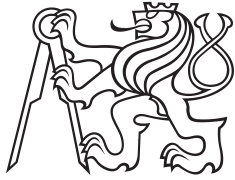


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Uživatelský výzkum zábavnosti her žánru budovatelská strategie s vysokou mírou autonomie simulovaného prostředí

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II. ÚDAJE K DIPLOMOVÉ PRÁCI

Název diplomové práce:

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Název diplomové práce anglicky:

User Research of the Fun Elements of City-building Strategy Games with the Significant Autonomy of Simulated Environment

Pokyny pro vypracování:

Provedte výzkum zábavnosti her žánru budovatelská strategie, které se vyznačují vysokou mírou autonomie simulovaného prostředí a herních postav. Klasifikujte druhy her tohoto typu a identifikujte výzkumné otázky ve vztahu k motivaci a zábavnosti hráče. V rámci výzkumu zohledněte také interakci hráče s herními systémy a umělou inteligencí herních postav. Navrhněte a vytvořte prototyp hry podle svého uvážení, která bude reprezentovat vybraný typ a bude splňovat nezbytné podmínky pro úspěšné uživatelské testování. Na základě testování s uživateli zodpovězte výzkumné otázky a navrhněte metodiku návrhu herních systémů daného typu, chování agentů a konfigurace agentního systému ve vztahu k zábavnosti.

Seznam doporučené literatury:

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Datum převzetí zadání

Podpis studenta

Poděkování

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Prohlášení

Prohlašuji, že jsem předloženou práci vypracoval samostatně a že jsem uvedl veškeré použité informační zdroje v souladu s Metodickým pokynem o dodržování etických principů při přípravě vysokoškolských závěrečných prací.

V Praze, 3. ledna 2019

Abstrakt

Tato práce se zaměřuje na problematiku vlivu umělé inteligence na subjektivní vnímání zábavy v herním prostředí. Hlavním cílem této práce je lépe pochopit aspekty umělé inteligence a formy interakce hráče s entitami řízené umělou inteligencí, které přispívají nebo naopak snižují vnímání pocitu zábavy, specificky v rámci žánru budovatelských strategií. V rámci práce je provedena teoretická rešerše problematiky videoher, hraní, motivace hráče a psychologického prožitku zábavy, jsou analyzovány elementy her a možné způsoby formální analýzy herních systémů. Dále je navržena typologie her, v rámci níž je klasifikován žánr narativních simulací, který je dále analyzován výzkumnou částí práce. Za účelem výzkumu je vyvinut high-fidelity prototyp hry Landlord, který je dále srovnáván prostřednictvím kvalitativních experimentů s existující komerční hrou Rimworld, přičemž obě hry se liší zejména v úrovni kontroly nad umělou inteligencí, která je hráči v herním světě poskytována. Výsledky experimentů jsou doporučení pro další vývoj prototypu, případně dalších her podobného žánru a také podkladem pro další výzkum v oblasti umělé inteligence ve hrách.

Klíčová slova: umělá inteligence, videohry, hraní, zábava

Vedoucí: doc. Ing. Zdeněk Míkovec, Ph.D.

Abstract

This thesis focuses on the impact of artificial intelligence on the distinctive perception of fun in video-games. The main goal of this thesis is to better understand the aspects of the artificial intelligence and form of interaction of the player with entities controlled by the artificial intelligence, who either support or undermine the sensation of fun, specifically in the genre of building sim strategies. Theoretical research of games, play, motivation to play and psychological sensation of fun as well as elements of games and potential forms of analysis of game systems is realized. Additionally, a typology of games is designed and used to define a genre of narrative simulations, which is further analyzed in the research part of this thesis. For the purposes of the research, a high-fidelity prototype of the game Landlord is designed and implemented, and via qualitative experiments compared to an existing commercial game Rimworld, where both of these games are different in the level of control over the artificial intelligence provided to the player in the game world. Results of these experiments are recommendations for further development of the prototype or possibly other games in a similar genre and also a basis for additional research in the area of artificial intelligence in games.

Keywords: artificial intelligence, video games, play, fun

Title translation: User Research of the Fun Elements of City-building Strategy Games with the Significant Autonomy of Simulated Environment

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Part I

Theory



Chapter 1

Motivation and Goals



1.1 Motivation

Game development is both my personal hobby and career-wise long-term goal so my motivation to develop games have come naturally to me. I stumbled across a genre of games that I find particularly interesting - games where a simulation of an environment with an intelligent AI system generates fun gameplay. I set out to create one such game of my own and the first necessary step was to understand such games in more depth as to be able to design a well functioning and impactful system. Finally, I aimed to test my findings on a functioning prototype.



1.2 Goals

The main goal of my thesis was to analyze simulation games from the perspective of the influence of artificial intelligence on the gameplay and individual perception of fun. Main questions and problems I wanted to solve:

- What are the possible ways to classify games?
- What are the core elements of play and games and what can be said about the perception of fun derived from playing a game?

- What types of games can be classified as simulation games and what characteristics are defining such genre?
- What role plays the AI in said games and what questions should be taken into account when designing and implementing fun gameplay?
- How impactful and in what ways is the role of the AI to the overall gameplay experience in terms of fun?
- What are the possible ways to improve the prototype and how to adjust the direction of the development based on user testing.

1.3 Realization

In order to meet the goals of my thesis, I decided to include the following process:

- Theoretical research to establish a basic understanding of games and play and summarize traditional elements of games.
- Analysis of possible classifications of games.
- Derivation of a classification system to define the genre of narrative simulations.
- Formulation of hypothesis and research questions.
- Design and implementation of a prototype of a game within the genre.
- User testing with interviews and questionnaires to gather data.
- Evaluation of the data and summarizing results.



Chapter 2

Defining Games



2.1 Games, Toys and Play

In my theoretical research, I was concerned with one intuitive but complicated question: what is a game and what makes it fun? I would be able to recognize a game and judge how fun it is for an individual simply based on my instinct, yet I would seem to struggle to define it in a specific frame of law, suggesting that perception of fun is highly emotional and a wide variety of perspectives must be considered in order to be understood.

It appears that games are very distinctive by nature, which is both advantageous and difficult. The distinctiveness of games allows them to take many shapes and forms, therefore, they are very flexible as a medium. On the other hand, the discipline of finding the right combination of all the elements games are made of is rather challenging. Games share many similarities with everyday life and can be seen as a reflection of our desires, motivation or emotional drive. Discovering the elements that can or can not be part of the game is no easy task but without a common field of understanding, it would be impossible to avoid confusion.

Ludology (also called game studies) has become a school of thought serving that purpose. It utilizes mainly the knowledge of anthropology, sociology, and psychology to understand games, play and players surrounding them while aiming for a broader picture of games and their role in society and culture.

Even though the goal of the first part of my research is to understand how to design a good game (meaning a game that provides fun and engaging experience in the general sense of the word), I have to understand the underlying principles so that any model of games that exists builds upon highly understood and well-tested foundation. Based on my research, I decided to use the foundations of three basic elements - a game, a toy and an act of a play. [SCH14]

■ 2.1.1 Word about Definitions

Before I begin to discuss the possible definitions for all mentioned concepts, I should say that it is probably impossible to come up with an exact definition that would encapsulate everything what games are while safely disregarding all what games are not. There is an ongoing discussion about this topic and none of the definitions are flawless.

In this thesis, I covered te perspectives I've found to be the most valuable and important and in the end formulated a definition of my own. Not in the pursuit of the perfect definition but rather to show what is going to be central for my following work on the subject of this thesis.

1

¹Similar issues can be found in other forms of art like music. There is a discussion to this day about the exact definition of music. Many examples are trying to push the boundaries of music only to show how broad and specific it is at the same time, unable to be captured by a single defining sentence. One approach is relying on the sensible capabilities of the human organism (e.g. defining frequencies and tempos which are not distinguishable to a human ear) which is quite a provable way to define limitations of music but is still only a part of the picture. When trying to dive into the theory of music, the definition might give a general sense but the context of the definition should always challenge to explore its boundaries.

2.1.2 Definition of Play

Even in its simplest forms on the animal level, play is more than a mere physiological phenomenon or a psychological reflex. It goes beyond the confines of purely physical or purely biological activity.

- Johan Huizinga[HUI14]

Perhaps the most influential on the subject of play has been the work of Johan Huizinga constituted in his book *Homo Ludens: A Study of the Play Element in Culture*. He describes play as a central activity, something common amongst both animals and humans, which has an exploratory purpose and solidifies the rules by which a culture is governed. He sees the act of play to have both functional and sensational purpose, meaning we can play without any reason yet still derive meaning from the play itself. Perception of fun is thus closely related to the sensation of play, while the function of play is the experience derived from it which transcends to other spheres of life outside the so-called magic circle of play.[HUI14]

Huizinga also defines five essential characteristics of play:

Summing up the formal characteristics of play we might call it

- *a free activity (meaning done voluntarily as an act of freedom)*
- *standing quite consciously outside "ordinary" life as being "not serious", but at the same time absorbing the player intensely and utterly.*
- *It is an activity connected with no material interest, and no profit can be gained by it.*
- *It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner.*
- *...Into an imperfect world and into the confusion of life it brings a temporary, a limited perfection. Play demands order absolute and supreme. The least deviation from it "spoils the game", robs it of its character and makes it worthless.[HUI14]*

Huizinga also speaks about the representation or display of an act of play. He claims that every act of play naturally converges to a formal game which is a representation of a contest, or else the play becomes a contest to find such representation.[HUI14] In other words, the act of play is naturally progressing

towards an ordinary set of rules (perhaps around a common theme) and a game is a natural platform to exercise and display an act of play.

Roger Caillois further expanded on the work of Huizinga by defining additional characteristics of play, such that an act of play is uncertain and cannot be pre-determined and requires a make-believe attitude from players to create and follow imaginative realities.[Cai62] He also defined the tendency to formalize an act of play into a game as a continuous transformation between so-called *paidia* and *ludus* and argued that there are other types of play than those revolving around contest (referred as *Agon*). Specifically *Alea* (an act of chance), *Mimicry* (an act of role-playing) and *Ilinx* (an act of altering perception).[Cai62]

Interesting view on the significance of play in culture is the transactional analysis described by Eric Berne. Berne defined a set of psychological rules which turned many social interactions into a contest of ego protection of the player who initiates the game (Berne describes it as recovering from ‘I’m not OK, you’re OK’ state to ‘I’m OK, you’re OK’ state of mind and returns control to the adult part of one’s personality).[BER67] Although his work has been heavily criticized as overly simplified and ultimately did not survive in modern psychoanalysis, it has been surprisingly popular and relatable by the general public. Perhaps it shows how an act of play can be essential to our interactions or even psychological recovery, especially when people lose (or are incapable of managing) the adult part of their psyche.

Research has shown that play is not only fundamental for the healthy development of a child[Par32], but also important for the adult’s happiness, mainly for its relaxing qualities and its ability to disconnect from the real world and connect with our own self.[?] Several therapy methods have also been developed around the concept of play as a way to support social integration, growth, and resolution of trauma.

It has been noted that an act of play is disconnected from a real world. For example an act of role-playing a firefighter does not necessarily mean the person becomes more competent in extinguishing a growing fire. Rather it is connected with the development and nourishment of underlying cognitive patterns and the process of learning.[Bro]

The non-seriousness of play is also debatable.[Rod06] Huizinga and Caillois view play as something that is done with no intention other than the pleasure of playing itself. They also describe many effects of play on culture which developed from an act of play into more serious phenomena and continues to be explored and developed alongside with it (such as the governmental

systems of law protection). I could also find many cases of so-called serious play - methods which consciously integrates essential elements of play in order to support the development of skills, problem solving and creativity. Here the primary goal is not a pleasure of playing, but to use the concept of play to achieve desired results in the real world.

Other definitions of play explore it as a form of aimless exorbitation of energy, spontaneous activity or manipulation fueled by curiosity.[TEK03]

Based on my research on the subject of play, I would not see play as an activity but defined it in the following way:

Play is a state of mind, an enjoyable approach to a transformative process with abstract boundaries which exploration is the inherent purpose of play.

In this sense, any activity can be playful (referenced as an activity of play or playing) as long as it is (and can be) approached with playful attitude in respect to characteristics of play defined by Huizinga[HUI14] and Caillois.[Cai62]

2.1.3 Definition of Toy

Toy could be seen as a step between the pure act of play which is governed by very few rules while being mostly spontaneous (not necessarily involving any objects at all) and a game with well-defined mechanics or structure. It is argued that at a core of every good game is a well designed playful toy.[SCH14]

Jesse Schell defines a toy as an object that is fun to play with. The word “fun” references a pleasure with surprises. In fact, any object that can be played with could be considered a toy, but the fun aspect is essential to a good toy, Schell argues.[SCH14]

Two important characteristics of a toy are that they represent an inherently interesting object and provides an experience of fun through interaction with that object. Manipulation is then essential to enter the act of playing.

It is important to realize that such an object does not necessarily need to have a fully physical representation. There can be a virtual toy as long as

an interactive interface exists. Specifically, digital games represent this by requiring a physical controller for interaction while in itself are completely virtual. Przybylski, Rigby, and Ryan reference this lack of physicality as the key difference between the real-world and gaming context where it leads to a lack of proprioceptive feedback with a loss of intuitive sense of orientation and action which requires additional time investment into the mastery of controls.[AKP10]

The simplicity of a toy is what makes it a powerful source of joy but what is also its limitation. A toy can last only for so long. The freshness of it can disappear rather quickly and even though it is really simple to engage with, it does not provide much depth or complexity. By introducing more rigid and complex structure, we can expand the influence of the toy to many different contexts and create a functional game.

■ 2.1.4 Definition of Game

One interesting view on the definition of games comes from the work of Jesse Schell who examined several existing definitions and rounded up ten essential elements of games:

- Games are entered willfully.
- Games have goals.
- Games have conflict.
- Games have rules.
- Games can be won and lost.
- Games are interactive.
- Games have a challenge.
- Games can create their own internal value.
- Games engage players.
- Games are closed formal systems.

Jesse Schell himself criticized this approach for being too broad and seemingly endless, arguing there are probably other characteristics that have not

been mentioned and it might not be a very useful way to define games.[SCH14] That is why in his own definition he tried to see games from the perspective of the player instead: *A game is a problem-solving activity, approached with a playful attitude.*

- Jesse Schell[SCH14]

Through this definition, he describes games as “miniature realities based on the real world...for a particular problem that manipulations of this internal world...are valid and meaningful in the real world.” He also encourages that games should introduce new and interesting problems and allow the player to discover them through game-play to fulfill the criteria that games should be engaging and interactive as not all problem-solving activities necessary have to be.[SCH14] The downside of this definition is that it does not help us understand very well what is so essential to the actual structure of games that a “playful attitude” can flourish within them so well and produce enjoyment and fun. It is also not exactly clear what a playful attitude is referencing in this sense.

Salen and Zimmerman are classifying the relationship between games and play in terms of their descriptive and evaluative meaning. The gameplay must be meaningful in the sense that the systems of the game have to respond to the actions of the player and create a discernable outcome which is integrated into the larger context of the game. The role of the designer is then to create the context of the game which allows for a meaningful play.[TEK03] This description fits the definition of problem-solving activity and implies that the sensation of fun is driven by the perceived meaningfulness of the player’s action. Indeed an action-less game is no different from watching a film or reading a book and could hardly be considered playful. It would seem though that there is much more to the sensation of playing a game than simply performing a set of meaningful actions, as I will try to show later in this chapter.

The definition of games presented by Salen and Zimmerman is that

A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.

- Salen and Zimmerman[TEK03]

This definition arose from a comparison of eight other authors including Huizinga, Caillois, and Crawford as an attempt to unify their definitions into a single one. All of its features have been captured by Schell as well except that the involved conflict is artificial and yields quantifiable outcome. It is though somewhat comparable to the notion that games can be won and lost

and resemble a problem-solving activity.

Salen and Zimmerman also point out that games with no explicit set of goals like sandbox games or simulations do not necessarily have a quantifiable outcome but I would argue it largely depends on the interpretation of the term and whether or not the goals the players are setting for themselves are part of the gameplay system. It also heavily relies on the interpretation that all games are contests (hence the artificial conflict), which does not seem to be true (borderline examples are heavily linear and narratively driven games) or at the very least also depends on the interpretation of the term.

The semantics of the terms “games” and “play” has been captured by Salen and Zimmerman in two directions. Both that games include play as one of its elements and that games are a subset of play in a sense that they represent a specific type of activities which can be considered playful.[TEK03] It highlights the ambiguity of these two terms and that their relationship is not exclusive to one another. One way to explain this relationship I would propose would be to see play and games as a transformative process where one evolves into the other as a more complex structure or a system is involved.

The nature of this transition has been partially described by Caillois in his taxonomy of games.2.1[Cai62]

	AGÔN (Competition)	ALEA (Chance)	MIMICRY (Simulation)	ILINX (Vertigo)
<p>PAIDIA</p> <p>Tumult Agitation Immoderate laughter</p>	<p>Racing Wrestling Etc. } not regulated Athletics</p>	<p>Counting-out rhymes Heads or tails</p>	<p>Children's initiations Games of illusion Tag, Arms Masks, Disguises</p>	<p>Children "whirling" Horseback riding Swinging Waltzing</p>
<p>Kite-flying Solitaire Patience Crossword puzzles</p>	<p>Boxing, Billiards Fencing, Checkers Football, Chess</p> <p>Contests, Sports in general</p>	<p>Betting Roulette</p> <p>Simple, complex, and continuing lotteries*</p>	<p>Theater Spectacles in general</p>	<p>Volador Traveling carnivals Skiing Mountain climbing Tightrope walking</p>
<p>LUDUS</p>				

Figure 2.1: A taxonomy of games by Roger Caillois

The distinction between paidia and ludus as structured activities with explicit rules has proven itself over the years to capture the essence of games and play very well. There are not many examples that would break this rule. Needless to say, the taxonomy has been developed before computers and digital games existed and are largely considered outdated since most modern games are seemingly able to combine all of the four subtypes of play into one coherent game system or create vastly different combinations.

2.2 Self-Determination Theory

Another modern approach to the definition of games and play builds upon research of the Self-Determination Theory (SDT) model established by Deci and Ryan. Originally as a psychological model of motivation, it has been later applied to the analysis of games.

According to the SDT, people have inherent ability to engage in an activity (be motivated) by their own will and for their own sake as long as the “events and conditions enhance a person’s sense of autonomy and competence.”[aRMR02]

In the context of games, SDT explains the term “fun” as a sensation of motivational satisfaction. Description of games by Przybylski, Rigby, and Ryan reflects this as well:

“Video games have the potential to enhance intrinsic motivation and short-term well-being insofar as they provide players with experiences that satisfy universal psychological needs. This perspective emphasizes the motivational processes inherent to the structure of gaming contexts. To say this another way, it is our view that games are generally more or less appealing, and have a greater or lesser influence on player well-being, as a function of the extent to which the in-game experiences they provide fulfill fundamental psychological needs.”[AKP10]

This fundamental observation is backed up by statistically significant data, revolving around the PENS (Player Experience of Need Satisfaction) model[CSR07] as a measure of player engagement in relation to the three basic psychological needs defined by SDT:[AKP06]

- **Autonomy** as being in charge of our own universe, displaying our ability to make voluntary decisions and manipulate our fate freely and willingly (referred to as volition).
- **Competence** as being able to overcome the challenges presented in front of us.
- **Relatedness** as having a sense of community, understanding, love, and belonging.

The concept of basic psychological needs in the context of SDT is described

as innate psychological nutriment that are essential for ongoing psychological growth, integrity, and well-being.[aRMR02] Even though there are examples when the satisfaction of basic needs is the specific purpose of an activity, particularly when a severe lack of satisfaction is experienced beforehand, satisfaction of basic needs is generally viewed as a condition to perceive activity as inherently interesting while the purpose of the activity is rooted in the integrating tendencies of human organism (self-determination).[aRMR02]

This means that games can also be defined from the perspective of well-structured activity whose purpose is to provide nourishment to satisfy basic psychological needs. However, there is a large sum of criticism about the SDT framework, specifically that the definition of three basic psychological needs is debatable, pointing towards other psychologists like Maslow or Murray who were able to define other systems which have not been addressed or aligned within SDT.

2.3 Conclusion

To conclude my research about the definition of games, I tried to build upon the work of Jesse Schell and incorporate the motivational aspect of player experience:

A game is a virtual system that provides an engaging experience.

To understand this definition better, let's examine each of its parts separately:

The game is a virtual system - references the abstract qualities of the gameplay structure. Games are by nature an imaginary construct. Whether they are reflecting a real world or build upon vastly unrealistic fantasies, it is bound to be some sort of abstraction. This distinction is important to differentiate games from other systems which are intended to provide motivational structure in the real world, like societal systems, economics, and others.

The game provides engaging experience - describes the purpose and boundaries of the virtual system. A game should motivate for action, ideally to be seen as a source of harmonious self-determining experience in order to be perceived as fun.

One big flaw of this definition is that it hides the nature of games behind the nature of motivation which must be understood if we are to build quality gameplay experiences. It is my belief that motivation plays a key part in good game design and thus I aimed only to establish its connection to games without necessarily defining the motivation itself.

Chapter 3

Understanding Gameplay

3.1 Elements of Game

Considering the broad definition of games, I would have a difficult time to tell what could or could not be in some context an element of a game. Yet some established concepts in the field of game design exists so my aim is to cover those I consider important or widely implemented.

Jesse Schell in his book Art of Game Design mainly discusses the following elements of game:[SCH14]

- **Rules**, a set of behaviors or events that can or can not happen, win and lose conditions, systems of points, in-game economies, rewards, and punishments.
- **A world**, the specific content, a practical application of a given set of rules. Schell defines three subcategories:
- **A story**, all of its components and narrative tools or features to tell it.
- **Characters** both interactive and non-interactive, as part of the story or to support immersion (the player's suspension of disbelief).
- **Space** as the spatial system of the game, its size, shape or look, including the applied rules of physics.

- **Mechanics** describes the particular components of the game, at the level of data representation and algorithms.
- **Dynamics** describes the run-time behavior of the mechanics acting on player inputs and each other's outputs over time.
- **Aesthetics** describes the desirable emotional responses evoked in the player when he interacts with the game system.

Starting from mechanics, these are the specific elements of the game. Concrete rules, exactly described relationships, entities, possible actions and behaviors which applied to the game content creates variety and opens up gameplay.

Interaction with mechanics in given context leads to dynamics, events within the game system, long-term strategy of the player, chain of actions and reactions leading to a final outcome or the narrative level of the game.

The interpretation of observed dynamics by the player leads to a certain emotional experience, often closely related to the pleasurable aspects of play. Aesthetics could describe feelings like surprise, discovery or challenge experienced by the player and are the basis for the subjective evaluation of “fun”.

MDA also describes possible relationship between the player and the game designer as indicated in the picture 3.1.

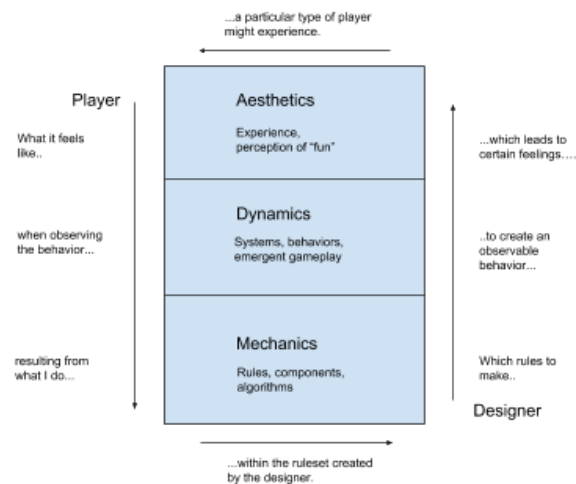


Figure 3.1: Visualisation of the MDA framework

Authors of the MDA encourages to create formal models to analyze the

■ 3.1.3 Story

Narrative elements of every game can be studied in at least three ways.

An embedded narrative is the story told within the context of the game.[TEK03] It may involve artificial characters, intentional conflict, events and cutscenes, dialogues or in-game items which all reveal part of the story to the player. To take advantage of video games, many contextual stories have branching systems to provide a feeling of autonomy and (often illusion of) choice and players influence over the story. In some cases, the story can be completely procedurally generated although still “injected” in the game by the designer.

An emergent narrative is the story that represents the actions the player takes within the game.[TEK03] For example in a platformer game, a series of actions that includes jumping, death and revival, avoiding (or confronting) enemies or collecting bonus items are a story that reveals itself through play. It is the unique story the player creates by playing the game.

Players narrative is the story about the experience of the player.[TEK03] The perception of aesthetics, how the player felt during the play session overtime for his own personal reasons. It is usually desired to align the goals of the embedded narrative with the player’s perception of the story so that a sense of connection and relatedness is achieved.

There is often a conflict between the mechanics of the game and it’s embedded story which we refer to as **ludonarrative dissonance**. [TEK03] Games still need to be fun and engaging and they need to give a sense of freedom while providing enough space for mistakes and repetition so that a mastery of the game can eventually be achieved. At the same time, crafting that desired narrative moment where the player is involved as a character with a meaningful agency is nearly impossible with such freedom and “limitless” power. Various tradeoffs are often made to solve that problem. The player may be partially stripped off of his freedom for a limited time, the game can use deus-ex machina to “fix” what is unintentional or the story may become non-linear or simplified at a cost of less direct power in the hands of the designer or writer. The real impact of ludonarrative dissonance is though widely discussed and it is not clear when and if it represents a real problem.

3.2 Player

First, it is important to establish the role of the player within the game. My interpretation builds on the work of Jesse Schell as well as Salen and Zimmerman, whereby the sentence that the player is playing a game, I generally mean the following:

- **The player is submitting** to the ruleset of the game and voluntarily accepts the suspension of disbelief.
- **The player is engaging** with the embedded (e.g. win conditions) or emergent (e.g. personal goal in a sandbox game) purpose of the game.
- **The player is influencing** the events in the game through his interaction.
- **The player is receiving** the outcome of the game and evaluates it subjectively.
- **The player is experiencing** the game through feelings as it happens.

The player is the person **to whom the game is designed for** and he definitely decides whether or not is it any good. To help with that question, several taxonomies of player behavior have been developed. One of the most influential is the Bartle's Taxonomy of Player Types[Bar], which introduces a two-dimensional scale with four quadrants of player types as seen in 3.2.



Figure 3.2: The dimensions of the Bartle's Typology of player types[Bar]

The two scales of the dimension refer to the focus a particular player is emphasizing in each area. This leads to four types of players:[Bar]

- **Killers** emphasize competition with other players and defeating others.
- **Achievers** are acting in the world and focusing on the goals of the game.
- **Explorers** have a tendency to interact with the world and experience sensation of discovery.
- **Socializers** are aiming to build relationships with other people.

Bartle's Taxonomy is strongly linked to LeBlanc's definition of eight possible game pleasures, which he based on observations inside of multiplayer games:[SCH14]

- **Sensation** in terms of sensory satisfaction, for example as in listening to music.
- **Fantasy**, the pleasure of imagining something unreal.
- **Challenge**, experiencing a sense of competence and skill.
- **Fellowship**, relating to other people, both specific and general.
- **Discovery**, finding something new.
- **Expression** of ourselves through our actions.
- **Submission** by leaving the reality behind through the suspension of disbelief.

There is a match of primary sensation for each type - a challenge for achievers, discovery for explorers, fellowship for socializers - with the exception of killer-type which is harder to define in terms of the listed sensations. Relating this taxonomy to the SDT framework, I would assume these pleasures represents the projection of self-determined behavior while three of the pleasures - challenge (competence), fellowship (relatedness) and expression (autonomy) are primarily driven by the satisfaction of basic psychological needs.

As helpful and practical these taxonomies are, it is not a complete representation of possible motivations to play. **The Unified Model by Bart Stewart**[Ste11] is attempting to combine several personality and player type models - The Bartle's Taxonomy of Players, The Four Keirsej Temperaments and the Chris Bateman's DGD1 model - into one, using the dimensions adopted from the Keirsej's model.3.3 This might give a more holistic approach in describing motivational drive in games but requires more extensive

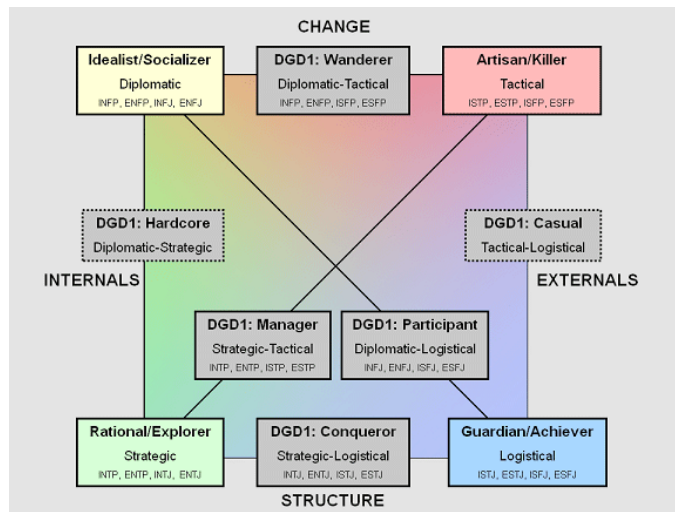


Figure 3.3: Visualisation of the Unified Model by Bart Stewart[Ste11]

explanation to be correctly understood, for which I refer to existing materials.

Outside of personality types, another way to differentiate players is through demographics. Players demand different levels of difficulty and complexity as well as different thematic setting or experience style based on their culture, age, gender or other demographic traits. I find particularly interesting the contrasting differences between man and woman, where a man might be looking for competitive experience with destructive elements and a learning curve based on trial and error while a woman would be looking for real-world emotional experiences they could apply to their own lives. These generalizations, while in itself dangerously vague, can help to specify the design goals of the particular game in order to appeal to a broader spectrum of players or, on the contrary, define a niche audience.

3.3 Psychology of Play

When considering the role of a player within the game, we should also look at the psychology of the player and what drives his behavior within the game. From this point of view, I will focus on the processes of Flow, motivation and engagement.

■ 3.3.1 The Flow

Flow is a well-documented concept described by psychologist Mihály Csíkszentmihályi. It describes a state of mind in which nothing seems more important than the activity itself. Csíkszentmihályi described six characteristics of Flow:[CSI08]

1. Intense and focused concentration on the present moment.
2. Merging of action and awareness.
3. A loss of reflective self-consciousness.
4. A sense of personal control or agency over the situation or activity.
5. A distortion of temporal experience, one's subjective experience of time is altered.
6. Experience of the activity as intrinsically rewarding also referred to as autotelic experience.

As such it is a state of mind often associated with happiness and intrinsic motivation - features significant both in play and non-play activities. The flow could be seen as a symptom of any highly intrinsically motivating activity or as a source of intrinsically motivating force. In this sense, Flow is self-reinforcing - it leads to a higher perception of motivation which in turn, makes the higher possibility of the state of Flow.

It is argued that three main conditions need to be satisfied to enter the state of flow:

1. The person must be involved in an activity with a clear set of goals and progress.
2. Clear and immediate feedback must be provided.
3. A good balance between the perceived challenges of the task at hand and the person own perceived skills exists.

The model of the Flow proposes that when the balance between perceived challenge and skill to overcome that challenge is broken, either boredom or anxiety occurs as visible in picture 3.4.

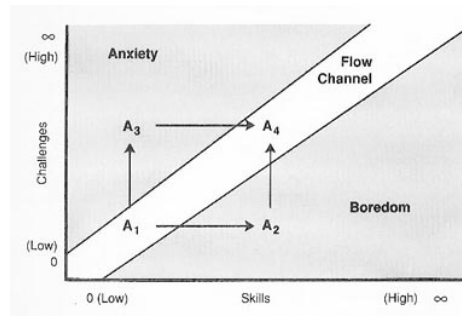


Figure 3.4: Visualisation of the Flow principle[CSI08]

More specific versions of the model describe other possible outcomes like worry, tendency to control or relaxation, but in the context of this thesis, I find the basic structure sufficient. The most practical implication of the model is the principle of tension and release where the state of Flow is the most satisfying when it's nonlinear, as we are able to feel the slight fluctuations towards boredom and anxiety and receive direct feedback about our increased skill and competence to conquer higher challenges as visible in picture 3.5.

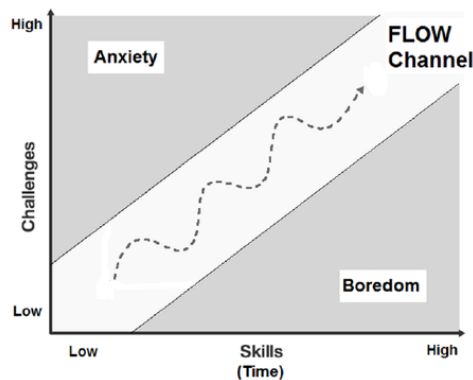


Figure 3.5: Visualisation of the Flow Channel[CSI08]

There are mainly two areas of criticism of Flow theory. Some criticism targets the implications of the model and argues that imbalance in skill and challenges does not necessarily lead to a lack of motivation in form of boredom, anxiety or other states described by the model. Other criticism pointed out by Csíkszentmihályi himself is that Flow can enrich life but also inspire compulsive, obsessive behavior that is potentially damaging. In other words, Flow does not necessarily guarantee happiness but can be often associated with it. This seems to correspond with findings of the compulsiveness of player experience concluded by the SDT research.

■ 3.3.2 Intrinsic versus Extrinsic Motivation

The aforementioned SDT framework makes several important distinctions in regards to external and internal motivation and its effects. Mainly:[aRMR02]

- Environments that support the nourishment of basic psychological needs leads to intrinsic motivation and supports well-being whereas undermining basic psychological needs can lead to a lack of motivation towards a specific activity.
- External rewards lead to lower interest in the inherent purpose of activity although if presented in an autonomy-supportive manner (such as to provide informative feedback on a person's skill and competence) they may support intrinsic motivation.
- Perception of motivation is subjective and relies on the person's own perception and interpretation of the context and the person's internal resources to self-motivation.
- Inherent purpose of an activity is recognized in relation to self-determined values and desires (e.g. "I want to do it because it corresponds to my own values and goals" vs. "I want to do it because I feel like I should"). Intrinsic motivation is more likely if such values have been identified and integrated both within self and in the context of an activity.

Based on the work of Przybylski, Rigby, and Ryan, I would assume that the inherent appeal of games is the accessibility of (intrinsic) motivation.[AKP06] Games can take many shapes and forms but most good games are considered engaging because they contribute to the concordance of the activity at hand with our own values, goals, and desires. The context of the game should match the player's own values and goals in a motivating environment such that it provides what is often described as meaningful gameplay and leads to a harmonious experience ("fun"). Such interpretation is different on a personal level or even on a cultural level and leads to vastly different games with different audiences that would or would not find a specific game enjoyable.

The mini-theory of SDT - **The Causality Orientation Theory** - differentiates between a focus on instructions and external control versus valuing a sense of autonomy and internal drive.[aRMR02] There is also a third trait which brings the attention to a lack of impact and leads to amotivation. Rather than personality types, these represent characteristics of behavior which to a certain degree are present within every person. Thus when designing a game, it should be taken into consideration that some players might

This kind of structure is sustaining the player's attention both in the moment as well as in the future for the necessary length of one play session. Carefully balanced cognitive demand on all levels of the game is well enough to be playable and interesting while leaving little to no space to pay attention to anything else than the game and thus supports high levels of engagement.

3.4 Artificial Intelligence in Game Design

AI plays a huge role in most modern games. It would be hard to imagine many games of today to be what they are without the large influence of these technologies. Based on the article by Richard Moss, I would list seven possible ways (linking it to examples provided by the author) the AI can influence game design:[Mos16]

- **Interesting gameplay** - AI has the ability to improve the behaviors of NPCs and other in-game objects to create more interesting situations which opens up space for more possible ways to play. Dynamic gameplay must be adaptive and intelligent to be interesting. Without the AI, all games would be mostly linear and scripted with very little freedom on the hands of the player (as was the case with most early video games). The listed example is the director system in *Left 4 Dead*.
- **Ease of play** - games are complex systems, often in the highly simulated 3D world. The player controlling a living character in a dynamic world only using a controller with twelve buttons and two sticks is sometimes not so straightforward and requires some guessing to be possible. Artificial intelligence can utilize techniques to correctly predict the real intentions of the player and keep the controls simple while allowing complex interactions. The listed example is the cover system in *The Division*.
- **Flexible difficulty** - in the attempt to appeal to a broad spectrum of players, designers are trying to adjust the difficulty based on the performance of the player to keep the gameplay interesting without causing frustration or boredom. Although by some considered a design mistake, a flexible difficulty is a real mechanic in many games and AI is a powerful tool that can correctly analyze the player's performance and make necessary adjustments. The listed example is the adaptive driving system in *Forza*.
- **Believable characters / world** - AI does not have to be always smart. Players require believable experiences and characters that can display

flaws, are somewhat unpredictable and behave irrationally when the moment is right. Designing such intelligence is a tricky task, but very powerful tool especially in narrative games. The listed example is the behavior system in *Alien: Isolation*.

- **Generated content** - procedurally generated content is a completely different approach to game design where instead of limiting the world in terms of rules, the designer is trying to describe underlying functions that would dictate the dynamics of the game in (perhaps infinitely) different situations. The listed example is the combinatorial narrative in *The Ice-Bound Concordance*.
- **Game balance** - to balance a game, an extensive amount of playtesting is often required, which takes a lot of time and resources and involves collecting and analyzing large amounts of data. AI systems can help with this task by simulating the player behavior and automate gameplay to test the boundaries of the system. The listed example is the genetic algorithm in *City Conquest*.
- **QA automation** - similarly to game balance, AI can be also involved in QA processes to detect inconsistencies in the physics system of the game, automate various QA tests and push the quality of games in otherwise impossible ways. The listed example is the walkability test in *The Witness*.

3.5 Conclusion

In my research on the elements of game and structure of gameplay, I have found many interesting viewpoints and frameworks that can be used to analyze and describe a certain game system.

In relation to my work, I can describe the basic elements of a game in a specific genre and take advantage of the MDA framework to analyze its relationships but it is not enough to argue what is a good way to design a specific game in the genre. For such a conclusion to be included in my work, further research and playtesting have been necessary to do.

My research also showed that it is very difficult to establish a uniform way of measuring fun and quality of a certain game and it must always be evaluated relative to the player playing it. Certain taxonomies of player types have been useful here but due to the complexity of gameplay experiences, it was impossible to draw a line between a group of players and the way a specific game should operate without considering all elements of the game.

Apart from the elements of a game and the taxonomy of players, I also focused on psychological processes or patterns of behavior that are common while engaging with gaming activities. The concepts of Flow, intrinsic motivation and engagement all shown, how the structure of the game elements should relate to each other and thus helped me to understand basic guidelines to design a game system in order to be engaging and stimulating for the player.

Finally, I researched the possible roles of artificial intelligence in game design and from the areas that I examined, I decided to focus more closely on the role of interesting gameplay, believable characters and generated content, as these were most closely related to the topic of my work.

Chapter 4

Taxonomy of Games

In order to analyze games in a specific genre, I first had to define a framework that allows me to describe and generate genres of game. In previous sections of this thesis, I focused on several areas of games, that can be used as a dimensions for a possible taxonomy. I've also build on the work of Andreas Schiffler cite:8 and the work of Craig Lindley[Lin03]:

- **Demographics of the player** (gender, age category, culture, country of origin...)
- **Personality types of the player:**
 - Primary focus on type of pleasure (*LeBlanc's Taxonomy*)
 - Primary focus on type of experience (*Bartle's Taxonomy*)
 - Primary focus on type of motivation (*causality orientation, sandbox vs. goal-oriented*)
- **The Player Experience of Need Satisfaction** (*autonomy, competence, relatedness*)
- **Theme or purpose of the game:**
 - Type of play (Caillois Taxonomy of Play)
 - Genre (*strategy, simulation, shooter...*)
- **Narrative elements:**
 - Narrative setting (*fantasy, sci-fi, realism, surrealism...*)

- Narrative structure (*linear, branching, dynamic, procedurally generated...*)
- Narrative impact (*story-driven, ludological*)
- **Camera and perspective** (*top-down, isometric, first person, third person...*)
- **Content** (*scripted, designed, generated*)
- **Learning curve** (*emergent gameplay vs. mechanically heavy*)
- **Structure of time and space:**
 - Dimensionality (2D / 3D)
 - Continuity (*real-time / turn-based, continuous / structured*)
- **Physics** (*realistic, simplified, alternative, non-existent*)
- **Complexity of the experience:**
 - Longevity of one session (*short, long...*)
 - Variety of gameplay (*casual, feature-rich...*)
- **Multiplayer structure:**
 - Symmetry (*asymmetric or symmetric gameplay*)
 - Purpose of interaction (*competition, cooperation*)
 - Physical presence (*local, online*)
 - Limited amount of players (*two players, massively multiplayer...*)
- **Sense of control:**
 - Level of perception (*micro vs. macro oriented*)
 - Distance of impact (*direct vs. indirect control*)

In order to define a genre, we can use each of these dimensions and list their subclass to narrow its elements. Most genres would then be linked to several of these (or other unlisted) dimensions. For example, the strategy game is usually representing a top-down, competitive, narratively linear game with scripted content and short session (per map) oriented towards player-types of killers and achievers.

In an attempt to specify what type of games are the concern of my research, I define specific genre of games - narrative simulations - using relevant (defining) dimension in table 4.1.

Additionally, the prototype that has been built as a representation of this genre, could be characterized more specifically also in terms of other dimensions in table 4.2.

Dimension of study	Specification (in order of importance)
LeBlanc's Taxonomy of Pleasures	Discover, fantasy, expression, sensation, submission.
Bartle's Taxonomy of Player Types	Explorer, Socializer, Achiever
Caillois Taxonomy of Play	Mimicry, Ilinx
Causality Orientation Theory	The autonomy orientation
The Player Experience of Need Satisfaction	Autonomy (expression), Relatedness (story), Competence (managing simulated economy)
Narrative structure	Procedurally generated
Narrative impact	Ludological (story emerges from gameplay)
Content	Generated
Learning curve	Emergent gameplay (simple ruleset leads to vastly dynamic behavior)
Longevity of gameplay session	Depends on type of simulation but mostly longer (two to three hours per session, twenty+ hours per game)
Level of perception	Macro-oriented
Distance of impact	Indirect

Table 4.1: Taxonomy of games

Dimension of study	Specification (in order of importance)
Narrative setting	Historical fantasy
Camera and perspective	Top-down, 2D
Structure of time and space	Real-time with altered intervals (movement is realistic but several years are simulated within span of few hours), continuous movement with grid-based object positioning.
Physics	Simplified
Multiplayer structure	Single player

Table 4.2: Specification of narrative Simulations within the taxonomy of games



Part II

Design and Implementation

Chapter 5

Concept

In order to describe the concept of the game, I use a one-page format that aims to sell the game to a target audience. In later chapters, I describe the concept further to expand on the general vision of the game and finally reduce it to the scope of the playable prototype that has been developed as part of the thesis.

You've been granted the status of a knight with land to rule over. Your life takes suddenly a different route. As a landlord, your duty is to cultivate your land and provide what is needed for your king. Work with peasants, create a sustainable economy, train soldiers, engage with noble houses and raise the glory of your family name over many generations. Experience a living atmosphere of your settlement enhanced through randomly generated events, simulated environment, and intelligent NPCs.



Figure 5.1: Image from the prototype of the game Landlord

The game introduces a top-down view over the village. The player can control the game via various UI options similar to other sim-strategy games. The city should evoke a living-breathing atmosphere with NPCs seemingly living their life in a feudal/medieval world. Each game should be somewhat different based on the randomness of the AI system but always bound to the same basic rules and principles to allow the player to improve or try different things when starting again. The game is designed as a single-player experience.

Game is focused on recreating the experience of a landlord in a medieval fantasy setting. It's supposed to be raw, surreal experience building upon historical facts about feudalism, economy, agriculture, and craft around the 14th century.



Chapter 6

Gameplay

Gameplay is structured around three distinct areas influencing the flow of the game:

- **Kingdom** creates a sense of progression and challenge. It introduces progressively more difficult objectives in each area of development. Completed objectives reward gold and reputation and can unlock new gameplay options. Lack of reputation will cause the game to end (land stripped away by the king).
- **The landlord** is represented by the player and his actions. The character of a landlord is present in the game as an NPC. Player focuses on developing the city, drive its economy and serve the king.
- **People** are represented by NPC controlled by an AI system. They have schedules dictated mostly by their job but are guided also by their needs, character traits and occurred events. They are mostly trying to meet the demands of the landlord but the behavior is also supposed to be reasonably unpredictable to evoke a sense of human-like behavior.

The game itself has no end and the city can be developed infinitely. Yet at some point, the player will run out of space to build on and the freshness of the game may disappear, so it is expected to start a new game after that.

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¹This structure was inspired by the so-called Feudal Pyramid, which distinguished the

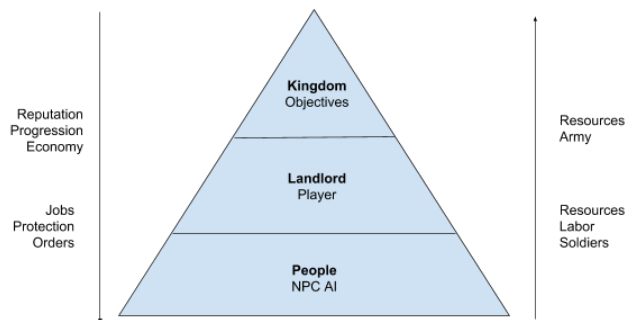


Figure 6.1: A scheme of the gameplay structure

6.1 Gameplay Loop

The gameplay is non-linear and adapts goals and reward system to the actions of the player but the overall goal is to grow the population, cultivate the city and build up a reputation. In general, the player has three main areas to focus on:

- Build the city using available resources
 - Zones split the land to manageable parts of a specific type, each with its own specific function.
 - Buildings consist of walls, rooftops, and other assets. Some zones require to be inside of a building to function properly.
 - Indoors consists of furniture and decoration. Increases attractiveness of the space.
 - Tools consist of crafted tools and structures. Used to produce goods and resources.
- Manage People to focus your economy in the desired way
 - Contracts are agreements between player and NPCs over a specific zone or services. NPCs will not accept all contracts and the player must negotiate.
 - Orders are given by the player (landlord) and have an impact over an NPC. Includes jurisdiction, zone-specific settings, and events.
 - Society is monitored through measured values reflecting several aspects of sustainability like reputation, criminality, and happiness.
 - The army is used for labor, as a means of law protection and as a resource to spend on reputation objectives (offering soldiers to the king).

power hierarchy of a feudal society to three classes and assigned specific role to each one of them.

- Nobles are members of the courtyard who enjoys the fruits of labor and rule the city. Nobles can be assigned to several functions that additionally support the economy.
- Manage Resources
 - The production consists of food, money, materials, and goods. It drives the local economy and ultimately allows to develop the land in order to produce an army and supply for the king.
 - Taxation requires the player to make sure the payments are due. Whether it is from peasants as agreed within contracts or to the king as requested from the baron.
 - Crafting is a means of progression. Advanced tools are requested to progress in other sections of economy.
- Objectives are guiding the player and provides temporary goals with rewards.

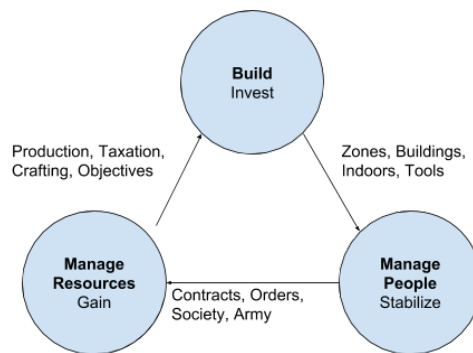


Figure 6.2: A scheme of the gameplay loop

6.2 Economy Systems

The game is running over a time period of several centuries and a natural cycle of life and death is implemented. NPCs may be born, travel in or out of the city or die and be buried. The player can also arrange a beneficial marriage to gain additional benefits and pass the title of the landlord across generations. Every new-born landlord has then different character traits which are taken into account when certain events occur to make the choice of the heir more interesting.

An economy should be also fully simulated with direct relation to in-game events without any kind of deus-ex-machina (such as resources appearing out of nowhere). The economy is bounded to a wide chain of production and

supply where the player can get from basic resources like stone, iron or wood to craft advanced materials like steel or planks of wood, cook food or even create specific tools and equipment.

Crucial gameplay element that gives the player tools to manipulate the economy is setting up tenures with peasant families. Each family maintains its own land and property and decides what goods and resources to buy with their own money in order to best satisfy the requirements of their lord. The tenures communicate the mandates of the player to these peasant families and as such indirectly impacts how the AI behaves and which economic transactions will ultimately happen in the game.

The connected system of resources resembles history-inspired craftsmanship, professions, and manufacture. The player can also trade resources with traveling merchants to gain faster access to resources he can't produce self sufficiently or turn superabundant resources for profit.

The player may spend resources to build buildings and develop lands. These lands are split into three different types:

The peasantry is zones inhabited by peasant (freeman) families and their purpose is to cultivate the land and develop a certain industry. Production may be based on map content (mountain tiles for stone, trees for wood, the field for wheat etc.) or as a way of transforming one resource to another (e.g. raw wood to planks).

Manor provides the governmental functions of the settlement and is also a home for the militia and advanced facilities like stables for horses or courtyard kitchen for quality food. These facilities produce resources exclusively for the members of the courtyard or militia. Manor must also be developed in order to maintain constant growth of reputation.

Clergy provides spirituality and happiness which is crucial in reducing the criminality. Clergy also provides public services like clerics who can heal people or priest to assist with funerals and also production facilities for unique resources like wine and herbs.



Chapter 7

Prototype

The overall design represents a vision of the final product. It requires more detailed work and iterations with a functional prototype to be developed further. I took it as a starting point to design a prototype which has been implemented and tested via playtesting experiments. In the research summary of this thesis, I further discussed possible changes to the design based on my findings.

Before designing the prototype, the minimal requirements for a prototype suitable for the designed experiment should be stated:

- The prototype must achieve a *certain level of aesthetic quality* so that the experiment is not violated by providing an unpleasant sensory experience that
- would overshadow other elements of the game.
- Core functionality that sustainably provides at least *one hour of meaningful gameplay* must be implemented.
- A *reasonable amount of possible interactions* with the AI of the NPCs must be provided.
- The simulated behavior must evoke a sense of living and engaging world despite its limited implementation.
- Tutorial instructions do not have to be provided but the UI elements must be clear and readable so that the player can have a reasonably smooth experience with a short learning curve.

Following these rules, the functionality of the prototype was reduced from the original design in the following way:

- A limited amount of buildings and resource types that takes a progression span for one hour of gameplay.
- No objectives - the objective is presented to the player by the researcher.
- Lack of long-term mechanics that do not take place (or have only a small impact) before later in the game (any kind of politics, marriage, life, and death of NPCs, crafting of advanced tools and any longterm progression system).
- A starting scene with randomly generated families with NPCs whose number and stats are higher to provide immediate options for interaction.
- No randomly generated events. The prototype focuses primarily on the production-chain gameplay developed through the actions of the AI.
- Limited complexity of the AI system. Limitation includes reduced amounts of character traits, actions, and NPC goals.
- The simulated economy of the NPCs has also been completely eliminated and all of the resources are immediately consumed or generated and displayed in the overlay UI.

The final prototype was developed using the Unity engine and was developed with a longterm development in mind so that the prototype could later be scaled without unnecessary effort. The scaling context include more content, the growing complexity of the AI and UI/controls and a bigger variety of assets. To satisfy this condition, numerous functionalities had been implemented with a proper architectural design with modularity and scalability in mind:

- The rendering technology based on tilesets and tile rulesets that automatically adjust sprites of individual tiles to its surroundings, with five different layers of the terrain (ground, sand, water, grass, and forest).
- An API that can build and change the world with respect to each layer of the terrain.
- Procedurally generated world with configurable variables such as rate of mountains, water, trees or hills, with options for lakes, seashores, rivers, and roads.
- Custom animation system for efficient rendering of sprite-based animations (basic Unity systems were insufficient and did not allow for automatic loading of animations from sprite sheets).

- The gameplay system that calculates in-game time and affects the rate of every in-game event, including animation and object movement speed. As such, the game can operate on three different speeds (1x, 4x and 8x).
- Day/night cycle with color filtering for nighttime colors.
- Clothing and appearance system to display random combinations of NPCs with different hairstyles, facial hair styles, skin color, hair color, the appearance of age groups and clothes and helmets from a combination of individual sprites and sprite masks.
- An API for a localization system that loads every in-game text from a JSON file and can support multiple languages.
- An API that can control the resources of the player and provides an interface for an inventory that can support parallel resource management with multiple NPCs.
- Data structures and systems that can support various types of build elements with the capability to scale the number of instances over time - walls, doors, fences, floors, furniture, structures, and zones.
- Polymorphism based system of behaviors of objects that can support different types of gameplay behavior on different objects, such as trees and plants that grow over time, doors that can open and close or structures that play animations when interacted with.
- An asset management system that can automatically load data from a sprite sheet folder and prepare internal game data structures.
- Audio management system that can queue music and play sound effects with object pooling for higher efficiency and high number of channels.
- State machine system that can support three main gameplay modes/controls - building, zone management and idle.
- An API for handling the UI elements of the game in the correct order and supports three basic types of UI windows - animated scroll, animated desk and context menu of the zone.
- Basic UI to control the game with various custom UI elements.
- NPC data structure that supports numerous traits such as ability stats, known professions, skin color, age, behavior archetype, family relationships and name with its own inventory and equipment.
- Lineage/family generator system that can randomly generate a family tree of NPCs for a given number of generations. The system also decides on which NPCs are dead/alive based on their age and random chance of survival, applies inheritance from parent traits and splits the lineage to individual families by the oldest living member of a specific family

branch. Every family is then a working unit that the player is interacting with, mainly through the head of the family by assigning them ownership of the zone.

- Optimized A* pathfinding system with path smoothing and an asynchronous job system that remembers previously calculated paths and is sensitive to changes in the accessibility grid.
- Custom Goal Oriented Action Planning AI system, that uses A* to calculate a plan of actions that satisfy the effects of the desired goal. Each agent then has a priority queue of goals that are constantly updated, an interface to execute plans for the selected goal of the highest priority including calculation of paths to contextual objects in each activity and execution of movement. The system is sensitive towards immediate interruptions (i.e. due to the rise in priority of a different goal while the current plan is executed), asynchronous calculations for a limited CPU usage per each agent in a single frame (via so-called coroutines) and it was also tuned to account for repeated failures in pathfinding or goal execution.
- The system of zone ownership where the player can assign a specific zone to a specific family which will then start interacting with production facilities and produces resources within that zone as long as it has the required profession. This is incorporated with the AI through a set of shared goals that are defined by the type of the zone and are passed to every family member with high priority who will then try to find and execute a suitable plan through the GOAP system while also locking the facilities for use and heavily decreasing the priority for any other family member to prevent them from executing the same task.
- 26 different goals, 39 activities, 25 object behaviors and 11 types of zones have been implemented.

Part of the visual assets had been included under the license CC BY-SA 3.0 from the contributions made to the Liberated Pixel Cup (<http://lpc.opengameart.org/>). Other assets are made by the author or licensed under Unity Asset Store Terms of Service and EULA or GameDev Market Terms & Conditions. Under this licence agreements, the author was not permitted to redistribute the assets and these assets have been removed from the source code. The source code itself is accessible in Appendix D - The Source Code.

Decent bug testing has been executed although several bugs are still present in the build, some of which had a small effect on the playtest sessions but overall, the functionality has been sufficient for the purposes of the research (with the exception of A/B testing discussed later).

Short gameplay has also been captured and included as Appendix E -
Gameplay Capture and can also be found online.[Roc]



Part III

Research



Chapter 8

Hypotheses

In the theoretical part of this thesis, I examined the current industry and theoretical knowledge in order to better understand the meaning behind video games, what drives people to play them, why they can find them enjoyable and how can we understand the meaning of fun that emerges from playing a game. I also examined what can be classified as a game, what elements it consists of (from the designer standpoint) and in general why they might be important and how these elements contribute to the experience of fun.

In the effort to achieve my goal, to analyze simulation games from the perspective of the influence of artificial intelligence on the gameplay and subjective perception of fun, I formulated several hypotheses that I felt could help me understand the problem.

Based on my research, I hypothesized that narrative simulation games can drive the pleasure to play these types of games through the following ways:

- **An element of surprise.** The unpredictability of the environment that stems from the complexity of the AI behavior could be a source of pleasure.[Mos16] On the other hand a large amount of randomness would take away too much control of the outcome from the player and result in a frustrating experience.[aRMR02]
- **An element of discovery and challenge.** The unpredictability of the environment also represents a challenge. Player submitting to these games would strive for exploration and understanding of the underlying

patterns that they could exploit to feel a sense of competence.[AKP10] Players of personality types that focus on external control rather than their own sense of autonomy would be discouraged by the inherent necessity to deal with randomness and probability based environment since it lacks clear or non-ambiguous instructions to play.

- **An element of fantasy.** Simulation implicitly requires a suspension of disbelief that revolves around entering a simulated world of a particular context.[TEK03] The role the player takes on himself within that context would be for many types of players inherently interesting because the simulation aspect of the game introduces real consequences to most of the actions of the player. These consequences are not only strong part of the emergent narrative of the game but create a sense of meaningful gameplay.
- **An element of expression.** The simulated environment of the game combined with the interactions of the player and real consequences to the players' action could represent a platform of personal expression.[SCH14] Main ways of expression would be observed through visual creativity, the craftsmanship of personal stories (player narrative) and decision making (sense of autonomy).
- **An element of fellowship.** Specific to narrative simulations that often involve interpersonal relationships as part of their storytelling toolset, the player could build a sense of attachment and empathy to these virtual characters.[SCH14] The strength of the attachment would vary greatly and could influence the decision making of the player, either against/along the inherent goals of the game or against/along the personal goals of the player.
- **An element of achievement.** Goals presented by the game or those the player sets for himself while overcoming challenges to meet these goals would provide a sense of achievement.[TEK03] The extent to which players would set personal goals would vary based on their personality type and the way the game would be restricting/supportive to the player in his ability to set these goals.

Alongside these hypotheses, I also theorized which game elements would I expect to be closely related and in what ways they could impact the intensity or relevancy of said pleasures within a specific game:

- **The complexity of the environment.** To simulate an environment, the mechanics of the game often have to use large amount traits and variables that the player is ultimately trying to understand to get better at the game. I expected this to have the potential to negatively impact the experience in the following ways:

- Either there is too much information to track at once,
 - or the player is unable to understand the simulation from what is presented,
 - or the simulation loses its interest due to its simplicity.
- **Level of control.** I tried to distinguish between two major subtypes of mechanics/general theme of narrative simulation games - micromanagement and macro management:
- Micromanagement focuses on the control of specific NPCs and their individual actions. As such, it would provide a stronger emotional attachment to the virtual characters as the game speaks to the player on a more personal level. The player may build a stronger relationship with the characters or experience increased feeling of ownership of the simulation state (being more sensitive to its potential destruction). These games would be attention heavy and could not handle a large number of actors/agents in the world as each of them requires individual control of the player, but in turn, would make the player feel more in control of the simulation and thus attract different personality types of players.
 - Macro management focuses on the simulations as a whole and the player is influencing the actions of the NPCs only indirectly through incentives, regulations or requirements. As such, I would expect it to develop a lower attachment to the NPCs but be more suitable to certain settings depending on the role of the player, specifically those where a direct control is not correlating with our real-world expectations (leaders, managers etc.).
- **Goal structure.** Sandbox environment can thrive in the simulation games but can also easily fail if the game is not inviting the player to make up his own goals. The game should be designed around intuitive goals that players naturally set for themselves and support them in doing so. Typical personal goals that I would expect would be:
- Develop the environment in a specific way that is not required by the game.
 - Moment-to-moment planning of actions that are not dictated by the game, but could be corresponding with the inherent goals of the game.
 - Goals that aim to experiment with the system in unexpected ways either in an attempt to understand the simulation or stimulate an element of surprise.
 - Develop an interpersonal story with the characters (player acts as a writer of a story that comes to fruition).
- **Storytelling.** The fantasy of the game draws on certain inner desires to explore a different role in life but simulations as a genre have unique ability

Metric	Evaluation
Bartle's axis of Players/World	Heavy focus on the world.
Bartle's axis of Interacting/Acting	Heavy focus on interaction.
Stewart's axis of Change/Structure	Heavy focus on structure (the inherent goal of the game is to provide structure to limit/regulate change).
Stewart's axis of Hardcore/Casual	Varies by type of game, but due to the complexity tends to be hardcore.

Table 8.1: Classification of dimensions based on the Unified Model of Bart Stewart

to generate emergent storylines. Although a linear story is not impossible (for example a scripted set of events that overrides the simulation), it would usually be shallow or generic so that it does not break the simulation in whatever state it might be when a scripted event would happen. For this reason, true storytelling capabilities of the genre lie either in the emergent narrative or the players narrative. Storytelling aspect could be analyzed from different perspectives as well:

- The development of the environment - what came first, in what order and why.
- The development of relationships between characters.
- The development of the player's goals, motives or emotions.
- **Artificial Intelligence.** AI is the prime system that governs the simulation and as such has a lesser or higher influence in most areas of the game. Its relative unpredictability generates surprising moments, its complexity that must be understood represents a challenge, its outcome supports the fantasy of the game and provides consequences and brings a sense of characters to its agents that is relatable and allows for a sense of fellowship.

Finally, I also hypothesized the effects of Bartle's typology of players[Bar] and the Unified Model by Bart Stewart[Ste11] on narrative simulations.

From this evaluation, my expectation is that narrative simulation games will be most interesting to the players that fall in the category of explorers, managers, or conquerors. I also examined potential points of interest for all categories:

Player type	Game element
Socializer	Interpersonal relationships between NPCs, relationships of the player to the NPCs.
Killer	Direct manipulation with the NPCs, direct control of the world.
Explorer	Understanding the simulation, in-game options, potential outcomes of the simulation, creating a sense of journey.
Achiever	Reaching the inherent goal of the game, satisfying the winning conditions.

Table 8.2: Classification of player types based on the Bartle's typology of player types.



Chapter 9

Research Questions

Based on my hypotheses, I formulated several research questions about the genre of narrative simulations.

1. Is the unpredictability of the AI behavior pleasurable to experience if the provided level of control stimulates motivation rather than frustration?
2. Is understanding of the underlying/emerging patterns of the AI behavior challenging and pleasurable part of the experience if the type of the player matches the explorer type?
3. Does the presence of complex AI stimulate a sense of competency and meaningful consequences if it directly or indirectly responds to the actions of the player?
4. Are players capable of building relationships with the AI agents if they represent a virtual character with specific set of behaviors? Is this relationship more personal if the player type matches the type of socializer in contrast to other types?
5. Is it less pleasurable to interact with the simulation if the provided level of control is less direct (i.e. macro management vs. micromanagement)?

These research questions were formulated in order to either confirm or disprove some of the hypotheses stated in the previous chapter. In addition to these questions, I've set some additional questions, that did not aim to test any hypotheses, either because the scope of the research and data that I would be

able to gather would not be sufficient to answer them completely, or because they were not directly aligned with the research goals but were interesting to explore and perhaps provide the basis for additional research:

- How does the player engage with the simulation if no inherent goal has been presented, given that the game has been designed with such goal in mind?
- What are some other ways the experience of the player has changed relative to the level of provided direct control?
- How should the mechanics of the prototype be altered to improve the player experience?

I further discussed my findings in later chapters of this part.



Chapter 10

Research Method

The method I chose to test my hypotheses was a combination of two methods:

1. Playtesting session on two representative examples of games with within-subject and between-subject A/B testing, combined with a series of questionnaires and an interview.
 - The within-subject A/B testing differentiated the macro management vs. micromanagement style of gameplay.
 - The between-subject A/B testing differentiated an introduction of an inherent goal vs. goal-less gameplay session.
2. Public survey oriented to the players of both representative examples.

First method oriented on qualitative research that aimed to examine each research question and gain an in-depth understanding of the participant's experience. The public survey aimed to gather more data and also to test the findings from the first method on the general public. Questionnaires that have been either developed and/or used throughout the research were the following:

1. **Demographics Questionnaire.** This questionnaire was part of the application form and aimed to gather basic demographic data about the participants of the experiment.

2. **User Testing Questionnaire.** Aimed to capture immediate experience after the playtesting of a given game. This questionnaire is completed twice - once for each game.
3. **Public User Testing Questionnaire.** An enhanced version of the User Testing Questionnaire which included questions that were formulated based on findings from the interviews and was provided to the general public.
4. **The Bartle's Test of Gamer Psychology.**[ESA] To measure the four Bartle's archetypes of gamer psychology (killer, achiever, socializer, explorer). For each archetype, there is a percentage number of how much of the total score within that category has been achieved. Every question is then a binary question to decide between pairs of each type. This means that the sum of all percentages from all categories is always roughly 200
5. **Basic Psychological Needs Satisfaction Test.** To measure the general satisfaction of three basic psychological needs - Autonomy, Competency, and Relatedness. For each basic need, an average is calculated and the resulting number describes how true it is for the participant on a scale from 1 to 7 (not true to completely true), to experience satisfaction of given need on a daily basis.

All of the custom questionnaires are part of the Appendix E - Research Questionnaires. The Bartle's Test of Gamer Psychology was originally created by Erwin S. Andreasen and Brandon Downey and can be found online.[ESA] Basic Psychological Needs Satisfaction Test is a copyrighted material of THE SDT Group, LLC and its affiliates and can be accessed directly from the Self Determination Theory website.[DR00]

It is also important to note that the Bartle's Test of Gamer Psychology was originally developed to study players of multiplayer online games. Although the test is supposed to measure a general preference, the results are known to vary based on the game the respondent is associating the test with and this is even more discouraged by the fact that both representative examples contained no multiplayer functionality. This caused the data from the test to be less relevant, but I expected them to be still applicable.

10.1 Representative Examples of Subgenres

The representative examples for A/B testing were chosen for each gameplay style:

- **Macro management** - Landlord (prototype of which has been developed as part of this thesis)
- **Micromanagement** - Rimworld (commercially successful game of the genre)

The Landlord has been chosen as a representative example of macro management style due to the mechanics that provide only indirect control over the actions of the NPC to the player. Here, the player is only administering leases to the peasant families (groups of NPCs) over a group of a zone with a specific purpose. Whereas in Rimworld, the player is directly managing a priority list of professions (a group of actions) for every individual NPC and has the ability to give direct orders with the highest priority. Other mechanics of both games are otherwise very similar and build upon progression system of developing structures that produce resources. The user interface of both games is also very similar and in many ways identical, although the art style of each game is significantly different.

During my research, I was aware that both games are in a significantly different state of development. Whereas Rimworld is fully fledged and finished game, Landlord is but a prototype, although with functionality that was more than enough to provide a (hopefully satisfying) gameplay for the duration of the test. These differences despite any effort proved to be a major obstacle that did not allow me to compare the two styles of gameplay reliably against each other and my findings in this regard were relevant, but their significance can be questionable, as I discuss in later chapters. Originally, I planned to develop two versions of the same prototype to eliminate this problem, but in the end, I made this decision in order to manage the scope of the project as the difficulty of development of only a single version of the prototype highly surpassed my expectations.

10.2 Procedure

The detailed procedure of the experiment in the first part of research has been designed as follows.

Setup. The participant is present in a room with a comfortable chair, sat to a table with a laptop, keyboard, and mouse. The room is isolated from outside noise and provides refreshment and food for the participant at any point of the experiment. Researcher is present in the room with the participant and is allowed to observe the participant silently from distance and take notes. The researcher was out of the participant's field of vision but sitting next to him, rather than behind his back. A variant of the experiment allowed for remote testing, where the participant shared their computer screen and communicated with the researcher through microphone using a Discord software.

Report (15 minutes). The researcher introduced himself to the participant and maintained a friendly atmosphere. The participant was assured about the privacy of the experiment, anonymization of all gathered data and confidentiality of the experiment. The participant was also informed that the interview will be recorded and was asked for permission. He was also informed that he is not obliged to participate in any part of the experiment and the experiment can be ended without explanation at any point if he chooses to. Participant is then informed of the procedure and it was also established that the participant should avoid engaging with the researcher for possible questions once the playtesting part of the experiment is engaged and continue with the experiment until interrupted. Additional questions of the participant are answered with the best of the researcher's knowledge and the experiment is initiated.

Playtesting experiment (75 minutes). According to the group of the participant, either the Landlord or the Rimworld gameplay session has been initiated. First, the participant has been introduced to the basic mechanics of the game according to a prepared script, in order to reduce the learning curve time and maintain a comparable starting point in both playtesting sessions. The participant may also have been asked to aim for a specific task (an in-game goal to achieve) depending on the A/B group he was a part of. Then, the playtesting session has been initiated and the participant engaged with a game for 30 minutes. After the 30 minutes, the participant was asked to complete a questionnaire about the experience and after a short break, gameplay session for the second game was initiated with the same procedure.

An interview (30-60 minutes). The participant has been interviewed with a set of questions according to a prepared script. Each topic has been explored with additional questions according to the judgment of the researcher, with last questions openly inviting for any topics the participant deems relevant or further exploring other, new or less relevant, themes that have been discovered through the interview.

Classification questionnaires (10-15 minutes). The participant has been asked to complete a set of two questionnaires - The Bartle's test of Games Psychology and Basic Psychological Needs Satisfaction Test.

End of the experiment (5-10 minutes). The researcher announced that the experiment is over and expressed gratitude to the participant for his time and effort in a respectful manner. The participant was reassured about the privacy of the experiment and if the participant was interested, further informed about the goals of the experiment and how the data will be used or how they can help with the research.

10.3 Population and Participants

Throughout my research, I was working with three different populations of participants.

The most significant population were students of the CTU University in Prague, specifically from Faculty of Electrical Engineering and Faculty of Information Technology. As a means of contact, I used the student Facebook groups.

Another separate population was the Rimworld community, a group of players that share their experience around the game. Members of this community were contacted via Facebook community group and an official Discord server (a software with memberships and immediate chat rooms).

The third population was the immediate circle of my friends, often passionate gamers or game developers.

The first part of the research - the playtesting and interviews - was carried out with participants from the first group - students of the CTU University

in Prague. Every participant applied via an online form which contained information about the research, demographics questionnaire and information that helped organize the meeting.

The second part of the research - the public survey - was carried with participants from all groups. Every participant was asked to complete the User Testing Questionnaire, with a voluntary option to also complete the Basic Psychological Needs Satisfaction Test and The Bartle Test of Game Psychology. I made this option voluntary due to the time required to complete all of the questionnaires in order to maximize the number of responses and because they were secondary to my research.

10.4 Risks

When conducting the research, I tried to mitigate the potential risks of invalidating the results. I identified mostly the following risks.

- **Inconsistent experiment conditions** - every experiment requires to explain the rules of the game which depends both on the quality of instructions as well as the participant's prior experience with games. There was a real risk of facilitating different understanding of the game for individual participants. A script of tutorial instructions explained in a specific order was used to mitigate this risk. Another form of this risk was represented through inconsistent state of development in bot representative examples of games. This risk has been mitigated by formulating questions that are more specific to limit the potential impact of generalization.
- **Acquiescence bias** - I was aware that the experiment is conducted with other students that I have either collegiate or personal relationship with. I did my best to select specifically participants that I did not have any personal relationship with.
- **Habituation** - several aspects of the experiment might cause fatigue or increased stress. The length of one experiment is about two hours and the researcher is present in the room which might cause some form of anxiety to some participants. Refreshments, food, and breaks have been offered during the experiment.
- **Culture bias** - games are to a large extent form of culture and there was a real risk of attributing culturally specific data to general characteristics

of games. This risk has not been mitigated in any practical way as it was not in my ability to conduct the research in different countries but I did my best to take it into account when evaluating the results of my research.



Chapter 11

Interviews

Interviews with each participant were conducted according to a following script:

- For each game in order of the test:
 - What are your first impressions?
 - What was fun, what was frustrating?
 - What occupied you the most?
 - How much attention have you invested in NPCs and what they were doing?
- General discussion about both games:
 - What were the biggest differences between both games?
 - Have you felt that the AI cooperated with what you want it to do?
 - What if the AI disobeyed your orders?
 - How would you compare direct and indirect control over the AI in both games?
 - How did you felt when the NPCs did not do their job as best as they could?
 - What did you understand about the behavior of the NPCs?
 - What drove you to understand it more?
 - How did you interact with the needs of the NPCs? What if they would not have them? How would it change your experience?

also observed that high sense of relatedness satisfaction did not show any effect on the interest of the participant in making relationships with NPCs or the quality or type of the relationship given. I was not able to observe any effect of a lacking sense of autonomy satisfaction.

Regarding the hours spend weekly on gaming activities, all of the participants could be classified as hardcore/experienced gamers, with exception of participants # 1 and # 2. Although they did not show difficulties understanding how to play both games, there has been small difference in how they approach the game, focusing more on exploring initial options and rules of the game.

11.1 Summary of Interviews

In the following text, I first discuss the importance of presenting a goal to the participant and later I will go through each of the research questions and mention what I felt was relevant from the interviews and could help better understand the problem.

Whether the participants received a task or not did not have a significant impact on their experience. All participants who did not have a goal adopted strategy that they felt would make the most sense based on the game presentation, which was either to build or to survive and as such were very similar to the tasks that would otherwise be given to them. This could mean that players intuitively draw on goals even when these goals are not explicitly presented but the games are designed around them. It might be interesting to compare this with other games that are classified as sandbox games, how they tackle this issue of inherent goals and if they can undermine the sense of autonomy in those games.

There was also a common theme of exploring all possible options and mechanics motivated by the desire to learn even if it would temporarily distract from the long-term goals, such as conducting experiments and testing the system. This did not change even with the participant # 4 who has been an experienced Rimworld player (having 100+ hours spent with the game) and whose chosen approach was to develop a settlement on water rather than on the ground, as he later explained “to explore what it would be like.”. Where building a settlement on water is more an aesthetic choice or a choice that can increase the difficulty of the game while other participants focused on basic mechanics and gameplay options in general, the underlying

motivation remained the same.

Based on the answers from the interviews, I further hypothesized that the importance of having a goal in these types of games is necessary for an impression of meaningful gameplay and replayability. Participant # 5 mentioned that “when the game does not give me any goals, I just explore all the options and usually it’s like when I learn how to do things they become easier to do like it is connected. Once I would know all the options I would not have fun anymore.”

Question # 1 - Is the unpredictability of the AI behavior pleasurable to experience if the provided level of control stimulates motivation rather than frustration?

Generally, participants described this topic in three different ways - as a threatening challenge, source of pleasant surprises and break from the monotony of the core systems.

The participant # 4 mentioned: *“the needs of the NPCs are part of the goal. If they would not be there, I would set things up but what then. Without this, I have no reason to keep improving, there is no goal, no threat.”*

The participant # 5 explained, that he only noticed changes in behavior randomly: *“I did not even know what all these NPCs can do and it was like a pleasant surprise.”*

The participant # 7 when asked about the importance of needs of the AI’s and their ability to disobey orders responded that *“the basic system is very monotonous since you keep doing the same things over and over. These moments stick in your memory and it makes the game more fun.”*

In regards to the level of control that would stimulate motivation rather than frustration, participant # 6 discussed the seemingly random behavior of NPCs: *“it did not have any particular value (note: in terms of in-game advantage). It was funny to see...part of me was interested in that system what it can do with the characters.”* This suggested to me that the optimal level of control can vary greatly as long as the game provided options to influence the outcome of the game. This was further revealed to me by participant # 8 who mentioned that *“if the game would ignore me and... have done it wrong, it would frustrate me and I would think the AI is stupid and did not play the game.”*

Question # 2 - Is understanding of the underlying/emerging patterns of the AI behavior challenging and pleasurable part of the experience if the type of the player matches the explorer type?

When asked about this topic, participants usually regarded it as a fun part of the game, that adds realism, presents a challenge to learn and understand and opens up options for exploration of all possible behaviors and combinations.

Participant # 4 also mentioned that he enjoyed accepting *“the responsibility to take care of them (note: the NPCs). It was fun that to have that challenge to learn a lot of things so everything would work and they would not die.”*

Participant # 5 talked about how he enjoyed pushing the boundaries. *“On Rimworld I liked how it is complex that I kept finding out new things and what all can be done and it would still work.”*

Participant # 6 however expressed a different point of view: *“I accept it as part of the game...everything needs to be done in order...it requires me to make fewer steps between me and the goal of the game. If it would not be there it would come really close to a creative mode with no restrictions.”* I would interpret it such that for this participant, the challenge resulted not from the simple desire to understand the game, but it was an interesting obstacle in the problem of maximizing the efficiency of achieving the in-game goal. He also mentioned a case, where it could cause problems: *“there was a scenario where I was trying to build a shelter and they started wandering around and I thought if it is some bug.”* This suggested to me that a complex AI behavior can easily cause confusion between what is intended part of the game and what should not exist.

Most of the participants indicated a high percentage of the explorer type so although the answers were interesting and seemed to confirm the hypothesis, I have no indication if it would be different with other types of players.

Question # 3 - Does the presence of complex AI stimulate a sense of competency and meaningful consequences if it directly or indirectly responds to the actions of the player?

Unfortunately, I was not able to explore this topic in great detail through the interviews, but many participants mentioned, that they appreciated the option to directly control the NPCs in the Rimworld game as a means to fix imperfections. For example, participant # 1 mentioned regarding an AI that was particularly inefficient when hunting an animal, that *“the intervention*

was necessary she (the NPC) did not realize she should come closer because she can't hit her from the distance." This would suggest to me that the exercise of control is often strongest when players can input their idea of efficiency and the complexity of the AI behavior can undermine a sense of competency if these options would not be available.

When asked about the frustrations this lack of ability would cause, participant # 2 mentioned, that *"it's like in real life. I don't want to spend ten minutes doing something when it can be done in one. I thought she would do it right, but if I could only watch her do it wrong it would feel like a waste of time."*

On the other hand, participant # 5 mentioned, that *"if I could motivate them to do better somehow, it would be interesting but my decisions would need to have positives and negatives. I'd like to choose my own strategy."* Suggesting to me that direct control may not necessarily be available as long as the player can have some kind of indirect impact as well.

Participant # 3 also commented on the complexity of the AI with the following statement: *"I was glad it's there...because you don't want to tell them basic stuff to go eat and such. Everybody expects them to be able to do it on their own."* This makes me cautious that a lack of complexity could also increase the number of mundane tasks which in effect would not allow the player to engage with more difficult parts of the game and could undermine the sense of competence indirectly.

Question # 4 - Are players capable of building relationships with the AI agents if they represent a virtual character with a specific set of behaviors? Is this relationship more personal if the player type matches the type of socializer in contrast to other types?

In regards to the relationships with NPCs, participants described several phenomena. Importance of naming and customizing characters to increase the likelihood of facilitating a relationship to them was mentioned by four out of nine participants. For example, participant # 2 mentioned that *"if you don't give it a name, it has a big impact that you can't make such a relationship to it. . . .I don't think people create deep relationships because they can control them. (the NPCs)"* which was interesting to see that the ability to control the NPCs was not necessarily facilitation of relationship.

Four participants considered the NPCs simply as a means to an end and the relationships they maintained with the NPCs was purely pragmatic, whereas

five participants regarded the relationships as an important aspect of the experience, often revolving around the ability to either observe emerging or create their own stories. Interestingly, all of these five participants had comparatively higher percentage in socializer category.

Participant # 6 mentioned that *“I generally see these types of characters as a labor force. It’s just another gameplay option I have.”* but he also mentions how a unique and special moment can affect the views he has on an NPC: *“If there is a raid and one guy miraculously shoots all the characters with critical shots...I would give him some hat or a special name to indicate that.”*

On the contrary, participant # 9 mentioned that *“I build the relationships on the stories I make up in my head. For example, I think about what type of character they are. I can get closer to them as I learn who they are.”*

Several participants also mentioned how they like to select a few privileged characters they would pay special attention to. This could either be based on the time they have spent with them in the game, a special event that happened to them or simply the type of character they represent.

When questioned about the impact of the relationships on their in-game actions, all participants prioritized the in-game goals above their relationships with a particular NPC. Participant # 8 though mentioned, that it could depend on the ability of the game to recognize it: *“I don’t care about morality in games, but if the game points that out to me, I always try to be the good guy. Otherwise, I just do what’s best for the game.”*

Participant # 2 pointed out, that relationships can also cause difficulties. *“I felt like it’s important to watch their needs but it was another thing to control and monitor and at some point I felt like it’s too many things to do.”*

Question # 5 - Is it less pleasurable to interact with the simulation if the provided level of control is less direct (i.e. macro management vs. micromanagement)?

Regarding the differences in management styles in both games, three participants mentioned, that the lack of control must be in some way compensated with more tools or information. Participant # 6 mentioned regarding the Landlord game that *“if there would be some indication that the character is overloaded with work I would be ok with not having any more control.”*

Participant # 8 also commented the family management mechanics in the Landlord game: *“(I would) like to have some worker teams instead of the families. I did not like how a son that could do a better job elsewhere had to work there with his family. It was not so effective.”* He also mentioned that not being exposed to that information could also be a solution to that problem, meaning that if he does not know it can be better, he assumes it’s the best it can be.

The notion of maximized efficiency was most apparent by the participants, who regarded the relationship with NPCs as pragmatic, rather than story based. To contrast that, participant # 2 mentioned, that *“it depends on what the game is about. If I would have to take care of the needs of every character, I would not have time to take care of the society as a whole.”*

Management style had also impact on the object of the relationship. Participant # 4 mentioned, that *“With the Landlord game, I did not even look on who is part of the family. It was more abstract.”* Participant # 7 also talked about how the Landlord game made him focus more on the family as a whole: *“The first thing I remember was how many members that family had, what’s the name of the family and what they could do because that’s what was important for the game.”*

Besides these questions, I was also able to gather valuable feedback for further development of the Landlord game. Often mentioned problems were specific areas of the UI that felt particularly unintuitive, such as the zone management controls or that the UI elements through which the game communicates what are the requirements and production chains were ineffective. I also learned more about potential expectations of players or directions of the design.

Participants often pointed out, that they were greatly lacking feedback on how the specific needs of the NPCs can impact their gameplay and what the NPCs are doing in a particular moment or why. They also knew their role in the game (to be a lord) but mentioned that the game did not remind them that very often and it felt off as a result. Participants were generally supportive of the different approach and found it rather unique, but some of them emphasized how this would need to be consistently maintained in all areas of the game (one given example was how the game should provide less information about individual NPCs and rather focus on the families as a whole because it felt distracting given the different roles in both games). Some participants also commented on the art style, that the pixel art stylization gives the characters a more friendly outlook, which should be further supported in the overall feeling of the game.

Based on this feedback, I am now able to better consider the role of the management mechanics in the game and make changes to the design, that I feel will lead to more coherent and engaging experience.

#	A/B Group	Age group	Sex	Gaming (hours / week)	BTGP (Achiever / Killer / Explorer / Socializer)	BPNST (Autonomy / Competence / Relatedness)
1	AB, with task	19-24	Male	5-10	E - 57.14% / 6.67% / 100.00% / 40.00%	5.29 / 6.00 / 5.13
2	BA, with task	19-24	Female	Less than 5	Explorer - 50.00% / 6.67% / 92.86% / 53.33%	5.57 / 5.50 / 5.50
3	AB, with task	19-24	Male	20+	E - 35.71% / 60.00% / 78.57% / 26.67%	3.71 / 4.00 / 5.88
4	BA, with task	25-34	Male	20+	E - 64.29% / 13.33% / 71.43% / 53.33%	5.86 / 6.67 / 6.13
5	AB, with task	19-24	Male	20+	A - 71.43% / 26.67% / 57.14% / 46.67%	5.57 / 3.83 / 5.00
6	BA, without task	19-24	Male	20+	E - 35.71% / 33.33% / 92.86% / 40.00%	4.43 / 3.67 / 5.00
7	AB, without task	25-34	Male	10-15	E - 28.57% / 46.67% / 78.57% / 46.67%	5.29 / 5.67 / 5.13
8	BA, without task	19-24	Male	20+	E - 35.71% / 33.33% / 71.43% / 60.00%	3.86 / 3.83 / 4.75
9	AB, without task	25-34	Female	20+	E - 35.71% / 26.67% / 71.43% / 66.67%	5.43 / 5.33 / 4.75

Table 11.1: Details about participants of the experiment



Chapter 12

Data Analysis

As part of my data analysis, I have included the following datasets:

- 15 respondents of The Bartle's Test of Gamer Psychology Questionnaire, 9 of which have been part of the experiment and interview, 6 of them were part of the public user testing (indicated with prefix P in participant ID).
- 15 respondents of the Basic Psychological Needs Satisfaction Test, 9 of which were part of the experiment and interview, 6 of them were part of the public user testing (indicated with prefix P in participant ID).
- 9 respondents of the User Test Experiment Questionnaire for the game Landlord
- 9 respondents of the User Test Experiment Questionnaire for the game Rimworld
- 22 respondents of the Public User Test Questionnaire for the game Rimworld, 6 of which also completed the BTGP and BPNST questionnaires (indicated with prefix P in participant ID).
- 4 respondents of the Public User Test Questionnaire for the game Landlord, none of which completed the BTGP and BPNST questionnaires.
- A combined subset of 26 respondents for a subset of questions of both public questionnaires that could be generalized on the whole genre.
- A combined subset of 15 respondents who completed both BTGP and BPNST questionnaires, with a subset of 10 questions that could be correlated to the results of BTGP or BPNST.

Complete dataset and detailed analysis are included as the Appendix G - Raw Data from Questionnaires. In the following chapter, I will point out the findings that are based on this data and I have found them relevant to the research questions.

I also already interpreted the results of BTGP and BPNST questionnaires in the previous chapter and so here I will focus only on possible correlations with data from other questionnaires.

12.1 User Test Questionnaire

This analysis is considering the User Test Experiment Questionnaires from the participants of the experiment in a combined form for both Landlord and Rimworld games. The summarized data indicates also differences between the subsets of participants who received or did not receive task. In a few specific cases, large differences could be observed, but due to the very small sample, I would not consider them significant in any way.

While the Landlord was slightly less understandable, it was also judged to be more predictable and demanding attention. The participants also felt like they have been able to take advantage of information about the state of the game in a lesser degree than in the Rimworld game, yet they felt in more control of the simulated environment. This would suggest to me that the prototype stage compared to the full version of the game did have at least some effect, as the Landlord game could be viewed as less complex and thus more predictable but with insufficient feedback from the game the unpredictability was attributed to the lack of knowledge, rather than overall complexity of the simulation (as was also often mentioned in the interviews). Nonetheless, both games were rated as rather enjoyable (see figure 12.1) with Rimworld being more enjoyable overall. I would hypothesize that the lack of knowledge or unpredictability did not have a significantly negative impact on the experience and that unpredictability that stems from the complexity of the simulation can contribute to higher enjoyment of the game.

When comparing the questions that aimed to rate the importance of different elements - NPC's, development of the settlement, winning conditions of the game and storytelling - in relation to personal goals of the participant, development of the settlement has been the most important by a large degree(see figure 12.2), followed by the NPCs, winning and losing conditions and then storytelling. Conditions of the NPCs were of significantly lower

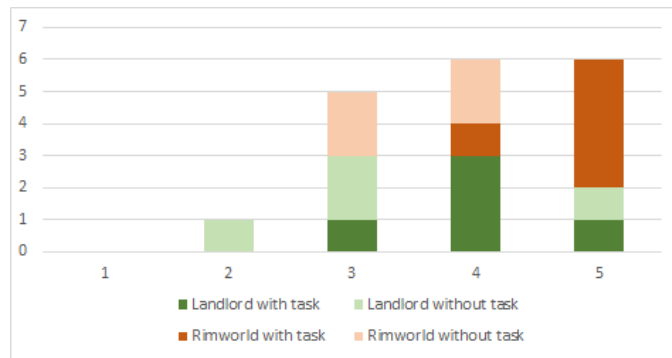


Figure 12.1: Sum of answers to the question “How enjoyable would you rate your gameplay experience?”

importance for Landlord game, which was also confirmed in the interviews that it was due to no visible connection of the happiness of the NPC to the gameplay itself. The public questionnaire had a similar result, except for the significance of winning and losing conditions, which averaged only at 2.5 points. It was interesting to see nonetheless, that the interaction with the AI seems to be secondary addition to the core gameplay (in this case evolving a settlement), at least in the two representative cases.

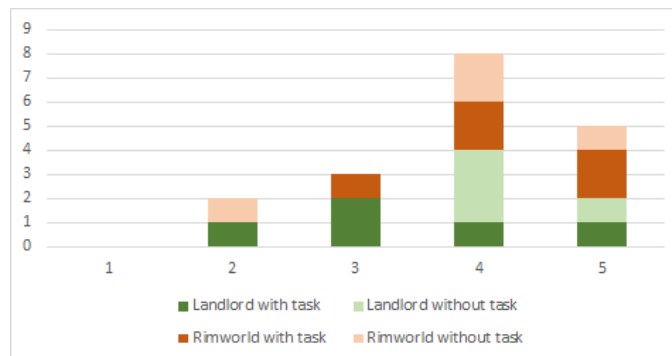


Figure 12.2: Sum of answers to the question “In terms of your personal goals, how significant or insignificant was the development of your settlement?”

Comparing the questions that aimed to rate the overall awareness of different game elements - NPC’s, resource management, moment-to-moment tasks and threats and danger - participants focused mostly on resources (see figure 12.3), followed by NPCs, moment-to-moment tasks and threats. This may have been explained by the length of the experiment because the gameplay session was not long enough and did not propose any threatening scenarios. These findings though have also been confirmed as part of the public user testing, as indicated in table 12.1. I would further argue that the simple presence of an NPC with simulated AI is not inherently interesting in a game setting and unless the game does something out of ordinary, the focus is towards the core gameplay mechanics (here resource management) first.

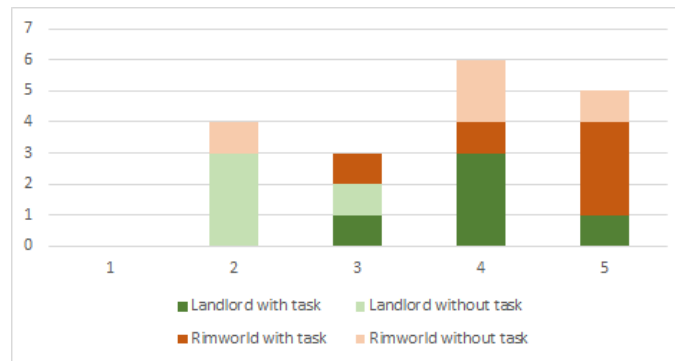


Figure 12.3: Sum of answers to the question “During the gameplay session overall, how aware or unaware of your resources and their availability have you been?”

Question	Average
How much fun do you find the building parts of the gameplay (i.e. settlement, hospital or prison building)?	4.64
How much fun do you find learning about the complexity of the game systems and hidden rules?	4.56
How much fun do you find exploring all the options?	4.4
How much fun do you find the element planning and strategizing?	4.36
How much fun do you find the unpredictability of the environment?	4.24
How much fun do you find the resource management?	4.16
How much fun do you find the interaction with the AI?	3.88

Table 12.1: Average of answers to the questions about relative importance of each game elements

Finally, analyzing the set of questions that focused on relationships with NPCs, Landlord scored significantly lower in terms of strength and attachment of the player towards the NPCs. Apart from the differences in prototype stages, this may also be contributed to the differences in micro vs. macro management styles (see figure reffig:graph4).

Interestingly, participants rated the number of NPCs to be rather nonoptimal and too few (see figure 12.5) rather than too many. I would suspect this may be affected by the core relationship between the game and its inherent goals since the player is rewarded for having more NPCs and it could further support the argument that NPCs are interpreted in these types of games as a tool first, and story/relationship element second.

Finally, the participants of the public users testing were asked to select one or more categories that would describe their perception of the NPCs within

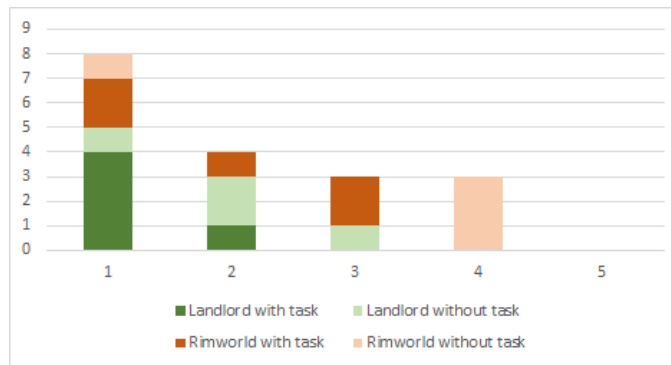


Figure 12.4: Sum of answers to the question “How strong relationship or attachment did you create towards the NPCs in the game?”

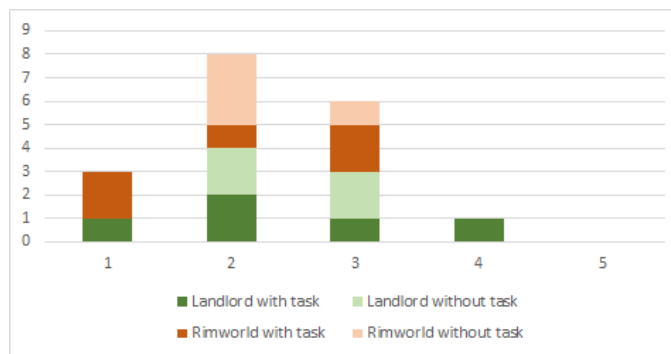


Figure 12.5: Sum of answers to the question “Would you consider the number of NPCs in the game to be (too few / too many).”

the context of the game. Interestingly and perhaps contrary to previous findings, element to tell a story has similar significance as a tool to achieve goals (see figure 12.6). It is though important to recognize the wording of each question, where previous questions asked to rate the importance to overall expression, this question asked specifically to describe the relationship itself. It could also mean that the players value the presence of the NPCs and their potential to tell a story, but would still see them primarily as a gameplay option to interact with the core gameplay.

12.2 Correlations

Due to the small sample size, I analyzed some correlations between BTGP and BPNST out of interest, but could not find anything significant. We could observe there may be a relationship between achiever type and autonomy BPNST subscale as most of the data points group in the bottom right corner (see figure 12.7). There also seems to be some relationship between relatedness

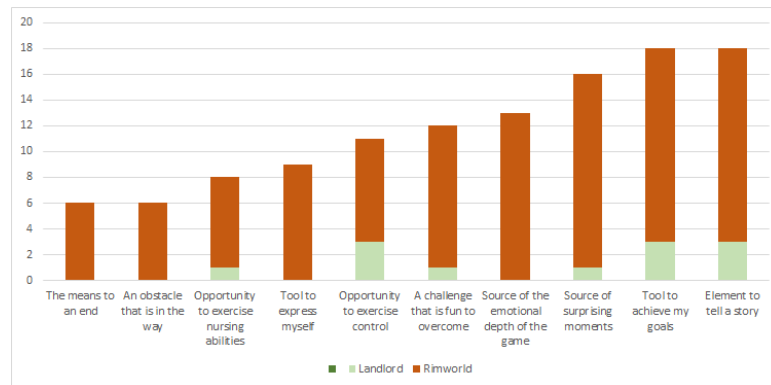


Figure 12.6: The number of responses for each category of the relationship of players towards the NPCs.

and socializer/killer type but I was not confident in the data enough to base any further findings on this analysis.

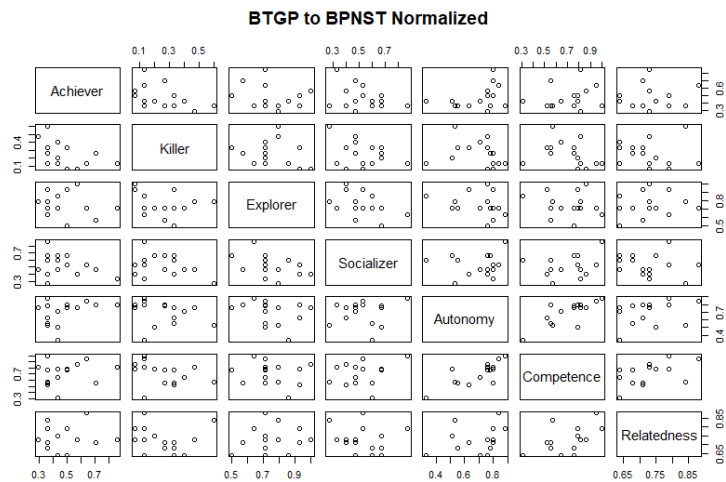


Figure 12.7: Scatterplot matrix of pairwise correlations between BTGP and BPNST



Chapter 13

Summary

At the beginning of my work, I set out to analyze simulation games from the perspective of the influence of artificial intelligence on the gameplay and individual perception of fun, more specifically in a genre of narrative simulations.

As part of my research, I first analyzed theoretical background about games and the nature of fun. I proposed a classification of games and designed a prototype that would represent those games. I further hypothesized what could be crucial in terms of fun for games in the genre of narrative simulations and how it can be influenced by the presence of an intelligent AI. After proceeding with research experiments according to a designed method, I had data that I used to evaluate my hypotheses further.

After these steps, I would propose that the influence of the AI in simulation games is rather secondary but still crucial part of the experience and can improve the experience in the following ways:

- **By producing unique moments** to make each gameplay session more distinctive and memorable, the AI can greatly increase replayability and provide depth to the whole experience.
- **By producing obstacles** in regards to the inherent goal of the game, the AI can improve the sense of competency as long as there is at least some way to manage the behavior and outcome. I further hypothesize there is a certain threshold where the lack of options to control and

stories, there seems to be a large suspension of disbelief that makes them feel real, even though the participants are fully aware of the difference.

- Fine-tuning the AI behavior versus its complexity that does not frustrate the player but is a welcomed surprise seems to be a major issue and very complicated problem. The more complex the AI is, the more unique and memorable moments can occur, but it requires to give the NPCs a sense of autonomy which often goes against the goals of the player and results in “wrestling” with the AI behavior to change how it behaves at all cost, regardless of the benefits the autonomy of NPC can bring. I would hypothesize that this stems from the perception of the AI as being secondary to the experience and players would often prioritize the core gameplay over these unique moments.

In regards to the differences between micro and macro management styles, I did not find any significant differences, besides a shift of attention to different entities (i.e. instead of a specific NPC to a whole group of NPCs), core gameplay mechanics and expectations of the player to the overall experience. The role of the AI as it is interpreted in this thesis remained the same in both examples.

In retrospective, based on the results of my research I would also improve my research methods to compare representative examples of similar depth and complexity, rather than a prototype and a full game, and I would also improve questions in the user testing questionnaires as they were not very indicative of the proposed research questions and did not prove to be of much value, as well as to invest more time in gathering significant data. Nonetheless, I value the information from my research as it allowed me to understand the role of the AI in narrative simulations in much greater detail and although unable to make any generalizations for the genre as a whole, I assess the goals of my research as being met by a large degree. I would hope that my findings would serve either as a basis for additional research or an interesting insight to anyone interested in developing similar games.



Appendices



Appendix A

Machinations Language Description

The description is intended to provide a basic understanding of the modeling language but it is by no means complete and further study is recommended if the reader is interested in coherent understanding. It is also worth noting that the language is relatively vague and the engine is not fully restrictive (meaning it allows for combinations otherwise unintended which do not usually work or at the very least is not clear what is the correct behavior). I would thus recommend not to consider the possibilities which are not described by the authors.

Every model referenced in the thesis including the Machinations framework to run the simulation is included as an attachment to the thesis.

The basic premise of the language is to use resources to represent the current state of the game and use flows and modifiers to model rules and restrictions on resource management. There are three possible time modes for each simulation (see example in A.1):

- **Synchronous mode** forces only one action per element per specified time interval.
- **Asynchronous mode** allows unlimited actions per element per interval. Automatic actions are carried once per interval.
- **The turn-based mode** does not use time intervals and instead has a fixed pool of action points. Each interactive action has cost in action

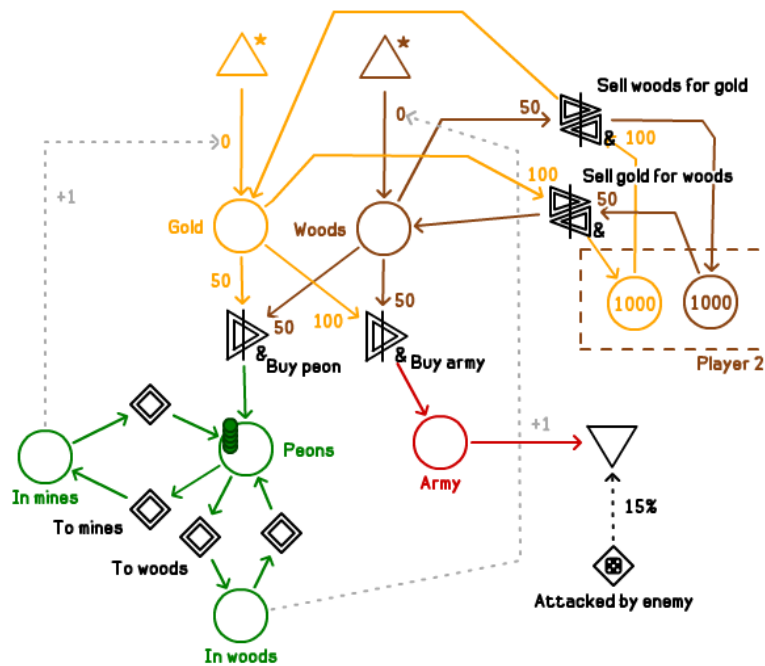


Figure A.1: A simplified model of the economy system in the Warcraft video game.

points and once all action points are spent, automatic actions are carried and a new round begins.

Every simulation also differentiates between two distribution modes:

- **Fixed speed mode** transfers resources on a fixed speed along the line of resource connection. Length of the connection (in pixels) affects the time required to move the resource.
- **Instantaneous mode** transfers resources immediately without delay.

The basic elements of resource management are:

- **Resource** represents a single unit of resource. Resources can be color-coded to differentiate between types of resources. Resources are depicted as circles (coins) or with a number in the center of the element.
- **Resource connection** represents a directed flow of resources between elements. Resource connections can have labels which specify the number of resources that may or must be transferred:

- *The text* has only descriptive meaning.
- *Numbers* determine amount of resources transferred per interval.
- *Random formula* represents the random amount of resources transferred per interval (e.g. D6+1 represents a random interval of integer numbers 2-8).
- *Fractions* (x/y) represents x resources per the intervals.
- *All* is a keyword representing all available resources.
- *Percentage* defines a probability of transfer per interaction (unintuitively 550)
- *DrawX* represents x amount of resources chosen randomly, violating the order of arrival (useful only with color-coded resources).
- *Symbol* represents one of four globally defined functions. Functions can define any formula otherwise specified in the label. They are used to describe an abstraction of behavior that is difficult to represent in the model.
- An unspecified label is equal to one resource per interval.
- **The pool** represents a holding point for resources. Four types of pools exist:
 - *Passive pool* holds all resources unless they are pulled away by other elements or sent away by triggers.
 - *Interactive pool* transfers resources when interacted with by the user.
 - *Automatic pool* transfers resources once per interval or turn.
 - *OnStart pool* transfers resources once on the start of the simulation and then behave as the passive pool.
- Resource transfer mode on a specific element is determined by one of the four types of interaction and the label of incoming/outcoming resource flows:
 - *Pull any* will pull any available resources from all incoming resource flows.
 - *Pull all* will pull resources only when all resources from all incoming resource flows are available.
 - *Push any* sends any available resources (but not higher than required) and distributes them evenly to all outcoming resource flows.
 - *Push all* sends the required amount of resources only when resources required to satisfy all outcoming resource flows are available.
 - Push behavior is indicated by “p” next to the symbol.
 - Pull all / push all behavior is indicated by “&” next to the symbol.

resources of a given type (color) on all outgoing flows. It also triggers all connected modifiers. Trade is a two-way transaction which uses color-coding to determine the two sides of the transaction - the price and the offer.

- **End condition** is connected via incoming modifier to any given pool or pools and once all conditions are satisfied, the simulation is terminated. End condition is used to automatically simulate multiple runs and generate data from the simulation.
- **Register** is used in combination with modifiers to utilize mathematical functions with variables to achieve more complex activation/deactivation mechanics. Registers can also be interactive in which case the user is manually setting the register value during runtime instead.
- **Delay** will hold incoming resources for specified time and can also create queue mechanics when resources are held and released in given intervals one by one.
- **Artificial Player** is a simple script where each row specifies a condition and a specific element to be triggered if the condition is satisfied. Each row of the script is evaluated once per interval.

Additionally, charts can be used to capture, visualize and export data of the number of resources in time present on connected pools across one simulation or over multiple runs.

■ A.1 Feedback Loops

Even though the usage of Machinations is not very limited, it has been constructed specifically to model feedback loop mechanics in games and evaluate them in terms of balance.

A feedback loop is a type of mechanic where a certain action causes a change in the behavior of other mechanic or part of the game system which in turn affects that same action as well. One example is the production facility investment pattern, where the expenditure of resources increases the rate of production of the same resource. Such mechanic provides the player the ability to grow the number of resources available to him yet at the same time introduces interesting choice to be made, as these resources are usually required to other actions as well and ramping up the production rate as soon



Appendix B

Prototype Feedback Loop Analysis

In the following text, I describe the basic feedback loop systems, that I kept in mind while designing the prototype of the game. Due to the early stages of the development, these models should be interpreted as a thought experiment with an intention to explore design ideas before actual implementation. Rather than a commitment to a final design, their purpose is to simply expand on the core ideas of the designed game. For further information about feedback loops and the description of Machinations notation, see Appendix A - Machinations Language Description.

The game is structured around several feedback loop systems. First is the investment facility pattern described as follows (see the model in figure B.1):

- Investment in production facility creates an opportunity to employ NPCs through contracts.
- Every assigned NPC produces more resources of that specific type and in some ways also increases production of gold (depending on the way the player decides to make a financial profit from these resources).

Adding all four types of buildings with their respective effects on production, happiness, criminality, and spirituality, we get the full model of the core feedback loop:

- Production facilities increase the rate of production but decrease spiritu-

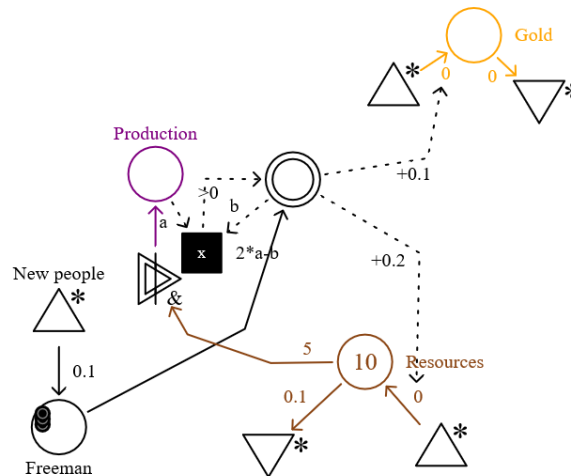


Figure B.1: Machinations model of the implemented investment facility pattern. Freeman is NPCs assigned to pools which are available if a production facility is built for resources. Assigned NPCs then increases production of gold and resource.

ality and increase criminality.

- Developing manor increases maintenance cost (reduces production) and increases happiness and criminality.
- Producing soldiers costs gold and increases maintenance cost (reduces production of gold) and reduces criminality and happiness.
- Clergy is the most expensive in terms of resources and maintenance cost but increases spirituality which has positive effects on happiness.

This set of feedback loops creates a dynamic where the player must invest in all types of buildings and develop a strategy based on his goals while keeping a certain level of freedom of choice as the threshold on affordable happiness, criminality, and spirituality is reasonably balanced (see the model in figure B.2).

These three factors (happiness, criminality, and spirituality) are only an abstraction for the purpose of designing the feedback loop. and the values in the model do not represent the full state of the game. These factors are more of a concept that should be communicated to the player and the model is only used to establish the general relationship between different areas of

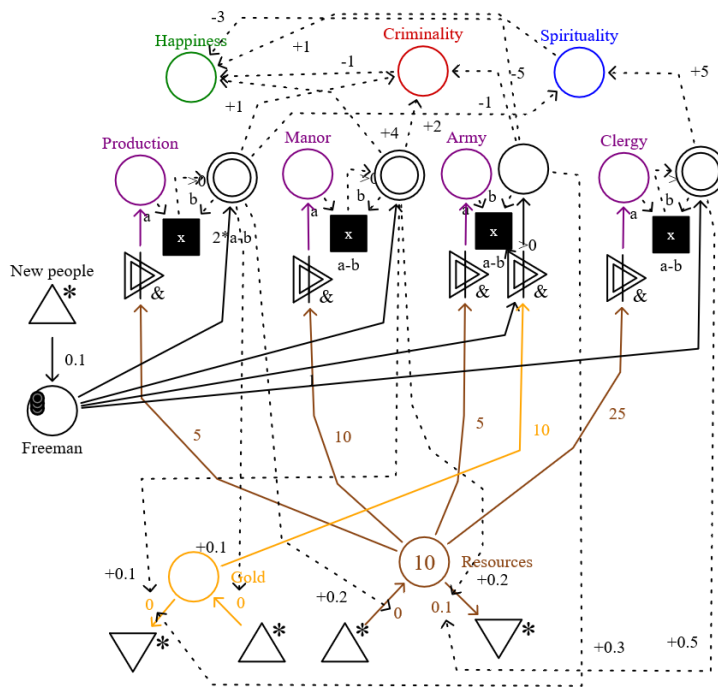


Figure B.2: Machinations model of the general progression feedback loop system. Every type of buildings creates an opportunity to assign new NPCs that settle or are born in the city. Assigned NPCs affect different areas of the gameplay in an asymmetrical way so that all parts of the economy are relevant and creates room for the personal strategy of the player.

settlement development, where an increase in one area immediately raises the need for other areas as well.

Another feedback loop is introduced through the objectives and an overall goal of the game (see the model in figure B.3). Developing all four areas of the city will sustain a healthy economy which can satisfy the conditions introduced by objectives. Economic growth is thus required otherwise the reputation of the player will slowly be reduced to a zero, at which point the game is lost. This is modeled as an abstraction of the overall impact of different types of buildings on production and reputation with random elements that simulate the decisions made by the player. Objectives are progressively more costly as the player should maintain constant growth to not fall behind. In the diagram, the consumer with a specific probability is indicating a chance the player fails to meet an objective and loses some amount of reputation.

One simulated run of this model can give a raw image about the state of resources and reputation of the player in an actual game:

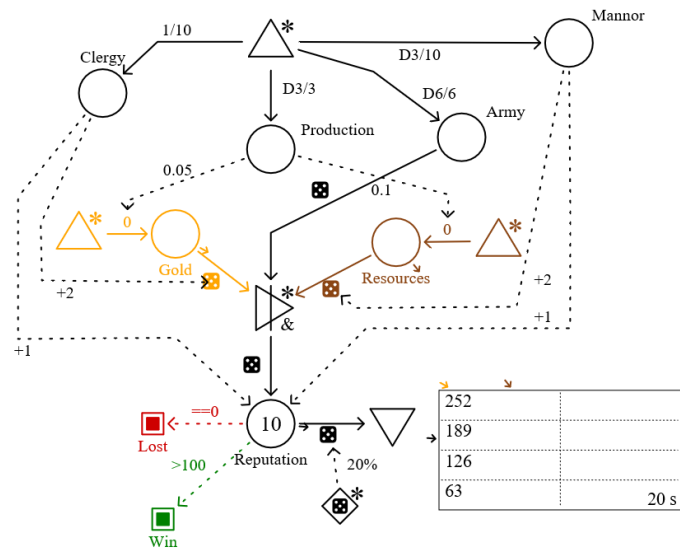


Figure B.3: Machinations model of the long-term feedback loop tied to the main objective of reputation growth through an overall development in four distinct areas.

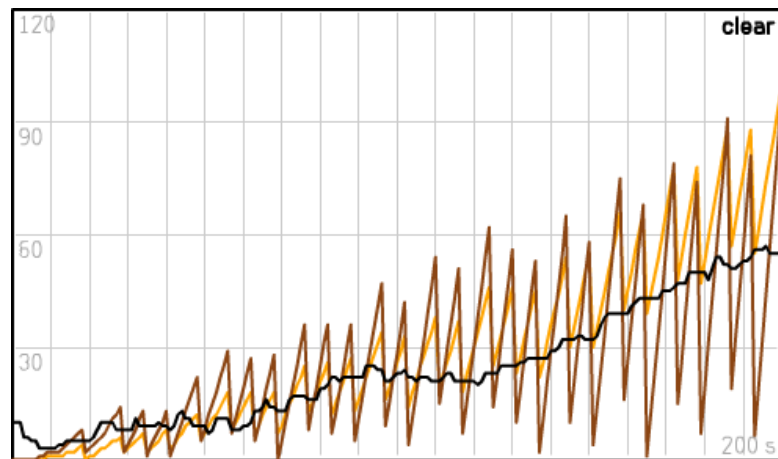


Figure B.4: State of resources over time in the simulated model. Resources (brown) and gold (orange) are spent on objectives to increase reputation (black) which is sometimes reduced when an objective is failed to meet.



Appendix C

Machinations Model Definitions

As a separate digital file, the definition that can be simulated via the application written in Flash are included in Appendix-C-machinationdefinitions.zip.



Appendix D

The Source Code

As a separate digital file, the definitions that source codes of the developed prototype are included in Appendix-D-sourcecode.zip.



Appendix E

Gameplay Capture

As a separate digital file, the video capture from the prototype is included in Appendix-E-gameplaycapture.zip.



Appendix F

Research Questionnaires



F.1 Demographics Questionnaire

Please specify your demographics with one of the following options

Specify your age:

- 15-18
- 19-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

How many hours a week do you engage in gaming related activities such as PC games, mobile phone games, board games or roleplaying games:

- 20+
- 15-20
- 10-15
- 5-10
- Less than 5

Select genres you would classify as your favorites (more than one answer is acceptable):

- First-person Shooters
- Action Games
- Racing Games
- Role-playing Games
- Strategy Games
- Simulations
- Platformers
- Card Games
- Puzzles
- Visual Novels
- Other (written answer)

■ F.2 User Testing Questionnaire

■ F.2.1 Gameplay

Answer the following questions on a scale from one to five.

How enjoyable would you rate your gameplay experience?

Not enjoyable at all	1	2	3	4	5	Very enjoyable
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How clear and understandable was the behavior of the AI?

Not at all clear	1	2	3	4	5	Very clear
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How demanding of your attention would you rate the gameplay experience?

Not at all demanding	1	2	3	4	5	Very demanding
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How much have you felt in control or lacking control of the simulated environment?

In no control	1	2	3	4	5	In full control
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How predictable or unpredictable the simulated environment felt to you?

Completely unpredictable	1	2	3	4	5	Completely predictable
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How much information about your game situation have you been able or unable to comprehend and take advantage of?

Very little information	1	2	3	4	5	Complete information
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■ F.2.2 Goal Structure

Answer the following questions on a scale from one to five.

For your overall experience, how important or unimportant were the inherent goals presented by the game?

Not recognizable	1	2	3	4	5	Very recognizable
------------------	---	---	---	---	---	-------------------

For your overall experience, how important or unimportant were your personal goals and motives?

Not reliant at all	1	2	3	4	5	Fully reliant
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How supportive or unsupportive you feel the game was in your ability to set and pursue your personal goals?

Very unsupportive	1	2	3	4	5	Very supportive
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In terms of your personal goals, how significant or insignificant were the conditions of the NPCs such as their health, happiness or well-being?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant was the development of your settlement?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant were the winning and losing conditions of the game?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant were the storytelling elements of the game?

Not at all important	1	2	3	4	5	Very important
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■ F.2.3 Awareness of the Environment

Answer the following questions on a scale from one to five.

During the gameplay session overall, how aware or unaware of the NPCs

and what they've been doing in a particular moment have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of your resources and their availability have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of the importance and urgency of tasks required by you have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of the risks and threats to your settlement you have you been?

Not aware at all	1	2	3	4	5	Completely aware
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■ F.2.4 Relationship with Non-playable Characters

Answer the following questions on a scale from one to five.

In your opinion, how optimal or nonoptimal was the number of NPCs present in the game?

Very nonoptimal	1	2	3	4	5	Very optimal
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How strong relationship or attachment did you create towards the NPCs in the game?

None at all	1	2	3	4	5	Very strong
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If one of the NPCs would unexpectedly die, how much it would affect you on an emotional level?

Not at all	1	2	3	4	5	Very strongly
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Would you consider the number of playable NPCs in the game to be:

Too few	1	2	3	4	5	Too many
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■ F.3 Public User Testing Questionnaire

How much time have you spent playing the game?

- Less than 30 minutes
- 30 minutes to 1 hour
- 1 hour to 2 hours
- 2 to 10 hours
- 10 to 50 hours
- More than 50 hours

■ F.3.1 Gameplay

Answer the following questions on a scale from one to five.

How enjoyable would you rate your gameplay experience?

Not enjoyable at all	1	2	3	4	5	Very enjoyable
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How clear and understandable was the behavior of the AI?

Not at all clear	1	2	3	4	5	Very clear
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How demanding of your attention would you rate the gameplay experience?

Not at all demanding	1	2	3	4	5	Very demanding
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How much have you felt in control or lacking control of the simulated environment?

In no control	1	2	3	4	5	In full control
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How predictable or unpredictable the simulated environment felt to you?

Completely unpredictable	1	2	3	4	5	Completely predictable
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How much information about your game situation have you been able or unable to comprehend and take advantage of?

Very little information	1	2	3	4	5	Complete information
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■ F.3.2 Goal Structure

Answer the following questions on a scale from one to five.

How recognizable or unrecognizable were the inherent goals presented by the game?

Not recognizable	1	2	3	4	5	Very recognizable
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In your overall experience, how much did you rely on your own personal goals to have fun?

Not reliant at all	1	2	3	4	5	Fully reliant
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How supportive or unsupportive you feel the game was in your ability to set and pursue your personal goals?

Very unsupportive at all	1	2	3	4	5	Very supportive
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In terms of your personal goals, how significant or insignificant were the conditions of the NPCs such as their health, happiness or well-being?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant was the development of your settlement?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant were the winning and losing conditions of the game?

Not at all important	1	2	3	4	5	Very important
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In terms of your personal goals, how significant or insignificant were the storytelling elements of the game?

Not at all important	1	2	3	4	5	Very important
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■ F.3.3 Awareness of the Environment

Answer the following questions on a scale from one to five.

During the gameplay session overall, how aware or unaware of the NPCs and what they've been doing in a particular moment have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of your resources and their availability have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of the impor-

tance and urgency of tasks required by you have you been?

Not aware at all	1	2	3	4	5	Completely aware
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During the gameplay session overall, how aware or unaware of the risks and threats to your settlement you have you been?

Not aware at all	1	2	3	4	5	Completely aware
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■ F.3.4 Relationship with Non-playable Characters

Answer the following questions on a scale from one to five.

In your opinion, how optimal or nonoptimal was the number of NPCs present in the game?

Very nonoptimal	1	2	3	4	5	Very optimal
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How strong relationship or attachment did you create towards the NPCs in the game?

None at all	1	2	3	4	5	Very strong
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If one of the NPCs would unexpectedly die, how much it would affect you on an emotional level?

Not at all	1	2	3	4	5	Very strongly
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Have you felt that the actions and behavior of the NPCs impacted the gameplay experience positively or negatively?

Very negative impact	1	2	3	4	5	Very positive impact
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Would you consider the number of playable NPCs in the game to be:

Too few	1	2	3	4	5	Too many
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Which of the following could describe your perception of the NPCs within the context of the game (more than one option is acceptable):

- Tool to achieve my goals
- The means to an end
- An obstacle that is in the way
- A challenge that is fun to overcome
- Source of surprising moments
- Source of the emotional depth of the game
- Element to tell a story
- Tool to express myself
- Opportunity to exercise control
- Opportunity to exercise nursing abilities
- Other:

■ F.3.5 Personal Preferences

This part of the survey aims to capture your general preferences over the whole genre of narrative simulation games. Examples of these games are Rimworld, Prison Architect, Anno series, Frostpunk or Landlord.

How much fun do you find the building parts of the gameplay (i.e. settlement, hospital or prison building)?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find the interaction with the AI?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find the unpredictability of the environment?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find the resource management?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find the element planning and strategizing?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find exploring all the options?

Not fun at all	1	2	3	4	5	Very fun
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How much fun do you find learning about the complexity of the game systems and hidden rules?

Not fun at all	1	2	3	4	5	Very fun
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How attractive or unattractive for you is the genre of narrative simulation games in general?

Not attractive at all	1	2	3	4	5	Very attractive
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■ F.3.6 Written Feedback

Is there anything you would like to mention as part of your feedback?



Appendix G

Raw Data from Questionnaires

As a separate digital file, the video capture from the prototype is included in Appendix-G-rawdata.zip.



Appendix H

Playable Prototype

As a separate digital file, the build of the playable prototype of the game Landlord is included in Appendix-H-prototype.zip



Appendix I

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