than just knowing the theory of it. The fact that units of different factions have the same generic appearance, helps the players to know what they are facing intuitively.

Many of the design choices of Age of Empires II have been made to emphasize the strategic part and challenge the player's long term planning skills. The economy of the game is based on four different resources and the player is called to change the production rhythm between the four in distinct parts of the game.

Players can offer or accept tributes as part of diplomatic activities. Two or more factions can be allies and the game even supports option of allied victory. Building a market allows the player to trade goods. No ally is required for that action but the player can trade goods that they have for others that they are missing. If there are one or more allies in play, the player can also

earn additional gold by creating trade routes for trade carts to travel by land and/or a trade cogs to travel by sea.

The multiple technology upgrades add an extra layer of complexity to the game. The formal analysis is not enough to uncover the connections between them and the optimal order that they should be purchased. There are upgrades that allow the players to strengthen any possible field of their faction they want. Different upgrades increase the power, speed or range of different units or the attributes of structures. Players can decide what they want to upgrade first depending on how each session evolves.

On the other hand, Age of Empires II also requires for the players to familiarize themselves with numerous micro actions. The use of villagers to gather the resources adds to the micromanagement of the game but many automations in the AI help to mediate the effect. For example, when the villagers are assigned to a deposit of gold, no other commands should be given until the deposit is exhausted. If villagers are ordered to build a mine near a gold or stone deposit, they will automatically start gathering from it, after the building is completed.

Usually the player should handle between ten to fifteen villagers even before the first age research is attempted. By the end of the game usually the number is doubled if not even more. The game offers the option for the player to detect any idle villagers by pressing the "Idle Villager" button. The mentioned button can potentially help the players to avoid unnecessary micro actions to detect idle villagers manually.

During the battle, the player can assign their selected troops between four formations which serve different purposes. For example, the flank formation, can be used for attacking enemy units from both sides. Knowing when to use each formation can be essential to win fight of smaller of bigger scale.

The amount of micromanagement needed can increase if some technical difficulties of erratic pathfinding occur. It cannot be proven by formal analysis alone, but the population limit and the limit on units' selection seem to be

connected to the potential pathfinding issues rather than a conscious design choice.

The formations might require micro actions, but some facilitation comes with it as well. If more than one unit types are selected, for instance archers and light cavalry and are ordered to get to a box formation, the AI will be particularly helpful. It is passed in the logic of the game that in the mentioned case the light cavalry should lead and archers should move behind them. And so, they will position themselves accordingly.

Age of Empires II: Age of Kings is a game that aims to challenge both strategic and tactical skills and succeeds on a big degree. It offers a very balanced experience between the two. The micromanagement can be at times demanding but the game's real strength is the focus on the macromanagement and the design of the game manages to make planning as entertaining as fighting.

4.2.4 Warhammer 40,000: Dawn of War (Relic Entertainment, 2004)

Warhammer 40,000: Dawn of War is a sci-fi RTS game that features four different factions: The Space Marines, the Orks, the Eldar and the Chaos. In the game's campaign, the player is called to control the Space Marines and fight against the other three. All four factions are available in the game's skirmish and multiplayer modes where the player can face the system's AI or a human opponent respectively.

The game's components are of the following types: squads, units, structures, resources, and weapons. All the mentioned components have different versions. The game keeps track of the player's resources, captured relics, captured strategic points and captured critical locations. The game also keeps track of the duration of each session.

The basic player actions related to the units consist of selecting, moving, stopping, attacking units, attacking areas and attacking in melee mode. Actions related to production are the following: Capturing strategic points, critical locations and relics, building structures, purchasing units and

researching updated technologies. Additional micro actions include using special abilities, changing the units' stance, increasing the squad members and equipping the unit squads with weapons. The left mouse button is used for each one of the mentioned actions and in some cases the right mouse button needs to be used. The game also utilizes the keyboard with hotkeys that can replace the mouse for brevity's sake.

The victory conditions of a standard game with a standard set of rules are the following. First, the player can win by annihilation, i.e. destroying all the opponent's structures capable of producing units. The second case is victory by controlling the area, i.e. the player controls sixty-six percent of the map's strategic points for a specific amount of time. Finally, victory can be achieved by "take and hold". In that case, the players should capture more than half of the critical locations of the game and then hold them under their control for a specific amount of time.

The game's environment consists of the following, as illustrated in Figure 17: resources and population information on the upper left corner. The strategic UI on the upper right shows essential information about the game, i.e. how many strategic points, critical locations and relics have been captured. The unit view on the lower center displays the unit's morale. On its right, the player can get information about the current selection. Further to the right, in the squad control area the player can reinforce and upgrade the squad. The minimap on the lower left corner.

Figure 17. Warhammer 40K: Dawn of War (2004) in game screenshot (Gamespot.com)

Infantry units are produced in squads, while leaders, vehicles and special units are produced as individuals. The worker units are also produced as individuals, except for the Orks faction which produces them in squads. Leaders can be attached to infantry squads to offer benefits. More than one squads and/or units can be grouped by using the game's advanced selection controls.

As in most RTS games, scouting is essential. The game features scout units and there is also an invisibility upgrade to make scouting easier. Of course, invisible units can be countered using other upgrades by the opponents. The map is concealed with fog of war from the beginning of the game. Players must be physically present in locations to keep track of the activities in it.

The squad cap and the Vehicle cap define how many squads and vehicles can be can be produced per game session. The Space Marines and the Chaos can increase the caps by researching technologies while the Eldar and the Orks can do the same by building the appropriate structures. However, there is a maximum cap that cannot be overpassed once reached.

The components have values of morale, squad size, melee damage, ranged damage and number of weapon upgrades. Melee and ranged damage values are applicable only to units that can cause that type of damage. Several units can cause both kinds of damage. Infantry squads do not have a health meter that describes the overall health of them but the units that consist it do. Units can gain additional positive or negative modifier values depending on the ground structure.

The relation between the components can be described in diverse ways. First, the players can purchase new structures, units and technologies by spending their resources. The available resources are requisition and power. The Orks have the exclusive additional Ork resource. Requisition is used for producing the main infantry squads and structures while power is additionally used for the advances squads, special units, advanced structures and upgrades. Captured relics generate requisition and give access to the most advanced units of each faction.

Requisition is gathered by capturing strategic points, critical locations and relics on the map. Worker units in RTS games have been traditionally connected with the resource management but this is not exactly the case in Dawn of War. The only task that the workers are responsible for is building. It is the infantry units that capture the points to generate the most basic resource of requisition. The workers can contribute towards the same direction by creating listening posts on top of the captured points. The listening posts add one more layer of protection from enemy units and increase the production rate of requisition on the respective settlement.

All four factions can obtain power in an equivalent way, by building plasma generators or thermo plasma generators. Plasma generators can be built anywhere within the player's area of command by the workers. Thermo plasma generators offer more power but they can only be built in specific locations in the map where their hubs can be seen. There is a limit of power generators that can be created. The Ork resource is determined by the amount of Ork settlements and Waaagh! Banners that are built by the workers.

The structures offer access to the game's upgrades and produce units. All the game's units are produced via the structures responsible for them. Depending on the faction, the barracks buildings have different names and appearances but share similar functions. For example, the Chapel-Barracks, the Aspect Portal, the Da Boyz Hut and the Chaos Temple are the structures that produce the main infantry units for the Space Marines, Eldar, Orks and Chaos respectively. However, not every structure of one faction has a similar one in the other three.

The relation between the units can be better understood if the concept of upgrading the squads is explained. Most squads are upgradable in two ways: By increasing the amount of squad members and by purchasing weapons. Increasing the squad members is possible by pressing the plus shaped button in the unit view, by pressing the leader icon in the same view and by attaching a leader unit that was produced separately. The weapons are purchased by pressing on the weapons buttons in the unit view, if they have been researched and thus unlocked.

The squad size differs depending on the faction, the type of unit and the number of members that the player or the AI can add. For example, the Orks' Slugga Boy infantry squad has four members by default which can be brought up to fifteen if in full strength. The Eldar's Ranger Squad has initially three members which can be brought up to eight. The new team members cost on resources but they do not increase the population when produced.

No hard counters are applied between the units' relations. Most units are by default strong against one of the following: infantry, heavy infantry, vehicles, structures or at breaking the opponent's morale. It is common for the advanced and special units of the game to be strong against all types of units. The means that the player can use to make their units effective against diverse types, is by adding leaders and weapons. Different weapons can add any of the mentioned bonuses to a squad or enhance the advantage that the unit already possesses. The availability of weapons and leaders varies from none of both, to one leader and four weapons. Researching technologies allows to more of the squad members to hold weapons but there is a hard limit that cannot be surpassed.

The game makes it particularly easy for the player to be aware of their units' strengths by displaying them on the unit's view. Even if a unit is upgraded and becomes effective against a new type of unit, the new strength will appear on the view. The squads have many members but they act for the most part as one entity. Whenever a weapon is purchased, it is added in one of the team members. Separate team members have their own health value but they cannot be selected as individuals. The morale value does not appear separately but only in the squad. It is reduced whenever a team member is killed or when shot with special weapons. If reduced to zero, the team's morale is broken and they suffer from disadvantages until they retaliate

Figure 18. Warhammer 40K: Dawn of War Soulstorm in game screenshot (Tech.net)

Figure 18 illustrates the strengths of the selected unit. The selected vehicle can cause morale damage and is strong against infantry. Both attributes can be seen on the selection information on the lower center of the screen.

In terms of macromanagement, the game seems to have a set of optimal actions that always should be taken. At the beginning of the game, the players should immediately start capturing strategy points, create a barracks structure and build plasma generators that will provide power. When the economy is in a decent shape, and some basic infantry units are produced, the players should proceed with the building that provides access to the upgrades. The players should try to not lose control of the map and try to attack harder by upgrading their squads and by producing more advanced units and vehicles.

As the game advances, the actions can become more complicated, but Dawn of War feels in general, as a simple game on its core. The players can decide in some cases the kind of army they want to produce. For example, the Eldar's units are not as versatile as the ones of Space Marines. Eldar units have more clear advantages and weaknesses while the Space Marines' squads can be upgraded to face any unit type. But in the long term, the game

feels as if there are not many different strategies that can be applied, at least not successfully.

One of the most important aspects of a game's macromanagement is to adjust to the opponent's actions and try to even predict them. In this case, the opponents' actions seem to be more predictable. The game concentrates and excels in the micromanagement aspect. The gameplay has been built around the perpetual fights that take place in the terrain. Even the economy of the game is in big degree dependent on the military units. In simple words, the game encourages the players to attack without thinking too hard.

The population and vehicle limits do not allow the players to produce oversized armies, but encourage them to learn how to use what they can produce. Part of the economy is handled by military units which is also a step towards the early expansion on the map. The player is called many times to decide what tactics they should follow.

Sometimes the players should decide if a unit should attack from a range or from close by. Some other times, the players should not move their squads during a fight, if they want one of its members to shoot a specific weapon. The terrain can offer defense bonuses or penalties and the players should know when to retreat before it is too late. Also, the leaders have special abilities that can change the outcome of a fight, if used correctly.

Even though the mentioned micro actions add to the tactical aspect of the game, the fights themselves are not dependent on heavy micromanagement. The game's AI resolves the fights by calculating the values of the units that collide every time, thus the victor of a session is not usually declared by the amount of maneuvering they did on the battlefield. What is more important is the structure of the squads and the basic knowledge of their capabilities.

In general, Dawn of War stands out as an RTS game that tries different things. The strategic part of the game is diminished to the very basics and the gameplay concentrates around the fights and the tactics that should be applied. For a game that relies on the micromanagement, it is surprisingly

friendly to a new player because it is not overused but placed under the right boundaries.

4.3 Comparative analysis

Formal gameplay analysis shows that the analyzed games share some things in common but at the same time they deliver quite different experiences in terms of gameplay. Although formal gameplay analysis put the games under its scope, the comparative analysis is focused on the relation between the macromanagement and micromanagement aspects of them alone.

4.3.1 Economy

It can be said that the basic principles of economy management are very similar in all four games. The players should collect or generate various kinds of resources to create structures, units and purchase updated technologies.

One of the first noticeable differences is that the resources are gathered in diverse ways and that affects the gameplay. In Dawn of War, there is no unit responsible for gathering resources. In Command & Conquer there is a gatherer unit, which can be controlled by the player but the mentioned action is entirely optional. Starcraft and Age of Empires II require from the player to create multiple worker units and keep them constantly engaged into gathering resources, along with their other tasks. Naturally, the more automated the gathering task is, the less micromanagement is required to perform it. It is safe to say that Dawn of War requires the least micromanagement while Age of Empires II requires the most, for the mentioned reason.

The amount of resources is also variable depending on the game. Most of the tested games use two main resources in separate ways. In first sight, Command & Conquer has only the Tiberium resource, but power is also required to maintain the base of operations. Dawn of War uses requisition and power and Starcraft features minerals and vespene gas.

Age of Empires II features four different resources: wood, food, gold and stone. It can be assumed that the need to keep track of more variables and put them into right use, challenges the strategic skills of the player. The fact

that Age of Empires II is the game from the sample that has the deepest strategic depth, points to that direction. At the same time, the game also requires more micromanagement as it was deduced in the paragraph above. But this seems to be a combination of the way the resources are gathered and the amount of them and not the latter one alone.

One more difference between the games' economic systems is that the resources can be finite or infinite. Dawn of War feature unlimited resources while Starcraft and Age of Empires II have a finite amount of deposits on each map. In Command & Conquer the Tiberium starts spreading again if completely collected but in that case the production rate drops radically. Naturally, having a specific amount of resources makes more important where and how it is spent by the player. But this feature does not usually become relevant, since every session usually ends long before all the resources are gathered.

Finally, Age of Empires II is the only of the tested games that features victory by building a Wonder which is strongly connected to the economy, since it requires massive amounts of resources. Also, numerous technologies should be researched before the player is able to build a Wonder.

4.3.2 Building, production, UI

It can be said that the concept of base building is the one that has the most similarities in all games. The basic idea remains the same. The players must establish a base of operations, train units and defeat their opponents. The structures offer access to new units and technologies and this is how the player advance to the next stage.

Although the described core idea of the base building does not change in any of the games, a few differences can be noted that can affect the gameplay. First, in most of the tested games, a structure is built when the players select their builder unit and issue the appropriate command. In Command & Conquer the player can simply perform the same action by selecting an available structure from the game's sidebar. The mentioned difference does not change

the gameplay radically, but at the same time it cannot be denied that in the latter case, the players should perform less micro actions.

Fog of war seems to be the most popular choice in the map concealing methods. Sometimes it is combined with the shroud effect depending on the game. The system of Command & Conquer seems to be the most outdated in this section. That does not come as a surprise since it indeed the oldest game in the list. On the other hand, more modern systems offer a better atmosphere of abstraction in the game but also increase the level of micromanagement. That is, because the players must scout throughout the whole session.

Figure 19 illustrates the combination of fog of war and shroud in Age of Empires II: The Age of Kings. The area outside the structures' view is shaded from the fog of war. In the minimap the dark area shows the shroud. The areas that have not been discovered yet.

Figure 19. Age of Empires II: The Age of Kings. Fog of war and shroud (Ytimg.com)

While the user interface works in very similar ways in all games, the feature that seems to make the difference, oddly comes from the oldest game in the list. The sidebar feature of Command & Conquer can be used as a good example of how the UI can affect the gameplay. It might seem as an insignificant detail at first, but the sidebar creates the most compact production system of all the tested games. It works as a control panel of macromanagement that requires the minimum amount of micro actions to execute the players plans.

Most of the tested RTS games are built with an esoteric logic of hotkeys that the players should memorize to execute their decisions faster. While this can be effective, the sidebar makes it even more accessible and intuitive. Sometimes players might have to scroll down in the side panel, when more units and structures are available. Even though this can potentially slow down the player, it seems that it was a technical limitation of the time rather than a conscious design choice.

Figure 20. Age of Empires II: The Age of Kings diplomacy panel (Mobygames.com)

The option of diplomacy was only tested on Age of Empires II. Figure 20 illustrates the diplomacy panel of the mentioned game. The diplomacy panel gives the option to offer tributes to opponents. The box of allied victory is checked, which the players to win as allies.

The option exists in both Dawn of War and Starcraft as well but it could not be tested since it is only available on multilayer. The concept of diplomacy is by nature simplistic on RTS games since the player usually must plan over the course fifteen to thirty minutes. The player is usually able to pay a tribute and become allies with another player. Dawn of War also features requisition sharing for allies.

4.3.3 Unit relations

The four tested games present three different systems regarding unit relations. Command & Conquer features a more abstract system compared to the rest of the games. Age of Empires II and Starcraft use a rock, paper,

scissors model even though Starcraft mixes it with soft counters. Dawn of War features a system in which most units can affect most units if upgraded correctly.

All four games achieve balance in their own way, but the amount of micromanagement needed changes depending on the circumstances. Starcraft requires the heaviest micromanagement during a battle. One of the main reasons why that happens is that the units are produced as individuals. Even if they are grouped under the same squad, they do not act as the same entity. The result is units of the same team fighting for the same space and even blocking the way of friendly units. The mentioned behaviors are avoided by experienced players only by intense micromanagement.

Age of Empires II falls under the same issues but the problems are mediated because of the slightly better AI that allows for formations and better pathfinding. Command & Conquer also uses single units but most of them cause ranged damage. That automatically prevents the units' AI to work against them. The only tested game that features squad units is Dawn of War. This design choice seems to make unit movement easier and the amount of micromanagement smaller. Part of it is redirected to the unit upgrades but in that case the task is less demanding.

The population limits exist in all four games in one way or another. It is understandable from the game design point of view that there should be a limit, especially in games of the previous decades. In the example of Age of Empires II: Age of Kings, it feels like a technical limitation more than a design choice. The fact that the limit was increased in the Conquerors expansion further points to that direction. In the case of Dawn of War though, the population cap seems like a decision that shapes big part of the gameplay. Small population limits favor gameplay that is developed around micromanagement.

The unit selection systems change from game to game with Starcraft having the strictest one. The selection limit of twelve units, leads to intensive micromanagement in the long term. This is one of the most important reasons

why the other games of the analysis with single units, do not require the same amount of micromanagement.

Finally, one feature that all four the games share is the straight dependency between the number of units and the chances of success. In simple words, the possession of a bigger army automatically offers and advantage against the opponents. In games that micromanagement is very important, this situation can be reverted to some degree. On the other hand, macromanagement seems to play a small part in reverting such a situation.

5 OUTLINE OF THE MANUAL

The product that accompanies the present paper, aims to list the findings of the research that took place in the previous chapter. The present chapter describes the outline of the manual and explains briefly what is the content of the product. Further information is available, in the attached pdf manual. A visual representation of the contents can be found in Appendix 4.

The manual consists of five chapters that cover different topics regarding the design of an RTS game. Chapter 1 focuses on the user interface (UI). The manual explains how the UI should be laid out to offer as much information to the player, with the minimum possible effort.

Chapter 2 revolves around the controls of the game. The controls of RTS games have been developed over the past decades and have established specific patterns that RTS players expect to find. The strategy manual suggests possible ways to extend some of the patterns in a way that serves the theme of the present paper.

Chapter 3 explains how base building should be executed to not cost many micro actions but let the player concentrate to the big picture of the game instead. It also includes information on how economy should work to achieve the same result.

Chapter 4 revolves around the military balance. Should there be a population cap? Should there be limitations in unit selections? The manual answers the previous questions in a way that can serve the purpose of the research.

Finally, chapter 5 includes information about the potential use of diplomacy. The mentioned concept has been used before and they faced specific problems. The manual offers a way for it to be used that is aligned with the logic of RTS.

6   CONCLUSION

The formal gameplay analysis combined with the comparative analysis in chapter 4, show that RTS games are created using traceable design patterns to emphasize specific aspects of the gameplay. If the patterns are observed and deconstructed, their elements can be used to create new constructs.

Qualitative research can offer a good insight on how RTS games work as pieces of entertainment and the findings could be used by the author to answer the research questions to a satisfactory degree. However, quantitative study should be considered in the future as a valid way to extend the research and its findings.

RTS games can offer pleasing gameplay experience without relying heavily on the micromanagement aspect. The strategic part can be emphasized in many ways to a degree that it challenges the player's long term thinking and not only their reflexes. Games have achieved to emphasize the macromanagement in the past and they can do it better in the future.

The strategy manual that was produced, uses the conclusions that were extracted from the research and lists them as instructions that can be used in RTS game development. It should be noted that the manual does not claim to contain the ultimate guidelines for creating an RTS game. The whole study was conducted to find out if tactics can be minimized in favor of strategy in RTS games. Therefore, the strategy manual should be primarily used by game developers that try to solve the same or similar problems.

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LIST OF FIGURES AND TABLES

Figure 1. Top Selling Strategy Games on Google Play as of 10.4.2017 (Riskas, G. 2017).

Figure 2. Stonkers (1983) in game screenshot. Teamliquid.com. Available at: http://www.teamliquid.net/staff/choboPEon/stonkers5.jpg [Accessed: 10 April 2017].

Figure 3. Mega Lo Mania (1990) in game screenshot. Impur.com. Available at: http://i.imgur.com/DkU9U.png [Accessed: 10 April 2017].

Figure 4. Herzog Zwei (1989) in game screenshot. Gamefaqs.com. Available at: https://gamefaqs.akamaized.net/screens/5/f/f/gfs_92114_2_8.jpg [Accessed: 10 April 2017].

Figure 5. Command & Conquer (1995) in game screenshot. Old-games.ru. Available at: http://www.old-games.ru/games/pc/command_and_conquer_tiberian_dawn/screenshots/14_52d67fcc9a17e.png [Accessed: 10 April 2017].

Figure 6. Starcraft (1998) in game screenshot (Riskas, G. 2017).

Figure 7. Company of Heroes (2006) in game screenshot (Riskas, G. 2017).

Figure 8. Halo Wars 2 (2009) in game screenshot. Sosgamers.com. Available at: http://www.sosgamers.com/wp-content/gallery/halo-wars-2/Halo-Wars-2-015.jpg [Accessed: 18 April 2017].

Figure 9. Battle for Middle Earth (2004), top-down view of the map "Fords of Isen". Gamereplays. Available at: http://www.gamereplays.org/community/uploads/post-67635-1177372246.jpg [Accessed: 18 May 2016].

Figure 10. Age of Mythology (2002), in game view of technology tree. Available at:

http://vignette1.wikia.nocookie.net/ageofempires/images/3/32/Greek_Tree_(Z
eus).png/revision/latest?cb=20130109224448 [Accessed: 15 May 2016].

Figure 11. Command & Conquer: Generals (2003), in game view.
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https://www.releasegamestudio.com/wp-content/uploads/2016/12/Command-
and-Conquer-Generals-Zero-Hour-Free-Download-3.jpg [Accessed: 15 May
2016].

Figure 12. Command & Conquer (1995), in game screenshot (Riskas, G.
2017).

Figure 13. Starcraft (1998), in game screenshot (Riskas, G.2017).

Figure 14. Starcraft (1998), in game screenshot (Riskas, G.2017).

Figure 15. Age of Empires II: The Conquerors (2000) in game screenshot.
Gamershell.com. Available at:
http://www.gamershell.com/static/screenshots/0/2728/42597_full.jpg
[Accessed: 15 May 2016].

Figure 16. Age of Empires II: The Age of Kings. Unit counters (Riskas, G.
2017).

Figure 17. Warhammer 40K: Dawn of War (2004) in game screenshot.
Gamespot. Available at:
https://static1.gamespot.com/uploads/original/gamespot/images/2005/264/revi
ews/688412-926497_20050922_004.jpg [Accessed: 15 May 2016].

Figure 18. Warhammer 40K: Dawn of War Soulstorm (2008) in game
screenshot. Tech.net. Available at: http://images.bit-
tech.net/content_images/2008/03/warhammer_40k_dawn_of_war_soulstorm/
b37.jpg [Accessed: 15 May 2016].

Figure 19. Age of Empires II: The Age of Kings. Fog of war and shroud.
Ytimg.com.

Available at: https://i.ytimg.com/vi/5U7gmUr3HlU/maxresdefault.jpg
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Figure 20. Age of Empires II: The Age of Kings diplomacy panel
Mobygames.com. Available at:
http://www.mobygames.com/images/shots/l/255822-age-of-empires-ii-the-
age-of-kings-windows-screenshot-diplomacy.png [Accessed: 15 May 2016].
Table 1. Structures and units' relation of the GDI faction (Riskas, G. 2017).

Mindmap. Riskas, G. 2016.

The initial mindmap that the author used in the first steps of this project. Many of the ideas are used in the report, others were altered while others were left out. For example, the prototype was changed into the strategy manual.

The mind-map is used as a helping tool for the author to illustrate the initial thoughts about the project. The main pillars of the mind-map, as it can be seen on the picture below, are research, real-time strategy and prototyping. The connection between the basic pillars can be seen both in the mind-map and the framework of the research.
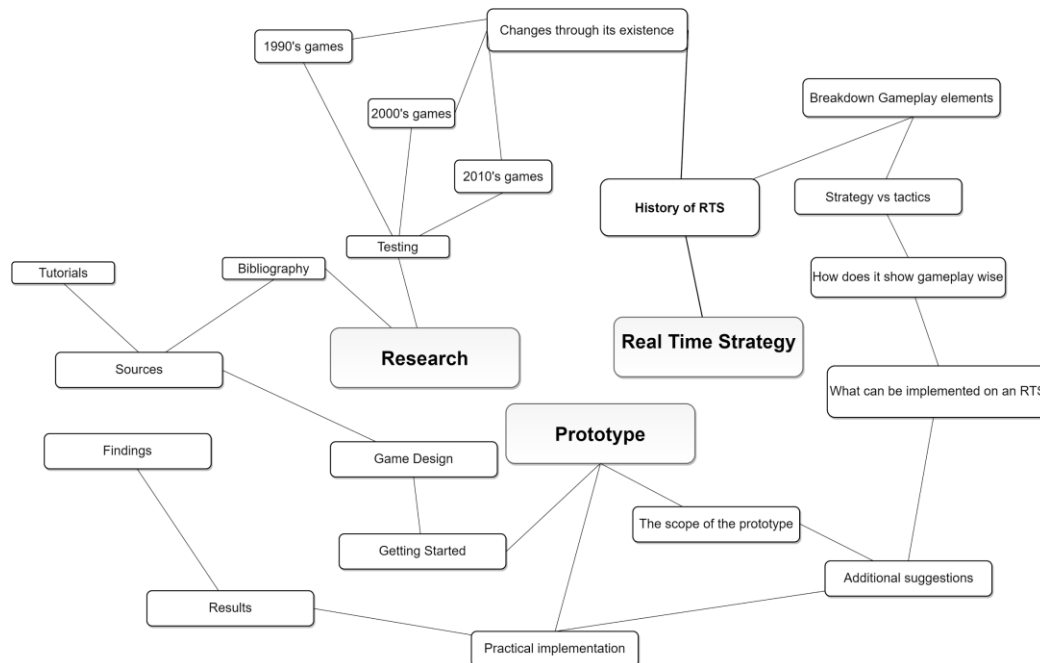
Framework of reference. Riskas, G. 2016.
A visual depiction of the interaction between the main concepts that the project touches.

The framework, mostly illustrates the connection between the main concepts that are covered in this report. The interaction between the game mechanics the research and the final prototype are described visually on the framework.

The project will move interchangeably between the findings of the research, and through the prototyping process the suggestions will be applied in the final product. Testing and comparative analysis with other game products of the same genre will be necessary to finalize the process.

Testing

Game Mechanics   Comparative analysis   **Research**

Ideas to be tested   Applicable ideas
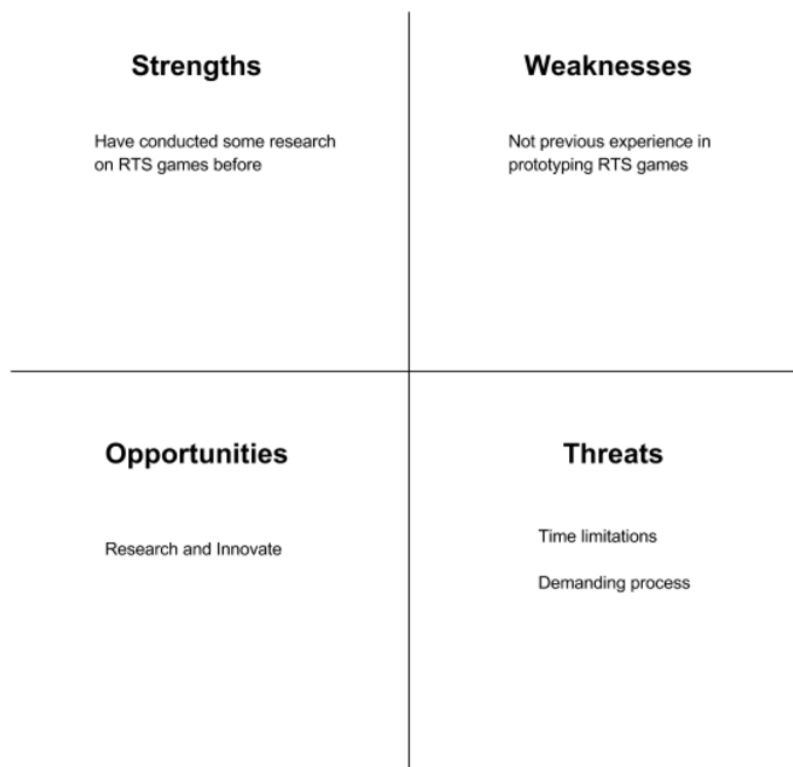
Prototype
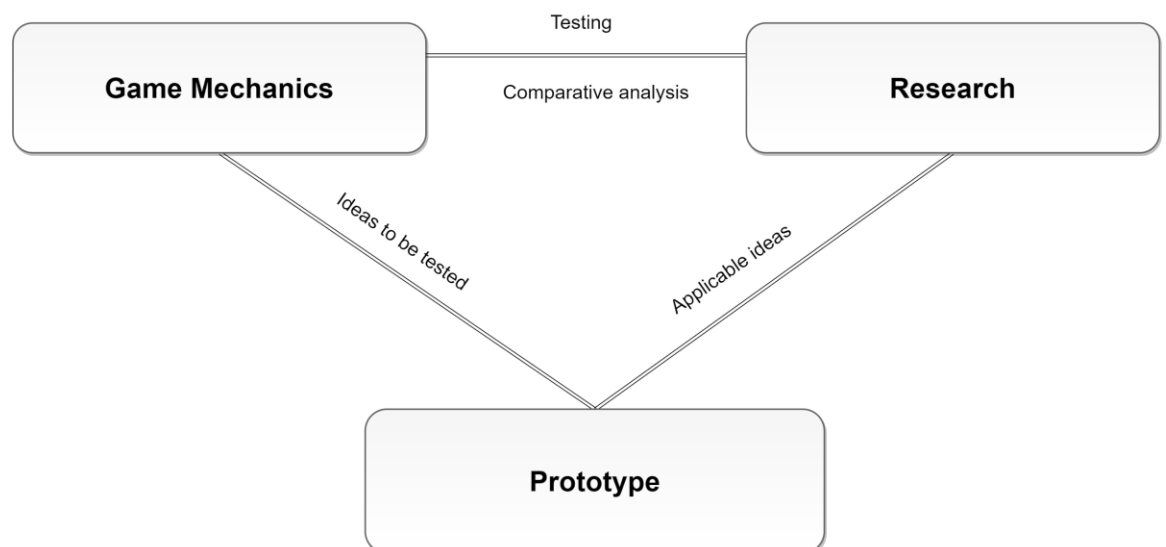
SWOT analysis. Riskas, G. 2016.
A graph that visualizes the strengths, weaknesses, opportunities and threats of the project.

The strengths (advantages) of the research is that the author, already has some fair knowledge of real-time strategy games, both as player and as a researcher. The author has conducted in the past, a theoretical research on strategy games and how the business models affect their gameplay. The subject that is analysed in this report is not of the same nature, but the genre analysis of the previous report can be used as an aiding tool.

The weaknesses of the research are that the author has not been involved before in developing a real-time strategy title. That category of games is one of the most demanding to design and to produce and this should be taken in account as a threat of the research. The demanding process should be adjusted to the realistic time constraints when the prototype will start getting produced.

Finally, the opportunities of the research are that it can break some new ground. The findings may help in bringing something new to the genre or creating another sub-genre that offers new interesting experiences for the players.

Strengths	**Weaknesses**
Have conducted some research on RTS games before	Not previous experience in prototyping RTS games
Opportunities	**Threats**
Research and Innovate	Time limitations Demanding process

Manual contents. Riskas, G. 2017.

The contents of the product can be seen in the figure below. The subjects that are covered revolve around the User Interface, the controls, the base-building, the military balance, the economy and diplomacy features.

Table of Contents