Master Degree Project

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USER INTERFACE DESIGN IN GAME DEVELOPMENT:

How does the game industry create user interface design?

Master Degree Project in Informatics
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Abstract

The game development processes behind entertainment games are not well understood. While there are studies that report on user interface evaluation in game production, there are very few studies that report on user interface design. The purpose of study is to explore and learn more about the game industry perspective and their processes behind user interface design. A systematic literature review was performed on the Game developers Conference database, *GDC Vault*. The review uncovered 105 presentations that relate to UI Design. A thematic analysis was performed to explore the eight most relevant presentations to the research question. The analysis resulted in two themes. The first theme describes UI designers' experience of interdisciplinary collaboration. The second theme describe two seemingly conflicting goals in the UI design process: aesthetics and usability. The study contributes to the field of game development research with some knowledge about how the game industry create UI design.

Keywords: Game Development Research, User Interface Design, Interaction Design, User Experience Design, Game Industry, Entertainment Games

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1 Introduction

The game industry is growing, and thousands of novel game experiences are developed every year. Correspondingly, the interest in games research has also grown. The past two decades, several research communities have formed to study digital games and its effect on society. Engström (2020) states that games research has thus far mostly focused on: serious applications of games; analysis of games and players; or the social aspects of playing. Further he adds that, there are few studies that focus on the game development itself, and even fewer that focus on the development of games for entertainment. The game development processes behind the most popular games are not well understood (Engström, 2020).

Game development research can be beneficial to both the game industry and society at large. For example, the research can lead to new recommendations on how to improve practices and how to avoid pitfalls in development. This could in turn reduce development costs, crunch, burnout, and the number of delayed or cancelled projects. Most importantly, this knowledge could also increase the output of high-quality games.

Engström (2020) writes that Game User Experience (GUX) is one of the more well researched areas in game development. However, he also notes that the existing research focus almost entirely on the evaluation of games, such as user tests and analyses of gameplay. He states that there are almost no studies that report on how, for example, interaction design is created in game production (Engström, 2020, p. 62). This work aims to explore this gap.

This study aims to explore the industry perspective on UI Design. The purpose of study is to explore and learn more about the game industry perspective on the processes behind interaction design and user interface design. With this purpose as a basis, the following research question are:

"How does the game industry create user interface design?"

The approach taken to answer the research question is a systematic review of the presentations at Game Developers Conference (GDC) Vault. The GDC Vault contains a library of more than 12,000 videos, audio files and presentations that has been presented over the past 20 years. The systematic review is performed to find all UI design presentations on GDC Vault. Thereafter a thematic analysis is performed.

2 Background

This work stands on the crossroad between (1) game development and (2) game user interface design. The first section (2.1) introduces the research area; Game Development, including the subarea Game Design. The second section (2.2) describe the research area: Human-Computer Interaction (HCI), with a focus on game User Interface Design.

2.1 Game Development

Digital games have been developed commercially for more than 50 years. While first the instances of game development occurred in research labs in the '50s and '60s, the first commercial game development was led by Atari in the early '70s (Izushi & Aoyama, 2006). Although, Atari's Pong wasn't the first digital game ever produced, it was the first game to become a commercial success. Pong helped to kick of commercial game development all over the world.

Advancements in technology as well has regional and cultural differences made a significant difference to how the game industry developed in different regions. Izushi & Aoyama (2006) studied the birth of game development in the United States, United Kingdom, and Japan. The authors found that aspects such as, pre-existing industries, socio-economic wealth and cultural background made a significant impact on how game industries developed in the different regions.

According to Izushi & Aoyama (2006) the game industry in the United States emerged from a group of highly educated hardware and software engineers, who started companies to produce arcade machines and later personal computers. Japan had a different start, its game industry grew from combining industries such as toys, consumer electronics along with manga and animation. In the United Kingdom the game industry grew from "bedroom coders" which refers to teenagers who self-taught started programming games on family computers (Izushi & Aoyama, 2006).

The 'bedroom coders' phenomenon is quite similar to how the game development industry emerged in several Nordic countries. According to Jørgensen, Sandqvist & Sotamaa, (2017) the video game industry in Sweden, Norway and Finland emerged from a subculture known as the demoscene. The demoscene consisted of groups of teenagers forming groups to produce audio and visual experiences that ran in real-time and showcased creative and technical skills. Both the UK and Nordic countries therefore emerged from teenagers with a hobby for programming on personal computers.

Game development is different from software development. Murphy-Hill, Zimmermann and Nagappan (2014) performed a substantial study with Microsoft employees which had experience from both fields. The authors found several differences. For example, game developers tend to apply a more agile development method, and the requirements for games are different and more vague than traditional software requirements. Personal abilities such as high creativity and the ability to communicate with people outside one's own discipline are valuable. Another major difference is that less emphasis is put on design as planning activity. This is because games have the requirement to be "fun", and that is a vague requirement that separates game development from traditional development (Murphy-Hill et al. (2014).

The game industry shares many similarities with other creative industries. Similar to TV and movie production, games are often produced within a studio environment which incorporates people from many different disciplines and produce a multitude of assets, such as artworks, concepts, animations, sounds and music. However, game production is different from film and media production. O'Donnell (2011) analysed the simultaneous production of the Spider-Man 3 movie and along with two games for multiple platforms. He identified several reasons why game and movie production are different. Whereas movies follow a narrative in a controlled and sequenced manner, games follow rules and the interactions of players. O'Donnel writes that a game needs to offer some gameplay and content that gives players meaningful choices. Therefore, game production needs to put intense labour into creating a gameplay with rules and logic that enable players to control a character and interact with the narrative.

O'Donnel (2011) also studied the use of tools and content between different medias. He discovered that content from different media and platforms cannot easily 'flow' from each other. For example, movie and game production use different tools to create animations and 3D assets, and the assets from the movie production tool cannot not easily be imported to games, and therefore new assets were often made from scratch. Even different game platforms also posed a problem due to each platform had unique processing and graphical capabilities (O'Donnel, 2011). Finally, he adds that these sets of challenges – unique to game production – are not always recognized executives and decision makers in creative industries. Movie production management is not fully applicable to game production.

Despite game development being uniquely different from software, film and media production, there is a lack of academic studies that address the game industry, and specifically game development. This gap was highlighted by Martin (2018) who performed an extensive review of the field of digital game research between 1966-2016. The review focused on identifying how the field of game research has developed historically and formed sub-fields. Figure 1 displays the growth of academic texts on digital games. The interest in game research has increased multifold during the past two decades.

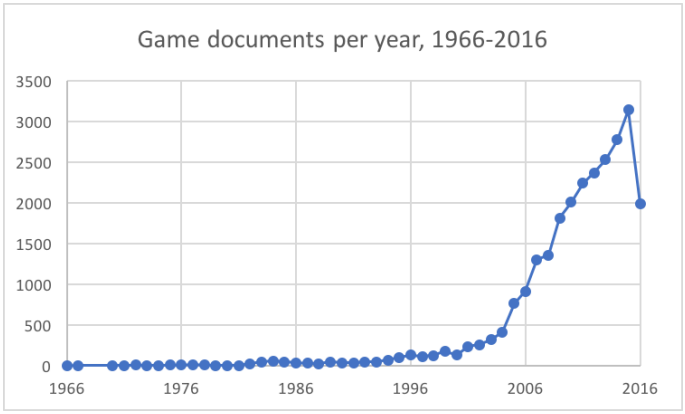

Figure 1 Academic texts on digital games in the Scopus database, 1966-2016 (Martin, 2018).

Martin (2018) identifies that there has been a great interest for various areas, although there is a lack of research that focusses on the game industry. For example, only 1 of the 300 most-cited authors focused on the game industry. When it comes to the identified subfields in game research, neither *game industry* nor *game development* were prominent enough to be

listed. This highlights the gap between game industry production and game industry research. Despite games being one of the most popular forms of entertainment, there is barely any research on the game industry (Martin, 2018) nor the processes behind which games are developed (Engström, 2020).

Game development research can help to articulate the unique challenges and struggles in game production. For example, Whitson, Simon, and Parker (2018) performed an interview and survey study to uncover some differences between indie and AAA game development. The study focuses on the indie developers experience and their motivations. The authors write that AAA companies are often more commercially motivated, often building their company on the revenue and growth from popular game series. Whereas many Indie game companies have different motivations. The motivations do not lie in making profit or growing in size, but in the ability to keep on making games (Whitson et al., 2018). Another important motivation the strive for unfettered creative freedom.

Whitson et al. (2018) point that out indie companies often neglect the producer role, and the important responsibilities the role has. The interview showed that some indie developers didn't account for the important non-development work that comes with running a company. Some developers even saw non-development work as unpaid work (Whitson et al., 2018).

AAA companies face different challenges. For example, Cohendet and Simon (2016) describe a major reorganization project that stemmed from management issues facing the largest game studio in the world, Ubisoft Montréal. The study describes how the traditional game production structure which relied on a 'stage-gate process' stifled creativity and eventually caused a cancellation of a game project. This cancellation came to open up the *always playable* project where the work was reorganized around creating playable prototypes with weekly playtests. The producer responsible for the project also introduced two development principles: "fail fast" and "follow the fun" (Cohendet & Simon, 2016). The above examples describe how game development research can provide interesting insight into the inner operation of game studios. The next section provides examples of game development research from the perspective of Game Design.

2.1.1 Game Design

This section continues to describe what game development research is, and what insights that can be gained from studying game development 'in the wild'. Game design is one of the best studied roles within game development research.

Within game development there are various roles and disciplines such as graphic artist, sound artist, animator, writer, programmer, tester and so forth. These disciplines can sometimes be distilled down into a triad of "programmer-designer-artist" (Whitson et al., 2018, p. 609). In this view, the role game design can be considered as one of the three core disciplines within game development. A game designer often works in close collaboration with the team, and is responsible for designing the gameplay, in other words, creating the game theme, rules, goals and mechanics.

In academia, the discipline of game design is often studied within the academic field of game studies. In the context of 'game development research' there are three types of game design literature: *grey literature*, *non-industry*, and *industry-based research*. Out of these, it is the

industry-based research that is of main interest for game development research, although *grey literature* may also be highly relevant (Engström, 2020, p. 82).

Grey literature

The grey literature are books written by industry professionals. Within game studies, grey literature are the most cited sources on game design (Engström, 2020). One of the most cited books is *Rules of Play* (Salen & Zimmerman, 2004). While other often cited sources are: *The game design workshop* (Fullerton, 2014); *A theory of fun for game design* (Koster, 2013); *The art of game design: A book of lenses* (Schell, 2008); *Fundamentals of game design* (Adams, 2014) and *Characteristics of games* (Elias, Garfield and Gutschera, 2012). All these books focus on game characteristics and how to design and evaluate games. These books provide a brief glimpse of the nature of game development based the authors' own practical experience as game designers. However, while the books may provide useful insights for game development research, it is important to be cautious of the contents, since the books are based on personal experience and are not peer-reviewed.

Non-industry research

When it comes to scientifically grounded, non-industry research, an approach that has received much attention is Game Design Patterns (Björk, Lundgren & Holopainen, 2003). It is a conceptual model that aims to provide a shared vocabulary for game creators and academics to discuss elements of game design. The patterns can be used either to analyse or design games. One definition is: *"game design patterns are semiformal interdependent descriptions of commonly reoccurring parts of the design of a game that concern gameplay" (Björk & Holopainen, 2005, p. 34).* The patterns are essentially abstractions of commonly recurring elements in game design. In practice, Game Design Patterns can be used as an encyclopaedia to look up definitions and specifications of game elements. Although, in actual industry practice, there are no reports on pattern use by game companies. It appears that the patterns – although influential among academics – have not reached the industry, and therefore fall out of scope for game development research.

Industry-based research

The final type of literature is the industry-based research. Namely, the research that builds upon empirical data from game industry practice. This type of research is central to game development research. The remainder of this section will highlight three notable examples of this literature.

First and foremost, is the work done by Annakaisa Kultima. She has been involved in several empiric studies that address the game design process and to what extent it involves systematic methods. In one study (Kultima, 2010) study the nature of game ideation within game companies. The results draw from interviews with 23 game designers representing 8 different Finnish game companies. Kultima found that the game developers mainly had an *informal approach* to idea creation:

1. The first step consisted of seeking inspiration from other sources, such as reading, watching television and movies, and playing other games.
2. The second step was to purposefully perform activities to come up with ideas, for example: taking walks outside or having long showers. The important part was to retract to solitude.
3. After the designers had come up with idea of their own, the third step was to bounce their ideas with the team, to further develop them.

In other words, Kultima (2010) found that game ideation in the wild mostly consisted of an organic and informal process. The articles subtitle summarizes the finding well: Game ideas arise from solitude and mature by bouncing. However, while Kultima (2010) argues that systematic approaches for game ideation should also be introduced, she also sees great potential in the informal approaches and tools developed by industry professionals.

The second notable example is Ulf Hagen, who similar to Kultima studied game ideation within game companies. His first study (Hagen, 2009) is primarily an interview study with four game designers from four different major Swedish game companies. Hagen observed that all game ideas are a combination of reused ideas and innovative ideas. The study resulted in a framework that categorizes the *origins of game ideas*. From the interviews, Hagen (2009) identifies four main areas that influenced the game companies he studied:

1) inspiration was taken from other games,
2) narratives and visual art (television, film, cinema, and books),
3) human activities (sports, playful activities, war, and warfare) and
4) technology.

Hagen (2009) also describes the game development process in relation to game ideation. He writes in which specific stages in development that ideas are formed and developed. Initially, in the concept phase, when the development team is only consisting of a few members, the first high-level ideas are formed by the game designer. At a later stage, the mid-level and low-level ideas are fleshed out partly by game designer, but more importantly by the entire development team. This is similar to an interesting reflection in Kultima (2010), where she discusses her takeaways from the interviews:

> *"A 'good' idea may not be the one that is fully described from the beginning, but is more inspirational and open-ended in terms of allowing the whole production team to modify it. Even though initial ideas are produced mainly in solitude, it is important that the voices of others on the team are also heard, engendering a process of many ideas contributing to one idea that, despite inevitable changes, carries the game idea through the production process."* (Kultima, 2010, p. 37)

Therefore, the observations in both Hagen (2009) and Kultima (2010) highlight what a "good" game idea consists of, namely, it's an idea that is vague, inspiring and allows the whole production team to modify it. It is reasonable to assume that this way of working open-endedly with game ideas, allowing the whole production team to modify it, is crucial to making a highly motivated and inspired development atmosphere.

The third notable example is Hicks et al. (2018) empiric study on Juicy design. Juicy design is a popular game design concept that has been around for decades. However, despite the

long-term popularity, Game juice remains a vague concept that is difficult to define. In the study, the Higgs et al. (2018) seek to bridge the gap between academic and industry perspective on Juicy Design. The results draw from an online survey which received 17 responses from professional game designers.

From the survey, Higgs et al. (2018) found that many game designers seem to have an intuitive understanding of juicy design but sometimes struggled to articulate their ideas. A key insight, according to the authors was that developers understand juiciness to be more than just feedback since the addition of Juicy Design will often change the game as a whole.

According to Higgs et al. (2018) the central idea with Juicy Design is that large amounts of audio-visual feedback contribute to a positive player experience. In other words, Juicy design can be understood as design that adds a sense of weight or power to player actions. For example, a game can become juicier by adding effects such as a *screen-shake effect* to emphasize in-game explosions.

Higgs et al. (2018) contributes to game development research by exploring the industry perspective on "Juicy design". From the survey results, Higgs et al. (2018) developed a framework to facilitate analysis and design of Game Juice. The Game Juice framework consists of three main components: Game characteristics, Game state and Direct feedback. Each component comes with a set of subfactors and analytical questions.

An interesting part with Game juice is that it calls for a creative and collaborative team effort that involves many different disciplines. For example, in order to exaggerate the feedback of a sword-to-sword clash, there might be flashing lights, harsh sounds and so forth. If a player hits a hard object the screen might shake, along with strong force feedback in the controller. Audio designers may need to emphasize bass to create a more impactful experience, an interaction designer might work on how to display critical information and provide timely feedback. In this sense, whole team contributes to the interaction design. This potential for interdisciplinary team collaboration sets game development apart from traditional software development, where specific software features may be developed in solitude.

These three notable examples provide a glimpse of the industry perspective on game production. Industry-based research can highlight the gap between the academic theory and the actual practice of game design in the wild. Game developers are often less methodical and choose different approaches than what is formally suggested in books and academic literature. Game developers need to constantly discover practically feasible approaches given the complex and unique environment for each game project. Given the gap between theory and practice, more research is needed to understand game development in the wild.

2.2 Game User Interface Design

This section aims to outline the research on game User Interface (UI) Design. The next subsection will clarify common UI design terminology, and the following two subsections focus on game usability and game usability heuristics.

The past four decades, there has been a great interest for research on User Interface (UI) Design for software and websites, however, there has been limited research on game UI design. The first category focuses on utility, and its history stretches back to beginning of the 80's (Carroll, 2013). It was during this decade, the first graphical UIs started to become

common, along with the boom of affordable Personal Computers (PCs). The boom of PCs also meant that it was no longer a few academics and professionals that could interact with computers, but the general population. However, when users from the general population started to interact with software built by experts for experts, numerous of problems started to appear. In 1982, Human-Computer Interaction (HCI) emerged to address the problems. (Carroll, 2013) To address the problems, HCI applied theories from Cognitive Science, Computer Science and Human-Factor Engineering (Rogers, 2012).

For many years, the field of HCI focused strongly on utilitarian software and its usability. Usability is central concept within HCI. According to Carroll (2013) usability has always the guiding star within the field. He writes that, initially usability was used as a slogan: *"easy to use, easy to learn"*. Although, over the years the concept has been further developed and several new definitions and methods have emerged. Barnum (2012) writes that designers use usability throughout the development process to measure how well a design meets a specific user's goals and needs, and how well the user can achieve the goals. However, Nielsen (2012) defines usability as a quality attribute that assesses how easy user interfaces are to use. He also states that the word usability may also refer to the methods for improving ease-of-use during the design process. Simply put, usability is a *measurement*, or most often, a *set of measurements* used in the development. During the past two decades, the concept of usability has been adapted to game UI design (see section 2.2.2 Game usability).

In the monograph *Game development research*, Engström (2020) reviews the existing game industry-based research of consisting of hundreds of studies on game development 'in the wild'. In this work, Engström summarize the literature on applied Game User Experience (GUX). He observed that, out of HCI's dual focus of design and evaluation, it's mostly evaluation of UI and player experience that has been integrated with game development:

> "As mentioned above, the user experience community has a dual tradition of both designing interaction and evaluating existing solutions. GUX research is heavily dominated by the latter. Very few studies report on how, for example, the interaction design is created in game production. Most studies focus on user tests and analyses of gameplay. A separation between developers and GUX personnel is common in the industry."
>
> Engström (2020, p.62)

As Engström observed, very few studies report on how game developers to *design* game UI. This gap will be discussed further in chapter 3. The next section will clarify UI design terminology, and the following two sections focus on the research on game usability and usability heuristics.

2.2.1 UI Design and its synonyms

User Interface Design is a term that can have different meanings depending on the context. For example, in an academic context, UI is often discussed in terms of usability and user experience (UX), while in an industry context, it may be discussed more in terms of visual design. Besides the term UI design, there are two additional terms that are similar and sometimes used interchangeably. The first one User Experience (UX) Design and the other Interaction Design. While the three terms can be used to refer to the same thing, 'UI design', the terms do have slightly different meanings. As there seem to be no agreed upon distinctions between each of these terms, a tentative distinction is provided in Figure 1.

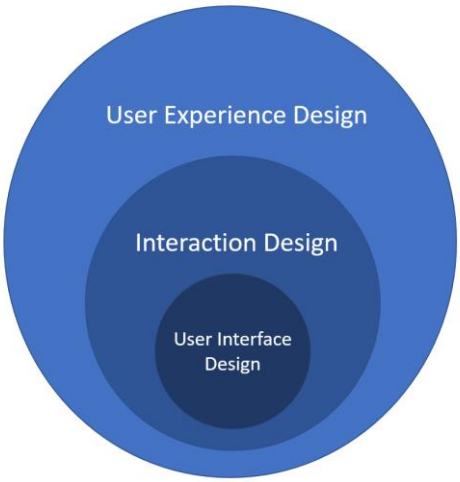

Figure 2 The relationship between common terms related to UI design.

UI Design concerned about both the visual design the information architecture (Unger & Chandler, 2012), such as when and where information should be displayed, and how it will be presented on different devices. According to Fullerton (2014) wireframes, flowcharts and prototypes are effective means to communicate UI Design. *Interaction Design* is closely related to UI Design, but more concerned about interaction and how the UI responds in terms of flow, animations, transitions, and sounds (Unger & Chandler, 2012). The difference between UI Design and Interaction Design seems to be that the former is more focused on the structure of static layouts, while the latter is concerned about how the interface responds.

Finally, *UX Design* encompasses all the design aspects from Interaction Design and UI design, while also concerning about players' journey from the game's website, packaging, manual, platform to the experience of the game itself (Unger & Chandler, 2012).

The term User Experience (UX) is a central concept within HCI. According to Nielsen (2017) the term was coined in 1993 by Don Norman, who aimed to widen the perspective of usability to better describe all aspects of the human experience. The term UX started to become widely used in the 2000s (Hassenzahl & Tractinsky, 2006).

Today, there are many definitions of UX. One definition provided by Don Norman and Jakob Nielsen is: *"[…] 'User experience' encompasses all aspects of the end-user's interaction with the company, its services, and its products."* (Norman & Nielsen, nd). The authors state it is important to distinguish total UX from usability and User Interface design. They write that UX is a much broader concept that incorporates all interaction that the end-user has with a company, including engineering, marketing, graphical, industrial and interface design. All disciplines contribute to the total UX, and an important goal is that all parts are seamlessly merged (Norman & Nielsen, nd). From this definition, UX is concerned more about a more holistic perspective of the company, its services, and its products, while usability is more concerned about the design of the user interface.

In this thesis, the term UI Design is used to refer to more static visual design, such as the information architecture, while Interaction Design is how the interface responds to interactions, such as the interface responding to mouse over and similar behaviour.

2.2.2 Game Usability

As mentioned above, *usability* is a measurement to evaluate *the quality of use* of utility software. The most common definition of usability is from the International Organization for Standardization (ISO, 2018): *"[the] extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"* (ISO 9241-11, 2018). However, an issue with traditional usability measurements (for utility software) is that they are often ill suited to assess game UI design. This is because of the different nature of games and utility software. While utility software is used to perform work-related tasks as easily and efficient as possible, game playing is performed voluntarily and for enjoyment (Jørgensen, 2004). Paavilainen et al. (2018) state that *Game play* is the key defining factor that differentiate games from utility software. Game play emerge from aspects such as goal structures, challenges, rewards, and story components. Jørgensen (2004) state that "a challenge" is perhaps the most important difference, by way of an *intended difficulty*. Because of the differences of utility software and games, researchers have been adapting the concept of traditional usability to *game usability*.

There are two common terms used to define usability for games: *game usability* and *playability*, however unlike traditional usability there is still no common definition for these measurements (Rajanen & Nissinen, 2015; Aker, Rızvanoğlu & Bostan, 2020). A definition provided by Paavilainen et al. (2018) is that *Game usability* cover aspects such as clarity of audio-visual presentation, user interface layout and navigation logic, control and feedback and help among other things. All these aspects are related to the game user interface that the player interacts with. *Playability* is a term to describe the overall quality of a game, including game usability and game play (Paavilainen et al., 2018). In other words, *game usability* seems to be concerned with the clarity and logic of the game UI design, while *playability* is broader measurement which considers the both the quality of game UI design along with the quality of gameplay aspects, such as the story, challenge, and rewards.

Jørgensen (2004) state that before the 2000s there was virtually no interaction between computer games and usability. However, by the 2000s and onwards, a number of exchanges have appeared. According to Rajanen and Marghescu (2006) there is limited amount of research done about game usability or quality of game user interfaces. Some researchers focused on applying heuristic evaluation to evaluate game usability, while some have focused on applying usability testing methods to computer games (Rajanen & Marghescu, 2006). The next section will review the research on game usability heuristics, as Malone (1982) and Desurvire and Wiberg (2009) suggests that the heuristics can also be considered when *designing* game UI.

2.2.3 Game Usability heuristics

The purpose this review is to discover how game usability heuristics have emerged and developed over time. Specifically, the heuristics that relates to game UI design. Heuristics are rules of thumbs that can be used in evaluation and design of UI. The next two paragraphs will describe the heuristic evaluation method.

Heuristic evaluation is inspection method that is performed by evaluating user interface design based on a list of heuristics (Unger & Chandler, 2012). These lists of heuristics are used to identify common usability problems. According to Wilson (2014), there are a plethora of heuristics in existence, however, to facilitate for both evaluators and recipients of the result, the lists are often limited to about 8 to 12 heuristics.

Wilson (2014) recommends heuristic evaluation as a time- and cost-effective evaluation method. The method can be performed without previous experience, longer preparations and without involving users (Unger & Chandler, 2012; Wilson 2014). The evaluation can be performed both individually or by a group of evaluators (Wilson, 2014). According to Nielsen and Molich (1990), it is advantageous to use more than one evaluator in heuristic evaluation. For the reason that different evaluators find different usability problems.

Heuristics can also be applied by designers without any formal evaluation session. Designers who are familiar with the heuristics can consider them during design of new interfaces (Malone, 1982; Desurvire & Wiberg, 2009).

The first known list of game heuristics was developed by Malone (1982). He developed heuristics from analysing features that make computer games enjoyable. His list of heuristics contains three categories: challenge, fantasy, and curiosity. While Malone's intent was to develop heuristics for instructional games, the heuristics can also be applied to games in general. For example, it's important for games to have *clear goals*, *uncertain outcome* as well as that the game provides *performance feedback* by means of *score-keeping* or *timed responses*. Malone concludes that the heuristics should be viewed as a checklist of ideas to be considered when designing new interfaces, although not all features will be useful in all interfaces.

The second influential work on game usability heuristics is provided by Federoff (2002). She developed a complete set of heuristics from analysing previous work done by at least 10 authors, and then performing a case study with game developers. Federoff's list of 40 heuristics is divided into three categories: game interface, game mechanics and game play. Out of these, 14 heuristics were categorized into game interface. Out of these, some of the heuristics relate to the visual user interface, and some to the user input devices (i.e., the keyboard or game controller). For example, "*Controls should be customizable and default to industry standard settings*", and "*The interface should be as non-intrusive as possible"* (Federoff, 2002).

Desurvire, Caplan and Toth (2004) also provided a set of heuristics: Heuristics to Evaluate Playability (HEP). Their work contains 43 heuristics divided into four categories: game play, game story, game mechanics, and game usability. They define the four categories as follows (Desurvire et al., 2004):

> *game play* is the set of problems and challenges a user must face to win a game; *game story* includes all plot and character development; *game mechanics* involve the programming that provides the structure by which units interact with the environment; and *game usability* addresses the interface and encompasses the elements the user utilizes to interact with the game (e.g. mouse, keyboard, controller, game shell, heads-up display).
>
> (p. 1509)

According to Desurvire et al. (2004) the HEP heuristics are based on the current literature and then reviewed and validated by having several playability experts and game designers to perform heuristic evaluation on an early game design concept. According to the authors, the HEP heuristics proved effective in uncovering playability issues, especially the game story and game usability categories. Table 1 lists the category of usability heuristics provided by Desurvire et al (2004). This list is nearly identical to the list provided by Federoff (2002).

Table 1. Game Usability Heuristics (Desurvire et al. 2004)

1	Provide immediate feedback for user actions.
2	The Player can easily turn the game off and on, and be able to save games in different states.
3	The Player experiences the user interface as consistent (in control, color, typography, and dialog design) but the game play is varied.
4	The Player should experience the menu as a part of the game.
5	Upon initially turning the game on the Player has enough information to get started to play.
6	Players should be given context sensitive help while playing so that they do not get stuck or have to rely on a manual.
7	Sounds from the game provide meaningful feedback or stir a particular emotion.
8	Players do not need to use a manual to play game.
9	The interface should be as non-intrusive to the Player as possible.
10	Make the menu layers well-organized and minimalist to the extent the menu options are intuitive.
11	Get the player involved quickly and easily with tutorials and/or progressive or adjustable difficulty levels.
12	Art should be recognizable to player, and speak to its function.

Table 1 provides an example of how game usability heuristics are typically formulated. The heuristics suggest design that can make a user interface easy to learn and use. The designer or evaluator can judge whether the design follows or breaks a certain heuristic.

During the past two decades, numerous of articles on game usability heuristics have been published. For example, Korhonen & Koivisto (2006) developed playability heuristics for mobile games. Desurvire and Wiberg (2009) further developed the HEP heuristics into Heuristics for Playability (PLAY) and so forth.

In recent years, Aker et al. (2020) performed a methodological review on playability heuristics to gain a holistic understanding for how the dispersed field has developed. The authors included 44 articles in the study. They discovered that researchers have developed a large variety of approaches and heuristics for evaluating games and concluded that it is not possible to identify a generally accepted approach. They also found that most of the articles presented new heuristics, either by building on past research or by providing new heuristics. Despite this the heuristic approaches have neither proved to fully incorporate the player experience nor are they empirically tested adequately for validation to set a ground for future studies (Aker et al., 2020). Therefore, despite the large amount of research done on game usability heuristics during the past four decades, there are still no generally accepted approach nor a generally accepted set of heuristics to evaluate and design games.

Rajanen and Nissinen (2015) performed a survey to study the prevalence of game usability practices in Northern European game companies. The results showed that larger companies appeared to be using more usability methods than smaller ones. Out of 34 companies that do use usability methods, 32 of them use playtesting. Other popular methods were observation of gameplay, usability testing, interviews, focus groups, think aloud and so forth. However, a surprising finding was that among the least used methods were heuristic evaluation (6/34). The authors discussed that out of the few companies that do use heuristic evaluation, the companies are mostly large, and also have created their own game heuristic lists.

Rajanen and Tapani (2018) performed a similar survey for North American companies. They found similar results. The results showed that the least used methods were cognitive walkthrough (12/50) followed by heuristic evaluation (10/50) and similar methods such as empirical guidelines (5/50) and pluralistic walkthroughs (3/50). These results highlight a disconnect between the industry and academic research. While game usability heuristics has received some attention in academic research, the same interest has not been reflected by game development companies. Another interesting finding is that twelve North American companies used cognitive walkthrough to evaluate game usability, despite the method being relatively uncommon in academic research (Rajanen & Tapani, 2018). This finding highlights the disconnect between game industry practice and academic research. Furthermore, the authors also learned that the companies in their study often use their own applied versions of usability methods rather than to follow pre-written instructions step-by-step. Therefore, when it comes to game usability in general, the disconnect in between academic and game industry seem to be both wide and substantial. More research is needed to understand the industry perspective.

3 Problem

Game production and game research has grown multifold during the past two decades. Recent studies have revealed that there is lack of research that focusses on the game industry (Martin, 2018) and more specifically game production (Engström, 2019). In the monograph *Game development research*, Engström (2020) argues that the development processes behind the most popular games are not well understood. Therefore, there is a need for game development research.

Research into game development can help to bridge the gap between game production and game research. Kultima's (2010) study on game ideation is a great example of how empiric studies can close the gap. Her study reveals that many game designers apply an informal and organic approach to game ideation. While Kultima concludes that a better understanding for systematic approaches could benefit game ideation, she also acknowledges that game research can learn from the successful practices developed by industry professionals. She states that the industry approaches show a: *"[…] great potential for emergent, novel tools and methods that are especially suitable for game production"* (Kultima, 2010, p. 38).

Game development research is a wide problem area that covers many different disciplines. Engström (2020) writes that Games User Experience (GUX) is one of the more well researched areas, although the research focus almost entirely on the evaluation of games, such as user tests and analyses of gameplay. There are almost no studies that report on how User Interface (UI) design and interaction design is created in game production (Engström, 2020). Therefore, the aim of the thesis is to bridge this gap. The aim is to explore how game industry professionals create UI design within game production.

The role of UI design is more specific than UX design (see section 2.1.1). While the UI designer are more concerned about designing the UI, the UX designer is a broader discipline which more concerned about design research. This thesis focus on the role of UI designer.

In Human-Computer Interaction (HCI) research, there is a great number of studies that focus on usability and interface design. Although, this research is mostly focused on design and evaluation of productivity software, rather than games (see chapter 2.2). In game research, studies are first and foremost focused on UX evaluation, such as playtesting and evaluating player experience. However, while there are a few studies that relate to UI Design for games, the majority of this research focus on heuristics for how to design and evaluate games. During the past two decades, the method heuristic evaluation, and playability heuristics have received a substantial interest from academics (Aker et al. 2017). Despite the large interest, two empiric studies show that almost no game companies apply heuristic evaluation in game production (Rajanen & Nissinen, 2015; Rajanen & Tapani, 2018). This evident lack of interest from game companies leaves heuristic evaluation out of scope for game development research. However, with heuristics out of the picture, there is little to no empiric research on game UI Design.

It is reasonable to believe that game industry UI Designers apply a plethora of interface and interaction design approaches. However, in academic game research, the industry perspective of game UI Design is largely unknown. Therefore, there is a need to explore the industry perspective from applied game UI Design.

The purpose of this study is to gain an initial understanding of the industry perspective of how UI design is managed within the game industry. With this purpose as a basis, the following research question are:

"How does the game industry create user interface design?"

The expected contribution from this study is a initial understanding of the game industry's perspective, such as: what approaches and methods professionals use to create UI design.

This study is only concerned with empirics from industrial game production. It is therefore out of scope of this work to study experiences from non-industry game production, such as empirics from student projects or academic research. The focus is on experiences from game industry professionals.

3.1 Choice of method

To answer the research question, this study follows an inductive approach. A qualitative approach is deemed suitable since the research question has an explorative nature. According to Patton (2014) the qualitative method is characterized by exploratory studies, descriptive data as well as theory generation. This study aims to generate descriptive data from empirical data, rather than to follow a deductive approach based on previous research.

There is more than one way to answer the research question. For example, an ethnographic study could potentially provide rich data about game development processes. Another option could be to perform interviews or surveys with game industry professionals. However, an impediment with both these approaches is that most game companies are rather secretive about their processes, nevertheless their intellectual properties. Therefore, it can be difficult to gain access to the field. Furthermore, even if granted access, the desired work processes are often protected by the company's Non-Disclosure Agreements (NDA). Also, in the interview study by Linderoth (2015), there was a firm that on top of the NDA, required the researcher to sign a special contract that give the firm control over what is published. This sort of contracts removes the ability for researchers to perform independent research. Therefore, to remain as an independent researcher, Linderoth chose not to use the interviews from that company. Besides ethnographic approaches, there are some game companies that willingly share their best practices at, for example, the Game Development Conference (GDC).

The approach taken in this study is to review the presentations at GDC Vault. The GDC Vault contains a library of more than 12,000 videos, audio files and presentations that has been presented over the past 20 years. The presenters are often game industry professionals. Although, while there are almost 20 tracks on GDC that relate to different topics and disciplines in game production, there are no specific track for UI Design. Furthermore, the GDC Vaults website's own search function (or search API) does not support any advanced search options, such as inclusion or exclusion criteria and therefore making the relevant presentations even harder to find.

4 Method

The method used is a systematic review. Gough et al. (2012) writes that a systematic review is a method which aims to identify and describe existing research according to a fixed system or a plan. The authors write that the method can be summed up into three key activities:

1) identify and to describe the relevant research ("mapping" the research).
2) systemically appraise the research.
3) synthesize the research in a coherent manner.

In essence, systematic reviews are useful to summarize previous research and identify research gaps. However, in this thesis, the standard "systematic literature review" is slightly adjusted. While the literature on systematic reviews describe how to apply the method to review research reports, this study is different since the idea is to apply the method to a *non-research database*, with *video presentations*.

I have made two adjustments to the method. Primarily, the first key activity, "mapping the relevant video content" needs to be performed differently from when performing traditional systematic reviews of texts. This is because the electronic database, Game Developers Conference Vault (GDC Vault) does not support any of the advanced search functions commonly available at research databases. For example, there is no support for Boolean operators. The second difference is that the primary format for this review is not text-based academic articles but video presentations from the game industry. Therefore, both the search and screening process in this review have undergone adjustments from traditional systematic reviews.

In this thesis, the stages outlined in Gough et al. (2012, p. 8) and the steps in Okoli and Schabram (2010) has been used to create a structure for the systematic review:

1. The data retrieval of GDC Vault Title-Abstract list
2. Pre-review mapping study
3. The purpose of the systematic mapping and the synthesis
4. The review protocol and the search procedure
5. Thematic analysis

In this chapter, I will present the methodological considerations taken in each of the five steps outlined above. While the first four steps describe the customized systematic review, the final step describe the thematic analysis (or the synthesis) of a subset of the most highly relevant presentations for the research question.

4.1 The data retrieval of GDC Vault Title-Abstract list

The first step of the method is also the first major adjustment from a traditional systematic literature review. In the literature for systematic reviews (e.g., Gough et al. 2012, p. 120-123) the planning and strategies for finding relevant studies often presuppose that the researcher has access to advanced search functionalities often provided by bibliographic databases. In the case of the electronic database for GDC Vault, there are no advanced search capabilities. GDC Vault has no support for advanced search with Boolean operators (e.g., AND, OR, NOT) to combine or exclude keywords in search. There are also no statistics on search results and

so forth. Therefore, the search capabilities on GDC Vault does not support systematic reviews.

An alternative to using advanced search is to retrieve a 'title and abstract list'. First, I contacted the university library and asked if they could reach out to GDC Vault for a title-abstract list. Awaiting the response, I pilot tested a second approach. The second approach was to manually copy all the title and abstracts from GDC 2021 (397 video presentations). The manual extraction took about 3-4 hours to complete. Considering there are several thousands of video presentations on GDC Vault, it could take more than a work week to manually extract all the video presentations. There was no success with neither the first or second approach to retrieve a title and abstract list.

The third and successful approach was to build an application that could automatically perform the manual labour performed in the second approach. This application can retrieve the data at a substantially quicker pace than manual retrieval. When developing an application to automatically retrieve data there are some ethical aspects to consider. Mainly, it is important to consider the traffic and activity generated by the application. If the application is designed to retrieve data without constraints, the activity is likely to disturb the service in some manner, by using more bandwidth than the database is designed for. In order to not disturb the experience for other users, it is important to put constraints on the data retrieval, with brief pauses after each request (1-2 seconds of delay).

To retrieve all the title and abstracts from GDC Vault, the application was designed to work in two simple steps. The first step was to retrieve a list of all the presentations by visiting each URL of all the different conferences on GDC Vault (e.g., GDC 2021, GDC 2020), and then from there retrieve a listing of all links from each specific conference. The second step was to visit each and every presentation to retrieve the title, abstract, presenter, company, format, and tags for each presentation and then store it in a JSON file format. After 11 hours the retrieval was complete and resulted in a list of 15'147 URLs. After the data retrieval the JSON file was converted into a XLSX file format to enable analysis with Microsoft Excel.

After successfully retrieving all the data and storing it in an Excel document, the list contains all presentations between 1996-2021. The list is structured as in Figure 3. As mentioned above, the data retrieval is based on URLs, and each row contains the data for a presentation. The document contains 15,417 URLs, which is substantially more than 12'000 presentations. This is because the data retrieval has created multiple entries for a single presentation. For example, if a presentation comes in three different formats (video, audio, and slides), that presentation will appear three times in the spreadsheet. It is a shortcoming with the data retrieval method.

	Title	Description	Speakers	companies	format	tags	url
2	Closing Down Game Communities: How to Plan a Dig	The care and planning you pu	Chloe Swain	Lionbridge Game Services	Community M	Community M	https://www-gdcvault-com.l
3	Designing with Physics: Bend the Physics Engine to Y	Modern indie-friendly framev	Bennett Foddy	NYU Game Center	Independent G	NYU Game Ce	https://www-gdcvault-com.l
4	Rayman Legends: The Design Process Within the Ubi	The critically acclaimed Rayn	Chris McEntee	Ubisoft Montpellier	Visual Arts	Ubisoft Mon	https://www-gdcvault-com.l
5	Debugging Python into Maya		Cyrille Fauvel	AUTODESK	Visual Arts	GDC 2011,fre	https://www-gdcvault-com.l
6	The Audio Technology of 'Torchlight 3'	Action RPG games have a part	Guy Somberg	Echtra Games, Inc.	Audio	free content,	https://www-gdcvault-com.l
7	Behind the Scenes: The GEARS OF WAR 2 Cinematics	Pipeline	Tanya Jessen, Greg	Epic Games, Epic Games	Visual Arts	Greg Mitchel	https://www-gdcvault-com.l
8	Mobile Audio Has Gone Bizerk!		Brad Fuller, Chris	Sonaural LLC, Beatnik, Inc	Audio	Chris Grigg,M	https://www-gdcvault-com.l
9	Concepts & Animating Sam Fisher in Splinter Cell:The	Chaos Theory	Eric Bibeau, Gilles,		Visual Arts	free content,	https://www-gdcvault-com.l

Figure 3 The Title-Abstract list from GDC Vault.

The main purpose with this retrieved list is to be able to reliably search for presentations. In this study, Microsoft Excel's search function "Find and replace" was used to manually search

for presentations. The main advantage of using Excel's search function compared to GDC Vault's own search engine, is that Excel will present how many *hits* a search term has provided. The main issue with GDC Vault's search engine is that it lacks data about the search results. However, a disadvantage of working with a Title-Abstract list, is that the researcher needs to perform a more labour-intensive search. Essentially, first search for a term, then flag all the presentations that contain the term, and finally extract all the flagged presentations.

4.2 Pre-review mapping study

After the Title-Abstract list was retrieved, I performed a *Pre-review mapping study* to explore the data and try to get an initial understanding of the data set. Specifically, I wanted to get an idea of how many presentations that may appear when I search for large number of UI Design related search terms. This information would give some idea of the scope of the review.

First, I started with one search term. I used the *Find and Replace* feature to search for "user interface" and then flagged all presentations with an X in a separate column. After all presentations had been flagged, I extracted them into a separate page.

The new list consisted of 76 items. After sorting the list in alphabetic order, it was possible to see the multiple entries for each presentation. For example, the talk "Art Direction: Graphic Design is Key" contains two entries, video and slides (See Figure 4).

	?	Title	Description	Speakers	companies	format	tags	url
2	x	A Year in Roomscale: Design Lessons from the HTC VIVE	Virtual reality development becomes	Patrick Hackett, C	Google, The Void, I	Entertainment	VRDC @ G	https://www-gdcv
3	x	Advanced Prototyping	Creating effective prototypes of gam	Chaim Gingold, Cl	levity lab, definitio	Programming	Chris Heck	https://www-gdcv
4	x	Art Direction: Graphic Design is Key	First impressions count. In a crowdec	Liam Wong	Ubisoft Montreal	Visual Arts	GDC 2016,	https://www-gdcv
5	x	Art Direction: Graphic Design is Key	First impressions count. In a crowdec	Liam Wong	Ubisoft Montreal	Visual Arts	GDC 2016,	https://www-gdcv
6	x	'Assassin's Creed Syndicate: London' Wasn't Built in a Da	Assassin's Creed Syndicate is the first	Damien Bastian	Ubisoft	Programming	GDC 2016,	https://www-gdcv
7	x	Autodesk Gameware Updates (Presented by Autodesk)	In this session, we'll provide informat	Ankur Mohan	Autodesk	Programming	Ankur Moh	https://www-gdcv
8	x	Autodesk Gameware Updates (Presented by Autodesk)	In this session, we'll provide informat	Ankur Mohan	Autodesk	Programming	Ankur Moh	https://www-gdcv
9	x	Automate, Streamline, Win! Content Creation for Small T	Last year Rumpus released the first e	Alexander Birke	Out of Bounds Stuc	Independent Games Sum		https://www-gdcv
10	x	Automate, Streamline, Win! Content Creation for Small T	Last year Rumpus released the first e	Alexander Birke	Out of Bounds Stuc	Independent C	GDC Europ	https://www-gdcv

Figure 4 Flagged presentations sorted in alphabetic order

A lesson learned from performing the pre-review mapping was that while the search in Excel resulted in 79 cell(s) found, there were instances where the keyword was mentioned both in the title and the abstract, and therefore the actual number of presentations was slightly less. Furthermore, after I had grouped the different presentation formats (audio, video, slides), the number of *unique presentations* was 42. Therefore, the number of cell(s) found with Excels *"Find and Replace"* were roughly twice the number of actual presentations.

The final part of the pre-mapping review was to explore how many hits that a set of different search terms might result in. I experimented with searching for roughly 20 terms that relate to UI design. For example, user interface, interface design, interface, user experience and so forth (Table 2 in section 4.4 contains all the terms explored). From, this exploration, I assumed that a search for these terms might result in around 600-1200 unique presentations. I also assumed that one person could screen this number of presentations within two weeks of time.

4.3 The purpose of the systematic mapping and the synthesis

In this section, the purpose and scope for the systematic map and synthesis is determined. Based on the *pre-review mapping,* there seem to be a be large number of GDC presentations that relate to UI Design. An issue with GDC Vault is that there is currently no search category for "UI Design", and in turn it is challenging to find UI design related talks. Therefore, this study aims to contribute with a map of all game UI design presentations on GDC Vault. The purpose of the map is to identify all presentations that discuss experiences from *games for entertainment* and has a *focus on UI Design*. These are the two inclusion criteria that will be used in the screening process.

While the systematic mapping aims to include all presentations that discuss UI design for games for entertainment, the final synthesis aims to answer the research question with a narrower focus. The research question is: "*How does the game industry create UI Design?*" To provide an answer, the purpose of the synthesis will be to analyse a set of presentations that focus on describing "*empirics from a specific games UI design process*". This purpose builds on the problem identified in the third chapter. Engström (2020) states that there are few studies that describe how UI design and Interaction design are created in the game industry. To assess the most relevant presentations for the synthesis, the relevance appraisal will use the following eligibility criteria:

> *"The degree the presentation contains empirics from a specific mobile, console, or desktop game's UI Design Process?"*

This criterion is assessed on a five-grade scale, from a very low to a very high degree. For example, a very high degree talk would be a presentation where the main focus is to describe experiences from the UI Design process of a specific game. A high degree talk would be a presentation that spend most of the talk on the topic.

Furthermore, the relevance criterium is narrowed down to focus on UI Design for screen-based games. In other words, games that have a screen such as mobile, console and desktop games. This is because UI design for screen-based mediums is substantially different from mediums such as Virtual Reality, Augmented Reality and Mixed Reality. The mediums are different in the way that visual UI can be presented, and the way that players can move and interact in the game. Therefore, for the synthesis, the presentations that describe UI design for AR, VR or MR games will be assessed as of very low relevance.

4.4 The review protocol and the search procedure

The review protocol was essentially created by structuring the Excel document into three pages which represented the steps in the review process. Each page was structured with additional columns for criteria assessment, and for commenting about the contents. The three steps in the process were: *Database (search)*, *ScreenMe*, *Relevance*.

Page 1: Database. This page contains all the 12'000 GDC presentations. This page is used to search and flag presentations. In essence, Excel's search and replace function was used to identify talks that contain the search term in either the title or description. Table X (on the following page) contains the search terms used. Note that some search terms contain an additional space before or after the term, this is to prevent false positives. Otherwise, the term UX without spaces can give results such as Linux or Molyneux. The search resulted in a list of 699 URLs (or 374 unique presentations) to be extracted to the ScreenMe-page.

Table 2: The applied search terms

Search term	Cell(s) found	Comment
"user interface"	81	Reasonable
"interface design"	25	Reasonable
“interface”	261	Reasonable
"user experience"	258	Reasonable
"UX"	651	Too many false positives
"UX "	356	Too many false positives
" UX"	183	Reasonable
"usability"	92	Reasonable
“interaction design”	21	Reasonable
“GUI ”	11	Reasonable
“UI”	7439	Too many false positives
“ UI“	129	Reasonable
“UI “	113	Reasonable
“ HUD “	8	Reasonable
“up display”	3	Reasonable
"human-computer"	1	Reasonable
“human computer”	4	Reasonable
“human-centered”	15	Reasonable
“human centered”	0	No hits
“user-centered”	5	Reasonable
“user centered”	4	Reasonable
“User Research”	75	Reasonable
“ GUR ”	3	Reasonable
“ UR “ “GUX”	0	No hits

Page 2: ScreenMe. At this page, all the search results are screened by title and abstract to determine if the presentation should be included to the next step. The first step in this page is to sort the data in alphabetical order. By sorting the data, the different formats for each presentation will be grouped (video, audio, and slides). The second step was to identify the format of each presentation by visiting all the 699 URLs and comment: video, audio, or slides. The next step was to follow the review protocol for this page. On this page, the review protocol consists of additional columns for inclusion criteria and for commenting about the contents. Then, the work procedure to assess each presentation was to open the presentation on the GDC Vault webpage, read the title and description. Then open the video presentation and search for the outline or agenda. Finally, answer the inclusion criterium with yes, no, or maybe. The first criteria were if the talk about games for entertainment? Second, does the presentation contain any part that has UI design focus? Finally, write a comment about the contents discussed. The Screening identified 113 presentations that met the inclusion criterium. These talks were extracted to the third page.

Page 3: Relevance. At this page the talks that were included in the screening process are assessed with rigour to assess their relevance to the research question. A relevance criterion was developed at this step to identify the presentations that on a 5-grade scale describe “empirics of the UI design process of a specific game for mobile, console and Desktop game”. This question was developed to identify talks that focused on sharing experiences and approaches to how game UI design is created. The procedure at his step is to open each presentation, read the title, abstract and watch the first 3 minutes of each video. Thereafter, fill in the review protocol for the relevance criteria and write a comment about the content. Presentations that are too unambiguous about the content are rated as of very low relevance. After all presentations have been assessed, sort the list for relevance and extract the very high relevance talks to the next page. At this page, eight presentations were identified as of very high relevance and were included in the thematic analysis.

4.5 Thematic Analysis

The final step in the systematic review is to synthesise the presentations that were ranked as of very high relevance to the eligibility criteria. To perform the analysis, I followed the steps and guidelines provided in Braun and Clarke (2006):

Table 3: Phases of thematic analysis (Braun & Clarke, 2006)

Phase		Description of the process
1	Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2	Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3	Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4	Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5	Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6	Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back to the analysis to the research question and literature, producing a scholarly report of the analysis.

When I performed the analysis, I began by familiarizing myself with the data by watching the eight video presentations and briefly noting down the contents. After I had seen all the GDC presentations once, I followed Braun and Clarke's recommendation to transcribe verbal data. However, since the talks consists of roughly 5,2 hours of verbal data, it was not feasible to carefully transcribe the full contents of all talks. In order to save time, I had to be selective about what content to summarize and what content to transcribe. In practice, I transcribed the high-level content, ideas and principles of each talk relating to the UI design process. I summarized the low-level content where the speaker discussed about something very specific only to their game. Whether the content was summarised or transcribed, the content was always timestamped so that I could revisit that portion of the talk if needed.

During the time I was re-watching the presentations, I also started to note down initial codes for the data. I used coloured tags to highlight when the speaker talked about what could be an overarching theme. For example [Usability]. By writing the hashtags, I could easily search and collate the codes. All the transcription and coding were performed in Microsoft Word. To collate the codes, I started extracted all the data for each code to a separate document.

At the beginning of the analysis, I had about 15 unique codes. However, at the end, it amounted to 77 unique codes. In order to create an overview of all codes and their frequency of use across all presentations, I summarized the unique codes into Excel. First, all the unique codes for each presentation were summarised. Then, all the codes of all eight talks were summarised. With this list, it was possible to see the code use across all eight talks. For example, it was possible to see that: 5 of 8 talks discussed [Interdisciplinary collaboration]. This way of summarizing the frequency of code use for each presentation provided an additional perspective for identifying overarching themes and sub-themes.

5 Results

This chapter is divided into two sections. Section 5.1. describes the results from the relevance appraisal, and 5.2. presents the outcome from the thematic analysis of the GDC talks assessed as very high relevance for the research question.

5.1 Relevance

The screening process resulted in a list of 113 UI Design presentations. This list was then reviewed for relevance for the research question. During the relevance appraisal, three presentations were identified as duplicates in the sense that the presentation had been performed previously with the same title and content at an earlier GDC event. There were also five presentations that had made it through the screening process although the content does not focus on UI Design, these presentations were excluded as "Not on topic". Of the remaining 105 presentations, 52 were rated in the thorough manual review to be of very low relevance, 10 were judged to be of low relevance, 23 of intermediate relevance, 8 of high relevance, and 12 to be of very high relevance. A list of all the 105 presentations, including the 8 that was excluded, can be found in Appendix A.

The talks that were assessed as of *very high relevance*, were talks were the main focus is to share experiences from the UI design process of a specific game. The talks focus on the design process and contains activities such as working with user flows, information architecture and exploring design concepts with prototypes and wireframes.

The talks that were assessed as of *high relevance*, were talks that seem to discuss the design process of a single game, along with other topics, such as business and marketing. Another factor that lowered the relevance from very high was if the talk focused heavily on UI Art such as icon design and typography, rather than information architecture.

The talks assessed as *intermediate* are talks that had UI design as a secondary topic. A majority of these talk's primarily focused on Game design, while there are also talks that discuss other topics such as accessibility, building UI frameworks for interdisciplinary work, and how to build trust for UX inside the company. These talks are of intermediate relevance due the fact that they may contain some experience from the UI design process.

The talks that were rated as *low relevance* were talks that had UI design as one of many topics discussed in the talk. These talks could possibly contain some experience of the UI design process. The main topics of these talks are for example: User research, Usability checklists, UI development. It could also be talks that focus primarily on UI design theory, such as the four different types of UI.

The talks that were rated as *very low* are also the most diverse. First, if it was clear that the talk was not going to discuss the UI design process of a specific game, it was immediately rated as very low relevance. Secondly, talks that share experience from Mixed Reality, Virtual Reality and Augmented Reality were rated as very low relevance on the basis that the challenges and experiences from these mediums are fundamentally different from screen-based mediums, such as desktop, console and mobile. A majority of the talks discuss best practices, principles, or guidelines for UX or UI design for games in general or for game developer tools.

5.2 Results from the thematic analysis

In the thematic analysis, I have analysed eight different GDC presentations. These presentations are all assessed as very high relevance for the research question. Table 4 presents the presentations that were analysed:

Table 4. The list of analysed UI design talks

ID	Year	Title	Speaker	Role	Game	Platform
1	**2011**	THE SIMS 3 Create-a-Sim User Experience	Sammi Kim	UI Designer	The Sims 3	PC
2	**2013**	Crafting Destruction: The Evolution of the Dead Space User Interface	Dino Ignacio	Lead UI Designer	Dead Space 1-3	Console
3	**2014**	UX Redesign: Creating a Consistent Cross-Platform Experience	Misa Damjanic	Game Designer	Top Eleven	Mobile
4	**2015**	Designing UX in WoT Blitz: What got us to Best Appstore Game 2014	Olga Kachalina	Lead UX Designer	War of Tanks: Blitz	Mobile
5	**2015**	Hearthstone: How to Create an Immersive User Interface	Derek Sakamoto	Senior UI Designer	Hearthstone	PC
6	**2016**	Tenacious Design and The Interface of 'Destiny'	David Candland	UI Design Lead	Destiny	Console
7	**2019**	Building the Interface of 'The Elder Scrolls: Blades' in Landscape and [...]	Marie Jasmin	UI Designer	The Elder Scrolls: Blades	Mobile
8	**2021**	Cutting Apart the Diegetic Interface of 'Hardspace: Shipbreaker'	Vidhi Shah	Game & UX Designer	Hardspace: Shipbreaker	PC

All talks on the list describe experiences from the UI design process, and most of the talks are presented by the game's UX or UI designer. The size of the companies ranges from indie to AAA-companies. While some of the games listed may have been released for multiple platforms, the GDC talk focused on the platform listed in the table. The platforms range from mobile, console to PC.

In total, the eight video presentations consisted of about 5 hours and 20 minutes of verbal data. The analysis document containing the transcriptions, summaries and codes consist of 84 pages or about 26000 words. The number of unique codes amounted to 77. Although, out of these, there was 24 codes that only occurred in one talk, and 19 that occurred in two talks. The number of codes that occurred in at least three different talks were 34. Figure 5 presents the most commonly recurring codes and their frequency across talks.

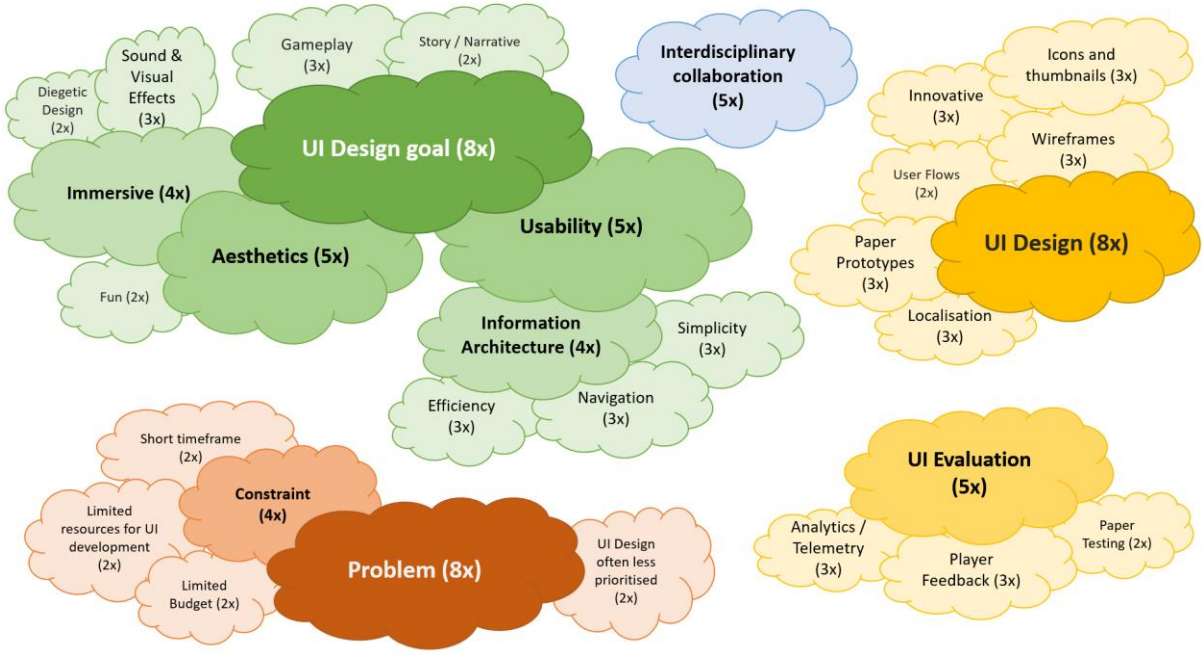

Figure 5 The codes and their frequency across talks

This map above was also used to as a pointer to identify potential themes and sub-themes. For example, while all eight presentations had UI design goals, the concept of aesthetics was discussed in 5 of 8 talks, and then there was four talks that discussed the aesthetic goal of designing the interface to feel more immersive, two talks aimed at designing a fun interface.

Although, it was possible to group the frequency of codes in this manner to provide an overview, this cloud did not translate well into identifying actual and interesting themes across talks. In other words, the frequency of codes was mostly useful to identify potential themes, rather than actually interesting themes. When looking up the quotes for each code, there was rarely any similarities or interesting themes to extract from the quotes, even though four talks touched on the topic.

While each talk is very different from each other, there are themes identified from similarities in what is said, and what the designers strive for. The following section present two main themes that were identified in this analysis.

Theme 1 – Interdisciplinary collaboration

An overarching theme is how other disciplines might want to involve and collaborate with User Interface design. Derek Sakamoto, Senior UI designer at Hearthstone spends a large portion of his presentation to discuss interdisciplinary collaboration. He suggests that one contributing factor with Hearthstone's success is the leadership which not only involved UI design from the start of the project, but also elevated UI design to be part the core team, working as an equal to game design:

> This is my final point which is… UI gets to sit at the big kids' table. And what I mean by this is that – this is not true of every project – but I've seen it where designers come up with a game, they come up with mechanics, and then they're like… 'Let's slap an UI on top of this thing!' Right?"
>
> The other aspect of that is, I've seen UI be kind of a second-class citizen in terms of production, right? Maybe they get a dedicated programmer, maybe not, or maybe a dedicated artist?
>
> And so… these are some issues that - I think - we tried to address. […] We wanted to be at the big kids' table. And so… it's a testament to our leadership – I think – that UI design was given a fair share and was given a, you know, parity with game design.
>
> (Sakamoto, 16:45)

In this quote Sakamoto explains that he has seen projects where UI design might not be involved until late in development, and once involved they may not have access to any dedicated developers or artists to work with the UI. The first aspect – that of being involved late in the process – is evidenced by these three quotes from the Game & UX designer on Hardspace: Shipbreaker, Vidhi Shah:

> The game's been in development for over five years and players have had it in their hands for over a year now. [27:00]
>
> We're a fairly small team of about 30 people and have been in early access for over a year now, and that's how long I have been on this project. [1:18]
>
> We wanted to not only redesign the interface to make it more usable. It was very much, you know, made by devs in the past, but we wanted to make the experience more immersive and embedded into the game world. [06:00]
>
> (Shah, 2021)

The quotes above show that Hardspace had been developed for over four years before Shah was involved in the project. Additionally, Shah mention that the UI has been made very much by developers in the past. This makes it reasonable to assume that the project hasn't had any dedicated UI designer until the game was released as Early Access. This is evidence of what Sakamoto mention, that UI design might not be involved until late in development. Although, out of the remaining six presentations in this analysis, most UI designers seem to have been involved early in the development process. Therefore, in this study, it seems that there was only one case where UI design was involved late in development.

However, once Shah becomes involved in the project, she was able to work closely with game design and narrative design. In other words, she was able to "sit at the big kids' table". She mentions that her role in the project is Game and UX designer. As mentioned in the background chapter, "UX design" or "User Experience Design" is treated as a synonym for UI design. However, by being a UX designer, Shah also seems to consider analytics data and player feedback and from Early Access, rather than working solely with Game & UI design. Similar to Sakamoto, Shah also talks about her experience of working as UI / UX designer who is a part of the core team:

> [...] two sections of design had to work together. One impacting the other and vice versa. Oftentimes they [game design and UX design] are two separate factions in a studio, and they don't get to be so closely integrated. So, I thought I would be very much like the Spiderman pulling these two ends together [Figure 6, left]. I'm so cool! I'm so smart and strong! But in reality [Figure 6, right], that's kind of what my experience was mostly like. I definitely felt like that cat, and I especially felt like this cat when we were addressing the densest screen of our game.
>
> (Shah, 2021, 9:14)

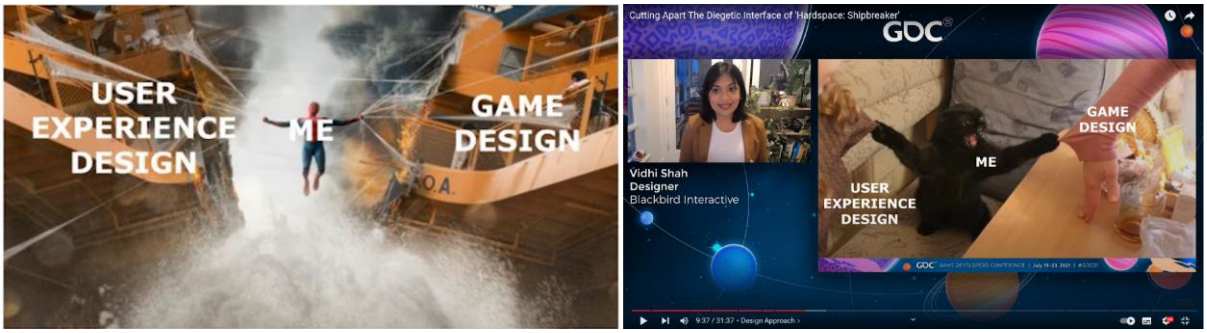

Figure 6 Two screenshots from the Hardspace: Shipbreaker talk. The left picture (9:30) shows Shah's anticipation of how she would feel while pulling together UX Design and Game Design (strong and confident), and the right picture shows what she actually felt while doing it (small and distressed).

From the quote above, Shah suggests that it was a challenging to collaborate closely between UX and game design. Although, she does not mention what parts that caused UX and game design to disagree, she does mention that working with the Heads-up Display's (HUD) Information Architecture was the most challenging part. In the end of the presentation, she concludes:

> Some of the learnings and opportunities from this experience. UX and games worked closely together they sat at the exact same table, and I kind of rarely but no, I did feel like Spiderman. Having both, in the same room, at the same time, meant influencing the game holistically and not in silo. I have worked in on games where I've had to be in one department of the other but having the ability to leverage all components: the game, the story, and user experience design… what you're really doing is building emotion for players, and that's incredibly valuable. Especially, with the constraints that I mentioned earlier this became an inexpensive and innovative way – I guess – to introduce story and to build a presence into the game through the game's UI.
>
> We leverage not just UI but also effects and audio, and I understood that value very strongly through this experience. It was just plain fun. I don't know what to tell you. I've worked in both departments separately, but this was an incredibly fulfilling experience as a creative, and now I find myself thinking always holistically. I can't make a design decision purely without considering the UX implications, or vice versa… and I think that makes, that has helped me become a better designer, but it's also helped impact the game in a positive manner.
>
> (Shah, 2021, time)

In this quote, she suggests that there are benefits to having UX and game design collaborating close together. The benefits seem to be that by joining forces, the disciplines were able to turn the constraints, such as short timelines, limited budget, limited development time for UI, into affordable and innovative solutions. While the company could not afford to convey the narrative by elements, such as cut scenes or 3D model characters, the collaboration focussed on how the interface could be designed to convey the narrative and build a sense of presence. For example, to convey the narrative, one inexpensive solution was to simulate in-game voice communications over radio. They used audio recordings, along with designing the in-game HUD to display a picture of the person speaking along with a text message. Although Shah explained if this particular design solution may not be realistic:

> This UI elements that probably wouldn't exist […] was a conscious decision that we made to ensure that we made room for every element in the game, and we try to bring the player back into that sense of presence using the post-effects and audio […] to sell that realism.
>
> (Shah, 2021, time)

As mentioned in the quote, Shah and her team leveraged visual and audio effects to build a sense of presence. For example, they designed the in-game HUD to start malfunctioning in response to the hazards in space, such as a collision or extreme temperatures. Nevertheless, the most substantial element for building a sense of presence is arguably the diegetic UI design approach, but that is a topic for another theme. While Shah was not explicit about how the interdisciplinary collaboration actually worked between the UI / UX designer and Game Designer. Derek Sakamoto (2015) provides an example of how UI and game design collaborated in Hearthstone:

> [...] One way this works is that... sometimes [game] design would give us a very loose design, maybe a couple sentences, and we [the UI team] start doing mock-ups, and then [game] design would come and be informed by those mock-ups.
>
> And... it was kind of like a canary in the coalmine situation, where if the UI was super complicated looking then, maybe design needed to take a step back and see what design was causing those complications, and maybe removing those or mitigating those problems.
>
> (Sakamoto, 2015, 17:36)

This example shows how game design provide the UI design team with a vague design goal consisting of a few sentences, which then UI design can start to creatively explore and create mock-ups. It is interesting to note the canary in the coal mine metaphor. UI design might be useful to visualize how the current set of ideas might be realized on a screen, and the game designer can look at those mock-ups and discover if there are any issues with the ideas when put into practice. This way of collaborating from vague design goals seem to be how interdisciplinary collaboration works at larger game companies as well. For example, David Candland, UI Design Lead at the AAA title Destiny explains the use of vague design goals as the following:

> "So... We prototyped and we explored, and we thought about the design... and came to the conclusion that we really wanted to move forward with this decision. So, we talked to Jason Jones. He is our Creative Chief, and he agreed, but he gave us the following goals to work from... And... you know... When you are talking about working on a game and getting direction from, you know, your leads, it is important to work from goals. Because when you tell the designers exactly what you want them to do, then it kinda, stifles creativity and exploration.
>
> (Candland, 2016, 6:30)

In this quote, it is interesting to note that the UI design team in AAA studio seem to collaborate and receive direction from a Creative Chief. Similar to Sakamoto's experience of collaborating with a game designer, the Creative Chief also seems to provide loose design goals. Candland explains that goals are used over detailed specifics to foster creativity and exploration. In the eight talks, the design goals and challenges were very different from each other, but a similarity was that all goals were set at a high level. Returning to Sakamoto's experience of collaborating with a game designer. Sakamoto provides a number of examples of where the UI design mock-ups informed game design and ultimately resulted in changes to the initial ideas. One example is:

> Here's our play screen [See Figure 7, left]. We used to have a ton of text on this. Describing the play mode. Describing the hero class and their power and all these numbers.... And... we just got rid of it all... [See Figure 7, right] Because nobody reads, right? We know this... And also, we didn't want this screen to be too scary to just frighten people off, before they, you know actually play the game. And... they would learn all these details through playing the game which is what we want.
>
> (Sakamoto, 2015, 18:05)

Figure 7 On the left is the initial design, on the right is the current design.

This example shows that it was not until the design was realized visually that the problems were identified. As Sakamoto mentions, the substantial amount of information might give of the impression that the game is complicated to players. Finally, Sakamoto also mentions that they were a number of cases where the UI design mock-ups had implications on the gameplay design as well, for example:

> In this case, we had designed a board, and we had the minions that we liked, but only seven fit. So we're like... well, maybe we'll just shrink them down as you start adding them? And... I think we all decided that this was not a good idea because, it would mess with the physicality of our stuff. When you see things zooming bigger and smaller, it's subtle but it affects your perception of the value of these things, I think, and having just a seven-minion limit is an interesting play mechanic, I think.
>
> Sakamoto (2015, 18:34)

This shows that UI design may have implications on game design as well. It is worth mentioning that Hearthstone uses an aesthetic design approach where the goal is to design the UI to feel as physical as possible. If the cards can shrink or enlarge that would make the card feel less physical. Ultimately, it seems to be a decision taken on group consensus after the problem was identified in a UI mock-up.

This theme has described how other disciplines might want to involve and collaborate with User Interface design. It has also described how game designers and other leads collaborate with UI design by providing them direction and goals for the UI design to explore. Finally, there is evidence UI design mock-ups can be used to inform game design.

Theme 2 – Aesthetics versus Usability

In the eight talks, there are distinctly different UI design approaches and priorities. Although each talk has rather unique goals with their design, there seem to be similarities based on what is the highest aim during the process. Among the talks, there were two aims that seemed to compete with each other: Usability and Aesthetics.

In several talks, usability is the guiding light for the UI design process. In these talks, the focus is on meeting user needs and making the UI easy and efficient to use. A lot of effort is put into exploring different design solutions with users. User feedback and testing are an important source of design decisions. For example, *War of Tanks: Blitz* conducted user

testing to investigate whether icons can be used instead of text for certain buttons. They learned that several players misunderstood the meaning of the icons. Therefore, the takeaway was that "*text is the best icon*" (Olga Kachalina, 2015). This approach could be called Usability First. In this approach aspects such usability, and user feedback are the primary in design decisions. This approach is also perhaps most common in web and software development. The GDC talks that follow this approach to a greater extent are: *The Elder Scrolls: Blades*, *The Sims 3*, *Top Eleven* and *War of Tanks: Blitz*.

In contrast to Usability First, there are two GDC talks in which the UI design approach is characterized by a more aesthetic-centred approach. In these talks, the highest priority is to convey a certain feeling or experience with the UI Design. For example, Dead Space focuses on designing the UI to allow the game to feel as immersive as possible. While Hearthstone focuses on designing the UI to feel as if you are interacting with physical objects. Both Dead Space and Hearthstone could therefore be considered as *Aesthetic First,* since their highest design priority is to achieve a desired aesthetic, rather than focusing on improving usability. This intent to prioritise aesthetics is explicitly mentioned in the following quote by Derek Sakamoto regarding Hearthstone:

> […] we generally design for 'Flavor Over Efficiency'. We designed this box to fold open, the drawers to slide around… all for you to have a sense of place of where you are in this box. You can't instantly jump from place to place, because we feel that kind of disconnects you from the experience.
>
> (Sakamoto, 2015, 15:14)

This quote is taken from a context where Sakamoto presents a usability issue, which will be described further down. However, what is interesting to note is the design principle "Flavor over efficiency". This principle shows that Hearthstone prioritizes design that better conveys a certain experience, over design that is more efficient.

Another example of Aesthetic First is Dead Space which aims to design the UI to be as immersive as possible. To achieve this goal, Ignacio used a Diegetic design approach, which essentially makes the UI as something that exists in the game world, rather than a screen-based overlay that exists outside the game world only for the player of the game. Ignacio says that he wanted to increase immersion by getting rid of the UI as safety glass between you and the game. However, during the process of making diegetic UI design, Ignacio encountered many usability issues. For example, when he tried to convey a feeling of uncertainty, he designed the UI with visual effects such as scan lines and flickering fluorescent lights. However, he learned that it was challenging to use these aesthetic effects without making the UI to feel unusable or illegible.

Among the eight talks, the two last remaining, Hardspace: Shipbreaker and Destiny seemed to lean towards Aesthetic First approach, although they also seem to have found a middle ground, by also focusing on usability. The talk regarding Hardspace: Shipbreaker focuses on how the UI design can convey the aesthetics, narrative and be easy to use. While GDC talk on Destiny is concerned about both efficiency and aesthetics. Therefore, these two talks seem to stand somewhere in middle ground between Aesthetic First and Usability First. For illustrative purposes, the talks can be presented on a continuum stretching from Aesthetic First to Usability First (see Figure 8).

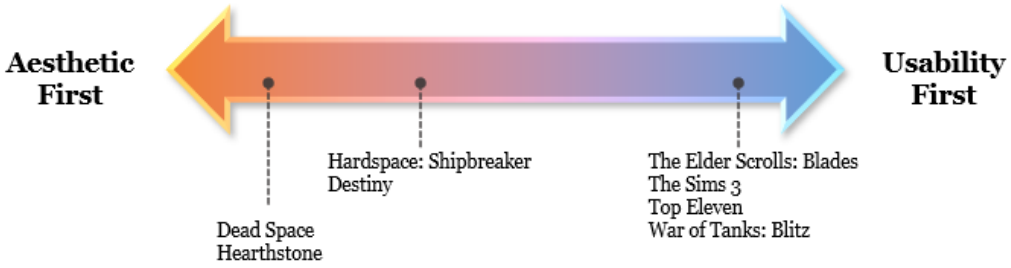

Figure 8 This diagram presents an abstraction over the different GDC talks' design priorities.

Regardless of whether it is usability or aesthetics that is the highest priority during the design process, both aspects need to be considered in order to succeed with design. Among the eight talks, there were three setbacks that relate to insufficiencies in either aesthetics or usability. In Dead Space and Hearthstone, the setbacks relate to usability, while in Destiny it was aesthetics.

The biggest setback in Dead Space was in the design of "The Bench". Ignacio describes that their intention was to create a workbench where players can build and upgrade their weapon. The aesthetic goal was a construction table with the information and controls spread out on several glass screens, all while the in-game character was displayed interacting with this interface. However, because the screen was very information dense, it was challenging to find a design solution that lived up to the aesthetic goals and was usable at the same time. After months and many iterations, Ignacio ultimately had to part from the aesthetic ambitions and instead design a more traditional UI with all the information condensed in one screen. After the experience Ignacio concludes:

> "And so… what you realize is that, after all those things I said, all those rules we setup, all that fiction stuff that I believe in… at the end of the day, none of that is important if your users can't interact with the game. The bottom line is, fun and usability is more important than the bullshit I was talking about in the beginning. All that is cool, all that is amazing, all those rules, all the fiction stuff that I love, that I really care about… It doesn't really matter if they can't get the game across. And so, we had to make these changes, and I stand by those changes, these are changes that I believe make the game a lot better. They are not necessary the prettiest solutions, but it made sure that YOU were able to use the system, and you were able to use it as fast as possible, and in the limitations that you had with the console controller."
>
> (Ignacio, 2013, 48:43)

The quote shows that the highest priority was to achieve the aesthetic design ambition. Although, it was difficult to accept, Ignacio and his team had to part with their aesthetic design conventions in order to find a more usable design solution. The accompanying presentation slides also summarize this message well: *"We had to accept that having an easy to use interface is ultimately more important than keeping our aesthetic conventions"* (Ignacio, 2013, presentation slides, 48:47).

The second setback in regard to aesthetics and usability is presented in Hearthstone. In the following quote, Sakamoto explains that there was one case where they had to sacrifice their Aesthetic First principle, "Flavor over Efficiency" to make the UI more efficient to use (See Figure 9):

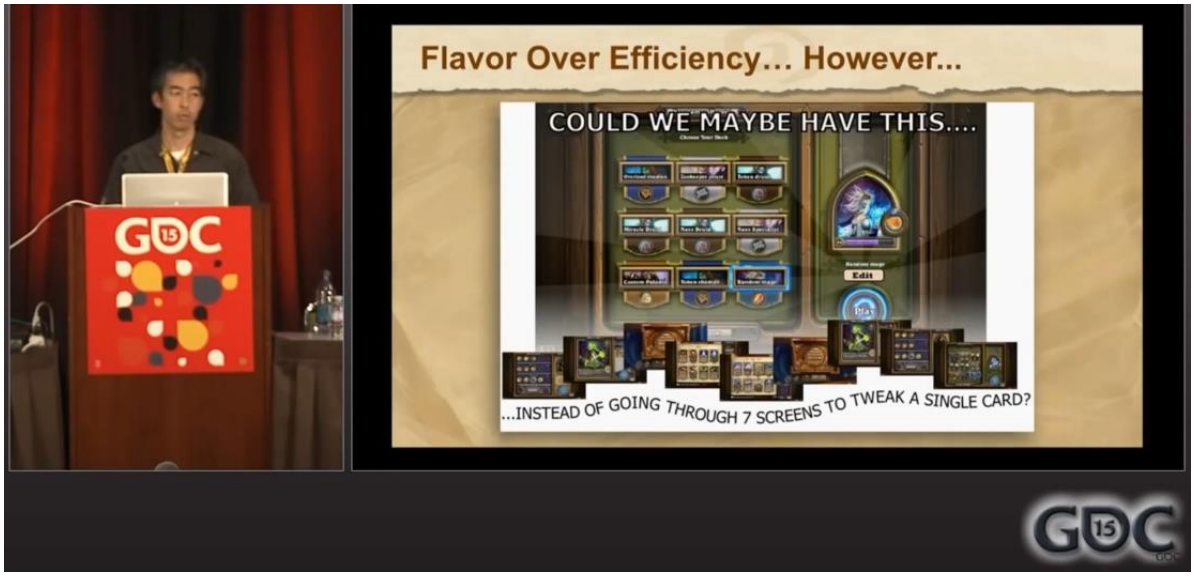

Figure 9 Sakamoto, UI Designer at Hearthstone, describes a case where they had to break their design principle "Flavor Over Efficiency".

> "This is a big knock against us. This is... This screenshot is from Reddit. We look at Reddit a lot, and are sad sometimes but... um... This issue is: 'Not the most efficient navigation'. And so... for this example, it takes a ton of clicks to do something that maybe should be a lot more straightforward, and our answer is this is that... We generally design for 'Flavor Over Efficiency'. We designed this box to fold open, the drawers to slide around... all for you to have a sense of place of where you are in this box. You can't instantly jump from place to place, because we feel that kind of disconnects you from the experience.
>
> HOWEVER, when things are this bad. [...] We realize that this is a real problem, and we need to solve. So, this is something we are looking at... and so... It is nice to have a point of view, but once... things start affecting the player, I mean... we have this in the middle of our campus engraved in bronze... 'Gameplay first'. So... this is... There is definitely times when you need to make compromises."
>
> (Sakamoto, 2015, 14:54)

The two last examples show that there is often a conflict between designing a UI to convey an aesthetic or designing it to be efficient to use. These setbacks seem to occur when a design solution starts to go too far in one direction.

Another thing that is interesting to note in the quote above is Sakamoto's argumentation for design prioritization. Sakamoto mentions that they generally design for "Flavor over efficiency", however, then he presents "Gameplay first" as the secondary (or tertiary) prioritization that the current design needs to be compromised for. However, the issue is that "gameplay" is a different phenomenon than "efficiency". Gameplay is an outcome of game design, such the intended challenge, goal structures and story. In this context, it is reasonable to believe that Sakamoto actually meant "efficient use" rather than gameplay. When dissecting the meaning of the principle "Flavor over Efficiency". Then "Flavor" should represent the intended aesthetic of "Physicality". In the presentation, Sakamoto mentions

that the UI is designed to feel as if you are interacting with a physical object. Then "Efficiency" has to represent efficient use (or usability) rather than gameplay. Therefore, gameplay is no tertiary UI design priority or a "third dimension" in UI design decisions, because "the gameplay" is a responsibility of the game design team. Ultimately, it is also arguable if the action of "adding or removing a card to a deck" is considered to be gameplay in this context.

While Dark Space and Hearthstone show examples of where the pursuit of aesthetics has gone too far, the following example shows a case where the pursuit of usability has come at the cost of losing the initial aesthetic. The setback that Destiny presented concerns the design of the mission selection screen, also known as "The Director". The initial concept of this screen was a map of the solar system where players could choose a location and various types of missions. In the initial concept, there was an implied aesthetic of that the solar system provided with a "sense of place". The game was developed over several years, and Candland and his team created several design iterations to make it easier and more efficient for players to choose missions and locations. Although, over the years, the map of the solar system had disappeared and in favour of an efficient menu system (See Figure 10). This meant that the initial aesthetic idea of navigating a solar system had been lost over the years of iterating. David Candland, UI Design Lead of Destiny describes the issue as follows:

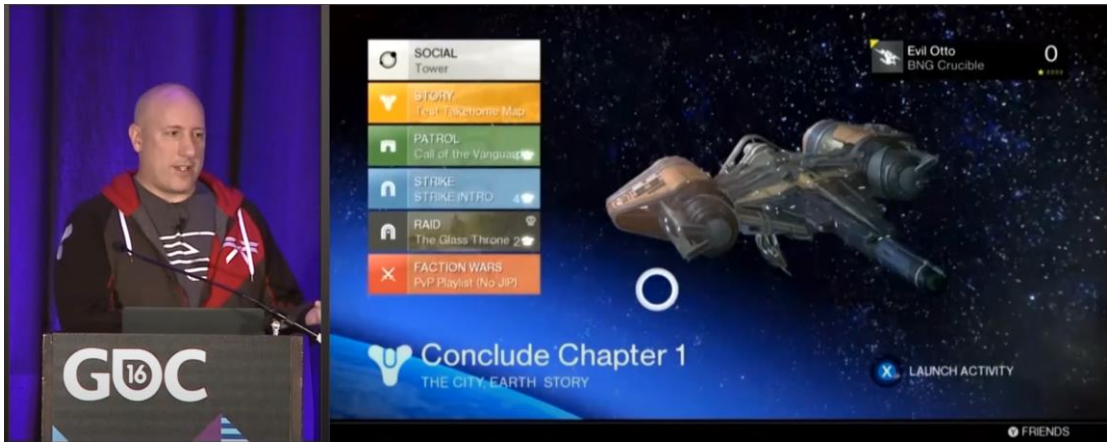

Figure 10 This prototype of The Director (mission select screen) did not make it to the final game due to lacking important aesthetics.

> "[...] and here, is where we landed. Now... this is like at the end of the development cycle. and we had basically streamlined the process, solved lots of issues, made it absolutely easy to do what you want it to, and do it extremely efficiently. BUT... we had totally sucked all the fun and cool stuff that we had in that very first prototype, and we realized that we had somehow gone astray. So... this was an important lesson that we learned. It's that, when you are iterating, and improving, and trying to fix everything from the last iteration, you got to take a look at ALL your previous iterations instead of just the last one. Because, then it can start driving you in the wrong course."
>
> (Candland, 2016, 45:58)

Eventually, Candland and his team got around solving the aesthetic issue before the release of the game. However, this example shows that both insufficient aesthetics and usability can become large setbacks, and it is important to find a balance in order to succeed with design.

6 Discussion and conclusions

This chapter discusses the results (7.1), the implementation of methods (7.2), how this investigation relates to ethical and societal aspects (7.3), proposals for future studies (7.4) and conclusions from the results (7.5).

6.1 Results

To summarize, the purpose of this thesis is to explore how UI design is created in the game industry. There are two results in this thesis. First are the results from the systematic review, second are the results from the thematic analysis.

A systematic review was performed to identify all the presentations from Game Developers Conference (GDC) that relate to game UI design. The review resulted in a list of 105 presentations (see Appendix A). Thereafter, a relevance appraisal was performed which revealed eight presentations that focus on describing the UI design process of a specific game. The eight presentations were analysed with a thematic analysis to learn about how the game industry create UI design.

The result that was expected from this study was to gain an initial understanding of game industry perspective, such as what approaches and methods professionals use to create UI design. The research question has been answered to some extent by the thematic analysis of the video presentations. The results give an indication of what methods and approaches that some game companies might apply. However, it is also important to consider that the results have limited trustworthiness. The results are biased, skewed, and limited in certain ways.

The results from the systematic review have limited reliability and validity. The aim was to reveal all presentations on GDC that describe how the game industry create user interface design. According to GDC vault, there are more than 12’000 presentations as of 2021. It is unlikely that the resulting list of 105 unique presentation contain all the UI design focused presentations as of 2021. One of the largest concerns is that the title and abstracts are often not enough to assess actual the content of the presentation. It is possible that there are UI design presentations haven’t been hit by the search terms used in this study.

The relevance appraisal also had limited reliability. First, it took many iterations to find a workable criterion and a method to appraise the relevance. The final method was to read the title, abstract and watch the first 3 minutes of all the presentation. However, even with this method it was still time-saving method to quickly assess whether the presentation had one primary topic or consisted of a mixture several topics, and then finally assess if any of the topics related to the relevance criteria. The final relevance criteria were: “The degree the presentation contains empirics from a specific mobile, console or desktop game's UI Design Process”. Ultimately, any time-saving method will lower the reliability of the results obtained.

In regard to the thematic analysis, there are several aspects that limit the trustworthiness of the results. The first and the most critical aspect is the lack of triangulation. This study only consists of one method. Additional methods such as, field work, interviews or surveys with game industry professionals could improve the trustworthiness by triangulating the results in the thematic analysis with the feedback and perspective from professionals.

A second aspect is the limitations with the thematic analysis and the presentations. The results are based on what the presenter has shared in a recorded presentation. It is not possible for the researcher to ask questions to help clarify what was done and why. Furthermore, the presenters are limited to 30 or 60 minutes, and therefore they need to select the most interesting topics and learnings. It is therefore not possible for a researcher to gain a comprehensive picture of the whole the design process. Another factor that may skew the results is that the presentations at GDC may not be representative for the game industry at large. It is reasonable to assume that most of the presentations on GDC Vault are special cases. For example, world-renowned speakers, companies, or ground-breaking games.

The third aspect is my own limited experience, my preconceptions and bias toward what aspects that constitute as relevant to the research question. My background in traditional UX design has certainly influenced how I perceive important patterns in the thematic analysis. For example, while I felt that I could instantly understand the speakers who had a more Usability First approach, the speakers with Aesthetic First approach required more time to understand. During the project, it was helpful that my supervisor questioned many of my preconceptions, and I believe that more researchers with diverse backgrounds could have reduced the effect of one individual's bias and preconceptions.

The thematic analysis revealed two themes relating to the research question. The first theme describes methods and activities performed in game UI design, the second theme suggest that there are two high level aims that compete as the primary aim during the UI design process: Aesthetics and Usability. A limitation with the first theme is that few presentations were explicit about their activities and methods. For example, in many of the presentations it wasn't until the Q&A-sessions that important points about the methods were answered. For example, it was not clear that The Sims relied on internal user testing until that was clarified in the Q&A. The second theme, Aesthetics and Usability is an early theory based on underlying patterns in the talks. Essentially, I have assessed the priorities from the talks based on topics discussed, and whether the design decisions pushed the UI design towards aesthetics or usability. The theories and patterns identified in the thematic analysis are limited in trustworthiness, more research is needed.

There were two results that was consistent with the relevant theory presented in the background. The first was that few game companies perform user test often and early during the design process. In the results it was only War of Tanks: Blitz and Top Eleven that performed design testing with users during the design process. The second result was that game companies rarely use heuristics during the design process. Among the eight talks it was only Top Eleven that mentioned Nielsen's 10 heuristics. Although, a limiting factor in this result is that few if any GDC presentation discuss all the methods and activities used during the design process.

6.2 Method

My study consists of a systematic literature review and a thematic analysis. The benefit with systematic reviews is that the method can potentially reveal and collate findings from a large set of studies. Systematic reviews are typically performed on databases which support advanced search functions. However, as GDC Vault does not support any form of advanced

search, this study has contributed with an approach to enable the review by first extracting the title and abstract data.

I learned that systematic reviews can be challenging to perform. The scope I had for the review, was to uncover all presentations that discussed UI design to some extent. However, I underestimated the time needed to screen 374 presentations. The process of screening presentations based on title and abstract were often not enough, due to the ambiguity of the contents. Therefore, to assess the presentations, the approach was to open the videos and briefly skim more accurately through the outline. However, even skimming videos did not always provide an accurate idea of the contents. Some talks were too vague about the topics that more time and effort was needed identify the content. After assessing a presentation, it was documented in the review protocol with either yes or no on two inclusion criteria. The first was if it focusses on games for entertainment and the second if it discusses UI design. The final step to write a comment about the content. This comment was useful in the relevance appraisal, although the first impression was not always accurate.

If I could change anything with the screening process of the systematic review, it would be to narrow the scope. When I discovered that the search returned several hundred potential presentations, it might had been a good time reassess and narrow the scope. For example, a better scope would possibly be to only identify presentations that primarily focus on UI Design, rather than contain UI design to any extent. A narrower inclusion criterion would save time and effort in the review.

After the screening process, 113 presentations were included in the relevance appraisal. For this step, a more specific criteria were specified. The criteria were ranked on a five-grade scale, From very low to very high: *The degree the presentation contains empirics from the UI design process of a specific mobile, console, or PC game.* There was also an additional criterion to assess presentations: *The degree UI design and interdisciplinary collaboration is discussed.* However, I discovered that the two criteria did not work in conjunction to narrow down the number of presentations. Since the talks that focused more on UI design and interdisciplinary collaboration rarely discussed this topic along with empirics from the UI design process. Therefore, two different sets of presentations were generated, and ultimately the second criteria were excluded.

Compared to the screening process, the relevance appraisal was more systematic in the approach. A challenge with a quick appraisal method is that it will always be a tradeoff between quality and efficiency. For the highest quality appraisal, it would be best to watch the presentation in its entirety. However, to strike a balance between the quality and efficiency, the rule was to watch only the first 3 minutes of each presentation and then make the best attempt to assess the presentation to the relevance criteria. The consequence of this quick appraisal method is that there is room for misjudgments.

In total the Appendix in this thesis contains 113 presentations that were included in the manual screening process. Thereafter, the relevance appraisal led to 8 of them being excluded due to being either duplicates or not on topic. Out of the remaining 105 talks that survived the relevance appraisal, it is highly likely that not all GDC presentations that describe UI design were discovered. The process of the systematic review to manually screen title and abstracts from a datamined database has many flaws. For example, the search terms may not have returned all talks. One area that could be improved for the next review is the list of search terms.

The method that used to answer the research question is a thematic analysis. The thematic analysis is essentially a document analysis of video presentations. One of the benefits of performing a document analysis, compared to interviews or surveys is that it's often possible to gain access to a broad set of experiences. In this study, the eight different presentations provided a broad picture of how several companies approach the UI design process. However, a downside with document analysis is that it's not possibly ask probing questions or ask the presenter to clarify what was said. Although, it is outside the scope of this study, it would be beneficial to try to contact the speakers of the GDC presentations to enquire about what was said and meant in the presentation. This could address the above mentioned the downside with document analysis.

When it comes to the thematic analysis, I followed Braun and Clarke's (2006) recommendation to write extensive transcripts of the verbal data. This allowed me to familiarize myself with the data, however I underestimated the time needed to transcribe eight presentations, what was planned to take about 2 weeks end up taking 4. My approach was to write timestamps, quick summaries of the content and transcribe the parts that were may be part of an overarching theme. Parts that were too specific for a certain game was summarised instead. The presentations contain about 4.5 hours of material. The analysis document amounted to 25600 words, which included both analytical notes and transcriptions. Ultimately, the groundwork of the analysis took longer than expected, leaving limited time to collate and write about the results.

I spent less than a week to collate codes and writing drafts of potential results. While I had several potential patterns, many of them collapsed when I tried to combine the quotes from different presentations. The speakers were often referring to different phenomena. In the end, I only had time to finish with one inductive theme, which is what is presented as Aesthetic vs. Usability. However, this is but a fraction of the potential themes that reside in the data set.

Although the intention was to carry out an inductive approach, the result of the first theme ended up of becoming a top-down approach. When I compiled which methods and activities for all talks, the approach was guided by a question. Namely, which methods and activities appear in the eight presentations? Therefore, for the first theme, I unwittingly went astray from my intention to perform an inductive analysis.

If I could change anything in the thematic analysis, it would be to reduce the scope in some regard. Either limit the number of presentations to analyse, or to try to transcribe the content in a more efficient way. For example, record a timestamp of where there could potentially be interesting overall themes and then only transcribe the data after all talks have been analysed. A disadvantage of this approach, however, would be that it becomes more difficult to become familiar with the data without the groundwork of listening and transcribing the content. A third, and less ideal approach would be to apply a top-down approach and search for specific questions. It could save time to perform the analysis, but the study would also miss deeper and more underlying patterns. The largest issue with both methods has been to underestimate the scope.

6.3 Social and ethical aspects

According to Engström (2020) digital games are widespread and consumed to a large extent in society. In many countries game development has become a large and important industry. Over the past 20 years, there has been a great interest in games research (Engström, 2020). However, as Martin (2018) identified there is a lack of research that focusses on the game industry. Despite games being one of the most popular forms of entertainment, there is barely any research on the game industry (Martin, 2018) nor the processes behind which games are developed (Engström, 2020).

Game development research can be beneficial to both the game industry and society at large. For example, research can lead to new recommendations on how to improve practices and how to avoid pitfalls in development. This could in turn reduce development costs, crunch, burnout, and the number of delayed or cancelled projects. Most importantly, this knowledge could also increase the output of high-quality games. Games are not merely a past-time for a few select hobbyists, games are an invaluable medium for self-realization and entertainment for a large part of society.

In this study, the focus has been to explore the industry perspective of how the game industry create UI design. It is important to understand how the game industry approach UI design, as well as the processes and methods that game industry professionals' use. Without this knowledge, there risk that academic research fails to understand the game industry, and in turn produce irrelevant recommendations to game industry practices. Even worse, academic research may end up producing frameworks, methods and heuristics never used by the game industry or anyone in society. A better understanding for the industry perspective is necessary to address this gap.

This study describes a systematic review that was performed on the database GDC Vault. GDC vault is a database where the title and abstracts for all presentations are open and accessible to the public. While the data may be publicly accessible, there are many ethical concerns that comes with performing a systematic review on a public database.

First of all, it is important to try to reach out to the management responsible for the database and inform them about them about the study. In this study, I mailed the GDC Vault support, and my university's library also contacted GDC Vault.

Second, when developing an application that automatically retrieve data, it is important to consider the traffic and activity generated by the application. In this study, the first version of the application was designed to retrieve data with almost no constraints. This caused an activity spike that might have raised concerns. After an hour of data retrieval, the server became inaccessible from our location. However, after I had reached out to support and explained the situation, the server became accessible again. Therefore, the lesson learned was to be careful when retrieving data in an automated manner. It is important to design the application with constraints and brief pauses.

Finally, even if the title and abstract data is made publicly available, a spreadsheet containing all the information from 12'000 presentations does contain a considerable amount of data. This aggregated data may not be shared or made public. It is ethicly crucial to protect the data. Only store and use it for research purposes. In this study, I have carefully selected to share a portion of the data set (See Appendix A).

6.4 Future Work

This study presents a systematic literature review method which is customised to be applicable on GDC Vault. The results from the systematic review revealed a large portion of the UI design related presentations on GDC Vault. A thematic analysis was also performed to explore the game industry perspective on UI design.

More studies are needed to explore how a systematic literature review can be customised to be applicable for the challenges of GDC Vault. While this study uncovered a substantial amount of UI design related presentations, it is reasonable to assume that not all presentations have been found. More studies are needed to develop a more reliable and efficient systematic review method.

The eight presentations analysed in this study are rich with information, and more studies are needed to uncover the themes within. While this study uncovered some of the methods and activities that the game industry applies during the UI design process, as well as a theme about the primary design goal. More studies are needed to explore if the results are trustworthy. While the thematic analysis of this study contributed with a document analysis of video presentations, more studies with other research methods are needed to triangulate the results.

6.5 Conclusions

The purpose of study was to explore and learn more about the game industry perspective and their processes behind interaction design and user interface design. With this purpose as a basis, the following research question is:

"How does the game industry create user interface design?"

To explore this question, a systematic literature review has been performed on the Game developers Conference (GDC) database, *GDC Vault*. The review uncovered a substantial portion of UI design related presentations (See Appendix A). These presentations were assessed for the degree the presentation focus on the UI design process of a specific game. Finally, a thematic analysis was performed to explore the eight most relevant presentations. The results from the thematic analysis are two themes.

The first theme describe how other disciplines might want to involve and collaborate with User Interface design. For example, UI designers are often not part of the core team and may even be involved late in game development process. Collaboration between game designers and UI designers seem to be fostered by game design providing loose design goals for the interface, and the UI designer providing mock-ups to fulfil those goals.

The second theme describe two seemingly conflicting design goals in the design process: aesthetics and usability. In several talks, usability is the guiding light for the UI design process. In these talks, the focus is on meeting user needs and making the UI easy and efficient to use. A lot of effort is put into exploring different design solutions with users. This approach could be considered as an Usability First approach.

In contrast to Usability First, there are two GDC talks in which the UI design approach is characterized by a more aesthetic-centred approach. In these talks, the highest priority is to convey a certain feeling or experience with the UI Design. For example, Dead Space focus on

designing the UI to allow the game to feel as immersive as possible. While Hearthstone focus on designing the UI to feel as if you are interacting with physical objects. Both Dead Space and Hearthstone could therefore be considered as *Aesthetic First,* since their highest design priority is to achieve a desired aesthetic, rather than focusing on improving usability.

Overall, the study contributes to research with some knowledge about how game industry professionals create UI design. Another contribution is how a systematic literature review method can be customized to be applicable to GDC Vault. With these contributions, future studies can be performed to explore how game companies create UI design, and how future systematic reviews may be performed on GDC Vault.

There are few, if any previous studies that have customized systematic literature reviews to be applicable on GDC Vault. This study has explored how a systematic review may be performed GDC Vault, and other public databases which do not support any of the advanced search features needed to perform a systematic review. Finally, this study has also contributed with some knowledge about how the game industry create UI design. However, more studies are needed to improve reliability and efficiency of systematic reviews on GDC Vault, and more studies are needed to understand how the game industry create UI design.

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Appendix A - UI Design presentations at GDC Vault

Table 5: The UI Design presentations that remained after the search and filtering process:

ID	Year	Title	Link	Relevance
1	**2019**	Building the Interface of 'The Elder Scrolls: Blades' in Landscape and Portrait	YouTube	very high
2	**2013**	Crafting Destruction: The Evolution of the Dead Space User Interface	YouTube	very high
3	**2021**	Cutting Apart The Diegetic Interface of 'Hardspace: Shipbreaker'	YouTube	very high
4	**2015**	Hearthstone: How to Create an Immersive User Interface	YouTube	very high
5	**2016**	Tenacious Design and The Interface of 'Destiny'	YouTube	very high
6	**2015**	Designing UX in WoT Blitz: What got us to Best Appstore Game 2014	YouTube	very high
7	**2014**	UX Redesign: Creating a Consistent Cross-Platform Experience	GDC Vault	very high
8	**2011**	THE SIMS 3 Create-a-Sim User Experience	GDC Vault	very high
9	**2019**	Changing Navigation Mid-Flight: 'War Dragons', a UX Redesign on Mobile	YouTube	high
10	**2010**	The Art of Interface Design at Harmonix Music Systems	GDC Vault	high
11	**2013**	Working the Crowd: Engaging Players Through the User Interface	GDC Vault	high
12	**2015**	Defining "New" for the Time-Honored Experience of Words with Friends	GDC Vault	high
13	**2021**	UX Summit: UX Buy In through Trust: Lessons Learned from DICE	Member	intermediate
14	**2009**	User Interface Art: Production from the Ground Up	GDC Vault	intermediate
15	**2019**	One Hundred Versions of 'Losswords'	Member	intermediate
16	**2009**	(305) The Story of AudiOdyssey & My Journey through Usability	GDC Vault	intermediate
17	**2017**	'Ice Age Adventures': UX Diagnosis for a Live-Ops Game (Case Study)	GDC Vault	intermediate
18	**2013**	Minimalist Game Design for Mobile Devices	GDC Vault	intermediate
19	**2012**	Postmortem: Bringing Diamond Dash to iOS	GDC Vault	intermediate
20	**2014**	Rift Transformed: From Subscription to Free-to-Play in Seven Months	GDC Vault	intermediate
21	**2019**	Building a Unified Cross-Project UI Framework	Member	intermediate
22	**2017**	UX Methodologies for Holistic Product Design	GDC Vault	intermediate
23	**2017**	'Mini Metro': When Less is More	GDC Vault	intermediate
24	**2001**	Graphical Interface Design: Design Basics	GDC Vault	intermediate
25	**2017**	Dots That Go for Walks: How to Maximize Minimal UI	GDC Vault	intermediate
26	**2021**	Developing a UX Mindset on Fortnite	GDC Vault	intermediate
27	**2013**	Building the Touchy-Feely World of Tearaway	GDC Vault	intermediate
28	**2017**	Data Binding Architectures for Rapid UI Creation in Unity	GDC Vault	intermediate
29	**2016**	Narrative Experience First: Interaction Design in 'Fragments of Him'	GDC Vault	intermediate
30	**2002**	UI Case Study: This is Football 2002	GDC Vault	intermediate
31	**2006**	One Button to Rule Them All: Extending Real Time Strategy Beyond the PC	GDC Vault	intermediate
32	**2017**	'Pokemon GO' & Designing Interactive Games for the Real World	GDC Vault	low
33	**2015**	User Research on Destiny	GDC Vault	low
34	**2009**	Ace Usability and Avoid Kobayashi Maru	GDC Vault	low
35	**2018**	Designing Text UX for Effortless Reading	GDC Vault	low
36	**2015**	Tailor Your Game for Mobile Devices	GDC Vault	low
37	**2018**	Immersing a Creative World into a Usable UI	GDC Vault	low
38	**2017**	Lessons Learned Creating UI for 'The Division'	GDC Vault	low
39	**2016**	'SimCity BuildIt' - What Did I Learn as a Game Designer?	GDC Vault	low
40	**2013**	Crossing Microsoft Screens: Building Cross Platform Gameplay in Skulls of the Shogun	GDC Vault	low
41	**2019**	Playing in the Real World with 'Project Create': Characters and UI with Spatial Awareness	Member	very low
42	**2018**	VR Interaction Design in 'Moss'	GDC Vault	very low
43	**2017**	VR Interaction Design of 'Cosmic Trip'	GDC Vault	very low
44	**2016**	Building 3-Dimensional UI for VR	GDC Vault	very low
45	**2016**	Designing a HUD for a Third Person VR Game	YouTube	very low
46	**2018**	Mind Control in Mobile VR: Gaze Activated UI in 'SingSpace'	GDC Vault	very low
47	**2021**	Call Me on My Cell Phone: The VR UI of 'Dance Central'	Member	very low
48	**2018**	UI/UX for Creating Your Mobile Game in VR	GDC Vault	very low
49	**2016**	Menus Suck	GDC Vault	very low
50	**2021**	Entertainment AR/VR: Design Challenges and Opportunities in Mobile AR: A 'Table Trenches' Retrospective	Member	very low
51	**2017**	Making Music in VR: Interaction Design for Creative Production	GDC Vault	very low
52	**2021**	UX Summit: Expanding the Dreamiverse: Making Dreams an Experience for Everyone	Member	very low
53	**2013**	What We Learned Porting Team Fortress 2 to Virtual Reality	GDC Vault	very low
54	**2019**	The Schema is (Still) Mightier than the Sword: How Cognition Predicts Player Spatial Coding Systems	Member	very low
55	**2018**	The Schema is Mightier than the Sword: How Player Cognition Predicts Gaming Behavior	GDC Vault	very low
56	**2015**	UI Design for Global	GDC Vault	very low
57	**2014**	Usability Lessons from Mobile Board Game Conversions	GDC Vault	very low
58	**2015**	UI Design from Pc Game to Mobile Game	GDC Vault	very low
59	**2016**	Integrating 2D UI with VR Environments	GDC Vault	very low
60	**2018**	Adaptive Design in MR: UX Problems and Solutions	GDC Vault	very low
61	**2015**	Interaction Design in VR: The Rules Have Changed (Again)	GDC Vault	very low
62	**2016**	VR Usability in Wonderland	GDC Vault	very low
63	**2018**	Art Direction for AAA UI	GDC Vault	very low
64	**2016**	Art Direction: Graphic Design is Key	GDC Vault	very low

65	**2016**	The Design of Everyday Games	GDC Vault	very low
66	**2016**	The Gamer's Brain, Part 2: UX of Onboarding and Player Engagement	GDC Vault	very low
67	**2017**	The Gamer's Brain, Part 3: The UX of Engagement and Immersion (or Retention)	GDC Vault	very low
68	**2015**	The Gamer's Brain: How Neuroscience and UX Can Impact Design	GDC Vault	very low
69	**2019**	From Zero to Hero: Visualizing Player Progression within UI/UX	Member	very low
70	**2015**	How to Choose the Best Typographic System for Your Global Game	GDC Vault	very low
71	**2014**	Developing UX Practices at Epic Games	GDC Vault	very low
72	**2018**	AAA Gaming While Blind	YouTube	very low
73	**2019**	Android Games for Larger Screens and Foldables (Presented by Google, Inc.)	GDC Vault	very low
74	**2013**	Beautiful Gestures	GDC Vault	very low
75	**2005**	Befuddlement in Action: Classic Usability Problems in Games and How to Avoid Them	GDC Vault	very low
76	**2014**	Beyond Graphics: Reaching the Visually Impaired Gamer	GDC Vault	very low
77	**2019**	Brain-Computer Interfaces: One Possible Future for How We Play	GDC Vault	very low
78	**2020**	Canary in the Coal Mine: Warning Signs for Accessibility During Production	GDC Vault	very low
79	**2004**	Cross Platform User Interface Development	GDC Vault	very low
80	**2017**	Dark Patterns: How Good UX Can Be Bad UX	GDC Vault	very low
81	**2015**	Design Lessons from Multiplayer Installations	GDC Vault	very low
82	**2013**	Developing Apps in the 3rd Dimension	GDC Vault	very low
83	**2013**	Developing Better Games by Optimizing the User Experience	GDC Vault	very low
84	**2013**	Enhancing the User Experience Through Good Tactile Design	GDC Vault	very low
85	**2019**	Every Sound in the Universe: New Frontiers for Audio UX	Member	very low
86	**2018**	Explorations in XR Creation Tools	GDC Vault	very low
87	**2017**	Getting Productivity from Play: How Ubisoft Is Making Better Tools by Using a Familiar Resource	GDC Vault	very low
88	**2012**	Guidelines for Successful Mobile Interactive Apps for Children	GDC Vault	very low
89	**2015**	How to Implement AAA Game UI in HTML and JavaScript	GDC Vault	very low
90	**2016**	Human-Centered Design of Immersive Interactions	GDC Vault	very low
91	**2012**	Little Hands, Foul Moods and Runny Noses: Developmental Research Meets Emerging Technologies in Game Design	GDC Vault	very low
92	**2016**	Mobile Devices and Disabled Gamers	GDC Vault	very low
93	**2016**	No Text, No Tutorial: Fully Embracing Human-Centered Design in VR	GDC Vault	very low
94	**2013**	Perceptual Computing and Hands-Free UX Design	GDC Vault	very low
95	**2020**	Shifting from Emotion to Function: Auditory UX/UI Practices for XR	Member	very low
96	**2016**	The Body Is Back! Understanding Embodiment in VR & AR Game Design	GDC Vault	very low
97	**2014**	Unity Technologies Developer Day (Presented by Unity Technologies)	GDC Vault	very low
98	**2018**	Untethered: Building Apps Beyond Room-Scale	GDC Vault	very low
99	**2021**	UX Summit: Approaching Accessibility in Production: A Practical Mindset for Developers	Member	very low
100	**2021**	UX Summit: History Shaping Design: Learning UX through the Evolution Of Playing Cards	Member	very low
101	**2017**	VR to MR: How Real World Data Changes the Use of VR in the Automotive Industry	GDC Vault	very low
102	**2018**	Defining the Laws for a Parallel Reality	GDC Vault	very low
103	**2018**	Hardware vs. Software: UX Loops, 1960s to Now	GDC Vault	very low
104	**2010**	How The Conduit Made Alien Controls Intuitive through Control Customization	GDC Vault	very low
105	**2019**	Voice Changes Everything: Bringing the Natural Language Processing Revolution to VR	GDC Vault	very low
106	**2012**	Working the Crowd: Engaging Players through the User Interface*	GDC Vault	excluded
107	**2019**	Developing a UX Mindset on Fortnite*	GDC Vault	excluded
108	**2015**	Mobile Devices and Disabled Gamers*	GDC Vault	excluded
109	**2018**	Bridging the Gap Between UX Principles and Game Design**	GDC Vault	excluded
110	**2009**	Helping Your Players Feel Smart: Puzzles as User Interface**	GDC Vault	excluded
111	**2017**	The Interaction Design of 'Oculus Medium': Sculpting in VR**	GDC Vault	excluded
112	**2017**	From Rational to Emotional: Designs that Increase Player Retention**	GDC Vault	excluded
113	**2017**	It Takes Two to Tango: Integrating UX Research and Production at EA**	GDC Vault	excluded

*Presentations that have been presented twice with the same content. Excluded as duplicate.
** Presentations that should not have survived the screening process. Excluded as not on topic.

Appendix B - Results from the Systematic Review