The Serious Business of Serious Games

A study of business models in the serious game industry

by Julien Estourgie

The Serious Business of Serious Games

A study of business models in the serious game industry

Master Thesis submitted to Delft University of Technology
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in **Management of Technology**
Faculty of Technology, Policy and Management

by
Julien Estourgie
Student number: 4230035

to be defended in public on July 30th 2019

Graduation Committee:

Chair:	Dr. R.M. Verburg, Section Economics of Technology & Innovation
First Supervisor:	Dr.rer.soc. H.K. Lukosch, Section Policy Analysis
Second Supervisor:	Dr. R.M. Verburg, Section Economics of Technology & Innovation
External Supervisor:	A. Bezuijen MSc, The Barn

Abstract

This thesis studies how serious game developers can develop robust business models with regard to future uncertainties that these developers must be able to deal with. Twelve in-depth interviews were held with managers, owners, and entrepreneurs of serious game developers in the Netherlands to identify and describe in detail the future uncertainties that the industry faces and to form insights about various business model elements. During the interviews, a PEST analysis (Political, Economic, Social, and Technological aspects) was done with the participants to identify the uncertainties and the STOF business model ontology (Product, Technology, Organisation, and Finance domains) was used to structure a discussion about the business model elements. 25 Uncertainties within the industry are identified and described, and 34 business model elements are examined. Five uncertainties are chosen as input for a Business Model Stress Test. This resulted in 212 insights about how the 34 business model elements hold against the five selected uncertainties. These insights can be used as a basis for serious game developers to construct and test their own business model and do business model innovation.

Executive Summary

This thesis presents qualitative insights into how serious game developers in the Netherlands can create future-proof business models. In this executive summary, the most important findings and research methods are given, along with references to the main text for further reading.

Firstly, some important terms are defined. Secondly, the research objective and research questions of this thesis are presented. Thirdly, the main research methods used in this thesis and how they are linked is briefly discussed. Then, the results from the employed research methods are summarised. Finally, the main conclusions of this research are presented.

Definitions

In order to make the scope of this thesis project clear, some definitions are required:

- **Serious Game***: artefacts, both digital and physical, that use a game structure to achieve a non-entertainment primary goal (section 2.2).*
- **Business Model***: blueprints for how a company can create value for its customers and partners and capture value for itself (section 3.1.2.2).*
- **Viability of a Business Model***: the degree to which a business model can create and capture value (section 2.4).*
- **Feasibility of a Business Model***: the degree to which a company can implement and execute a business model (section 2.4).*
- **Robustness of a Company***: the degree to which a company remains able to create and capture value in future scenarios.*
- **Robustness of a Business Model***: the degree to which a business model remains viable and feasible when confronted with an uncertainty.*
- **Uncertainty***: a trend, opportunity, or threat that may affect a company's business model.*

With these definitions, a research objective and a research question can be set up.

Research Objective and Questions

Only a limited amount of academic knowledge exists about the robustness of business models within the serious game industry. This thesis aims to develop a foundation for this topic, resulting in the following research objective:

To gain insights into how different business models can contribute to the robustness of serious game developers in the Netherlands.

This leads to the formulation of research questions that, when answered, would achieve this objective. The main research question follows directly from the objective:

How can serious game developers use business models to remain robust in relation to various uncertainties in the serious game industry?

To answer this research question, three sub-questions are formulated. When answered, these sub-questions answer a part of the main research question.

SQ 1*: What uncertainties does the serious game industry in the Netherlands currently face?*
SQ 2*: What business model elements are currently used in the serious game industry in the Netherlands?*
SQ 2.1*: How do serious game developers in the Netherlands estimate the effectiveness of these business model elements?*
SQ 3*: How do the business model elements from SQ 2 hold up against the uncertainties from SQ 1?*

From the definitions, the degree of which a business model holds up to an uncertainty is the robustness of a business model. As such, answering sub-question 3 achieves the research objective.

Section 1.1 describes the research objective and the research questions in detail.

Literature Study

Little has been published about how business and business models relate to the serious game industry (section 2.1). In the literature, four business models are identified that should be useful for serious game developers (section 2.3). They are presented in figure Summary.1, below. In the figure, they have been divided into the different domains of the STOF model (Service/Product, Technology, Organisation, and Finance), which is an approach to structuring business models (section 3.1.2.2).

In addition to these business models, another two business models are identified in the literature that are successful in the entertainment game industry and therefore might also be interesting for serious game developers. These business models are pay-per-download and advertisement supported. Even though serious games are defined as having a primary focus on non-entertainment goals, the industries are often compared to one another. It is, therefore, worthwhile to explore this comparison.

One uncertainty for the serious game industry is also presented within the literature (section 2.4). This is the difficulty in achieving customer acceptance of serious games as a useful tool.

These business models and uncertainties are used as the basis for the remaining research.

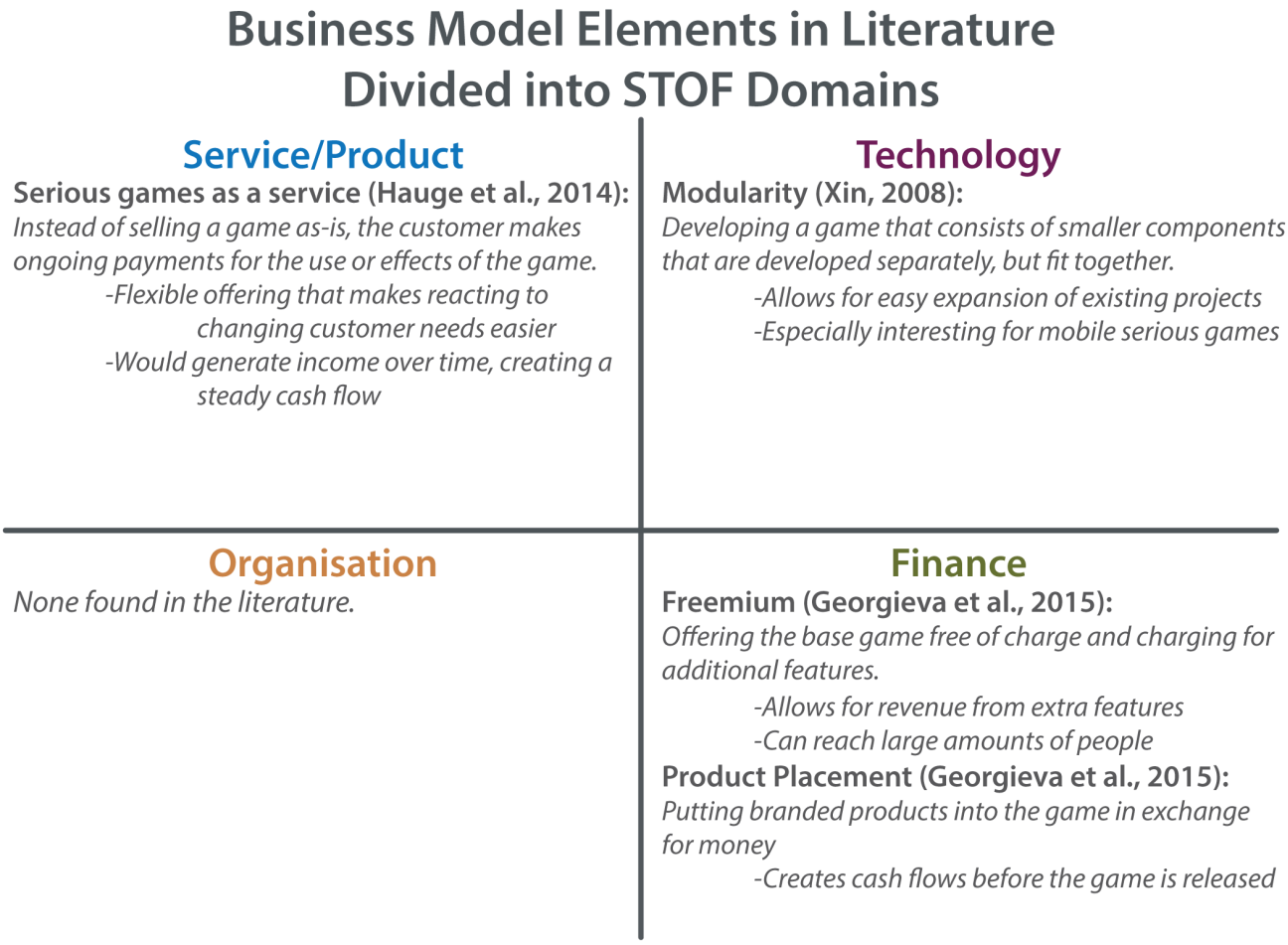

Figure Summary.1: Business model elements as discussed in literature categorised into the STOF domains.

Research Methods

In this thesis, several research methods are applied to answer the research questions. The different research methods, along with references to the sections that discuss them, is presented in figure Summary.2.

A categorisation system was set up for serious game developers based on whether they are specialised in developing serious games for a specific market (like healthcare or education) and on whether they develop custom-made games commissioned by a customer or not (section 4.1). This was done to better allow for comparison between these different categories to try and determine whether there are differences between them.

The interviews are the main part of this thesis project. Twelve interviews were held among practitioners within the Dutch serious game industry, specifically with those people responsible for the business side of the company. During these interviews, additional uncertainties were identified using a PEST analysis (Political, Economic, Social, and Technological). And, using business model cards developed by ENVISION (n.d.) (section 3.1.2.2), various business models within the different STOF domains have been discussed in detail.

Finally, a Business Model Stress Test is done to develop insights about the influence of certain uncertainties on the business models (section 3.2.4).

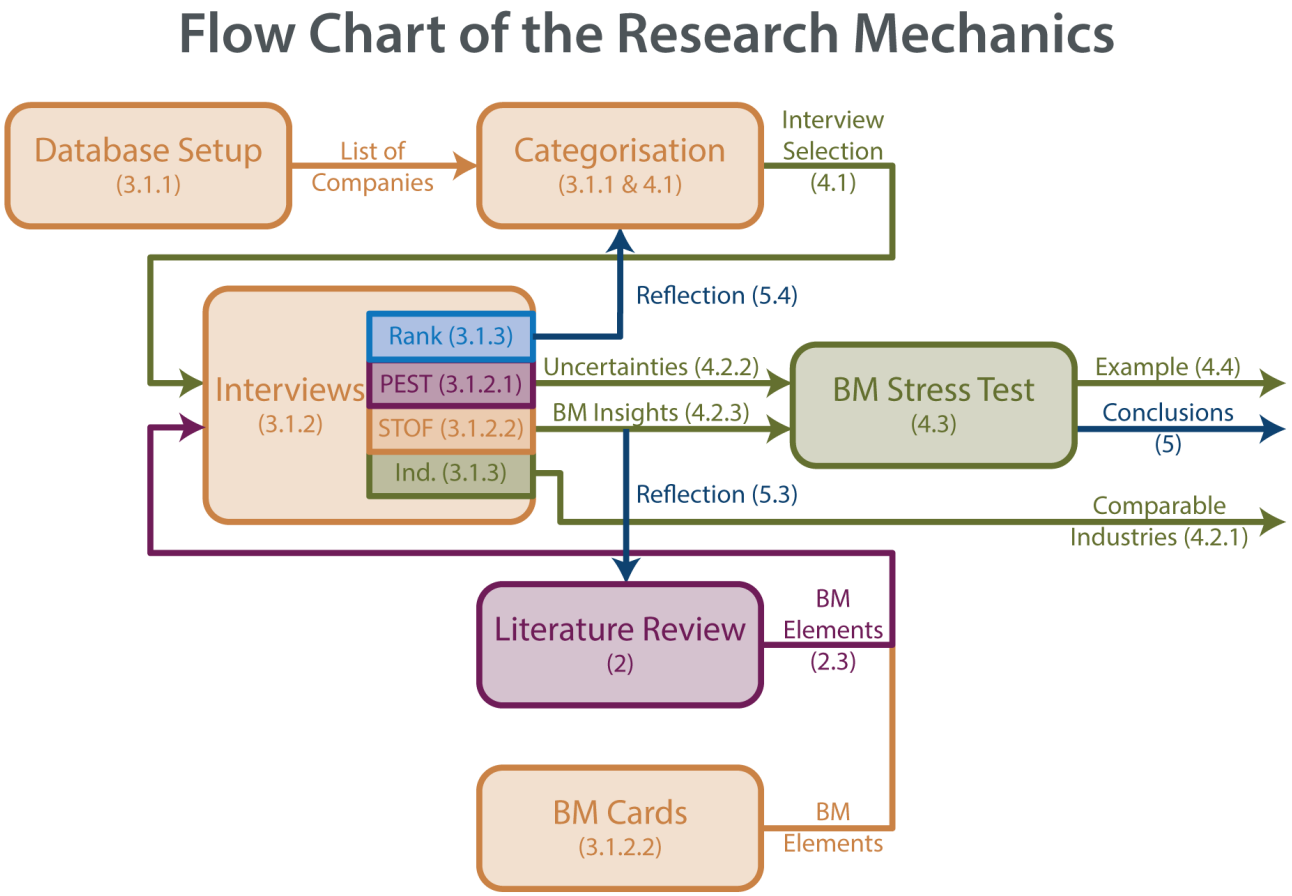

Figure Summary.2: Flow chart and structure of the research and results of this thesis project, including section references.

Results and Conclusions

The categorisation system based on specialisation and on custom-made game offerings proved less useful than expected. However, a different categorisation system is expected to work better for future research. This new categorisation system would differentiate between companies that make custom serious games, companies that make serious games from their own initiative, and companies that make serious games to augment their other service(s). This new categorisation system seems more suitable based on the companies that were interviewed.

Twenty-five different uncertainties have been identified that might influence serious game developers in the future (section 4.2.2). These insights can help practitioners in their considerations about what to expect from the future and thus help them prepare for scenarios that they previously had not anticipated. These uncertainties can also be used to evaluate the robustness of business models. This is done in section 4.3 by means of the Business Model Stress Test. This resulted in 212 conclusions about how 34 business models relate to five selected uncertainties (appendices C to F). These conclusions are summarised in four tables, which can also be found in those appendices. Academically, it is found that the stress test is effective in offering a structured approach for developing insights about business models within the serious game industry. For practitioners, the conclusions from the stress test can be used as a means to structure their own process of developing their own business model. As such, serious game developers will be able to make a better and more informed decision on what business model will be right for them, using the collective considerations of the various practitioners that this thesis researched.

Contents

1 Introduction

In recent years, the importance of business models for companies has become increasingly recognised (Foss & Saebi, 2017). Business models offer a mapped-out structure about how a company creates value for its customers and about how it captures value for itself. In order to survive, delivering valuable offerings is essential and a company should do this in a way so that it can also sustain itself. To that effect, methods have been developed to help construct business models like the Business Model Canvas (Osterwalder & Pigneur, 2010), the VISOR model (El Sawy & Pereira, 2013), and the STOF model (Bouwman, Vos, & Haaker, 2008). These approaches help with guiding a structured thought process about both an existing company's business model, and a completely new business model.

Still, within the relatively new and upcoming market of serious game development, many companies have difficulty finding a business model that is future-proof. The number of active serious game developers in the Netherlands has grown by 28% between 2012 and 2015 (Games Monitor, 2015). This number is expected to keep climbing as the serious game market also grows (Sonawane, 2017). As such, there is increasing interest in business-models within this industry. Current literature about serious games tends to focus on the effectiveness of specific serious games to attain the goals they were developed for. There is little academic work available about the robustness of business models for serious game developers. Hence, serious game developers are left without academic reference. This thesis aims to give insights about business models and their robustness within the serious game industry, thus laying a foundation for researchers to better understand the industry from a business perspective as well as for practitioners to build and test their own business models. This is done by examining the different trends, opportunities, and threats that the industry faces and testing different business models against these uncertainties.

In this thesis, **serious games** are defined as *artefacts, both digital and physical, that use a game structure to achieve a non-entertainment primary goal* (Djaouti, Alvarez & Jessel, 2011a; Michael & Chen, 2005). Section 2.2 elaborates on this definition. Additionally, **serious game developers** are defined as *companies that develop serious games for any purpose*. This includes companies that make games commissioned by customers as well as companies that develop them out of their own initiative. The definition also includes companies that develop serious games as part of another service or product.

Business models are defined according to Bouwman et al. (2008). They are *blueprints for how a company can create value for its customers and partners and capture value for itself*. Here, value is taken broadly and includes economic value and social value. Business models are seen as product- or service-level constructs that describe how a company creates and retains value. Business models can be divided into several components that each deal with a different domain of business models. These different domains are defined according to the STOF model (Bouwman et al., 2008). This choice is discussed in section 3.1.2.2. The domains are the Service domain, Technology domain, Organisation domain, and Finance domain. Each of these domains can be structured individually. The different domain-specific structures are henceforth referred to as business model elements. And a set of these business model elements from the different domains constitute a business model. Note that multiple business model elements can be applied by a company simultaneously, also within domains. Section 3.1.2.2 describes this definition in more detail.

When discussing business models, their robustness is also relevant. **Robustness** is *the degree to which a business model remains viable and feasible when confronted with a specific uncertainty in the long-term* (Magretta, 2002). These **uncertainties** are defined as *possible future threats and opportunities within the serious game industry.* From the definition of business models, a viable business model generates value for both customers and the serious game developer itself. A feasible business model is one that a serious game developer is able to implement in terms of resources, such as financial capital, technology, and human resources. Section 3.2.4 elaborates on robustness. (Haaker, Bouwman, Janssen, & de Reuver, 2017)

This thesis is structured as follows. First, the research objective and research questions are made explicit in section 1.1. Then, in chapter 2, the relevant literature about business models, the serious game industry, and the knowledge currently available about business models applied to the serious game industry are reviewed and discussed. Then, chapter 3 discusses the methods used to answer the research questions. Chapter 4 analyses the results of the research. And finally, conclusions about the research are given in chapter 5, followed by a discussion about the limitations and possible future research.

This thesis project was commissioned by The Barn who wanted to identify possible useful business models that are applicable and robust. The Barn is a serious game developer located in Delft, the Netherlands. The researcher performed most of his work at their office under the guidance of Arne Bezuijen, MSc. The thesis is the final requirement for the master study of Management of Technology at the Delft University of Technology. This project combines a multitude of scientific methods to analyse a problem that falls within the entrepreneurship domain and technology & strategy domain of the study. Additionally, the problem concerns the serious game industry, which is an innovative industry. Hence, the scope of this thesis adheres to the requirements of a Management of Technology thesis project. From the Delft University of Technology, Dr.rer.soc. Heide Lukosch guided the project. Additionally, Dr. Robert Verburg chaired the graduation committee.

1.1 Research Objective and Research Questions

The objective of the research was

to gain insights into how different business models can contribute to the robustness of serious game developers in the Netherlands.

With these insights, an overview is made to compare different business models, allowing companies to make better decisions on how to design their own business models and, hence, increase their chances of long-term success. It is noted that there is no one business model that can ensure robustness. Instead, this thesis aims to discuss relevant considerations. That discussion also deepens the academic understanding of business models within the serious game industry.

To achieve the objective, several research questions are formulated. The main research question follows directly from the objective.

How can serious game developers use business models to remain robust in relation to various uncertainties in the serious game industry?

This main question must be subdivided into workable sub-questions (hence: SQs). To test for robustness, it is necessary to first determine what uncertainties within the serious game industry might threaten or assist business models.

SQ 1: *What uncertainties does the serious game industry in the Netherlands currently face?*

Secondly, the different business model elements that are currently being used must be identified.

SQ 2: *What business model elements are currently used in the serious game industry in the Netherlands?*
SQ 2.1: *How do serious game developers in the Netherlands estimate the effectiveness of these business model elements?*

Finally, the different business model elements must be tested against the uncertainties.

SQ 3: *How do the business model elements from SQ 2 hold up against the uncertainties from SQ 1?*

This question can be answered by using the Business Model Stress Test tool (Haaker et al., 2017). Section 3.2.4 elaborates on this. The results from SQ 3 answer the main research question in the form of a matrix-like model wherein different business model elements are featured on one axis and industry uncertainties on the other. How they relate to each other is described qualitatively.

2 Literature Study

To get a better understanding of the state of the serious game industry, a literature study has been done. While doing the literature research, it became apparent that many papers exist about serious games. Yet, the vast majority focus on one of three things: (1) whether certain serious game mechanics work as intended, (2) case studies wherein a serious game was developed, (3) tools on how to develop a serious game. Very few papers discuss the business side of developing serious games.

In this section, the definition of a serious game, as presented in existing literature, is discussed so that the scope of this thesis project can be better determined. This definition of a serious game also leads to a better understanding of what it means to develop them. In section 2.3, the few papers that were found in this thesis research that do discuss the business side of serious games are analysed to identify business models that could be of interest to serious game developers. Finally, some uncertainties that are discussed within the found literature are also examined. But first, the methodology used in doing the literature search is discussed. The aim of this literature search is to find articles that combine serious games with business or business models.

2.1 Literature Search and Selection Criteria

This section describes how the search for literature on papers that discuss the business side of serious games was done and how papers were selected for inclusion in this paper. Note that this section is about the literature search for the definition of serious games and for how academic papers relate serious games to business and that more literature is used to substantiate claims throughout this thesis that was retrieved throughout the execution of the thesis project as the topic became of interest. This section, instead, focuses on the dedicated literature study that was done at the start of the project.

Since the serious game industry is relatively new, it was expected that only a small number of relevant papers have been published. Hence, to find as many of these papers as possible, a variety of academic search engines was used: Google Scholar, Scopus, and Microsoft Academic. To ensure that the search

Literature Search Keywords

"Business Model" "Serious Game"	*Serious Game Revenue*
Business Model Games	*Advergames Business Model*
"Serious Game"	*Business Model*
"Serious Game" "Business"	*Business Games*
"Serious Game" "Competitive Advantage"	*Serious Game Design*
Simulation Game Business Opportunities	*Serious Game Business Threats*
Serious Game Business Opportunities	*Simulation Game Business Threats*
Gamification Business Opportunities	*Gamification Business Threats*
Immersive Game Business Opportunities	*Immersive Game Business Threats*
Serious Game Definition	*Serious Game Market Trends*
Applied Game Definition	*Serious Game Trends*
Serious Game Categorisation	*Serious Game Market*

Table 2.1. Keyword search strings used in each of the search engines.

yielded a complete overview of all available papers, every keyword search was done on all three search engines. A list of these keywords is presented in table 2.1.

For the first two keywords ("Business Model" "Serious Game" and Business Model Games), the first five pages of results were sieved through. If the title indicated that the paper connected business models and serious games in a broad sense, the article was opened. Since only the first two pages of results yielded papers of interest, the remaining keyword searches were limited to the first two pages.

The selected articles were then evaluated based on their abstracts. If the abstract indicated that the paper indeed did contain information on the implications of serious game development as a value generating service in business models, the paper was selected for a thorough review.

After this, the papers were filtered once more by thoroughly reading its contents. If the paper indeed did connect business to serious games, the paper was selected for inclusion in this review paper. In the end, fifteen articles were selected in this way.

In general, it is important to look at in what journal an article has been published and whether it has been peer-reviewed. However, since it was anticipated that little academic information about the topic, thorough peer-reviewing was not expected and hence not a criterion for inclusion in this thesis. Consequently, additional care is taken in the discussion of the selected papers, especially in the examination of their validity.

In addition to searching for articles on search engines, the journals in which these articles were published have also been reviewed. Aside from that, the journal impact factor lists as published by Siddiqui (2018) and ResearchGate (2016; 2018) were reviewed for relevant journal names. This selection was done by looking for journals that either contained the phrase "serious game" or linked the "game" concept to something other than entertainment. For each of these journals, their mission as stated on their website was reviewed. Journals that focus solely on the design of games (the mechanics of the games and (digital) architecture) were excluded from this thesis document as the likelihood of them publishing relevant literature was low. The selected journals are in the table below.

Consulted Journals

Journal Name	JIF	Selected Articles
Computers & Education	*4.538*	*1 (Connolly et al., 2012)*
Entertainment Computing	*1.76*	*1 (Stapleton, 2004)*
Games for Health Journal	*1.876*	*0*
International Journal of Computer Games Technology	*1.24*	*1 (Laamarti, Eid & El Saddik, 2014)*
International Journal of Learning and Media	*4.00*[1]	*1 (Mayo, 2010)*
International Journal of Serious Games	-	*4 (Castronova & Knowles, 2015; Hauge et al., 2014; Petridis et al., 2015; Siriaraya et al., 2018)*
JMIR Serious Games	*2.226*	*0*
Simulation & Gaming	*1.83*[2]	*0*

Table 2.2: Selected journals for review, including Journal Impact Factor (JIF) (Siddiqui, 2018; [1] ResearchGate, 2016; [2] ResearchGate, 2018) and the total number of selected articles that were published in this journal.

All published issues of the selected journals were reviewed in the same way as before: if the titles of the published articles indicated a link between business models and serious games in a broad sense, the article was opened. Like before, the abstract was reviewed and then the complete article. If the article indeed did connect business models to serious games, the article was selected for review. This resulted in eight papers of interest, four of which were already found through the keyword search. Hence, an additional 4 papers were included in this way.

While care has been taken to review serious game journals that do not limit themselves to technological aspects of serious game development or the validation of serious game designs, none of the journals specifically combine business and serious games. To the best of the researcher's knowledge, no such journals currently exist. In this literature study, business journals have not been examined specifically, other than that related articles came up during the keyword search. Therefore, it is possible that some articles have been published in such journals. However, this does not affect the validity of this thesis. Instead, any possible overlap would serve as independent verification, if other articles do exist.

Considering that the selection criteria were not at all strict, it is noteworthy that only nineteen papers were eventually selected and that most journals did not publish more than one relevant article. This illustrates that little is still known about how serious games and business relate to each other. Table 2.3 gives an overview of all nineteen selected articles.

Selected Articles for the Literature Study

Article	Content
Castronova & Knowles (2015)	*Physical serious games*
Connolly et al. (2012)	*Learning outcomes of (serious) games*
Djaouti et al. (2011a)	*Classification of serious games*
Djaouti et al. (2011b)	*The origin of serious games*
Game Developers Conference (2019)	*State of the game industry (survey results)*
Georgieva et al. (2015)	*Freemium business model for serious games*
Harteveld (2011)	*Serious game design approach*
Hauge et al. (2014)	*Business models for serious games*
Hussung (2019)	*Advergames*
Laamarti et al. (2014)	*Taxonomy for digital serious games*
Mayo (2010)	*Challenges for serious game developers*
Michael & Chen (2005)	*Book about serious games*
Petridis et al. (2015)	*Perception of serious games*
Serious Play Conference (2018)	*Serious game award winners*
Siriaraya et al. (2018)	*Serious game design approach*
Stapleton (2004)	*Influence of serious games*
van Kranenburg et al. (2006)	*Assessment of the serious game industry*
Xin (2008)	*Serious games in mobile game setting*
Yoo (2015)	*Perceived value of game items*

Table 2.3. Selected articles for the literature study.

2.2 Definition of a Serious Game

Based on the articles from table 2.3, the term serious game remains a topic of debate and a consensus on what it means has yet to be reached. Still, it is important to specify a definition, because that will help define the scope of the sector and thus this thesis project. Additionally, the definition will yield some of the first insights into the characteristics of the sector. These issues are the topic of this section.

In many papers, the definition of serious games is limited to digital games and software applications (Georgieva, Arnab, Romero, & Freitas, 2015; Petridis, et al., 2015; Hauge, et al., 2014; Laamarti, Eid, & El Saddik, 2014; Djaouti et al., 2011a; Mayo, 2010; Xin, 2008; Stapleton, 2004). If a definition is used where only digital games are included, it would limit the options and considerations for companies. For instance, physical games do not require programmers but do require physical production. Djaouti, Alvarez, Jessel, & Rampnoux (2011b) consider also including physical games in the definition but opt to exclude those games because they did not consider the number of physical serious games to be significant. However, the Serious Play Conference (2018) reports that physical serious games are relevant, and some papers do include physical games in their definition (Castronova & Knowles, 2015; Connolly, et al., 2012). Because physical serious games do have a presence, they are considered relevant for serious games in this thesis. The consequence of this decision is that this implies that serious games are not medium-dependent. Hence, the definition of what they are must lay elsewhere.

Most of the papers do seem to agree about one aspect of serious games: serious games use game elements for a goal other than entertainment (Djaouti et al., 2011b; Michael & Chen, 2005). This part of the definition is not dependent on the medium, but rather on what makes the concept different from entertainment games and is therefore relevant in evaluating the value proposition of serious games. The word “use” is deliberate and illustrates the intention of the designer to aim for achieving a non-entertainment goal. This is a necessary distinction because it separates serious games from entertainment games that are employed in a serious context, which is sometimes called “purpose-shifting” (Djaouti et al., 2011a, p. 121).

Some attempts at setting up a categorisation system for serious games have been made. This is relevant because the act of categorisation yields insights into the nature of serious games and therefore could have an impact on the company’s business model (Cohen & Lefebvre, 2005).

One of these proposed categorisation systems was introduced by Djaouti et al. (2011a). They discuss some other classification systems that are based either on (1) the scope of the game (for instance: healthcare or military), or (2) the purpose of the game (for instance: to teach or to advertise), or on both. Djaouti et al. note that these categorisations focus solely on the seriousness of the serious games, and not on the game part. Hence, they propose a model based on three dimensions: the gameplay, the purpose, and the scope, the so-called G/P/S model. The gameplay dimension focusses on what type of mechanics are used within the game. It classifies how the game is played. The purpose of the game classifies what the (non-entertainment) goal of the game is. The scope of the game refers to the question: who uses the game? With this definition, it is implied that a problem-owner exists and that this problem applies to a limited target group. This is an important finding, as it influences how to structure the business and the value proposition of a serious game, specifically. It implies that a form of problem-solving is appropriate.

This categorisation system claims that a serious game always has the three G/P/S parts (gameplay, purpose, and scope). In addition, this classification system is similar in many respects to the Triadic Game Design serious game design methodology (Harteveld, 2011). There, Harteveld proposes a design approach where three domains must continuously be balanced in a creative process. These domains are Reality, Meaning, and Play. The similarity with Scope, Purpose, and Gameplay respectively is noteworthy. As such, it makes sense that a definition of a serious game can also relate to these three dimensions. Together with the other insights discussed in this section, the following definition for serious games is proposed and used in this thesis:

> *Serious games are artefacts, both digital and physical, that use a game structure to achieve a non-entertainment goal.*

To illustrate what this definition means, an artefact with a game structure includes the following: video games, table-top games, board games, and even games that require nothing but a set of rules and players. As an indication of what the non-entertaining purpose of a serious game could be, they are often used to teach, train, raise awareness, or market brands. These are just some examples, and many more purposes exist.

The definition used in this thesis includes the three axes of the G/P/S model. The gameplay domain is included in the game structure. The purpose is in the non-entertainment goal. Finally, the scope domain is included implicitly as the non-entertainment goal's owner. In other words: who is serviced with the game.

The used definition of serious games includes the concept of Advergames (games made to advertise a product or brand). This is a subset of the purpose domain within the G/P/S model. This specific group of serious game is very similar to the marketing and advertising industry, which is much better documented than the serious game industry (Hussung, 2016). Hence, this thesis will not consider Advergames but focus instead on the other types of serious game.

From the discussion about the definition of serious games, four important insights were gained. Firstly, (1) serious games include physical games as well as digital games. Both media have different requirements for developing serious games. This has an impact on how a serious game developer would structure his business. For instance, physical games require the production of physical goods and the assembly and distribution of them, while digital games require a digital architecture to distribute them as well as hardware to use them. Secondly, (2) serious game design is a creative process. This means that specialist people must be involved with the development. Specifically, serious game developers require a vast breadth in competencies to successfully do their work. They require game design skills, the skills to test and validate their learning methods, an understanding of a game's content. Thirdly, (3) serious games usually have a problem-owner. This means that a serious game offering must provide value by solving this problem. This does not mean that this is the only value a serious game can offer, but the value proposition must at least include a (partial) solution to the problem. This means that a serious game developer must be able to properly identify what a customer wishes to accomplish and then translate that into a serious game. And finally, (4) the target group for serious games is often limited. This means that a single game might not fit every user. All of these insights must be kept in mind when looking at the serious game sector because they influence how a serious game developer structures their business.

2.3 Business Models for Serious Games

As discussed in section 2.1, business model literature about serious games is scarce. Most of the available literature about serious games is about their effectiveness or how to develop serious games. Serious game design textbooks and manuals fall in the latter category. They solely focus on how to design an effective serious game and omit how to generate and capture value with them. For instance, Harteveld (2011) proposes the triadic game design, based on three domains: Reality, Meaning, and Play. Business, marketing, and distribution are not mentioned. Siriaraya et al. (2018), who propose a "cookbook" for persuasive game design, also do not discuss these aspects. Still, these concepts are very relevant to a successful product or service.

In the literature four business model elements were identified. Figure 2.1 gives an overview of them as they are presented in the papers.

The views about Serious Games as a Service and Modularity were not substantiated by references or empirical evidence, but rather seemed like the researchers' judgement. The Freemium and Product Placement business model elements were tested on mobile users in general, rather than users of serious games. As such, the external validity of that paper is also low. Yoo (2015) writes about freemium as well and mentions that the value of the freemium offering increases as the perceived value of the additional features increases. However, what neither paper discusses, but what could be an issue is that the limited functionality of the free game might influence the perceived value or effectiveness of the product as a whole for the free users.

These four business model elements function as a basis for the research and they will be included in discussions with serious game developers (section 3.1.2.2).

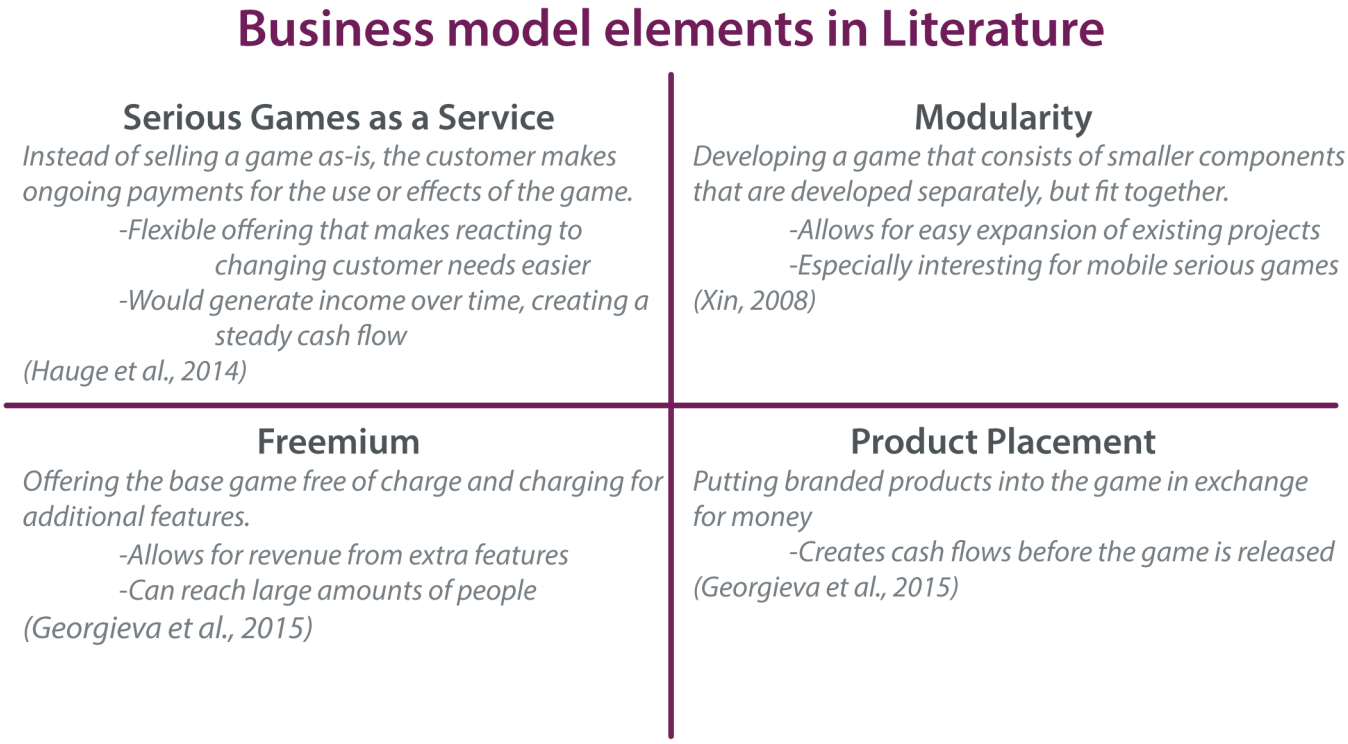

Figure 2.1: Business model elements as discussed in the literature.

2.4 Robustness and Uncertainties

As discussed in the introduction, the robustness of business models is important. This robustness is the degree to which a business model remains viable and feasible when confronted with a future scenario. These scenarios are future threats and opportunities relevant to the business model. Collectively, they will henceforth be called uncertainties. These stem from trends within the serious game industry. From the definition of business models, a business model is a blueprint for how value is generated for both customers and the serious game developer itself. A business model that can do both is a viable business model. The feasibility of a business model depends on to what degree the serious game developer is able to implement the business model in terms of resources. These resources include financial capital, technology, and human resources. (Haaker et al., 2017)

From the articles in table 2.3, only one article discusses three challenges for the serious game industry (Mayo, 2010). Only one of these three challenges fits the definition of an uncertainty, while the other two directly relate to the structure of a business model. The definition used for uncertainties is a trend, opportunity, or threat that may affect a company's business model. This section explores Mayo's challenges.

Mayo's (2010) three challenges are related to scaling up. Mayo assumes that scaling up is the objective of every company, which is not necessarily true. The problem in scaling up is presented as the difficulty of attracting a significant audience, which lies in three challenges: (1) developing sustainable revenue models, (2) finding distribution networks, and (3) achieving customer acceptance.

The sustainability issue (1) comes, according to the author, from the way serious games are often developed. The cash flow often comes from research grants, which is a one-time source of income. This one-time income is not sustainable, according to Mayo, because revenue models should be based on "product use, rather than product development" (Mayo, 2010, p. 89). This statement is, however, not substantiated.

The second issue (2), distribution, is a problem because the existing distribution network in the entertainment game industry is not compatible with serious games. In the entertainment game industry, marketing and distribution are often managed by publishers. But in the serious game industry, these tasks often fall to the developers themselves as not many serious game publishers exist or have the expertise to do it properly. As such, the role of serious game developers is more holistic, but most developers of serious games do not have the expertise and/or budget to do proper marketing, according to Mayo (2010).

Both the sustainability of the revenue model as the difficulties in distribution relate directly to different aspects of a business model. As such, this paper illustrates the need for serious game developers for more academic information about business models.

The third challenge (3), according to Mayo (2010), is that customers do not trust that serious games work the way they claim they do. As such, it would be problematic to get them to pay for the games on a large scale. Connolly et al. (2012) in their study corroborate this claim, blaming this primarily on the bad publicity that entertainment games receive with regards to their societal impact. This challenge could impact the robustness of a serious game developer's business model by making it more difficult to deliver value to customers.

Mayo's research methods are based on extensive background reading. Therefore, it is likely that the three challenges have merit. Additionally, the third challenge about the acceptance of serious games is considered as one of the uncertainties that a serious game developer should be prepared for. However, the actual challenges are not sufficiently substantiated. As such, it must be tested whether this uncertainty is really an issue for practitioners.

2.5 Comparable Industries

It could be of interest to consider the business models used in other industries that are comparable to that of the serious game industry and test whether they might also work for serious game developers. However, a study of each comparable industry of sufficient depth is beyond the scope of this thesis project. It is advisable for future research to examine this in depth. For now, this section discusses some insights gained from reading the selected articles and documents that were retrieved from the literature study in section 2.1 (table 2.3).

In the Netherlands, the serious game industry is regarded as part of the creative industry. Hence, according to van Kranenburg et al. (2006), the industry can be compared to the entertainment game industry. As such, it is interesting to identify what business models work well, there.

From the entertainment game industry, the Game Developers Conference report (2019) offers some valuable insights. An annual survey is held amongst those attending the conference and its statistics are published in the report. Amongst the survey questions are components of the employed business models. The focus is on the financial, distribution, and marketing aspects of the business models. Most entertainment game studios finance their games with their own revenues or with investments from their owners, rather than by finding external investors. This constituted for 84% (out of almost 4000 respondents) of the respondents in their survey. Some popular revenue models that entertainment game developers employ are (1) pay to download, (2) advertisement supported, (3) paid updates and/or downloadable content, (4) paid loot boxes, (5) paid in-game currency, (6) paid in-game items, (7) paid subscription. Note that, collectively, models 3, 4, 5, and 6 are similar to the freemium model proposed by Georgieva et al. (2015). They describe additional purchases after the initial purchase to extend the options within the game. This is also what models 3, 4, 5, and 6 do. Model 7 is similar to the service-based model proposed by Hauge et al. (2014), who advocates a subscription-based payment method with it.

The Game Developers Conference reports that the most commonly used distribution channel on PC is the sales platform Steam. Other popular sales channels are direct sales, and platforms owned by the developer's publisher. These distribution channels also seem to constitute most of their revenues for PC games. Marketing is mostly handled internally. Social media and word of mouth are indicated as the most important discovery methods for game sales.

2.6 Conclusion

The current state of the literature on business models in relation to the serious game industry is limited and in need of further development.

The current literature does discuss eleven specific options for different business models. Five of these can be combined within other business model elements to bring that number down to six. These business model elements are: (1) games as a service, (2) modularity, (3) freemium, (4) product placement, (5) pay per download, and (6) advertisement supported. These business model elements are used as the basis for answering research sub-question 2 of this thesis project:

What business model elements are currently used in the serious game industry in the Netherlands?

As such, these models are included in the research, as further specified in section 3.1.2.2. However, their robustness is not explored in the literature. This leaves the discussion largely unsubstantiated and makes it difficult to apply practically. As such, there is little reason to assume that these business model elements would work better than any alternatives. These business models are still included in this thesis in order to test the validity of the claims.

Aside from the business models, one uncertainty is also identified. This is the acceptance of serious games as a tool. Specifically, Mayo (2010) claims that serious games are currently not accepted very well. This uncertainty is one answer to research sub-question 1:

What uncertainties does the serious game industry in the Netherlands currently face?

However, it is probably not the only uncertainty that the industry faces. Hence, it is still necessary to identify others that are relevant. Section 3.1.2.1 elaborates on this.

3 Research Methods

This chapter discusses the various research methods used during the execution of the thesis research. The different methods are aimed at answering the different sub-questions of this thesis project. Some methods provide input for other methods. Therefore, a flowchart of how the different methods are linked is presented in figure 3.1.

This chapter is divided into three parts. The first discusses what data is still required to complete the research, after having done a literature study. This part also explains the methods used to collect this data. The second part elaborates on how the data is analysed after collection. Finally, a discussion is also given about the limitations of the selected methods.

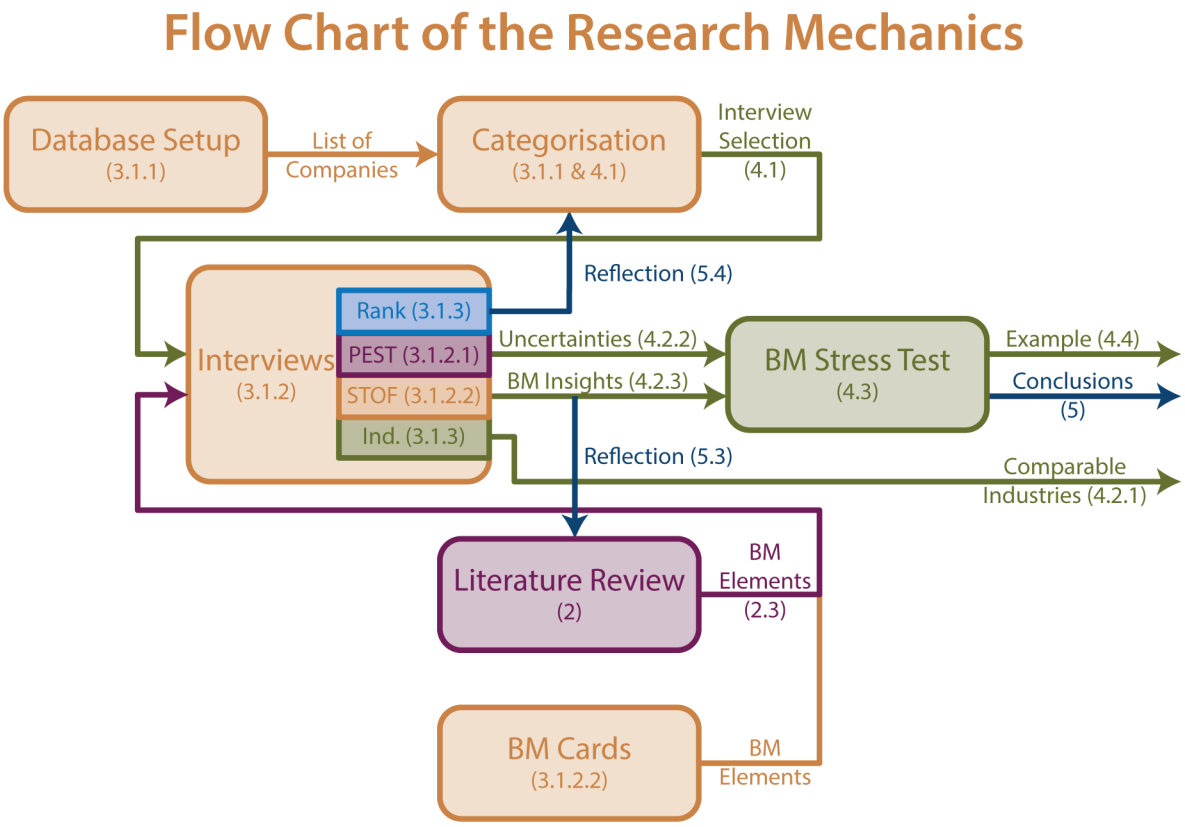

Figure 3.1: Flow chart and structure of the research and results of this thesis project, including section references.

3.1 Data Collection

Based on the research questions (section 1.1), three key types of information are required for this research: (1) insights into uncertainties that serious game developers in the Netherlands face, (2) insights into different business model elements, and (3) insights into how the uncertainties influence the business model elements. Of the first two types of information, a basis has been established through a literature study. However, none of the categories can be considered fulfilled. Hence, more data must be collected to extend and augment the three types of information. Practitioners are expected to have this key information because they are the ones who should apply this knowledge to structure their business.

Therefore, the data is collected from in-depth interviews. These interviews were meant to provide qualitative information about the key types of information. The interviews were held with serious game developers themselves, specifically those individuals who are responsible for the business model within their company. The interviews were semi-structured, meaning that specific topics for exploration were identified beforehand while letting the interview flow more freely in order to explore new ideas as well. The complete structure of the interview is explained in section 3.1.3.

In order to find suitable participants for the interviews, a database had to be constructed of serious game developers in the Netherlands. The next section explains how this was realised.

3.1.1 Building a Database and Sampling

Before participants could be approached for the interview in a meaningful way, a list of serious game developers in the Netherlands had to first be built. No complete list is currently openly available and, therefore, a database was constructed within this research. This section will discuss how the database was built and the identification of several categorisation possibilities. However, due to privacy laws, it is not possible to include any names of companies or share this database.

The database was constructed through the use of two channels: web searches and the Dutch Game Industry Directory (n.d.). Web searches were done on the Google, Bing, and Yahoo search engines to find as many Dutch serious game developers as possible. The used keywords are presented in table 3.1.

The keyword searches were done also done with the following synonyms for serious game: applied game, persuasive game, learning game, gamification, and advergame.

The Dutch Game Industry Directory (n.d.) is a web-based database of companies that are active in the Dutch game industry. Companies have to apply themselves for inclusion in this database, hence it is not a complete database, nor is it exclusive to serious game developers. The combination of the two channels yielded a database of 92 serious game developers in the Netherlands. It is likely that this list is not exhaustive and that companies without (or with a minimal) web-presence have been excluded. As stated before, it is not possible to publish this database in this thesis due to privacy laws.

Database Search Keywords

Serious Game Netherlands	*Serious Game Ontwikkelaar*
Dutch Serious Game	*Serious Game Developer*
Serious Game Nederland	*Serious Game Designer*
Nederlandse Serious Game	*Serious Game Ontwerper*

Table 3.1. Keywords used to search for serious game developers in the Netherlands.

3.1.1.1 Serious Game Studio Categorisation

To be able to select companies for interviews, it is first necessary to make a meaningful categorisation for the companies in the database. With such a categorisation, possible differences between sub-groups within the serious game developers can be identified. Information about those companies is required in order to make such a categorisation. This information is gathered from the websites of the companies in the database. The available information on their websites differs per company. Hence, the categorisation would have to involve information that is available from a large number of the businesses in the database.

The websites of the various developers were reviewed in two passes. During the passes, any company-specific information was noted down. After this, it seemed that only three aspects of the company were often made explicit. These aspects are presented here. For each aspect, the number of companies where the information is available is given in brackets. (1) company size (62/92 companies), (2) specialisations (92/92 companies), and (3) offering (82/92 companies). Note that the availability of information about these aspects does not necessarily mean that these aspects are directly relevant or that these are the only relevant aspects. In the next sections, the three identified aspects are defined in detail.

3.1.1.2 Company Size

The European Commission (2012, p. 8) identifies four types of enterprises: micro, small, medium, and large. The definitions are based on size, turnover, or balance sheet total. If one of the three falls in a higher category, the company is considered to be part of that higher category. However, since turnover and balance sheet totals are not always publicly accessible, only employee size is considered here. The table below shows the definitions.

The database that was built for this research contains serious game studios of varying sizes, from 1 employee to less than 50 employees. Note that, for companies for which serious games are not a core activity, only the department working on serious games is taken into consideration, and that for 30 of the companies in the database the size is unknown. Of the companies in the database of which their size is known, none fall into the medium or large enterprise categories. Therefore, this scale does not seem adequate to classify serious game developers in the Netherlands.

A more practical definition is proposed based on the database that was constructed. The average number of employees in a serious game studio in the Netherlands is 8 and the median is 5. Therefore, the definition of a small serious game studio is set at less than 10 employees (the European Commission's definition for a micro enterprise). The remaining serious game studios are divided into medium and large serious game studios with 10-24 and 25 or more employees, respectively. Table 3.3 shows these newly defined categories.

Using this new definition, there are 46 small companies in the database, 12 medium companies, and 4 large companies. Most serious game developers in the Netherlands are small and therefore have a low capacity for production. As such, the Dutch serious game industry's demand is currently being fulfilled by a large number of small companies. Section 4.1 evaluates size as a categorisation of the serious game industry in more detail.

EU Company Size

Category	Employee
Micro	*less than 10*
Small	*less than 50*
Medium	*less than 250*
Large	*250 or more*

Table 3.2. The definitions of micro, small, medium, and large-sized enterprises (European Commission, 2012, p .8).

Company Size

Category	Employee
Small	*less than 10*
Medium	*less than 25*
Large	*25 or more*

Table 3.3. The definitions of small, medium, and large-sized serious game studios.

3.1.1.3 Specialisation

Specialisation is defined here as when a serious game studio presents itself as an expert in the development of serious games for a specific purpose or scope (as defined earlier in section 2.2). So, being specialised in the development of serious games in general is not considered a specialisation in this definition. However, a company that specialises in business games or only makes games for participatory systems is considered specialised.

This information is retrieved from the studios' own websites. Due to the diversity of the different specialisations that are offered, it is not meaningful to differentiate between these specialisations in this categorisation. However, whether or not a company presents itself as specialised could already mean a difference in what business models are used because they target a specific part of the market. As such, a company is either considered specialised if they advocate this on their website or they are not if they do not advocate a speciality. Hence, this classification can be done for each of the companies in the database.

Out of the 92 companies in the database, 27 communicate a specialisation through their website. The other 65 do not communicate a specialisation through their database. Section 4.1 evaluates a serious game developer's specialisation for use in a categorisation system in more detail.

3.1.1.4 Offering

Finally, the product or service that the serious game studios offer is taken into consideration. The websites of the serious game studios are used to identify what the company offers to its customers. There are a wide variety of different product and service offerings ranging from licences and renting games to custom games. 61 Of the companies in the database offer the development of custom serious game development services to customers. 21 Do not offer custom serious game development services. The remaining 10 do not specify their offering through their website. This differentiation between custom game development and non-custom game development seems meaningful because of two reasons. Firstly, enough companies specify this on their websites in order to make classification possible. And secondly, custom game design means that relations with customers tend to be more intense than with non-custom offerings. As such, a difference between these groups in how they operate is expected. In section 4.1, the effectiveness of the offering as a categorisation method is examined in more detail.

3.1.1.5 Selecting the Companies for Interviews

In section 4.1 a selection of categorisation is made; the result is the specialisation/offering categorisation. This means that a total of 4 types of serious game developer is identified. Because multiple categories are identified, data must be gathered about each of them for this exploratory thesis. In other words, the database is stratified, and each stratum must be sampled (Sekaran & Bougie, 2016, p.244).

A sample is a subset of the total population of those of interest. In this case, the population is the collection of serious game developers in the Netherlands, of which an attempt has been made to build a database of. 10 In-depth interviews with serious game studios provide enough data to determine at least 80% of the insights and at least 90% with 15 interviews (van Boeijen, Daalhuizen, Zijlstra & van der Schoor, 2013; see also Faulkner, 2003). Hence, the aim was to do between 10 and 15 interviews with practitioners within the serious game industry.

Because of the categorisation, it is useful to distribute the interviews over the different categories, rather than take a sample from the database in general. Since the size of each category is not expected to be in proportion, and it is useful to get representative information about each stratum, a disproportional distribution of the samples is used. Section 4.1 explains the selection procedure in more detail. Unfortunately, to protect the privacy of the interviewed companies, their identity is not published here.

3.1.2 Interview

In this section, the content of the interview is discussed.

The interview was tested twice with real practitioners of the Custom Design/Not-Specialised stratum before it was used to collect data for this research. In this section, the resulting changes due to these tests are also explained where relevant.

Figure 3.2 shows the structure of the interview schematically and an in-depth explanation of the structure can be found in section 3.1.3.

The two primary goals of the interviews were (1) to collect insights about the uncertainties that the companies face as defined before (section 3.1). This relates to research sub-question 1:

What uncertainties does the serious game industry in the Netherlands currently face?

And (2) to collect insights about what business models are used by the industry as well as about other business models that might be of interest (Haaker et al., 2017). This relates to research sub-questions 2 and 2.1:

What business model elements are currently used in the serious game industry in the Netherlands?

How do serious game developers in the Netherlands estimate the effectiveness of these business model elements?

Since the practitioners must deal with uncertainties, it is expected that they have the most direct knowledge and experience with this. Additionally, since they know their own business, it is expected that they can give an informed opinion about various business models. Together, these interviews can then form in-depth insights to better answer the research questions. How exactly these insights were gathered is explained in the next sections.

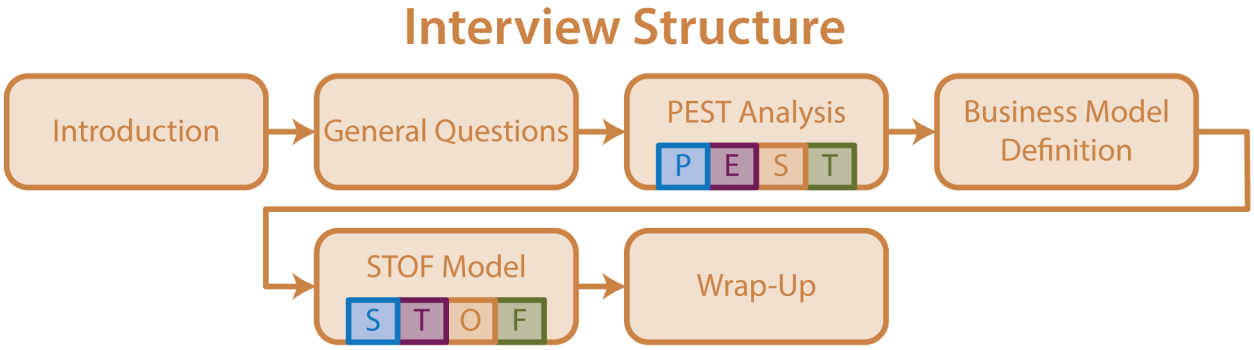

Figure 3.2: Interview Structure.

3.1.2.1 Uncertainties (PEST Analysis)

During the interviews, a PEST analysis was included to identify the different uncertainties in the serious game industry. As stated before, uncertainties are trends, opportunities, or threats that may affect a company's business model. A PEST analysis considers the external business environment and what factors therein could influence the business (in other words: uncertainties). It examines four categories of external factors: (1) political factors, (2) economic factors, (3) social factors, and (4) technological factors. (Ho, 2014)

The political factors cover the influence of the government (international, national, and local) on the business. This includes legislation, regulations, taxes, elections, and subsidies.

The economic factors include the influence of market growth and decline, the availability of funds and loans, changes in budgets, availability of experts, the influence of unemployment, and the influence of employee costs.

The social factors include social, cultural, and demographic factors. They deal with issues like changes in customer behaviour and beliefs, the national and international culture, and education.

The technological factors cover infrastructures, innovations, distribution, and the availability of technology for the company and competition.

Together, these domains should yield interesting uncertainties for this thesis.

3.1.2.2 Business Models

The second main goal of the interview was to gather insights about what business models would work for serious game developers. This section discusses how these insights were gathered, but first business models are discussed in a broad sense.

In essence, a business model is a structure that details how a product or service is valuable to both customers as well as the company that develops it. As such, it is an essential part for a company to consider when evaluating their business, as a company must deliver valuable offerings in order to survive and it must do so in a way that allows the company to sustain itself. In other words, a business model is a blueprint of how a company creates and captures value (Bouwman et al., 2008). The value, in this definition, is not necessarily a monetary value. Customers can get different forms of value, and so can the company that delivers it. Examples of these non-monetary values are happiness, social impact, awareness, and training. That being said, it is still important for a serious game developer to have a sustainable source of monetary income. Otherwise, the company will not be able to continue delivering its services. As such, profitability is an important part of the business model.

There are a number of different approaches to structure the development of business models. The exact definition of a business model is dependent on what approach is chosen. However, recurring themes across the different approaches are the company's value proposition towards a specific target group,

resources required to deliver this value, and the value generated for the company with the offering (Fielt, 2013). The last of these refers to how a company can sustain its activities.

To structure this research, a specific approach to business models must be selected. Fielt (2013) compares five approaches to business models. These are the first five business model approaches as depicted in table 3.4. In addition to these five approaches, the STOF model (Bouwman et al., 2008) and the VISOR model (El Sawy & Pereira, 2013) are also considered for use in this thesis.

Comparing the various business model approaches from the table, two core components are present in one way or another in all of them: the value proposition and the revenue model. Key resources are also often a part of the approach. However, the network of partners is not always considered. Due to the nature of business models, it is however important to consider how a company's business model fits within a network of other companies that each employs their own business model (Margretta, 2002). This means that the Entrepreneur's Business Model, the Business Model Canvas (which does this in a limited manner), and the Four-Box Business Model seem less suited for use in this thesis.

The Business Model Schematic is focused on e-business and, therefore, dedicates a large part of the approach to information flows, electronic relationships, and IT infrastructure (Fielt, 2013). This is not necessarily the primary focus for serious game developers. Hence, this approach is less suitable for this thesis.

The STOF model is developed for the ICT service domain. However, the model's basic principles can be applied to any offering. The model takes a customer-based view on developing business models and it takes into account many of the factors from the other approaches. This includes the external network of organisations (value network) and the technological architecture that the offering requires. The latter is in this approach not necessarily limited to digital products, even though the original approach does focus

Comparison of Business Model Approaches

Business Model Approaches	Focus
Entrepreneur's Business Model	Strategy, operations, and economy (Morris, Schindehutte & Allen, 2005)
Business Model Canvas	Company's position in the market. How a company creates value. Internal and external key resources and partners (Osterwalder & Pigneur, 2010)
Business Model Schematic	E-business specific. Company role within a network of suppliers and users. Value flows within this network (Value Network) (Weill & Vitale, 2001)
Technology-Market Mediation	Bringing new technologies to market. Value network. Value proposition. Competitive strategy (Chesbrough & Rosenbloom, 2002)
Four-Box Business Model	Value proposition. Revenue model. Key resources and processes (Johnson, Christensen & Kagermann, 2008)
VISOR model	Networked Digital Industry specific. Value proposition. Interface (user experience). Service platform (how to reach the offering). Organising (partners and relationships). Revenue/cost model (El Sawy & Pereira, 2013)
STOF model	Service (value proposition, target group). Technology (required functions and delivery) Organisation (relationships with other parties and value network). Finance (revenue/cost/risk model). (Bouwman et al., 2008)

Table 3.4: Comparison of various business model approaches.

on this. Because of these advantages over the other approaches, the STOF model is chosen for use in this thesis. (Bouwman et al., 2008; see also: de Reuver, Bouwman & Haaker, 2013)

The STOF framework offers a structured view on how to build a business model (Bouwman et al., 2008). It defines four domains: (1) Service, (2) Technology, (3) Organisation, and (4) Finance. To clarify that a product offering is also considered part of the service domain, this domain will be referred to as the Service/Product domain henceforth. Figure 3.3 schematically shows the STOF model for business models. It illustrates that the four domains work together to create and capture value.

The service/product domain involves those issues pertaining to a company's offering. As such, this domain focuses on the value proposition of a company. Issues that must be considered are: who is the customer? Who is the user? What is the context of use? What are the benefits? What is the perceived value compared to the experienced value of the service/product? Another aspect that might generate value is the mobility of the service/product, which is especially true for mobile applications. By considering the service/product domain, a company can determine how they create value for their customers and users.

The technology domain focuses on the technical architecture of the service. In other words, it looks at what functions are required and how the service is delivered. User requirements, security, and the required technical infrastructure are issues that must be considered when looking at this domain.

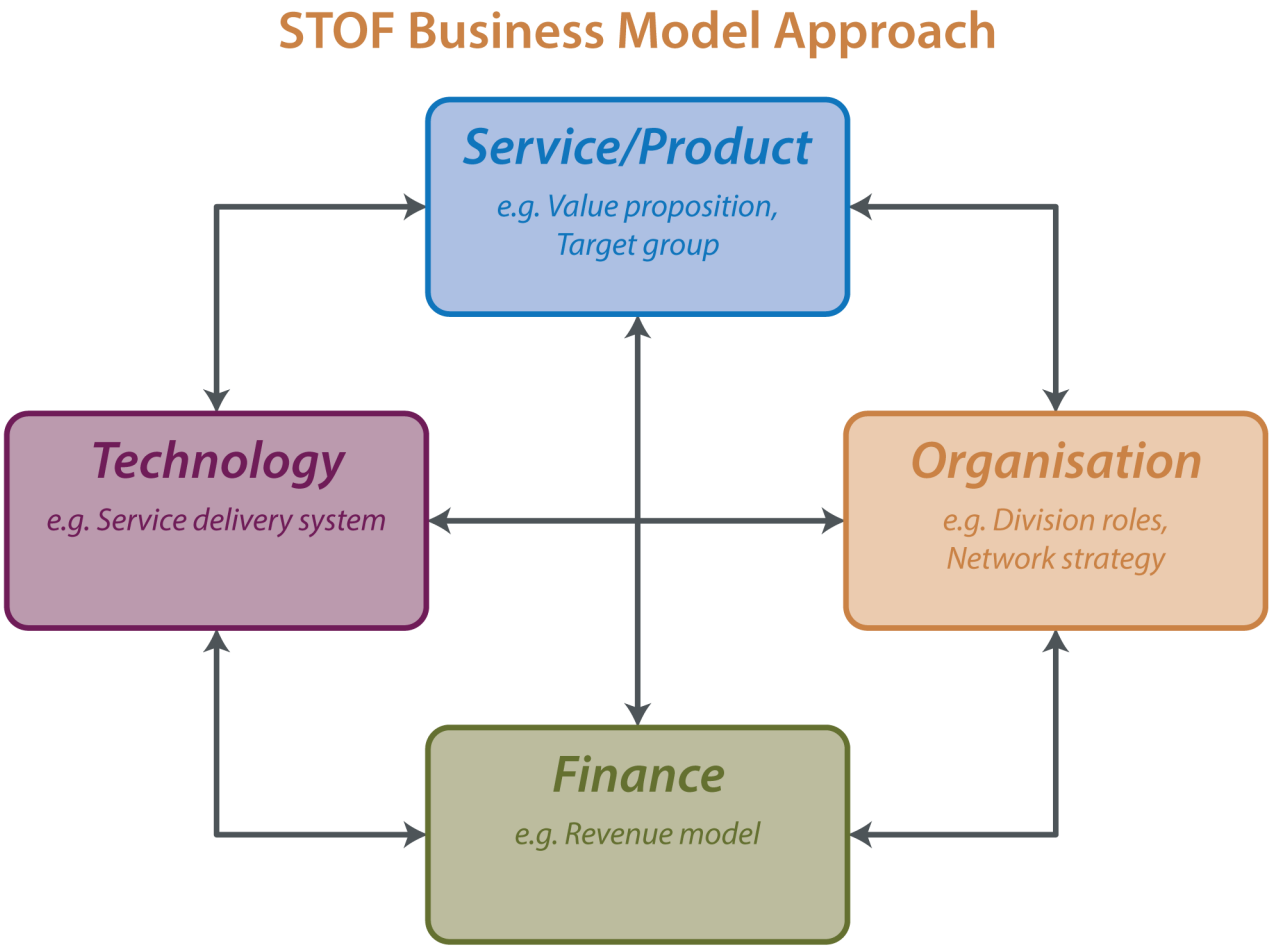

Figure 3.3: Schematic representation of the STOF model after Bouwman et al. (2008).

In the organisation domain, the focus is on identifying the resources and capabilities required to deliver the service/product and what parties can deliver them. In this consideration, it is necessary to contemplate the value flow for every participating actor and the relationships between these actors. That way, it can be ensured that each actor receives value and, therefore, has a stake in making a profitable service offering. Relating this domain to the definition of a business model, this domain considers how a focal company creates value for its partners and how the focal company captures value from its partners.

The finance domain considers the monetary arrangements between the actors. The primary concerns in this domain are the revenue model (how is money earned) and the sources of investment (who makes the service offering possible). Additionally, this domain considers the different sources of costs and risks, which should be fairly distributed over the actors. In this domain, the focus is on how a company can capture value with its offering.

Having selected the STOF model as the business model approach for this thesis, it becomes possible to group the four business models that are identified in section 2.3 into the STOF domains. This has been done in figure 3.4. The two additional business model elements from the entertainment game industry (section 2.5), which were Pay-to-Download and Advertisement Supported, are both part of the finance domain. No business model elements were recommended in the literature for the organisation domain.

To gather insights about what business models are used in the serious game industry in the Netherlands, the domains of the STOF model were a main part of the interviews. During a test interview, it quickly became clear that the STOF model itself was not enough for the interviewee to respond to. In this test interview, the STOF model was explained and for each domain (Service/Product, Technology, Organisation, and Finance), the interviewee was asked to explain how they currently approach and structure this domain.

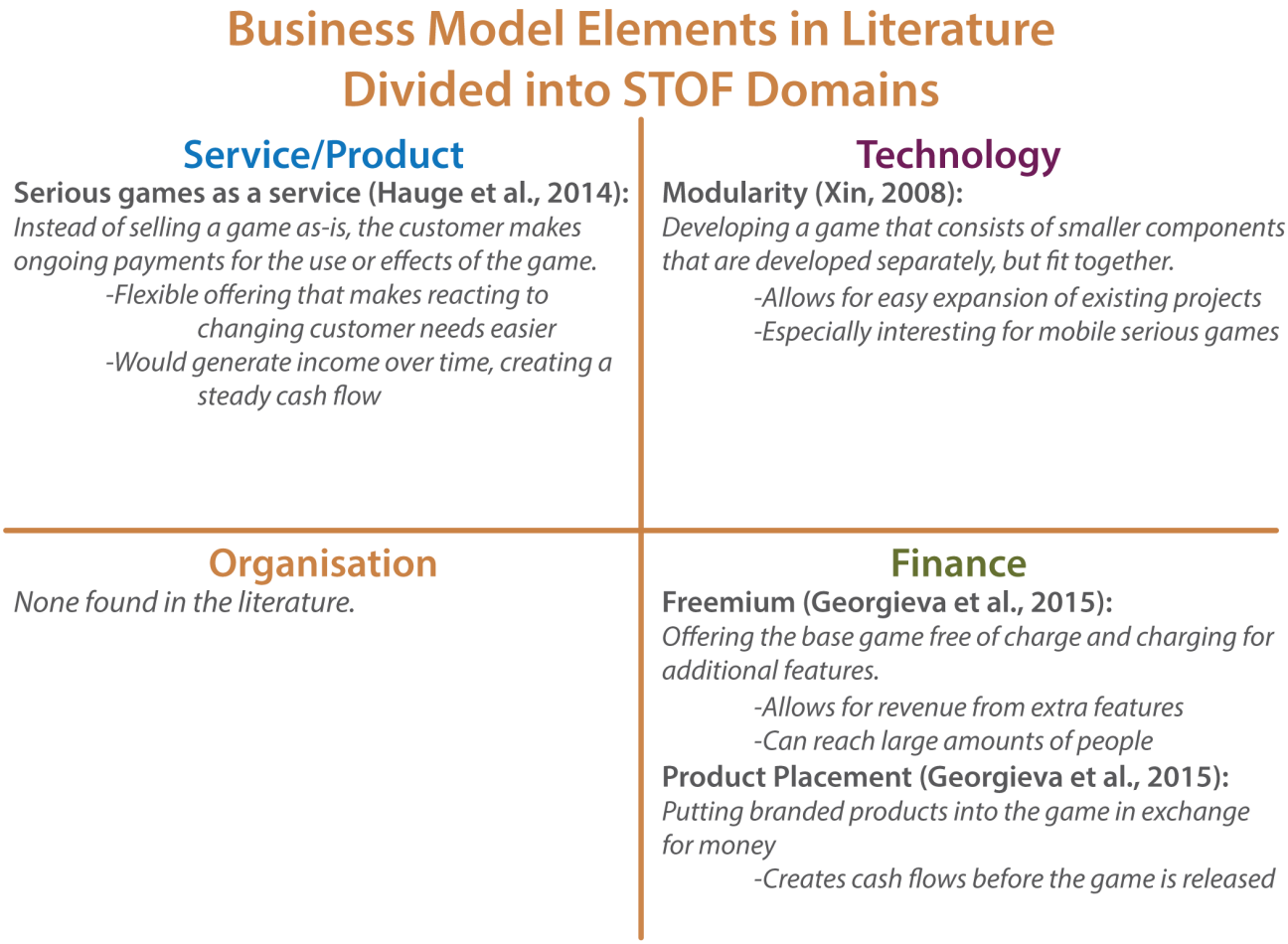

Figure 3.4: Business model elements as discussed in literature categorised into the STOF domains.

This question was generally well-answered. However, when asked what other options they might consider, the answers were less useful. Therefore, a more structured approach was needed.

Another approach was tested wherein the Business Model Cards tool from the ENVISION (n.d.) project was used to present the interviewee with several alternatives for each domain. Figure 3.5 gives an example of one of the cards as distributed by ENVISION (n.d.).

Figure 3.5: Mass Customisation business model card (ENVISION, n.d.) Left: Front. Right: Back.

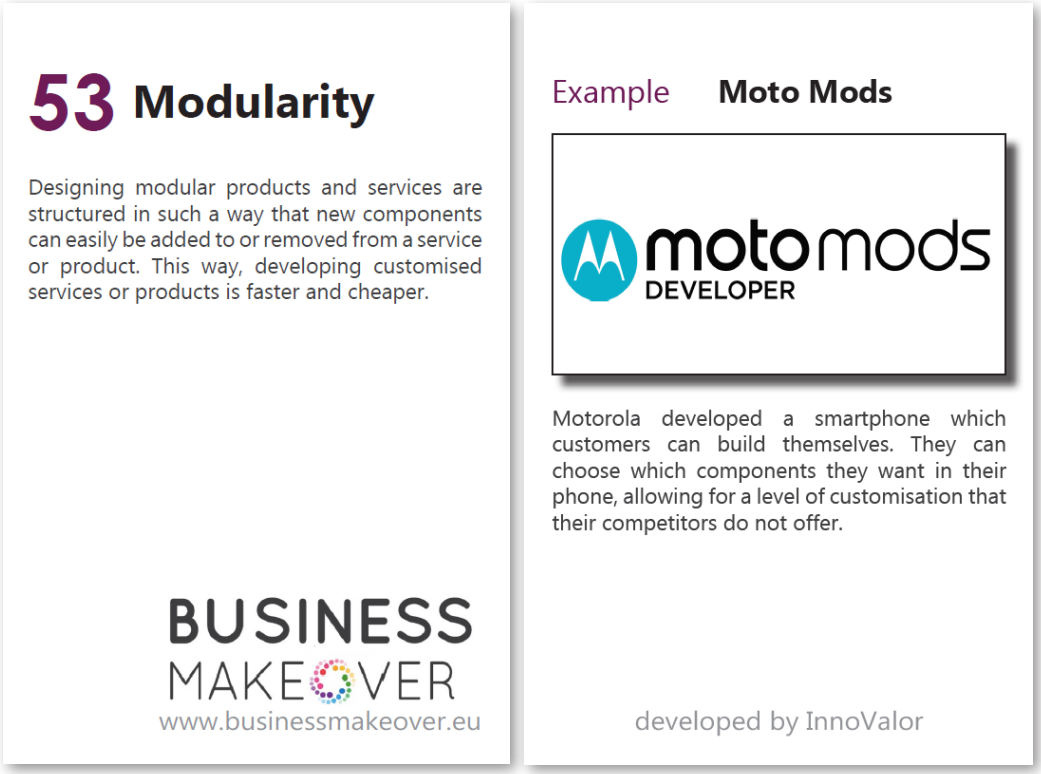

Figure 3.6: Modularity business model element card. Left: front. Right: back.

The Business Model Cards tool was developed to help entrepreneurs and small businesses innovate their business models. It consists of 52 business model elements printed on a card with an explanation of what the business model is on the front and an example of a company that uses it on the back. They are divided into the STOF domains. Appendix B gives a brief description of the Business Model Cards and the business model elements that they represent as they are used in this thesis. For a more detailed explanation of what each business model element means, it is suggested to examine the Business Model Cards themselves (ENVISION, n.d.). The tool includes most of the business model elements that are identified as valuable in the literature (figure 3.4). Games as a Service is included as Anything-as-a-Service. Georgieva et al.'s definition of Freemium is included partly within the card's definition of Freemium and partly in the definition of Add-On. In the remainder of this thesis, the definitions on the cards are used. Product Placement is included as Advertising, and so is Advertisement Supported. Pay-to-Download is included as Pay-per-Use. However, the tool does not include Modularity, so this business model element was added to the Technology domain. Since each card includes an explanation of the model and an example, these were also added to the Modularity card. Figure 3.6 shows the modularity card.

Cards such as this gave the interviewee something concrete to think about and the discussions about the various business model elements became more substantive. Because the business model cards are used exclusively after asking the interviewee to explain their own business model, this approach is not expected to limit the insights into what the practitioners are currently doing.

The business model elements number a total of 53 (14 in Service/Product, 11 in Technology, 14 in Organisation, and 14 in Finance). It was expected that including each of these business model elements in the interviews would make it too long and cluttered, which could influence the results. The test interviews corroborated this expectation. Therefore, two decisions were made.

Firstly, during the interview, each business model domain (Service/Product, Technology, Organisation, and Finance) will be handled separately. This will cut up the information into more manageable pieces, allowing the interviewee to go deeper into the business models presented to them.

Secondly, eight business models within each domain are selected for inclusion in the interview, while the others are left unexplored. This means that 32 business model elements will be examined in this research. This decision limits the scope of the research, but it does ensure that the data on the business models that are included is more accurate and complete. It is better to have in-depth information about a selection of business models rather than superficial information about all of them. The next section describes why the specific business model elements were either included or excluded from the research.

To stimulate the discussion about the usefulness of the various business models, the participant is asked for each domain to put the eight selected cards in a ranking from least interesting to most interesting for them. Such an ordinal scale, where the participant is forced to make a choice between the cards and rank them, is in principle a quantitative research method (Sekaran & Bougie, 2016, p. 208 & p. 219). However, this is true for the resulting rankings that can be quantitatively compared to those of other participants only. In this research, the final rankings, while they are reported, are not the reason for its use. Instead, the value of the ranking exercise is in the qualitative discussion about why a participant chooses a particular card over another.

Selecting Business Model Elements

As stated in the previous section, a selection must be made of the business model elements presented in the ENVISION (n.d.) Business Model Cards tool for the sake of making the interview more manageable and to ensure that the desired level of depth is reached with the interview. This section discusses the criteria and execution of this selection process.

Since the scope of this research is to identify sustainable business models for small serious game developers in the Netherlands, one consideration is company resources. Some business model elements might require the mobilisation of too many resources currently available to small serious game developers. Such business models are less likely to be of interest and would automatically be not feasible for these developers. They are therefore excluded from this research.

A second criterion is diversity. While each business model element is different, there are some similarities between some of them. For the sake of diversity, if two business models are similar, one of the two is picked for inclusion in the research.

Finally, the literature review from sections 2.3 and 2.5 identified a number of business model elements of interest. These are *Anything-as-a-Service* (Hauge et al., 2014), *Modularity* (Xin, 2008), *Freemium* (Georgieva et al., 2015), *Add-On* (Georgieva et al., 2015), *Advertising* (Georgieva et al., 2015; Game Developers Conference report, 2019), and *Pay-per-Use* (Game Developers Conference report, 2019). As such, these business model elements will be included in the interview. This literature review is also used to filter some of the remaining business model elements.

One must note, however, that these criteria do not narrow down the options far enough. Hence, the remaining business models are sampled for their inclusion in this study. In order to reduce researcher bias, this sample is taken randomly by shuffling the remaining cards and taking the first eight. It must be stressed that such a random sample means that none of the business model elements elected in this way can be considered superior in relation to the ones that are excluded in this manner. Hence, future research is required to test the business model elements that are excluded in this way. This is also true for the business model elements that are excluded because of the other two criteria because it remains possible that these business models are indeed interesting.

Service/Product

For in the Service/Product business model domain, the business model elements from table B.1 are evaluated. Eight of these are selected for inclusion in the interviews, which means that six have to be excluded.

The first criterion eliminates no business model elements, as none of the business model elements is limited to large companies. The second criterion allows for the comparison between *Leveraging Customer Data* and *Data as a Service*. Both elements involve collecting data and selling this data to other parties. Hence, only one of these is included in the interview. Since *Leveraging Customer Data* is about both selling data as a direct and indirect source of income, whereas *Data as a Service* only considers its direct value, *Leveraging Customer Data* is selected for the interview.

Hauge et al. (2014) claim that *Anything as a Service* is an effective business model. It is, therefore, included in the interview. Also, in the entertainment game industry, games are often sold through platforms. Therefore, the *Platform* business model element is also included in the interviews.

The remaining business model elements are shuffled and randomly selected until eight elements are included in the interview. This results in the business models in table 3.5 being selected for the interviews.

Technology

In the technology domain, three business model elements have been excluded, leaving eight elements for the interview.

Bricks & Clicks and *Omnichannel* are both about integrating digital and physical channels. *Omnichannel* is broader, as *Bricks & Clicks* only involves physical and digital shops. Therefore, *Omnichannel* was included in the interview over *Bricks & Clicks*.

Barter is a business model element that does not involve any exchange of money. As this is, according to Mayo (2010), not sustainable, this element is also not included in the interview.

Finally, *Peer-to-Peer* has also not been included in the interview because it does not make sense in the context of serious game development. Serious game developers are a required party in the development of serious games and are unlikely to be substituted by a *Peer-to-Peer* business model. Still, it is possible for a company to base its business model on supporting such a *Peer-to-Peer* model. Since the company would then, however, no longer be developing games themselves, the question arises whether such a company could still be considered a serious game developer. It could be an interesting business model element, but it is excluded from this research because of these reasons.

Selected Business Model Elements (S)	
Mass Customisation	*Anything-as-a-Service*
Solution Provider	*Platform*
Experience Selling	*Leveraging Customer Data*
Eco & Green	*White Label*

Table 3.5. The eight selected business model elements of the Service/Product domain.

Selected Business Model Elements (T)	
Sharing Economy	*Omnichannel*
Cross-Selling	*Versioning*
Lock-In	*Behavioural Segmentation*
e-Commerce Only	*Modularity*

Table 3.6. The eight selected business model elements of the technology domain.

The remaining business model elements (table 3.6) are all included in the interview, including *Modularity,* which Xin (2008) identifies as an interesting business model element.

Organisation

Eight organisation business model elements are selected for the interview, which means that six have been excluded.

The first criterion eliminates the *Franchising* business model. *Franchises* are only of interest if the company's brand holds considerable value. For small serious game developers, this is likely not the case.

For the second criterion, *Outsourcing* and *Insourcing* are similar, albeit opposite. But, as they are opposites, any discussion during the interview about one, will also likely involve the other. Hence, *Outsourcing* is included in the interview, while *Insourcing* is not.

Additionally, *Customer Analytics* is similar to the Service/Product business model element: *Leveraging Customer Data*. Although the focus is more on the indirect value of data, here, the similarities are enough to not include it in the interview.

The *Shop-in-Shop* element is also not included, because serious game developers do not have physical stores, making this business model element less valuable for them.

The remaining business model elements are randomly sampled until eight elements can be included in the interview. The final selection is presented in table 3.7.

Selected Business Model Elements (O)	
Business Alliance	*Content Curation*
Co-Creation	*Fractional Ownership*
Outsourcing	*Renting*
Orchestration	*Leveraging Resources*

Table 3.7. The eight selected business model elements of the Organisation domain.

Finance

In the last domain (Finance), another eight business model elements are selected for the interview. This means that six business model elements have been excluded.

The first criterion does not limit the selection.

For the second criterion, a comparison between the *Razor & Blade* element, and the *Add-On* and *Freemium* elements is made. There are similarities between the former and the latter two. In these elements, the product is split into multiple components, which require additional investments after the initial purchase. Since Georgieva et al. (2015) claim that the latter two are important business models for serious game developers, they are both included, but the *Razor & Blade* element is excluded.

Additionally, *Advertising* and *Affiliation* also have some common ground. *Affiliation* involves redirecting customers to other businesses and taking part of their revenue. *Advertising* does not actively redirect, but it does involve generating sales of other businesses. *Advertising* is included in the interview, while *Affiliation* is not.

For serious game developers, *Reselling* might be less interesting, considering they develop their own serious games, rather than selling other developer's serious games. As such, *Reselling* has also been excluded from this research.

Dynamic Pricing seems less suited for serious game developers as well, considering that demand is not expected to not fluctuate predictably. Hence, this element has also not been included in the interview.

Due to the high costs involved with the creation of a game, neither the *Auction* nor the *Pay What You Want* business model element seems suitable for serious game developers. Both elements involve the customers determining what they will pay for the service/product, and especially for small serious game developers, it is important to maintain a profit for every project.

The remaining eight business model elements are all included in the interview and are presented in table 3.8. They include the *Product Placement* (*Advertising*), and *Freemium* business models that Georgieva et al. (2015) claim could be effective. Additionally, they also include the *Advertisement Supported* (*Advertising*) and *Pay to Download* (*Pay-per-Use*) models that are often employed in the entertainment game industry (Game Developers Conference report, 2019).

Selected Business Model Elements (F)	
Crowdfunding	*Licensing*
Add-On	*Pay-per-Use*
Freemium	*Advertising*
Revenue Sharing	*Bundling*

Table 3.8. The eight selected business model elements of the Finance domain.

Consequences of Selecting Business Model Elements

Because certain business model elements have been excluded from this research, no conclusions from this research can be assumed valid for the omitted elements. Additionally, there is no reason to assume that any of the excluded business models are completely inapplicable to serious game developers. As such, additional research should be done on the 21 business model elements that have not been examined. For this future research, a similar setup could shed some light on the robustness of the untested business models. Since the interviews allow for 32 business models to be tested, the 11 unassigned slots should be picked from the already tested business model elements. These business model elements can provide a reference for each research and allow the results to be linked to each other.

3.1.3 Interview Structure

In this section, the structure of the interviews is discussed in detail, taking the results of the previous sections into account. The interview was semi-structured, meaning that a variety of topics for discussion were selected beforehand while maintaining the possibility to diverge into related topics (Sekaran & Bougie, 2016, p.115). The overall structure of the interviews is depicted in figure 3.7 below.

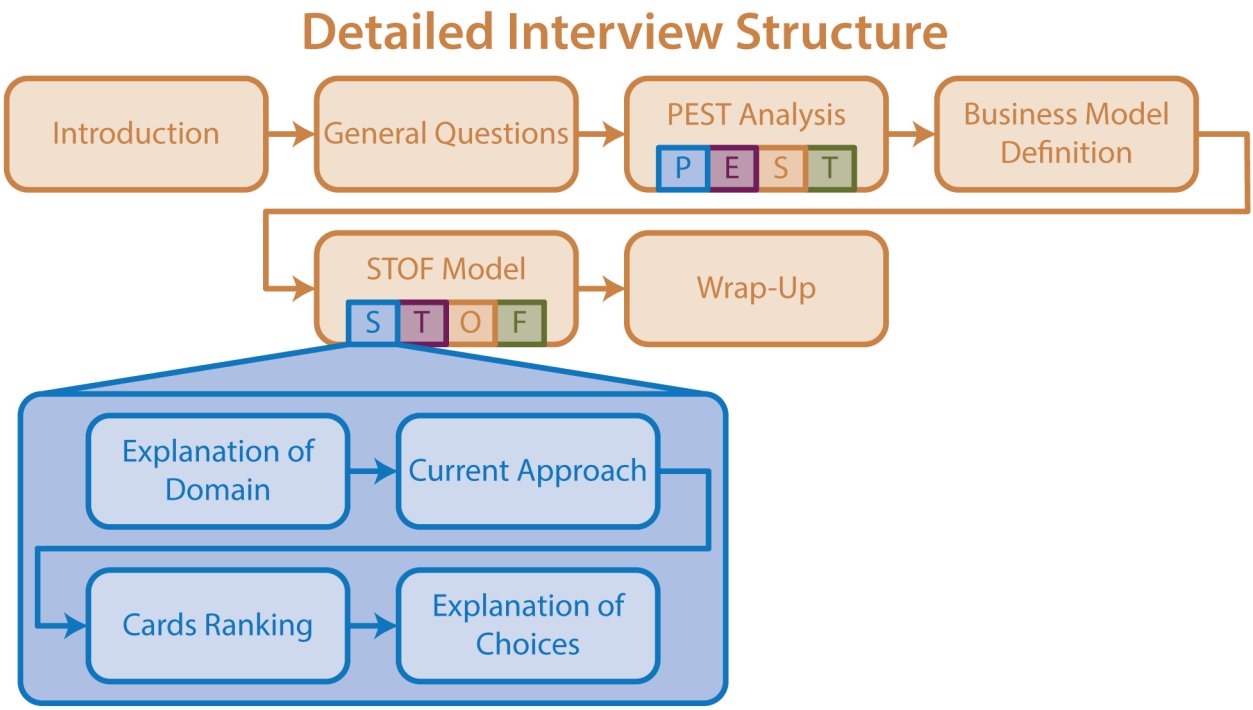

Figure 3.7: Structure of the interview.

The structure of the interview was maintained during the interviews by means of cue cards. These are presented in the figure below.

Firstly, the researcher introduces themselves, the context of the research, and its goal. Then, they walk the participant through an informed consent form which is in accordance with the GDPR (see appendix A). After the informed consent form is signed, a recorder is turned on for the remainder of the interview.

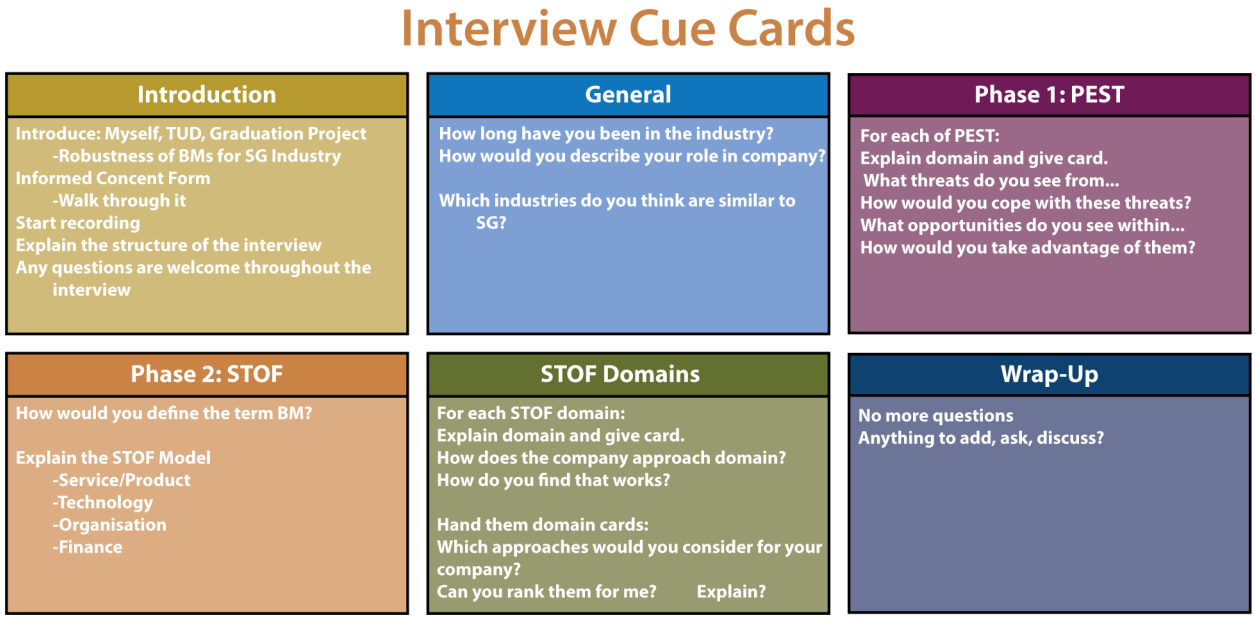

Figure 3.8: Interviewer cue cards.

In the final part of the first card, it is mentioned that, should the participant have any questions, they should feel free to ask them throughout the interview.

Secondly, some general warm-up questions are asked. The questions (first two of the "General" cue card) are good warm-up questions because people like talking about themselves (Ward, 2013). After these questions, it is asked what other industries they think are similar to that of serious games. The answers to this question do not directly relate to the research questions of this thesis but will provide context for future research.

After the general warm-up questions, the interview moves into the PEST analysis, which is briefly introduced to the participant. For each of the domains separately (Political, Economic, Social, and Technological) it is asked what opportunities, threats, and trends the participants expect in the future. To give direction to the participant, they are handed a card with some topics related to the domain on them (figure 3.9).

The researcher explains that the topics on those cards are suggestions only and if any other thoughts come up, that the participant should feel free to share them.

After finishing the PEST analysis, the interview focusses more closely on the company itself, specifically the business models. But first, the participant is asked to define the term "business model". This question is aimed at evaluating how well business models are understood by serious game developers.

The business model part of the interview starts with the definition used in this thesis to make sure that the participant is talking about the same things that the interviewer is. Then, a brief introduction to the STOF model and its four domains (Service/Product, Technology, Organisation, and Finance) is given. The STOF model's domains are discussed separately. For each domain, another explanatory card is given to the participant along with an explanation by the interviewer about the domain (figure 3.10).

These cards again help structure the debate with the interviewee by illustrating the scope of each domain. For each domain, the participant is asked to describe the company's current approach to structuring this domain. This open question is aimed at identifying new business models that are not specifically included in the Business Model Cards (ENVISION, n.d.).

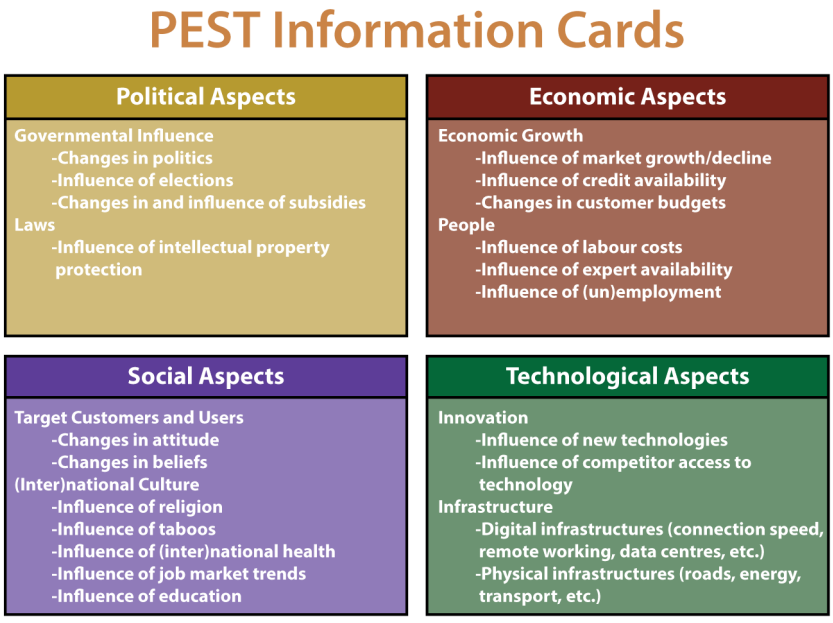

Figure 3.9: Explanatory cards for the PEST domains used during the interviews.

After this has been discussed, the participant is given the eight Business Model Cards relevant for that domain, as specified in section 3.1.2.2. They are asked to put the cards in order of the most interesting for their company to the least interesting for their company, considering the future as well as the present. As explained in section 3.1.2.2, the value of this sorting exercise is more in the qualitative discussion that it provokes than in the resulting quantitative ranking. The participant is asked to explain their choices. In this discussion, the interviewer will try to link topics discussed before to the cards and ask the participant to consider another side to the card that they might not have considered. This is especially useful for verifying thoughts and ideas. For instance, it might happen that a participant contradicts a previous statement. Pointing this out will bring to light underlying reasons. Finally, the participant is asked whether they still agree with the order of the cards or whether they would like to change the order. When they are satisfied, the ranking is documented.

Since the Advertising card in the finance domain does not explicitly mention product placement, which Georgieva et al. (2015) do state is important, the interviewee is explicitly asked to consider this and give their opinion during the discussion about the Advertising card.

At the end of the interview, the participant is given the opportunity to add, ask, or discuss anything they might want to.

This interview structure was tested twice with different interviewees before the interviews were used to gather data. The test interviews were done with the same target group as the research interviews were done. The tests led to a change in structure, which eliminated half an hour of interview time. Before this change, the business model of the company was first discussed separately from the STOF model. However, the insights gained from that discussion covered the same, but fewer topics as when using the structure of the STOF model separately. Additionally, the test interviews led to the inclusion of the explanatory cards for the PEST analysis and the STOF model for the interviewee to make it easier to understand the scope of the domains.

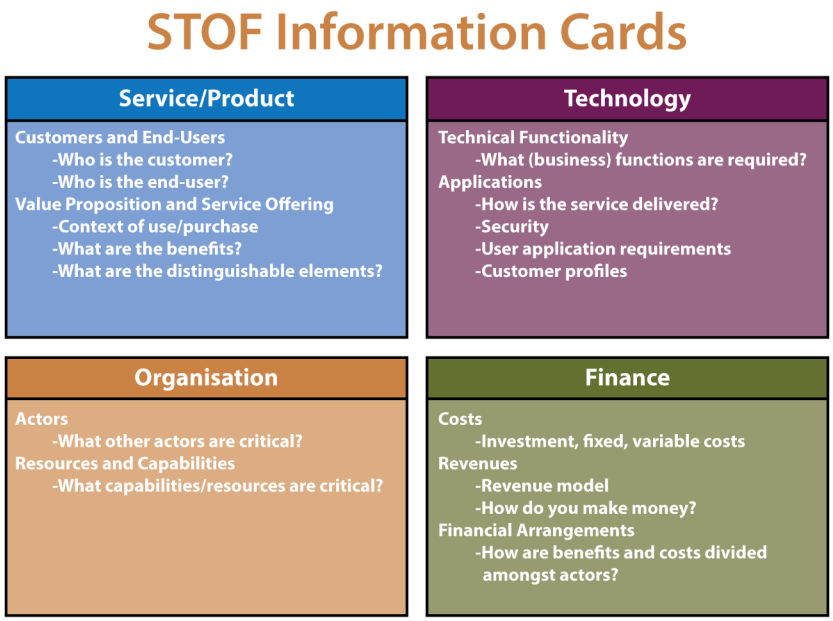

Figure 3.10: Explanatory cards for the STOF domains used during the interviews.

3.2 Data Analysis

In this section, the manner in which the data is analysed is explained and discussed. First, the documentation of the interviews is explained. Then, the selection procedure for the future uncertainties is discussed. After this, the methods for interpreting the data about the different business models are documented. Finally, the way that the uncertainties and insights about the various business models are combined using the Business Model Stress Testing tool is also explained (Haaker et al., 2017).

3.2.1 Interview Documentation

The interviews with practitioners were semi-structured. This means that a variety of topics were determined beforehand to always be part of the interview. These topics were the PEST analysis domains, the STOF model domains, and the selected business model cards from the ENVISION (n.d.) project. This allowed for the discussions to be grouped within these topics.

For each interview, an excel file was set up wherein the interview recording was summarised and coded into these discussion topics. Within the PEST analysis domains, the different opportunities, threats, and trends were coded, based on their content. For instance, if the topic coined by Mayo (2010), which is the acceptance of serious games as a tool, was discussed, it would be coded as "acceptance of serious games" followed by the actual content of the discussion. The same was done for business models that were discussed. If a business model came up that was not covered by the business model cards, a new overarching term was formulated as a code. Using this coded data, it was easier to combine the different discussions with the different participants that related to the same topics.

3.2.2 Uncertainty

The coded data about the uncertainties were combined in an excel file where all remarks from every interview were grouped together for each uncertainty. Having this data in the same place allowed for easier interpretation. This was done by identifying what the issue for each uncertainty was and where there was overlap. Additionally, the opportunities for each uncertainty were also documented this way. Then, these views were combined into a general insight about the uncertainty, describing both positive and negative outcomes, if they were part of the discussion. Not every issue was discussed by every interviewee and not every issue was discussed as extensively as the others, as such, some uncertainties are documented more extensively than others.

3.2.3 Business Model Analysis

The business model elements discussed without the cards are also coded by finding a term that covers its contents. Only two business model elements were brought up that was not covered with the cards (section 4.2.3.5). These business model elements are also included in the Business Model Stress Test (discussed in the next section). However, since these business model elements are not as extensively discussed as the other business model elements across the interviews, the findings about these business model elements are expected to be incomplete.

The interview data about each of the business model elements (including those of the business model cards) that were gained from the different participants were combined to create a deeper understanding of the usability of the business model element for the serious game industry.

The sorting exercise (ordinal ranking) of the Business Model Cards (section 3.1.2.2) is used to stimulate discussion and thoughts with the participants, rather than yield a useful ranking. This ordinal ranking is reported, but not used to draw conclusions from. Rather, these results are used as an illustration for insights about the categorisation method used in this thesis. The sorting yields a 1 to 8 ranking of how useful and interesting the participants find the business model element (lower is better).

Calculating average ratings for each of the four strata of the categorisation from section 4.1 then gives a general overview of how the participants view the different business model elements. While these numbers are not statistically significant, they do illustrate potential differences between strata.

3.2.4 Business Model Stress Testing

The business model stress testing tool's foundation lies in scenario planning (further reading: Bradfield et al., 2005) and business model innovation (further reading: Chesbrough, 2010). Its function is to evaluate the robustness of business model elements when confronted with a future uncertainty in a practical and structured way. The viability of a business model can be analysed by assessing the impact of a future scenario on a business model's value creating and value capturing capacity. The feasibility of a business model can be analysed by assessing how future scenarios impact the availability of required resources. (Haaker et al., 2017)

The business model stress testing tool contains six steps. (1) The business model must be described. (2) Uncertainties must be identified and future scenarios determined. These scenarios must be internally consistent and if multiple scenarios are considered, they must be different and distinguishable from each other (Van der Heijden, 2005). (3) The business model must be related to the uncertainties. (4) The impact of the uncertainties on the business model must be determined. (5) The results must be analysed. (6) Improvements and actions must be formulated based on the analysis. The analysis is qualitative in nature and the results are only as reliable as the input. (Haaker et al., 2017)

How the first two steps are executed is described in the previous two sections. For the stress test, it is necessary to define two extreme outcomes about a specific uncertainty. This is done in section 4.2.2.6 and involves taking opposing views from the interviews and using each to describe the extreme scenarios. Step three is done by identifying common topics between the business model element descriptions and the scenario descriptions of the uncertainties. Step four is done in accordance with how Haaker et al. (2017) describe it. They describe the step as assessing how an uncertainty outcome affects the business model element by allocating a certain colour to the expected impact accompanied by a motivation. These colours are (after Haaker et al., 2017):

Red: indicating that the business model element is no longer feasible in relation to the uncertainty. The uncertainty can cause big problems for the business model element.

Orange: indicating that the business model element is no longer viable in relation to the uncertainty. The uncertainty requires the company to revisit its business model.

Green: indicating that the uncertainty affects the feasibility or viability of the business model element, but not negatively. The effects may be positive.

White: indicating that the uncertainty does not affect the business model element.

Grey: indicating that not enough data is available about the relation between the business model element and the uncertainty.

Step five involves drawing conclusions from the resulting heat map on a meta-level. These are the conclusions of the thesis research. Step six is beyond the scope of this research and translates into what the resulting heat map can be used for within specific organisations. However, a brief analysis of the company that commissioned this research is done to illustrate the usefulness of the results (section 4.4).

4 Results

In this section, the results of this thesis project are discussed and developed into insights. Firstly, the categorisation systems presented in section 3.1.1 are examined to identify the categorisation that would be best suited for use in this thesis. Secondly, the results of the interviews are presented. This includes some general findings. Additionally, the interviews led to the identification of 25 uncertainties that influence serious game developers in the Netherlands. The different discussions from the interviews are combined to create in-depth insights about these uncertainties. This will answer research sub-question 1:

What uncertainties does the serious game industry in the Netherlands currently face?

From these uncertainties, several are selected for inclusion in the business model stress test. Furthermore, the discussions from the interviews led to in-depth insights into the 32 business model elements that were selected for inclusion in this interview. These are presented in section 4.2.3 and answer research sub-question 2:

What business model elements are currently used in the serious game industry in the Netherlands?

Thirdly, in section 4.3, the business model stress test is discussed, where the insights about the business model elements are combined with the selected uncertainties. This stress test provides the answer to the research sub-question 3:

How do the business model elements from SQ 2 hold up against the uncertainties from SQ 1?

Finally, in section 4.4, the results of the business model stress test are applied to an example case to illustrate how they can be used, answering the main research question of this thesis project:

How can serious game developers use business models to remain robust in relation to various uncertainties in the serious game industry?

Throughout this chapter, quotations by interview participants are given to illustrate the insights. Due to privacy reasons, they are presented anonymously.

4.1 Evaluating the Categorisation

Three diagrams were constructed to evaluate the practicality of using the different categorisation aspects in conjunction as identified in section 3.1.1. These aspects are company size, specialisation, and offering. In this section, three diagrams present the three possible sets of two categories populated with the companies from the database. This is done to select a categorisation that seems the most suitable for use in this thesis. This, however, does not mean that either of the other categorisations is in any way inferior to the selected categorisation. The purpose of the selection is to structure the rest of the analyses and to have a reference to group results with.

The first categorisation diagram combines company size and specialisation.

Specialisation/Size Categorisation

	Small	Medium	Large	Total
Specialised	14	4	2	20
Not Specialised	32	8	2	42
Total	46	12	4	62

Figure 4.1: Distribution of serious game studios based on size and specialisation.

This diagram depicts a total of 62 out of the 92 companies in the database. The other companies were not included because information was missing about their size. In the resulting diagram, it is easy to see that there are many more smaller companies than medium or large companies in the Dutch serious game industry. This is also the reason why a categorisation like this one would be unpractical. Getting a representative response from either large category would require every member of those groups to be interviewed. This is unlikely to be possible. This categorisation is therefore not chosen for this thesis.

The next diagram combines company size with the company's offering.

Custom Design/Size Categorisation

	Small	Medium	Large	Total
Custom Design	34	7	2	43
No Custom Design	6	4	2	12
Total	40	11	4	55

Figure 4.2: Distribution of serious game studios based on size and custom game design offerings.

This diagram depicts 55 out of the 92 companies in the database. The other companies were excluded because information was missing about their size, their offering, or both. The same limitation as with the previous categorisation is valid for this categorisation. Hence, this categorisation is also not elected for this thesis.

The final diagram combines specialisation with the company's offering.

Specialisation/Custom Design Categorisation

	Custom Design	No Custom Design	Total
Specialised	11	12	23
Not Specialised	49	7	56
Total	60	19	79

Figure 4.3: Distribution of serious game studios based on specialisation and custom game design offerings.

In this diagram, 79 out of the 92 companies in the database are depicted. Information about the company's offering was missing on the other companies. This distribution illustrates that a clear majority of serious game studios offers to make custom games for their customers, most of which are not specialised. However, a significant number does the opposite and offers no custom game development services and communicate a specialisation. Because this categorisation has a better representation of each category and still illustrates a fundamental difference between different serious game studios, this categorisation is used in the selection of companies for the interviews.

Across the strata, the aim was to do at least 10 interviews, which should yield at least 80% of the relevant insights (van Boeijen et al., 2013; see also Faulkner, 2003). Since the number of companies in the different strata is not uniformly distributed, the selection of interviewees is also done disproportionately. The desired number of interviewees per stratum was 2 in the specialised/custom design, 3 in the specialised/no custom design, 5 in the not specialised/custom design, and 2 in the not specialised/no custom design strata. This totals 12 companies, which should then yield more than 80% of the relevant insights. Companies were sampled randomly from the database. If a company did not want to participate, a new company was randomly sampled. Figure 4.4 shows how many companies were eventually included in this research per stratum.

A total of 12 interviews was held amongst the different strata. As such, it is expected to find between 80% and 90% of the relevant insights (van Boeijen et al., 2013; see also Faulkner, 2003). The largest stratum was also represented most with 6 interviews. The specialised/custom stratum has been under-sampled because only one of the companies in the database wanted to participate. As such, it is noted that the insights gathered about that stratum are possibly not representative of the stratum as a whole.

Another limitation of the selection process is that companies can refuse to participate. Hence, the sampling method is not purely randomised, meaning that there is a bias in the possibility that companies that refuse participation are different from companies that agree to participate.

Interview Participants Divided into Categories

	Custom Design	No Custom Design	Total
Specialised	1	3	4
Not Specialised	6	2	8
Total	7	5	12

Figure 4.4: Performed interviews per category.

4.2 Results from the interviews

In this section, the results from the interviews are discussed in detail. Firstly, some initial findings about comparable industries are presented followed by the value of the interview in itself. Then, an in-depth analysis of the various uncertainties that the Dutch serious game market faces is done. Finally, the various business model elements that this thesis studies are examined in detail.

4.2.1 Comparable Industries and Direct Value of the Interview

Part of the interviews included the question of what other industries the interviewee felt were similar to the serious game industry. This question was meant to identify some industries that might employ similar business models for future research and for verification of an assumption often made in the literature. This is discussed in this section.

Most interviewees did not feel like the entertainment game industry is similar. While a part of the development (programming, user experience design, and user interface design) is similar, there are not quite as many similarities in customer groups, organisational structures, or approach. This is noteworthy because literature often assumes that entertainment games and serious games are similar in these respects. Additionally, so do customers of serious game developers, according to some of the interviewees.

"[Serious games] are not like entertainment games, but we are compared to them."

"Many organisations that look at us from the outside think that [we are similar to entertainment games], but I don't agree."

The industry that is mentioned most as similar to serious games is the education and training industry. Other industries that are often mentioned are e-health & healthcare, design studios & behavioural change, organisational change & consultancy, communication, and research & development. The reasoning is that the serious games offer a new medium through which solutions can be offered within these other industries. Therefore, it would seem that the industries that can be compared to a company's industry the most are the same as a combination of the purpose and scope of a serious game, as per the G/P/S model (Djaouti et al. 2011a). Some interviewees believe that serious games offer a new, additional approach to these industries, rather than that serious games substitute parts of those industries. Some interviewees believe that the industry is unique, however, and that there is little point in making a comparison. Regardless, it would be interesting to explore the similarities between these industries in a future study and perhaps it will be possible to identify business models in those industries that can also be of use for serious game developers.

An additional result from the interviews that was not planned beforehand is that many of the interviewees found the interview itself to be very helpful. They described it as a pleasant way of thinking about their own company's structure. They said that there was value in using a structured approach to discuss their own business models and they found the Business Model Cards a useful way of considering alternative approaches.

"I once did a business administration study myself, but eventually that gets lost in the rush of the company."

This suggests that it is valuable for practitioners to take the time and use a structured approach like the one used in this thesis to evaluate their business even outside this research.

"[Looking at the business model cards], I get a bit insecure about what we're doing. Maybe we could do it differently."

4.2.2 Future Uncertainties

Before doing the actual interviews, two test interviews were done. During these tests, the PEST analysis did what was expected. The interviewees discussed the different domains and raised several uncertainties that they saw there. These uncertainties included an unfairness in how subsidies are distributed, the effects of a declining economy, and how game development technologies are becoming more accessible. Additionally, it touched upon the uncertainty that Mayo (2010) identified as well: achieving customer acceptance. As such, it was concluded that the PEST analysis is a good tool to start a discussion with to achieve the purposes of this interview.

In the actual interviews, about one third of the time was spent on the PEST analysis and finding external threats, opportunities, and trends. Together, this thesis defined those three external aspects as uncertainties. As explained before, PEST is a tool that allows for a structured qualitative analysis of external aspects that might influence a company based on four domains: Politics, Economics, Society, and Technology (Ho, 2014).

25 Different uncertainties were brought up in the interviews across the domains. 6 Were in the Political domain, 6 in the Economic domain, 8 in the social domain, and 5 in the technological domain. The next sections examine the uncertainties in detail per domain. Each section starts with a table wherein the uncertainties are mentioned and summarised. Additionally, it presents how many interviewees mention a specific uncertainty as an issue. This number does not include participants that mention it as something that has no or little effect on them. It is important to note that the purpose of these sections is not to offer solutions to the uncertainties but to present the considerations that were revealed during the interviews. Additionally, if the same problem is mentioned in the literature, it is also reviewed how the new insights relate to the literature.

4.2.2.1 Political Uncertainties

In this section, the insights about the uncertainties in the political domain of the PEST analysis are discussed based on the information discussed during the interviews. Table 4.1 gives an overview of the information, including the number of interviewees (N) that mentioned the uncertainty as an issue.

In the remainder of this section, the gained insights about the different uncertainties are discussed in more detail.

Uncertainties from the Interviews (Political Domain)

Uncertainty	N	Description
Subsidies	4	*Mostly not used because they are difficult to obtain.*
GDPR	4	*Requires companies to put more care into handling data.*
Intellectual Properties	1	*Small developers do not have the capacity to actively safeguard IPs.*
International Friction	1	*Working with other companies internationally can bring issues with it.*
Outdated Laws	1	*Some laws are outdated and limit the options for developers.*
New Laws & Elections	6	*Can either be a threat to the status quo or a subject for a new game.*

Table 4.1. List of uncertainties found within the Political domain from the PEST analysis. Including a short description and the number of interviewees that mentioned it as an issue (N).

Subsidies

Amongst the interviewees, subsidies were mostly not employed. The reasoning for this was that subsidies are considered difficult to obtain and not worth the time invested in them. It is mostly the same companies that get the subsidies due to their experience with the process.

"It's a lot of work and the income is uncertain."

Some companies are indirectly involved with subsidies, where their customer obtained their funds from subsidies. Still, the general preference seems to be to work without subsidies because of various reasons. One of the reasons was that companies feel like they should be able to make it without subsidies. Others feel that the government's requirements for the subsidies are too restricting and often do not cover enough of the costs to be able to finish the project anyway.

"I think that a product should prove itself [without subsidies]."

One of the companies actively pursues subsidies themselves but mentions that it is a rigid process that would benefit from some more leniency.

Mayo (2010) identified research grants and subsidies as an issue for serious game developers because it takes away their incentive to construct revenue models. As the interviews indicate, this was not the case for most of the interviewees. Only one of them was dependent on subsidies and this choice was consciously made by that party.

As such, it seems that the concern raised by Mayo (2010) is not as valid in the Netherlands or that things changed since he published his work.

There seems to still be an issue with subsidies, however, in the form where it creates an unfairness between companies that have experience getting subsidies and companies that do not. This might skew the market unfairly into the favour of companies that do work with subsidies.

GDPR

The recent installation of the European GDPR was a topic of discussion during most of the interviews. Four companies mentioned it as an issue. The primary concern was that it requires companies to put more care and time into how they handle data. This costs time, but the parties do feel it is a useful addition. Since every company must deal with this, the interviewees do not believe this issue is major, just an extra concern.

Intellectual Properties

Intellectual properties were mentioned once as an issue. The problem lies in the relation between small serious game developers and large companies that have the capacity to put time into the protection of intellectual properties, whereas smaller companies must use their capacity on their core business instead. Most interviewees do make clear agreements with their customers about intellectual properties when they make custom serious games.

"You want to protect your competitive position. Large companies sometimes have a whole department for this, while small entrepreneurs are trying to pay for their employees' salaries."

International Friction

This was mentioned as an issue with regards to the digital and physical infrastructure that companies use for their services. International relations between countries can limit the options when structuring or producing a service. For instance, saving data in one country might not be allowed by another country when doing business there.

Outdated Laws

Also mentioned by one participant as an issue was that some laws that are applicable to the serious game sector are outdated and written in a context that no longer is valid. It was not mentioned by the other interviewees.

"Back then, [when a law was made], the internet did not even exist yet, so it is strange that this law still exists in that form."

New laws & elections

Amongst the participants were two main ideas about the impact of new laws and elections. One side tries to work independently from what happens politically and works within the legal bounds. Here, the general sentiment was that a change in politics is disruptive and unwanted. The other side sees changes in politics as an opportunity to make serious games about them for customers who must deal with this change.

"Every new law is an opportunity for us because we can make a game about it."

4.2.2.2 Economic Uncertainties

Within the economic domain of the PEST analysis, 6 uncertainties were identified. These are presented in table 4.2.

In the remainder of this section, the gained insights about the different uncertainties are discussed in more detail.

Uncertainties from the Interviews (Economic Domain)

Uncertainty	N	Description
Economic growth & decline	9	*There is increased budget and demand. In decline, needs change.*
Importance of branding	2	*Developers are not proportionally appreciated relating to expertise.*
Scalability of serious games	3	*Software scales well, but custom games cannot make use of this.*
Availability of Experts	8	*It is difficult to find the right people due to scarcity of experts.*
Availability of credit/investors	2	*Developers who do not make custom games are more interested in this, while custom game developers prefer to remain independent.*
Setting up KPIs for effectiveness	1	*It is sometimes difficult to measure the effects of serious games.*

Table 4.2. List of uncertainties found within the Economic domain from the PEST analysis. Including a short description and the number of interviewees that mentioned it as an issue (N).

Economic Growth & Decline

The general feeling amongst the participants is that the market for serious games is growing and that there is a lot of potential for more growth. They notice an increase in the demand for serious games both in the number of projects they can do as well as the budget that is available for budgets. Still, the interviewees do not yet feel like serious games are part of the standard budgets of companies. As such, there is a fear that serious games will be less popular during a recession.

> *"If the economy declines, companies will not choose for serious games as much and probably focus on their core business."*

The interviewees that were active in the serious game industry before the last recession started in 2008 (Goodman, 2016) mention that budgets and demand for serious games did reduce significantly during the economic decline. They noticed that the application for serious games also shifted from a focus on the development of missions, strategy, and core values to cost reduction and the return to the core business. The responses of these interviewees illustrate that it is important to be flexible if the economy changes.

> *"Before the [economic] crisis, [serious games] were often about vision development, strategy development, and core values. During the crisis, the needs became more focused on cost reduction. There are opportunities on both sides."*

Importance of Branding

Two participants mentioned an issue with the image of game development and that companies underestimate the expertise required to make a good serious game. This makes it difficult for developers to communicate the added value of working with a professional serious game developer instead of "some guys in an attic", as one interviewee calls it. Having a solid brand is mentioned as a solution to this issue.

Scalability of Serious Games

Three companies touched on an apparent inherent inefficiency in the development of custom serious games. The development costs of serious games are high, while the marginal costs are low. Therefore, serious games are easily scalable. However, making custom games makes it more difficult (if at all possible) to make use of this scalability. This makes it difficult for these companies to grow reliably and it is one of the reasons why several of the companies choose to not make custom games. Still, many developers have a steady demand for tailored games, illustrating that a market for such work does exist.

> *"There are many custom game developers, but I do not believe in that so much. You cannot grow that way. It is expensive to develop a serious game and it will take time to earn that investment back."*

Availability of Experts

Most interviewees agree that it is difficult to find the right people for the development of digital games due to scarcity and high demand. This is mainly considered true for programmers and project managers, whereas illustrators are more readily available. Most of the participants that mention this issue also note that they are at a disadvantage compared to the other companies where these people could find work in terms of what they can offer financially. They rely on the non-monetary attractiveness of the work they offer, which lies in high responsibility and fun projects. One of the interviewees even mentions that this issue was the limiting factor for growth for a time.

> *"It is difficult to find people. We're a scale-up and can offer less than other, bigger companies. There's a shortage."*

Alternatively, companies can make use of freelancers that can temporarily increase capacity as needed. They say that the high demand also makes it increasingly difficult to find good freelancers as they find work elsewhere or have a full schedule as well. They stress that this is not a limiting problem yet, but that this is a trend.

On the other hand, some interviewees mention that they notice an increase in the number of graduates from game-related studies, and they believe the shortage of programmers will become less in the future.

Availability of Credit/Investors

Two of the interviewed companies make use of external financing that are not subsidies, while the other companies operate without external financing. The two that do are both companies that do not make custom games but develop games that produce revenue after they are completed. Another similar company uses subsidies for this external financing. The other companies feel that using external financing brings too much risk and pressure. Additionally, there is a desire to remain financially independent.

> *"We do not currently want to take loans because we want to do it on our own. (...) The thing is: loans provide pressure and introduce risks."*

Setting up KPIs for Effectiveness

One interviewee mentioned it is sometimes difficult to identify meaningful and measurable performance indicators to quantify the effect of their serious games. Business models that depend on a measurable impact are hindered by this difficulty.

4.2.2.3 Social Uncertainties

8 Uncertainties were identified within the social domain of the PEST analysis. These are presented in table 4.3.

In the remainder of this section, the insights gained about the different uncertainties are discussed in more detail.

Where Lies the Responsibility for Change

Two interviewees indicate that customers sometimes raise questions about why they are responsible for training users of the serious games, instead of the users themselves. Some customers believe they should focus on their core business, instead.

> *"'Should [companies] not just return to the basics?'*
> *That's a question many people ask."*

In this view, the users would become the customers, which would also change the way developers must present their offering in terms of marketing, but also pricing and support.

Uncertainties from the Interviews (Social Domain)

Uncertainty	N	Description
Where lies the responsibility for change	2	*Some customers believe that employees are responsible for training themselves, which would influence a developer's target group.*
International demand for serious games	3	*No consensus amongst interviewees.*
Customer does not understand user	3	*Customers often misjudge what the user of a game needs to achieve the serious game's goals. Still, many developers rely on customer input.*
Customer underestimates development costs	2	*If prices are perceived as too expensive, it makes it more difficult to convince customers that a serious game is worth it.*
Serious games for healthcare are upcoming	2	*There are opportunities within the healthcare sector for developers.*
Serious games for education are upcoming	2	*There are opportunities within the education sector for developers.*
Acceptance of serious games	10	*Serious games are either becoming more accepted or met with more scepticism. Either would result in changes in demand.*
Reaching difficult target groups	1	*There are opportunities with using serious games to reach difficult to reach target groups.*

Table 4.3. List of uncertainties found within the Social domain from the PEST analysis. Including a short description and the number of interviewees that mentioned it as an issue (N).

International Demand for Serious Games

The interviewees do not agree about the possibilities in the international market. While this goes beyond the scope of this thesis, it is interesting to note that some companies believe the international market has a demand for serious games and have worked internationally to service customers abroad.

"We also sell our games internationally (...) there is a demand for them."

However, other developers believe that Dutch serious games are a step too far for other countries. They are, according to them currently more interested in simulations, rather than serious games.

"Serious games are viewed [internationally] with a lot of scepticism. In the UK, there are only simulations and in the USA there are only games for the military."

Customer Does Not Understand the User

Three participants mentioned that their customer usually has a wrong understanding of the user and works on a different level. More specifically, they often misjudge what users find interesting or fun or they misjudge the difficulty that they can handle. Additionally, customers sometimes also have wrong ideas about how to approach a serious game's goal. As such, it is interesting to note that many of the participants are largely reliant on the knowledge and input of their customer when it comes to the content of the serious games (section 4.2.3.4).

"The customer can often not communicate well with the user. They speak a different language."

Customer Underestimates Development Costs

According to two participants, customers have difficulty estimating how much work and time is involved with the development of a serious game. Therefore, they are often surprised by how much it costs. This is an unpleasant obstacle, according to the interviewees.

"Customers are willing to pay for serious games, but they underestimate how much time it takes to develop them."

Serious Games for Healthcare Are Upcoming

Two participants indicated that the healthcare sector offers a lot of opportunities for serious game developers. As such, it might be interesting for developers to consider going in that direction.

"It's a greenfield. For every application, something can be developed."

Serious Games for Education Are Upcoming

There are a lot of opportunities for serious game developers in the education sector according to two interviewees. Therefore, it could be interesting for developers to get involved with that sector.

Acceptance of Serious Games

The interviewees largely seem to agree that serious games are slowly becoming more accepted as an effective tool. They notice this most in the time spent on convincing customers that serious games work, which has decreased over the years.

"Customers increasingly accept [serious games] as a useful tool."

Not all participants agree, however. They notice that games are sometimes seen as ineffective, addictive, and that they stimulate aggression. One participant blames this on the lobby of rehabilitation clinics, which vilifies games and is gaining traction. This uncertainty is one that Mayo (2010) also mentions. As such, there seems to be some merit in this view.

"People see gaming as ineffective, sitting still, as playing instead of learning."

Reaching Difficult Target Groups

One participant sees opportunities in using serious games to reach target groups that are ordinarily difficult to involve. Therefore, it could be of interest for developers to focus on inclusive approaches.

4.2.2.4 Technology Uncertainties

5 Uncertainties were identified within the technology domain of the PEST analysis. These are presented in table 4.4.

In the remainder of this section, the insights gained about the different uncertainties are discussed in more detail.

Innovation

Technologies are very accessible, which offers both opportunities and introduces threats, according to several interviewees. On the one hand, it is easier to involve many different people due to the widespread use of smartphones amongst citizens. Additionally, game development software is increasingly widely available and easy to use. On the other hand, this also means that it is much easier for people to start making games. This means that the threat of entry of new competitors also increases.

Uncertainties from the Interviews (Technological Domain)

Uncertainty	N	Description
Innovation	4	*Technologies are becoming more accessible for users and developers.*
Physical & digital games	5	*Digital games are more popular, but are not always the best solution.*
Maintenance of serious games	1	*Physically maintaining installations can be very costly.*
Security & data	2	*Increasingly, data must be safely kept, while data's value also grows.*
Outdated customer hardware	1	*Some customers (especially schools) work with very outdated hardware, which makes developement for them more difficult.*

Table 4.4. List of uncertainties found within the Technology domain from the PEST analysis. Including a short description and the number of interviewees that mentioned it as an issue (N).

Learning new technologies, like virtual reality and augmented reality, also requires investment from developers to learn how to use them for serious games. This costs time and effort, which is not always available. It is also difficult to determine whether a new technology will be worthwhile to invest in. As such, most participants do not put too much effort into this.

"You have to respond to new technologies.
This costs time and money."

Physical & Digital Games

The interviewees indicated that customers seem to be drawn more to digital games than to physical games. They also say, however, that digital games are not always the best option to achieve the goal a customer has in mind, and that the development of a physical game is much less expensive than a digital game.

"To customers, digital games are fun to see,
but board games sometimes work better."

Interviewees do note that customers are open to using physical games, but sometimes do opt for digital games, even if the effectiveness is lower.

Maintenance of Serious Games

One of the interviewees mentions the costs involved with physically maintaining their installations, which is very costly. Software solutions should, however, allow for easier and cheaper maintenance through the internet.

Security & Data

Two participants mentioned the need for security when collecting data. Since serious games often concern personal information, this is especially important for vulnerable and protected groups of people (for instance: patients and children). However, the data is valuable, and companies are increasingly interested in this data. Therefore, it is difficult to balance these two.

"Customers are increasingly interested in saving data and results."

Outdated Customer Hardware

One participant mentions that users often have outdated hardware, which limits the possibilities with digital serious games. They say this is especially true for schools. However, over the years, this problem has become less as these customers increasingly realise the value of modern hardware.

4.2.2.5 Conclusions

The 25 uncertainties that are identified in this thesis research each offer a valuable insight into the future of the serious game industry. Together, they offer an answer to research sub-question 1:

What uncertainties does the serious game industry
in the Netherlands currently face?

The interviews touched upon the uncertainty that Mayo (2010) coined (section 2.4): the acceptance of serious games. The interviewees were divided on the topic. One side agreed with the literature and says that games suffer from a negative viewpoint. The other side claims that serious games are becoming more accepted. There is no reason to assume either one is correct, but it does seem to be an issue. The implications of the two views are discussed in the next section.

4.2.2.6 Selection of Uncertainties for the Business Model Stress Test

Each of the uncertainties of the previous section is a valuable insight and should be considered when constructing or testing a business model. Yet, a business model stress test becomes much more complicated with each additional uncertainty. According to Haaker et al. (2017), who developed the business model stress test, up to five uncertainties are still considered manageable.

The selection of the uncertainties was based on three things: (1) how much information was available on the uncertainty, (2) how much different interviewees disagreed, and (3) how much it relates to business models. The more this was applicable to an uncertainty, the better suited for this analysis it would be.

This led to the inclusion of the uncertainties presented in table 4.5 for the business model stress test.

Each of the uncertainties in the table was discussed by many different interviewees, as can be seen by the number of mentions in tables 4.1 to 4.4. Additionally, the interviewees that discussed the issue had conflicting views, which were discussed before and will be examined in more detail further in this section. Finally, each of these uncertainties has an effect on various business model elements, which makes them interesting to review.

Once again, it is noted that the selection does not mean that the other uncertainties are necessarily less interesting or less relevant. Moreover, there are some uncertainties that could be very important but were not discussed in enough detail to be able to include them in the business model stress test, in this research. Still, these six uncertainties are of interest for various reasons. (1) **Outdated laws** were discussed as an issue and, if serious games are subject to outdated laws, this could be quite limiting. (2) **The scalability of serious games** is an issue for if serious games become more widely employed. It would be interesting to research whether custom-made games are still viable, there. (3) **Where lies the responsibility for change** is a question that wonders about whether the current customer groups (these are generally not the users according to the interviews) remain the customer. It is, according to the interviewees, a possibility that the user will become the customer. (4) **International demand for serious games** should be the focus of a future study. The Netherlands' position in this international market could then be defined, which might help developers expand beyond the national borders. (5) **Customer does not understand the user**. This is interesting because of the dependency of many developers on their customer for the content of the serious game through co-creation (see section 4.2.3.4). Finally, (6) **customer underestimates development costs**. This hints at a mismatch between the perceived quality of serious games and their prices (Doyle, 2010, p. 14, p. 211 & p. 283).

Selected Uncertainties	
News Laws & Elections	*Availability of Experts*
Economic Growth & Decline	*Physical & Digital Games*
Acceptance of serious games	

Table 4.5. Selected uncertainties for the business model stress test.

In this section, future scenarios are formulated for each selected uncertainty based on the insights from the interviews. Each uncertainty scenario consists of two parts, which are both extreme outcomes (A and B) for that uncertainty (Haaker et al., 2017). To formulate the two extreme outcomes, the opposing views that were brought up during the interviews are taken as a basis. The effects of those outcomes are partly based on interviewee comments and partly logical deductions. The figures below give a brief summary of each of the selected scenarios.

New Laws & Elections

The influence of new laws and regulations can be divided into two outcomes: one where the opportunity arises for serious game developers to develop games about the new laws or about the election (the one extreme scenario), and one where laws are passed that impact serious game developers themselves (the other extreme scenario). These two scenarios are not necessarily opposites, but they are both outcomes relating to the same uncertainty that interviewees both coined as expected scenarios.

For the first option (scenario B), a serious game developer would have to employ a business model that allows for the exploitation of this opportunity. If they do not, other serious game developers that do could eclipse them.

For the second option (scenario A), a serious game developer must be flexible enough to account for these changes. If they are not, they would either miss opportunities or be hindered by these laws, while competitors might not.

Economic Growth & Decline

This uncertainty can be divided into a situation where there is rapid economic growth and one where there is rapid economic decline.

In the first case (scenario B), budgets and the demand for serious games increases. Then, company capacity becomes an issue and the business model must be able to deal with this. This is considered the one extreme scenario for this uncertainty.

"[Demand] is more likely to go up than down!"

In the second case (scenario A), the demand and budgets for serious games decreases and the type of serious games that are in demand changes. The business model must be flexible enough to deal with the change in the type of games, and also with the generally lower scale. This is the other extreme scenario for this uncertainty.

"Growth and decline are both good for us.
The role of the games just changes."

Availability of Experts

There are two outcomes possible when it comes to the availability of experts. Either they become scarcer, which drives up the costs of labour, both for hiring new employees and for contracting freelancers. Or, they will become more easily available.

In the case where experts become scarcer (scenario A), and labour costs increase, companies must do more to retain their current employees, because it becomes more attractive to find new offers (Leacy, 2017). Additionally, it is important to have a business model that allows for effective and efficient use of the limited resources that are available. For this uncertainty, this is considered the one extreme scenario.

"[Experts] are scarce, especially because we do not want to pay too much."

In the case where experts become more readily available (scenario B), labour costs decrease and this gives more space for companies to grow in size. The business model must be able to accommodate for or make use of this. This is the other extreme scenario for this uncertainty.

Acceptance of Serious Games

According to the interviewees, serious games are either becoming more accepted as an effective tool, or less accepted. Both of these scenarios are considered with the business model stress testing tool.

For when serious games become widely accepted (scenario B), it can be expected that demand for these games will increase. Additionally, the acquisition of new projects or the selling of existing products will most likely become easier. The business model must be able to deal with these things. This is the one extreme scenario for this uncertainty.

"The market is starting to become ripe for serious games."

On the other hand, when serious games become less accepted (scenario A), demand is expected to decrease, and acquisition and sales will become more difficult. The business model should be capable of dealing with this outcome as well. This is considered to be the other extreme scenario for this uncertainty.

Physical and Digital Games

For this uncertainty, the outcome that digital games become the generally preferred method is examined, as well as the outcome where physical games become a more generally accepted method. According to the interviews, the first option is where the trend seems to go towards, while the second option would be preferred in some cases in terms of costs and effectiveness.

If digital games become the preferred method (scenario A), development costs for serious game developers that used to also develop digital products would increase and the skill requirements for employees would shift towards the digital aspects of game development. The business model must allow for this change. In the final results, this is one of the extreme scenarios.

The inverse is expected for the outcome where physical games become more accepted (scenario B). This scenario is considered the other extreme scenario. The two outcomes are not necessarily positive or negative. They are, however, opposites and could have a great impact on a serious game developer.

New Laws & Elections

Scenario A	Scenario B
Changes might hinder a serious game developer	*New laws and elections are opportunities for new projects*

Economic Growth & Decline

Scenario A	Scenario B
The economy declines, reducing demand and budgets	*The economy grows, increasing demand and budgets*

Availability of Experts

Scenario A	Scenario B
Experts become scarcer, increasing labour costs	*Experts become more available reducing labour costs*

Acceptance of Serious Games

Scenario A	Scenario B
Serious games become less accepted as a tool, decreasing demand	*Serious games become more accepted as a tool, increasing demand*

Physical & Digital Games

Scenario A	Scenario B
Digital games become the preferred medium	*Physical games become the preferred medium*

Figure 4.5: Summaries of the selected scenarios.

4.2.3 Business Models

In this section, the insights about the researched business models that were gathered from the interviews are discussed. This answers research sub-question 2:

What business model elements are currently used in the serious game industry in the Netherlands?

and research sub-question 2.1:

How do serious game developers in the Netherlands estimate the effectiveness of these business model elements?

One of the questions during the interviews was to define the term *business model*. The results from that question are discussed first. After this, the insights within each STOF domain (Service/Product, Technology, Organisation, and Finance) are examined. This is done by discussing each business model element that was part of the research, as well as any others that were brought up during the interview. As discussed in section 3.1.2.2, an ordinal ranking of business model element cards was also done for each domain.

4.2.3.1 Participant Idea of Business Models

As discussed in section 3.1.2.2, the definition of a **business model** used in this thesis is: *a blueprint of how a company creates and captures value*, based on the STOF model (Bouwman et al., 2008). This section discusses how the twelve interviewees defined the term before learning the definition used in this research. This creates an insight into the general knowledge that the participants have about business models and their use.

In four of the interviews, the business model was defined as a revenue model, which is the main part of the Finance domain of the STOF model but does not cover it completely. The domain also includes cost structures and risks for both the focal company and for how they are distributed with other actors that they interact with.

For one interviewee, the definition only included organisational aspects, which covers the Organisation domain of the STOF model only. Two interviewees included both revenue models and value offerings (the Service/Product domain). Another interviewee described how to formulate a business strategy plan. This is a different concept from business models, though related in a way that a strategy operationalises a business model (Bouwman et al., 2008). Yet another interviewee talked about finances in terms of return on investment as the definition of a business model. Another described business models very broadly, including all the four STOF domains, project management, human resource management, and logistics. Only two interviewees described business models as Bouwman et al. (2008) does.

"I see a Business Model as a plan about how to earn back as much as possible from investments."

This illustrates that the concept of business models is not widely understood by practitioners and would suggest that the benefits of doing business model innovation are not fully exploited by these companies, yet.

4.2.3.2 Service/Product

In this domain, eight business model elements were selected beforehand to be included in this thesis research. No other business models for the Service/Product domain were brought up during the interviews, suggesting that the most prominent ones were included in the selection. In this section, the insights gathered from the interviews are discussed for each business model element in the Service/Product domain.

In table 4.6 is the end result of the ordinal rankings for each Service/Product business model element.

The table presents how the different strata from the categorisation system (section 4.1) ordered the presented Business Model Cards. For each stratum, the ranking of a particular card was averaged using the results from each interviewed company that belongs to that stratum. Additionally, in the first column, the average ranking for all the companies together is presented. The deviation of a specific stratum in relation to the overall average illustrates how much a category is different from the others, from a business model perspective. Note that the specialised/custom design stratum is the result of a single interview and could therefore be an outlier. Also, note that this is a quantitative research method with a sample size of 12 interviews. This is not statistically significant. Therefore, these results have no direct bearing on the conclusions drawn in this thesis. However, the results do illustrate a conclusion from the qualitative discussion about the ranking exercise. This conclusion is that there is relatively little variation between the different strata in how they view the different business model elements within this domain. This suggests that the categorisation method employed in this thesis does not have a bearing on their approach to the Service/Product domain.

The remainder of this section discusses the insights from the interviews about the individual business models.

Ranking of Business Model Elements (Service/Product Domain)

Business Model Element	Total Mean	S/C	S/NC	NS/C	NS/NC
Mass Customisation	4	6	4	4	4
Solution Provider	2	1	2	3	3
Experience Selling	3	2	4	1	1
Eco & Green	6	7	7	7	7
Anything-as-a-Service	4	8	4	4	4
Platform	5	5	5	4	4
Leveraging Customer Data	6	3	5	8	8
White Label	6	4	5	6	6

Table 4.6. Average ordinal ranking results for the business model elements in the Service/Product domain. Here, S/C is the specialised/ custom design stratum of the categorisation system. S/NC is the specialised/ no custom design stratum, NS/C is the not specialised/ custom design stratum, and the NS/NC is the not specialised/no custom design stratum.

Mass Customisation

Many of the interviewees find the Mass Customisation business model element interesting because it allows for servicing many customers while spending less time on customisation. Still, only two of the interviewees actually apply this business model element at this time. The others consider it for the future.

"We can service new customers easily for low costs and with fast throughput times."

Other interviewees say it is not interesting, because the initial investment is high. Furthermore, it diminishes the effectiveness of custom solutions because it limits the flexibility of the development process. A more open process would allow a developer to focus on building a specific solution to a specific problem.

"I would love to do this (...), but then I would have to pick one thing and I don't want to."

The views on this business model do not seem bound to specific strata but are mixed within the strata and across them. This is also apparent from table 4.6, where the general average result is similar to the average values per stratum. The only exception is with the specialised/custom games stratum. This interviewee had difficulty imagining how to use this for their company and ranked it lower because of it. Combined with that this stratum is represented by only one participant, it is difficult to draw a conclusion from this.

Solution Provider

As is illustrated by the average value in the ranking table, this business model element was deemed very important by the interviewees, because the interviewees feel that a solution is what the customer wants from them. There was no real disagreement between any of the interviewees on this, both within and across strata of the categorisation.

"Whatever you need, we can arrange it for you."

Experience Selling

The second most popular business model element in the Service/Product domain, according to the ranking, was Experience Selling. All of the interviewees agreed that this is essential to the success of a serious game. Some interviewees even claimed that the experience is the reason why serious games are effective.

"The idea of [serious] games is that you experience something, so this is very important for the user."

As can be seen in table 4.6, the specialised, non-custom stratum scored this business model element lower than the other strata. The reasoning behind this was that they claimed the experience is something that enthuses the user of the serious game, but not the customer, because experiences are not part of their core business. In the words of one of these interviewees

"We do not sell experiences, but we do design them. That is why we are successful."

Eco & Green

The Eco & Green business model element was not considered useful for serious game developers. While the interviewees did find environmental issues important, personally, they did not think it would add any value to their service or product if they actively used this as a selling point.

"I do not really see this as value for my customer."

"This is not important (...). For customers, there would be no extra value."

Several participants did note that this is a condition for their business that they set personally. It is, however, not something that they see as value for their customers. Participants do occasionally have projects about sustainability, but this is not the same as having an Eco & Green business model.

"[Eco & Green] is a separate matter for me. This should be a part of responsible entrepreneurship."

Anything-as-a-Service

The interviewees differed a lot in opinion about this business model element both within strata and between them. On the one side, interviewees found it interesting and saw the potential to generate a steady income by offering their serious games as services.

"I think that you can get a lot out of [Anything-as-a-Service]."

Other interviewees did not believe this would be effective because they feel it does not fit with the custom work they do for specific customers.

"This is not really applicable."

It seems that this business model element is most interesting for non-custom work.

Platform

This business model element was generally viewed as an interesting support tool for the main product.

Some interviewees interpreted it as a way to deliver serious games or as back-end management of the game. This is however not how this report defines a platform. Here, the platform is defined as a means where multiple interdependent groups of users can connect to each other and interact. The platform facilitates this interaction.

Another recurring application of a platform that is consistent with the definition used in this thesis, is to build a platform through which different serious game developers can distribute their games. There have been several attempts at this, but none of them were successful. According to the interviewees, this was because these solutions did not accurately capture the necessary information.

"It would be useful if there was a platform with all serious games on it."

There was no significant difference in opinion between strata for this business model element.

Leveraging Customer Data

The leveraging of data was generally not considered as a good business model element. Interviewees claimed that users of serious games use them intimately and using data would lead to losing trust with the users and bad experiences.

"This is too risky, and we want to stay far away from it."

Some interviewees notice that customers are increasingly interested in the data about their games and that they would like to analyse this data. They apply this in a limited capacity at the moment, but they are considering doing more with this. The most resistance against this idea came from companies that work with vulnerable target groups.

"What we do is that we gather a lot of information about the user for our customers, but we don't sell this to other parties."

Between strata, there does not seem to be a significant difference.

White Label

The interviewees are generally negative towards the White Label business model element. They want their brand to be visible and their work to be part of their portfolio. Some of these companies are open to the idea but would not initiate this themselves.

"We like it if our logo is on [the serious game], but if that's not possible, we'll take it off."

Two of the interviewees mention that their customers require their products to be white label. In these cases, the end user was not part of the customer's company, and the customer's brand bears meaning for the user. The reasoning was different for the two, however.

Service/Product Domain Conclusions

From the individual insights about the business model elements, it seems that the Solution Provider element is most valued by the participants. However, in the opinion of the researcher, the websites of most of the interviewees did not communicate that this is what they do. Instead, the websites tend to focus on the development of serious games, but not specifically on how that would solve something for the customer. This hints at that the serious game developers do not communicate what they (want to) offer to their customers, but rather what they make for them.

In the literature, Hauge et al., (2014) advocate Anything-as-a-Service for serious game developers with the reasoning that this allows for flexibility in the offering as well as a steady cash flow. The latter argument was also mentioned by some of the participants. Still, the former argument was only mentioned once by a participant:

"This goes hand in hand with Mass Customisation."

Like that participant, the developers that offer non-custom games were interested in this approach. However, the participants that make custom games only were not as interested. This makes sense as well because if a developer makes a game tailor-made for a specific customer, they need to make sure that they get their initial investment back. Since they cannot sell this game to others, the commissioning client must cover these costs. Doing this with a service offering makes this more complicated.

4.2.3.3 Technology

Like in the previous section, the eight business model elements that were selected beforehand are discussed here, but this time for the Technology domain. No other business model elements for this domain came up during the interviews. This suggests that the most prominent ones were included in the selection. It is important to note that three of the interviewees had trouble seeing the use of this particular part of the business model. The technology domain's relevance to the business model is not always clear. This was primarily due to the phrasing of the different Business Model Cards. Some focused on how technology could be used to make money, while others were focused on how to structure an offering. This made it difficult for some participants to respond to the questions.

In this section, the insights gathered from the interviews are discussed for each business model element in the Technology domain. First, however, the results of the ordinal ranking are presented in table 4.7.

Like before, the table presents quantitatively how the different strata from the categorisation system (section 4.1) ordered the presented Business Model Cards. For each stratum, the ranking of a particular card was averaged using the results from each interviewed company that belongs to that stratum. Additionally, in the first column, the average ranking for all the companies together is presented. The deviation of a specific stratum in relation to the overall average illustrates how much a category is different from the others, from a business model perspective. Note that the specialised/custom design stratum is the result of a single interview and could therefore be an outlier. Also, note that this is a quantitative research method with a sample size of 12 interviews. This is not statistically significant. Therefore, these results have no direct bearing on the conclusions drawn in this thesis. However, the results do illustrate a conclusion from the qualitative discussion about the ranking exercise.

Ranking of Business Model Elements (Technology Domain)

Business Model Element	Total Mean	S/C	S/NC	NS/C	NS/NC
Sharing Economy	6	6	5	6	6
Cross-Selling	4	5	4	3	4
Lock-In	5	8	6	3	6
e-Commerce Only	7	7	7	6	7
Omnichannel	5	3	5	7	4
Versioning	4	4	2	4	6
Behavioural Segmentation	4	1	5	4	3
Modularity	2	2	2	2	2

Table 4.7. Average ordinal ranking results for the business model elements in the Technology domain. Here, S/C is the specialised/custom design stratum of the categorisation system. S/NC is the specialised/ no custom design stratum, NS/C is the not specialised/custom design stratum, and the NS/NC is the not specialised/no custom design stratum.

In this domain, the strata were mostly similar in their ranking. On two business model elements, there was a significant difference. For lock-in, the not specialised/custom stratum ranked it much higher than the other strata did. This was because custom game design usually locks a customer in for any future work on that same project. As such, this is a mild form of lock-in. For Omnichannel, the specialised/custom and not specialised/not custom strata ranked it higher the other two did. This was because, within the former two strata, the developers targeted difficult to reach user groups and needed to use multiple channels in order to do so. Note again that the specialised/custom stratum is the result of a single interview and could therefore be an outlier.

In the remainder of this section, the insights from the interviews about the different Technology business model elements are discussed.

Sharing Economy

The interviewees seem to be torn over this particular business model element. A part of them feels like this would not be relevant for serious games. This is largely due to the ease with which software can be copied. Additionally, some of the interviewees that make custom games say that this would not work because the games meet such a specific demand that this would be unpractical.

"Other customers can often not use [the same serious game]."

Another part of the interviewees feels like this would be a very useful idea to achieve a larger user base. These are companies that have products that appeal to a larger target group, usually consisting of a specific group of citizens.

"We tap the existing distribution and value chains [of our customers]."

Cross-Selling

This business model element was considered to be very important by all the interviewees. Keeping in touch with past customers occasionally led to new sales. Some interviewees noted that repeat customers are very important for sustainable success and growth.

"We do [cross selling] actively to offer new products or services after our previous sale."

It is interesting that the interviewees do note that they do not put a lot of effort into cross-selling other than keeping in touch with their customers. It is possible that the interviewees did not actively consider this approach before and realised while discussing that this is something that has been beneficial in the past.

"[Cross selling] happens a lot (...), but we don't actively pursue this."

Lock-In

Lock-in is not something that the interviewees do on purpose. They do note, within the non-specialised, custom stratum, that it happens automatically when making a custom game. Switching to an alternative means going through the entire design process again, which is very costly. Additionally, if a customer wants to change something after the project was finished, going to another party than the original developers is sometimes not possible because of IP violations, and otherwise very difficult due to the new party having to completely figure out how the game is constructed before they can start working. This incurs many extra costs.

"It is difficult [for customers] to switch to another solution. They are dependent on us for maintenance. We don't plan this, but it often does turn out this way."

Some interviewees, across the strata, do claim that this business model element is unethical because it limits the options of the customer. One participant says that lock-in should only be used if it benefits the customer.

e-Commerce Only

The developers note that face-to-face contact with the customer is very important when developing new serious games. Hence, having only a digital channel through which to communicate would be very ineffective.

"We once managed to do a project without ever seeing those people (...). It just does not work."

Three companies note that this could be used to distribute new games to existing customers in a comparable manner as the App Store or Steam platform. In that case, the e-Commerce Only would be used to distribute the games after development.

Omnichannel

Generally, omnichannel was deemed less useful by the participants. The physical connection with the customer is important, and software can be distributed digitally, but mostly, this method seemed more relevant for web shops.

However, two interviewees found this business model element to be very important to allow them to reach their target group better. This has to do with the inherent difficulty of reaching this target group. These companies were in the specialised/custom and not specialised/not custom strata, while the groups that found the approach less useful were in the specialised/not custom and not specialised/custom strata.

Versioning

Versioning was received differently by the different interviewees. Some of them felt that this was not useful, because their serious games are custom made. Hence, versions would make little sense as they typically would only have demand for one version.

"The final product is the final product."

Other interviewees make independent products and for these products develop multiple versions for different customers or different goals. Some of these participants use an existing game structure for different customers and customise it this way. This comes close to how the Mass Customisation business model element of the Service/Product domain was interpreted. Other participants make a specific game with different functionalities for different customer groups.

Behavioural Segmentation

Interviewees had trouble placing this business model element. Three interviewees actively use behavioural segmentation to effectively target different groups. For one of them, this is necessary to ensure they reach their target group. For one of the others, this is necessary because the organisational structure of the different segments is too different not to do this. The other one uses this to adapt their applications to the behaviour of the user.

Other interviewees either interpreted custom game design as a specific case of behavioural segmentation or did not think this was an appropriate business model element. The latter group did not know how to apply this for their company, specifically. There was little difference between the different strata for this business model element.

Modularity

Modularity was generally seen as the most useful business model element in the Technology domain. This is how the interviewees build up their games or would like to build up their games. It makes it easier for them to reuse work or to change things during or after a project. Especially code is considered to be a useful part of the development process that should be modular.

"We build formats, no final products. That way, we can make games very quickly."

One company notes the disadvantage of modularity and ranked it low in the ranking. It is time-consuming to make something modular and this is undesirable because the games they make are tailor-made.

Technology Domain Conclusions

Xin (2008) claims that Modularity is a good option for serious game developers and the developers seem to agree mostly with this, ranking it highest compared to the other business model elements. The main consideration seems to be the time that must be invested in making something modular. It seems that such an approach is more desirable for a company that expects their work to be useful later on as well.

Furthermore, it is interesting that Cross-Selling is regarded as very important, but still is not actively applied much. Considering that the participants claim that this is a significant source of projects, it seems prudent to invest more time into this method.

4.2.3.4 Organisation

This section examines the results of the interview about the eight selected organisation business model elements. The interviewees did not bring up any other business model elements for the Organisation domain, suggesting that the most important ones were included in the selection.

In table 4.8 are the results of the Organisation business model element rankings.

Like before, the table presents quantitatively how the different strata from the categorisation system (section 4.1) ordered the presented Business Model Cards. For each stratum, the ranking of a particular card was averaged using the results from each interviewed company that belongs to that stratum. Additionally, in the first column, the average ranking for all the companies together is presented. The deviation of a specific stratum in relation to the overall average illustrates how much a category is different from the others, from a business model perspective. Note that the specialised/custom design stratum is the result of a single interview and could therefore be an outlier. Also, note that this is a quantitative research method with a sample size of 12 interviews. This is not statistically significant. Therefore, these results have no direct bearing on the conclusions drawn in this thesis. However, the results do illustrate a conclusion from the qualitative discussion about the ranking exercise.

In this domain, there was little difference between the strata with regards to their ranking. The only remarkable ranking is the specialised/custom stratum's difference with the average. The company explained that outsourcing was often too expensive and would drive up the price of their services too much for their customers. Still, they did occasionally make use of outsourcing for some parts of their development process. Since this was the only significant difference between strata, it suggests that this domain does not explicitly help in the differentiation between the strata. Note again that the specialised/ custom stratum is the result of a single interview and could therefore be an outlier.

In the remainder of this section, the insights from the interviews about the different Organisation business model elements are discussed.

Business Alliance

The interviewees employ business alliances in three ways. Firstly, they work together with other companies and use their resources to develop the game. This is a means of increasing capacity. Secondly, they use the knowledge of other companies to determine and improve the content of the game, which was only employed by one company. And finally, they use the other company's network to better distribute their games, which one interviewee notes as being key when trying to grow internationally.

"You need someone who knows the market that you can work together with."

Ranking of Business Model Elements (Organisation Domain)

Business Model Element	Total Mean	S/C	S/NC	NS/C	NS/NC
Business Alliance	2	2	2	3	1
Co-Creation	2	3	1	2	3
Outsourcing	4	1	6	4	3
Orchestration	4	4	3	5	4
Content Curation	5	7	4	6	6
Fractional Ownership	7	8	7	6	8
Renting	6	6	7	6	6
Leveraging Resources	5	5	4	6	6

Table 4.8. Average ordinal ranking results for the business model elements in the Organisation domain. Here, S/C is the specialised/ custom design stratum of the categorisation system. S/NC is the specialised/ no custom design stratum, NS/C is the not specialised/ custom design stratum, and the NS/NC is the not specialised/no custom design stratum.

Co-Creation

Co-creation was deemed very important by every interviewee, for two different reasons. One part of the interviewees relied on co-creation with their customer for the content of their games. The specialistic knowledge is something that these developers do not have internally. The other interviewees either have this internally or use business alliances to include this specialistic knowledge.

"The customer delivers the content of the game."

The other part of the interviewees employs co-creation with the end-user to verify the effectiveness of the serious games. However, one interviewee in the non-specialised, custom stratum notes that this is usually not possible due to the limited replay-ability of custom-made games. In other words: games often only work the first time the user plays it. Hence, if the target group is limited in size, the number of users it will be useful for becomes smaller with every test.

"The better you involve people from the various layers in a project, the better the final product will be."

It is interesting to note that the companies that employ co-creation with the user are companies that have a large target group. These same companies do not usually sell the game to their customer as a product, but rather the effects of their game.

Outsourcing

The views are mixed on outsourcing. Some companies prefer to outsource a part of the development when needed to reduce risks to themselves in the long term. Other companies prefer to hire new employees to deal with this problem, which increases the quality of the work they receive, according to them, and is cheaper. Outsourcing brings with it a lot of overhead, which some companies are not ready to deal with.

"Our entire production process is outsourced."

"We do not do this much at all."

Orchestration

Orchestration is interesting to the interviewees that specialised in a specific field where it is important to involve many different parties to achieve their goals. For three interviewees, this was the case. The other participants did not believe this was immediately relevant because they can do their work together with the customer. What some participants did find interesting is to be on the other end of this business model element, where another company does the orchestration and involves them.

"We do not take control of such projects but would like to get involved."

Content Curation

Some of the interviewees employ this business model element by reviewing the content supplied by the customer/business alliance for the game, often through co-creation. They translate this into information that can be used to design and fill a game with. Four of the interviewees do this. The other interviewees do not employ content curation.

Fractional Ownership

Most of the interviewees do not work with this business model element. A few do this with regard to intellectual properties. These companies share the intellectual properties with their customers, who supplied the content of the game. Sharing the intellectual properties created a form of dependence on the other owners. However, some developers use this to create business alliances with the other owners.

"It has to be very clear what is ours and what our customers own."

Renting

The interviewees generally do not believe this business model element is interesting for serious games. For most participants, the reasoning is unclear. The two that do explain their reasons claim that custom-made games are not suitable for this because the initial investment must cover the costs of developing the game.

Additionally, the renting of required materials (laptops, VR sets) is something that some companies do, but not something that they make a significant amount of money with. It causes overhead and takes time that could be spent on other things.

Leveraging Resources

Some interviewees have office space that they do not fully use. They rent this out to other companies for a small additional source of income. Apart from this, it is not often that the interviewees have left-over resources to leverage. Hence, this is not that relevant to those parties.

What two interviewees did mention is that it might be interesting to sell code they made to other developers. A reservation is that this causes extra overhead costs for support.

"We could apply [Leveraging Resources] to our code base."

Organisation Domain Conclusions

Co-creation is mentioned as an important business model element by the interviewees. Most often, this was done in the form where customers provide the content for the serious game. However, one of the uncertainties identified in section 4.2.2.3 claims that the customers do not really understand the user that well. Combined with that the Content Curation business model element was not received as positively, it seems as though developers occasionally use incorrect information to build their games with. This is problematic. One of the interviewees solves this by involving a third party that delivers the content of the game, rather than the customer. An option that has not been considered is to involve an expert to review the information from the customer.

4.2.3.5 Finance

In this section, the results of the interview about the eight selected finance business model elements are discussed. Two interviewees brought up another two finance business model elements that they felt were missing, therefore, these have also been included in the analysis. These were *subsidies* and *product sales.* Both are also not part of the complete set of Business Model Cards.

Table 4.9 shows the results of the Finance business model element ranking. Since the two new business model elements were only discussed with the two interviewees that brought them up, these were not included in the ranking exercise.

Like in the previous sections, the table presents quantitatively how the different strata from the categorisation system (section 4.1) ordered the presented Business Model Cards. For each stratum, the ranking of a particular card was averaged using the results from each interviewed company that belongs to that stratum. Additionally, in the first column, the average ranking for all the companies together is presented. The deviation of a specific stratum in relation to the overall average illustrates how much a category is different from the others, from a business model perspective. Note that the specialised/custom design stratum is the result of a single interview and could therefore be an outlier. Also, note that this is a quantitative research method with a sample size of 12 interviews. This is not statistically significant. Therefore, these results have no direct bearing on the conclusions drawn in this thesis. However, the results do illustrate a conclusion from the qualitative discussion about the ranking exercise.

As in the other domains, there was little difference between the strata. The revenue-sharing model, however, is ranked higher by the specialised/no custom stratum. These are companies that produce games and sell the effects of the game, rather than the game itself or the service of making a game. Additionally, companies that are interested in setting up a platform whereon developers can put their games also found it interesting to offer this service in exchange for a portion of the proceeds. Note again that the specialised/custom stratum is the result of a single interview and could therefore be an outlier.

In the remainder of this section, the insights from the interviews about the different Organisation business model elements are discussed.

Ranking of Business Model Elements (Finance Domain)

Business Model Element	Total Mean	S/C	S/NC	NS/C	NS/NC
Crowdfunding	5	7	6	5	5
Add-On	4	6	3	4	3
Freemium	6	5	6	6	7
Revenue-Sharing	4	8	3	5	5
Licensing	2	1	3	2	1
Pay-per-Use	3	2	3	3	5
Advertising	6	3	7	6	5
Bundling	4	4	5	4	5

Table 4.9. Average ordinal ranking results for the business model elements in the Finance domain. Here, S/C is the specialised/custom design stratum of the categorisation system. S/NC is the specialised/ no custom design stratum, NS/C is the not specialised/custom design stratum, and the NS/NC is the not specialised/no custom design stratum.

Crowdfunding

Most participants feel that crowdfunding might be interesting in the future if done correctly. A few interviewees do occasionally work with crowdfunded projects, but it is only a small portion of their business. Because of that companies do not believe this will be an important source of income, the model was ranked relatively low.

"I can imagine that a serious game could be financed this way sometime."

Add-On

None of the participants try to make their initial offer more appealing and then tries to sell extras. What some parties do, however, is that they set up their quotation in such a way that customers can add additional functions to the game for a higher price. Also, if the customer wants additional sessions with a serious game, these are often sold separately. For a platform construction, it was also often possible to purchase extra games on that platform.

"If a customer wants to use [the serious game] more often, this will cost extra."

The participant from the specialised/custom stratum ranked this business model element lower than the others but gives the same argumentation as many of the other interviewees. Hence, there does not seem to be a large difference within or across the strata.

Freemium

Most of the interviewees did not feel that this business model element is useful for serious game developers, because the initial investment is large, and the target group is typically small. Companies note that this would not work for custom projects.

"[Freemium] is difficult for tailor-made games."

However, two interviewees say that this model would be interesting to get people interested in the serious games of their company or as a way to guide business towards another company in exchange for monetary compensation.

"It is a marketing tool to introduce people to [serious games]. This way you can reach a lot of people."

There was no difference between the different strata.

Revenue-Sharing

Revenue sharing is considered a good idea primarily for interviewees who had (or were in the process of developing a) distribution platform for their own games and also those of others. These companies would take a part of the revenue generated through their platform for themselves. Other companies have shared intellectual properties with their customers, who are sometimes used to distribute the game. In these cases, the revenues are shared. Some companies cooperated in the development of a game and use revenue-sharing to reward the involved parties appropriately.

One interviewee notes that it is important to not just share the revenue, but also the risks and costs. This is often more difficult to make clear arrangements about.

"It is always possible to share your revenues with everybody, but not the costs."

There was no difference within or across the strata for this business model element.

Licensing

This is the most often employed business model element amongst the interviewees. They set up a quote based on an estimation of the number of hours they expect the project will take and then multiply this with their hourly rate. There often are some margins to take overtime and delays into account.

"[Licensing] is what we do. Plain and simple."

The companies that do not use licences sell either games as a product in and of itself or the effects of the game. Other interviewees that employ these approaches also use licences, illustrating that licences are a versatile method for serious game developers.

Pay-per-Use

Some of the interviewees employ this business model element by charging per user of the game or per user, per play session. The companies that do this use it for non-custom work. In those cases, the idea is to earn back the investment from multiple parties while earning more from intensive use.

"You play and you pay. This is the business model that we have now."

In general, the companies that do only custom work find this model less appealing, because they see no option to charge a customer both for the development of a game as well as the use of the game. As such, the initial investment required to develop a game would be too large. There is an exception, however. One interviewee managed to reduce the required initial investment significantly by developing a Mass Customisation solution.

Advertising

Advergames are part of serious games, but as was discussed in the literature chapter, this sort of game is beyond the scope of this thesis. Here, instead, advertising within a serious game that has a different main goal is meant. Putting advertisement materials within serious games in any form was generally considered a poor idea; this includes product placement. The reason for that was two-fold. There were ethical objections to influencing people in this way. And, the serious game's effectiveness would diminish because of it.

"I think this hurts the purpose of the game."

"If you want to agitate people, do this."

There was one interviewee that thought it might be an interesting idea when used for serious games for the general public. In this case, the advertisements could be used to make the game more affordable. Another two participants mentioned that the gains from advertisements are usually small for entertainment games, compared to freemium models or in-game currencies based on add-on models. Hence, the usefulness of the model is not clear. In addition, since this type of advertisement has not been done much yet, it is still not known whether such a strategy would be interesting from an advertiser's point of view.

Bundling

Bundling was mostly interesting to interviewees that have products to sell to customers, though two that do custom work noted that they sometimes bundle multiple games for a better price. Some interviewees claim that bundling is not relevant at all, because (custom) projects are disconnected and shouldn't decrease in price if you take more.

Subsidies

One of the two business model elements that was not part of the research originally but was noted by an interviewee as missing was subsidies. The company applies for subsidies to fund its projects. This business model element was also discussed as an uncertainty in section 4.2.2.1. The insights from that section will be used to test this business model element in the business model stress test.

Product Sales

Two interviewees mentioned that their business model, the direct sales of the game, were missing from the interview. This is a very simple business model element where the serious game is simply sold to the customer. It means that the game becomes the customer's property and they can use it however they want. This is possible for both custom-made games and for games that are not custom-made. The drawback of this model is that possible future gains made with the game are not shared with the developers and that sales are typically one-time deals.

"The actual agreement on a set price followed by a simple sale I would rank highest, or maybe below Licensing."

Finance Domain Conclusions

From the Finance domain, it is interesting to note that the business model elements that Georgieva et al. (2015) mention as good options for serious game developers (Freemium and Product Placement) are not considered to be interesting options by the interviewees. The Freemium element was considered to be too costly for the limited target group for typical serious games. For large-scale projects, it was only considered interesting as an introduction to serious gaming. For Advertising (and Product Placement), the reasoning had to do with that the interviewees found advertising to be ethically questionable for serious games and that it would diminish the effectiveness of the serious game. As such, it would seem that Georgieva et al.'s views do not match that of practitioners.

Furthermore, two business models (Subsidies and Product Sales) were identified during the interviews that were not part of the Business Model Cards. Considering that Subsidies were sometimes extensively discussed during the PEST analysis, it is striking that only one company felt it should be added to the business model elements. Using the insights about the uncertainty, however, this might be due to the participants' general preference to not use subsidies. Product Sales is a simple business model element that some of the participants do employ. Hence, it is interesting to involve this business model element in a future study to develop the insights gathered in this thesis to the same level as the other elements. These two new business model elements are included in the Business Model Stress Test in section 4.3.

4.2.3.6 Business Model Conclusions

The interviews yielded in-depth qualitative insights about 34 business model elements, two of which were results of the interviews themselves. These two elements were both in the Finance domain of the STOF model. This can mean one of several things or a combination of them. Either the Business Model Cards covered the most important business model elements, or the participants found the Finance domain easier to think about. Alternatively, it is possible that the participants thought about the Finance domain more extensively on their own before the start of the interview. Considering that the participants' definition of a business model was often limited to revenue models before the start of the interview (section 4.2.1), it is likely that the last option is at least partly the reason.

In the literature, several business model elements were identified as valuable for serious game developers. These were Anything-as-a-Service (Hauge et al., 2014), Modularity (Xin, 2008), Freemium (Georgieva et al., 2015), and Advertising (Product Placement) (Georgieva et al., 2015).

According to the interviews, Anything-as-a-Service is only valuable for non-custom games, rather than for all serious games. This illustrates again the focus of most articles from the literature study (section 2.3), where the general view is that serious games are made for a broad target group. However, in practice, the target group is usually quite small.

Modularity was seen as a very useful approach. However, the costs involved make it unsure for developers whether they will be able to earn the extra time they spend on making a game modular back from other projects. The opinions are positive, but it is not applied that much yet.

Freemium and Advertising were generally not considered to be useful. A possible explanation for the conflicting views between Georgieva et al. (2015) and the practitioners is that the study did not interview practitioners specific to serious games, but rather gaming in general. Additionally, the questions in the quantitative study that they base many results on are also not specific to serious games. Still, Georgieva et al. related the results to serious games, which appears to not have been valid.

4.3 Business Model Stress Tests

In this section, the results from the uncertainty analysis and the business model element analysis from sections 4.2.2 and 4.2.3 are combined as input for a business model stress test (Haaker et al., 2017). This was done to gain a deeper understanding of how the results from the interviews can be used to develop insights into business models. This answers research sub-question 3 for the selected uncertainties and business model elements. The research sub-question is:

How do the business model elements from SQ 2 hold up against the uncertainties from SQ 1?

The approach here does offer in-depth information about the robustness of these business model elements, but it is by no means an exhaustive analysis. The effects of other uncertainties on a business model are also important. As such, while there is practical value in the results of the analysis, the greater value is in the thought process and the manner in which the insights about the individual uncertainties and business models are combined.

As discussed in section 4.2.2.6, not all twenty-five uncertainties were included in the stress test. Five were selected to keep the approach manageable: *New Laws and Elections*, *Economic Growth or Decline*, *Availability of Experts and Their Costs*, *Acceptability of Serious Games*, and *Acceptability of Physical and Digital Games*. For each of these uncertainties, two extreme future outcomes were defined. These are described in section 4.2.2.6.

For each of the business model elements (as described in section 4.2.3), each uncertainty's outcome was used to test the business model based on the insights gained from the interviews. This includes views from the literature study. This qualitative analysis was done by considering how a company that currently uses the focal business model element would be affected by the changes imposed by the uncertainties. This consideration involved both the insights and opinions from the interviewees about each business model element, as well as their concerns and opinions about the different uncertainties.

A table was constructed with the results. On the horizontal axis were the uncertainties and the defined outcomes (section 4.2.2.6). On the vertical axis are the business model elements. The conclusions drawn from the analysis were then used to populate the intersecting cells and used to determine which of the following would be true (from section 3.2.4, based on Haaker et al. (2017)):

Red: The business model element is no longer feasible with regards to the uncertainty and the uncertainty can cause big problems for the business model element. A feasible business model is one that a serious game developer is able to implement in terms of resources,

Orange: The business model element is no longer viable with regards to the uncertainty and the company should revisit its business model. A viable business model generates value for both customers and the serious game developer itself,

Green: The uncertainty affects the feasibility or the viability of the business model element, but not negatively. The effects may be positive or neutral,

White: The uncertainty does not affect the business model element, or

Grey: There is not enough data available about the relation between the business model element and the uncertainty.

The colour of the corresponding statement was used to colour the intersecting cell in the business model stress test table. This makes it easier to present the results and see more quickly what the conclusions are. For every grey cell, instead of writing down for every cell that there is not enough information available, this was omitted and is implied with the colouring of the cell itself.

Due to the amount of information that is stored within the table (212 qualitatively described conclusions), the full results of the analysis can be found in appendices C through F. Each appendix deals with a certain STOF domain. In the remainder of this section, the STOF domain's tables are presented without the conclusion of every cell. However, for each domain, one conclusion is described as an example.

The tables themselves are meant to be used in two ways: to help test their current business model or to help test a potential new business model. It must be noted that these results are by no means exhaustive; other business models exist, and other uncertainties also exist. However, the results from the tables can be used as a reference to consult as a starting point or addition to a company's analysis of business models for serious game developers in the Netherlands.

One can use the tables as follows. Firstly, a company that has identified their own business model can find the business model elements in a row and read which of the uncertainties would present issues for them as well as those that they are well-prepared for. The statements in the appendices would help explain what about those business models might present issues. Then, if the company agrees with the findings, they should evaluate for themselves, with the aid from the in-depth information in section 4.2.2, whether the uncertainties that they are less well prepared for are likely enough to happen to change their business model for. If yes, they can use the tables again to find a business model that works better in those cases.

Secondly, a company can identify those uncertainties that they expect to be problematic in the future, using the insights from section 4.2.2. Then, they can take the tables and find the columns matching these uncertainties and find a business model element that handles the columns well, using the considerations from the appendices. This way, a company can build a business model that they believe is well prepared for the uncertainties.

The tables should only be used in combination with critical thinking by the user, contemplating their own business and the relevance of the statements to their own business.

4.3.1 Business Model Stress Test – Service/Product Domain

For the Service/Product domain, eight business model elements were tested against the five selected uncertainties. These business model elements were *Mass Customisation*, *Solution Provider, Experience Selling*, *Eco & Green*, *Anything-as-a-Service*, *Platform*, *Leveraging Customer Data*, and *White Label*. Table 4.10 shows the results of the business model stress test and appendix C describes them in detail.

The conclusions were drawn from taking the insights from both the business model element and the uncertainty and developing them qualitatively and logically into a conclusion of how they would relate to each other.

While appendix C details all the conclusions, here, the solution provider business model element in relation to the economic growth & decline uncertainty is described as an example. The solution provider was relevant to all interviewees because it embodies what their customers come for. The serious game is a tool to solve a particular issue. See section 4.2.3.2 for more details.

The insights about the economic growth & decline uncertainty, like the other uncertainties, were used to formulate two extreme future scenarios (A and B in the table). Section 4.2.2.6 discusses these scenarios in more detail. For this uncertainty, the one scenario involves economic decline (A in the table) that causes a

decrease in customer budgets for serious games and a shift in focus for some companies, which reduces demand. The other scenario was economic growth (B in the table), where the inverse happens; demand increases and so do customer budgets for serious games.

A solution provider targets customer needs and therefore offers a personalised offering to a degree. This fundamentally requires a high degree of flexibility that they can use in the economic decline scenario. During an economic decline, the needs of customers change, and this flexibility allows the solution provider to respond to those changes. As such, the conclusion is that the solution provider business model element is affected by the economic decline scenario, but not negatively. Therefore, the cell is coloured green, and the conclusion in the appendix is labelled: *Due to the flexibility of solution providers, adapting to the different customer needs that arise during a recession is one of their strengths*.

For the economic growth situation, where demand and budgets increase, the solution provider's personalised approach becomes problematic. This is because such an approach requires a lot of personalised contact, which requires time. Therefore, having a higher demand means that more people will have to be hired to respond to this. Hence, competitors that have an offering that scales better might overshadow the solution provider. The conclusion is, then, that a solution provider business model is affected by the economic growth scenario and threatens to make it less viable. In other words, the value generating capability of the business model element is threatened. Therefore, the cell is coloured orange, and the conclusion in the appendix is labelled: *A rapidly growing economy increases demand and budgets. Solution providers must hire new people to accommodate for these changes. For a solution provider, people do not scale well.*

Business Model Stress Test Results (Service/Product Domain)

Business Model Element	New Laws & Elections		Economic Growth & Decline		Availability of Experts		Acceptance of Serious Games		Physical & Digital Games	
	A	B	A	B	A	B	A	B	A	B
Mass Customisation										
Solution Provider										
Experience Selling										
Eco & Green										
Anything-as-a-Service										
Platform										
Leveraging Customer Data										
White Label										

Table 4.10. Business model stress test results for the Technology domain. See appendix C for details.

4.3.2 Business Model Stress Test – Technology Domain

For the Technology domain, another eight business model elements were tested against the same uncertainties as in the previous section. The business model elements for this domain were: *Sharing Economy*, *Cross-Selling*, *Lock-In*, *e-Commerce Only*, *Omnichannel*, *Versioning*, *Behavioural Segmentation*, and *Modularity*. The results of the business model stress test for this domain are depicted in table 4.11. Appendix D describes the conclusions per cell in further detail.

The conclusions were drawn from taking the insights from both the business model element and the uncertainty and developing them qualitatively and logically into a conclusion of how they would relate to each other.

As an example, the deduction of the conclusions about the lock-in business model element in relation to the uncertainty of the acceptance of serious games is written out in more detail, here. The interviewees did not employ lock-in on purpose but do note that it is something that naturally happens on occasion.

For the acceptance of serious games, the one extreme scenario (A in the table) was the situation where serious games become less accepted as a tool. Consequentially, fewer people will be interested in employing them as such and demand for serious games decreases. The other extreme scenario (B in the table) was the situation where serious games become more accepted as a tool. This would mean that more people will be interested in serious games and demand for them increases and new markets emerge.

In the games are less accepted scenario, a developer that already has a locked-in customer base would not be as affected by the decrease in demand as others, simply because their customer base is less able to leave them. As such, this scenario does affect the business model, but not in a negative way. Therefore, the cell in the table is coloured green and the conclusion in the appendix is: *When serious games become less popular and demand decreases, locked-in customers cannot easily leave. As such, revenue can be maintained longer*.

In the games are more accepted scenario, where demand for serious games as a tool increases, more customers can be locked-in due to increased sales. If demand or budgets decrease in the future, then the developer has an even more stable situation due to the larger number of locked-in customers. The scenario has an effect on the business model element, but this effect is not negative. As such, the cell is coloured green. The conclusion in the appendix is: *Increased demand increases the number of locked-in customers. This increases the stability of the company further*.

Business Model Stress Test Results (Technology Domain)

Business Model Element	New Laws & Elections		Economic Growth & Decline		Availability of Experts		Acceptance of Serious Games		Physical & Digital Games	
	A	B	A	B	A	B	A	B	A	B
Sharing Economy										
Cross-Selling										
Lock-In										
e-Commerce Only										
Omnichannel										
Versioning										
Behavioural Segmentation										
Modularity										

Table 4.11. Business model stress test results for the Technology domain. See appendix D for details.

4.3.3 Business Model Stress Test – Organisation Domain

Eight business model elements were tested against the same uncertainties in the Organisation domain. The business model elements for this domain were: *Business Alliance*, *Co-Creation*, *Outsourcing*, *Orchestration*, *Content Curation*, *Fractional Ownership*, *Renting*, and *Leveraging Resources*. Table 4.12 shows the conclusions of the stress test for the Organisation domain. Appendix E describes the conclusions in detail per cell.The conclusions were drawn by taking the insights from both the business model element and the uncertainty and developing them qualitatively and logically into a conclusion of how they would relate to each other.

Here, the reasoning for the conclusions about the outsourcing business model element in relation to the availability of experts uncertainty is described as an example. Outsourcing received mixed responses from the interviewees. One of the advantages was having a dynamic and flexible capacity when outsourcing work. Disadvantages were that the quality of the work was most often lower, hourly rates are typically higher than for employees, and that there is a lot of overhead involved.

The availability of experts uncertainty's one extreme scenario was when fewer experts were available. As such, prices of experts increase. Therefore, it also becomes more difficult to retain current employees because the offers from other companies become more appealing. The other extreme scenario is the inverse. The prices of experts decrease, and this also makes it easier to retain current employees.

In the more scarcity scenario, outsourcing the work that needs to be done by experts becomes more expensive, due to their increased costs. However, the revenue for the same amount of work is not expected to increase. Hence, the capacity of a serious game developer becomes threatened and could decrease because of the increased scarcity of experts. This scenario affects the business model element and threatens its value-creating capacity and therefore its viability. So, the cell is coloured orange, and the conclusion in the appendix reads: *If experts become scarcer, their costs increase. And so do the costs of outsourcing them. As such, the scarcity could decrease the capacity of the company.*

For the less scarcity scenario, experts become cheaper. So too does outsourcing the expertise. However, the costs of insourcing also decrease and the ratio between the two is difficult to determine. As such, this business model element is affected by the less scarcity scenario. The exact effect is unsure, but the possibility is there for the uncertainty to reduce the value-creating capabilities of the company compared to hiring new employees. Hence, the cell is coloured orange, and the conclusion in the appendix reads: *When experts become cheaper, so does outsourcing them. Whether it becomes more or less viable to hire employees, however, is unclear.*

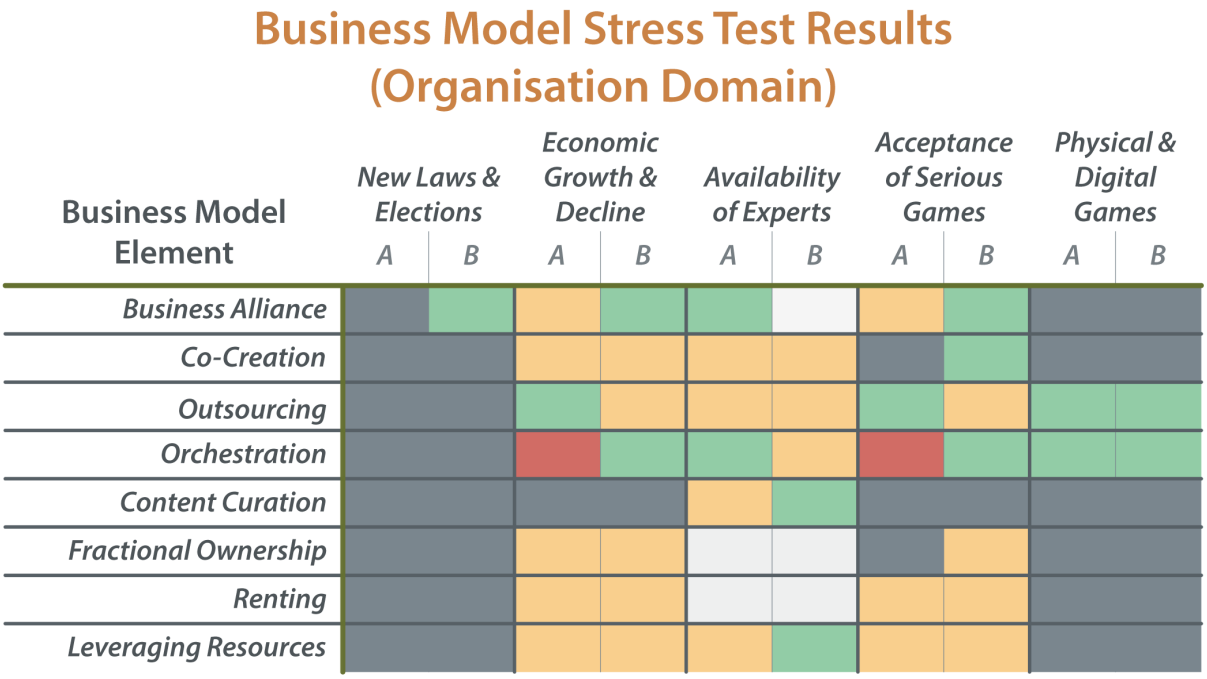

Table 4.12. Business model stress test results for the Organisation domain. See appendix E for details.

4.3.4 Business Model Stress Test – Finance Domain

In the finance domain, ten business model elements were tested against the same uncertainties as in the previous section. The business model elements for this domain were: *Crowdfunding*, *Add-On*, *Freemium*, *Revenue-Sharing*, *Licensing*, *Pay-per-Use*, *Advertising*, *Bundling*, *Subsidies*, and *Product Sales*. The conclusions are presented in table 4.13 and appendix F details the conclusions per cell.

The conclusions were drawn from taking the insights from both the business model element and the uncertainty and developing them qualitatively and logically into a conclusion of how they would relate to each other.

In this section, the freemium business model element and how it relates to the physical & digital games uncertainty is taken as an example. Freemium was one of the business model elements that Georgieva et al. (2015) suggested as an effective business model element. The interviewees mostly disagreed because the scope of most serious games does not fit the required scope to make this business model work and the initial investment is large. The idea to use freemium games to make the general population more interested in serious games was coined by two interviewees, however.

The physical & digital games uncertainty deals with trends towards a general preference towards either medium. In the one extreme scenario, digital games become the generally preferred medium for serious games. In this case, development costs increase due to the involved complexity to develop a digital game. Additionally, the skills required to develop the games shifts towards digital game design, rather than physical game design. The other extreme scenario is about physical games becoming the preferred medium for serious games. When this happens, development costs become lower, because the development of physical games is relatively cheaper according to the interviewees. In addition, the skills required to develop the games shifts towards physical game design.

Freemium games work well for digital games, due to the ease with which they can be distributed. Digital games scale well with a larger user base. A large user base is also necessary to get to the point where the paying users generate enough income to cover the investments made in making the game as well as the costs in supporting the game. Additionally, in a digital environment, it is easy to implement an "upgrade" that lets users switch between paying and free usage. Furthermore, this function can immediately be

Business Model Stress Test Results (Finance Domain)

Business Model Element	New Laws & Elections		Economic Growth & Decline		Availability of Experts		Acceptance of Serious Games		Physical & Digital Games	
	A	B	A	B	A	B	A	B	A	B
Crowdfunding										
Add-On										
Freemium										
Revenue-Sharing										
Licensing										
Pay-per-Use										
Advertising										
Bundling										
Subsidies										
Product Sales										

Table 4.13. Business model stress test results for the Finance domain. See appendix F for details.

linked to payment services and it can immediately give access to the premium features. As such, if digital games become the generally preferred medium, it would not harm a freemium approach. Hence, the cell in the table is coloured green and the conclusion in the appendix states: *Distributing digital games is cheap, so targeting the large audience required for freemium games is easier with digital games. Upgrading from a free to a paid user is also fast and easy with a digital game.*

For the other scenario, where physical games become the generally preferred medium, freemium becomes a less interesting business model element. First of all, the majority of users in a freemium structure are free users, which means that these free users must all be given a physical game to use for free. This does not scale well with physical products, because these need to be produced. In other words, the marginal costs for physical games are relatively high. Additionally, switching between free and premium usage is more complex, depending on how the product is structured. In most applications, the premium features would require an addition that was not there in the free version. As such, going from one to the other would be cumbersome. Because of these reasons, the business model element is likely no longer feasible due to the large additional costs in both finances and maintenance that a typical developer will not be able to cover. Hence, the cell is coloured red and the conclusion in the appendix is: *Physical games would be very costly to distribute free of charge. Additionally, switching between a paid version of the game must be physically facilitated.*

4.3.5 Business Model Stress Test Conclusions

The Business Model Stress Test gives an overview of how the various business model elements hold up against the five selected uncertainties. Three general observations can be made from the stress test tables.

Firstly, there is no one business model element that can handle every future scenario effectively. This is an important observation because it illustrates that no business model is inherently better than another. Each business model has strengths and weaknesses and it is up to the individual company to determine whether these strengths and weaknesses fit the company. For instance, in the Service/Product domain, for the Economic Growth & Decline uncertainty, the different business models do not have the same colour scheme. Some work better in a recession but do not work well in the event of growth. Others are the other way around. One even works well in both scenarios but does not hold up well for the New Laws & Elections uncertainty. The choice depends largely on what the context of the company is (Magretta, 2002), and on what scenarios the company wants to be prepared for.

Secondly, most business model elements do not hold up well against the scenario where serious games become less accepted as tools. This makes sense because if people no longer believe in serious games as a tool, it becomes difficult to sell serious games in general. Only two business model elements hold up well against this scenario. These are Lock-In because it guarantees a revenue source from existing customers for a longer time, and Outsourcing because it makes it easy to scale down.

Finally, relatively few results are available on the New Laws & Elections and the Digital & Physical Games uncertainties. The former is largely because it is difficult to predict what a new law may do to impact the options available to a business as these new laws may as of yet not be on the political agenda. The latter is primarily because the impact of the preference is not well enough understood. Insights about how customers would respond to either scenario would be required to paint a more complete picture.

4.3.6 Limitations of the Business Model Stress Test

As said before, the Business Model Stress Test is only as valid as its input (Haaker et al., 2017). It must therefore be noted that there is a bias in the input that stems from the selection method for interview participants. The database used in this thesis likely did not include every serious game developer in the Netherlands. Hence, it is possible that the group of developers that is not in the database has insights that the others did not. Additionally, not every contacted company agreed to do the interview. This means that the sample could not be done randomly and was therefore biased.

However, the Business Model Stress Test is usually done within the confines of a single company, sometimes with an external facilitator (Haaker et al., 2017). In that setting, the risks of confirmation biases within the company and missing relevant insights is higher. Within this thesis project, these two biases are much lower, because of the varied input between the different interviews.

4.4 Case Example: The Barn

To illustrate how the results of this thesis project can help improve the business model of a serious game developer, this section will use the business model of The Barn as an example.

The Barn is a company that makes custom games for customers on the one side and has several as-is products on the other.

The custom games are sold through a licence which covers the development of the game. The offering is based on providing a serious game that solves a particular issue for the customer and they could therefore be considered a solution provider. The development of these custom games is typically done in co-creation with the customer for the content of the games.

As for the products, they are also developed as solutions. They develop the games in co-creation with customers and users to test for its effectiveness and to identify customer needs and wishes. These games are sold on a pay-per-use basis.

Having identified the four business model elements that The Barn uses as *Solution Provider*, *Co-Creation, Licensing*, and *Pay-per-Use*, it is possible to compare them to the results of the Business Model Stress Test. The relevant subset is given in table 4.14. For the remainder of this analysis, the conclusions from appendices C through F are used.

For the New Laws & Elections uncertainty, the table offers too little data to make a good judgement with, but the known results are looking good for the custom work. The products do seem to have an issue with the scenario where politics can serve as a topic about which to make games. The reason for this is that games about new laws can only target one law, making a pay-per-use structure less valuable for the company. The Barn's products currently do not deal with politics. It is therefore up to the barn to consider whether they would like to start making products for these new laws. Since their custom work seems well suited for this, it would be likely that this would not be a reason to change the business model.

The Economic Growth & Decline scenarios both are in need of further examination. For both scenarios, the company will run into difficulties, according to the table. The main issue with the current approach for custom work in a growing economy is that it does not scale very well when there is more demand. While this is not immediately an issue, some benefits might be missed this way. For economic decline,

Business Model Stress Test Results Relevant for The Barn

Business Model Elements	*New Laws & Elections*		*Economic Growth & Decline*		*Availability of Experts*		*Acceptance of Serious Games*		*Physical & Digital Games*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Solution Provider										
Co-Creation										
Licensing										
Pay-per-Use										

Table 4.14. Business model stress test results for relevant for The Barn.

the current approach might become too expensive for customers when facing lower budgets. As for the products, the pay-per-use model works only if the delivery method scales well. Currently, this is not the case, but the company is working on improving this.

Looking at the table, the scenario where experts become more scarce seems like it could cause some issues in the future. The Barn would have to find a way to deal with them. Their current approach is labour intensive, which becomes more expensive as the type of experts they need becomes scarcer. To help solve this issue, they could move to a more standardised solution, where the development would require fewer experts. When experts become more available, it will become more interesting to involve independent parties to contribute to the content that is now gathered through co-creation, allowing the company to also service those potential customers that do not have the required information internally.

When serious games become less accepted as a tool, issues arise on multiple fronts for The Barn. The licences, as a relatively large investment for custom games, become less attractive for customers to try when they are no longer convinced that serious games work. For their products, the pay-per-use strategy is in danger of losing customers, meaning that the revenues here will decrease immediately. If this scenario is something they would like to be prepared for, they would most likely have to change their business model. The solution providing service that they currently have could work well, here, because the company could change its offering to better solve their customers' problems. It alone might not be enough, however. It could be interesting to incorporate some business model elements that work well against this uncertainty. For instance, lock-in from the Technology domain works well in this scenario. Another option could be to do more with add-on structures instead of the licensing or pay-per-use strategies. Since the starting costs for a customer would be lower in that case, a customer might be more inclined to try it out.

The scenario where serious games become more accepted as a tool is one that they are very well prepared for. All of the business model elements that they use is coloured green. This is largely because the higher demand means more custom projects, as well as more pay-per-use contracts that would be more intensively used. Switching to a different business model as suggested in the previous paragraph might reduce their preparedness for this scenario. Therefore, the Barn should evaluate whether they want to prepare for the case that serious games become less accepted as tools or whether they do not believe that to be a likely scenario.

Finally, there is little known about how these business model elements would be able to handle a shift towards physical or digital games. However, The Barn develops both physical and digital games. Having this duality and the related experience makes it easier for them to shift the focus as the market demands it.

These insights, together, help The Barn in evaluating the effectiveness of their business model. If these uncertainties are issues that they expect to encounter, this thesis' results offered concrete considerations that they can use to test their own business model as well as test models that they might consider using in the future.

Conclusions

As is illustrated with this example case, the tables of the Business Model Stress Test give a clear overview of the results and make it easy for practitioners to evaluate what the effects of the uncertainties could be on their own business model. The results in this section about these effects are slightly different from what they are in the appendices, but those results are used as a basis to apply them to The Barn. This is also exactly how the tables should be used. This is how serious game developers can use the results of this thesis to develop a robust business model.

5 Conclusions

The objective of this thesis project is:

To gain insights into how different business models can contribute to the robustness of serious game developers in the Netherlands.

This objective was formulated together with Dutch serious game developer The Barn. A literature study illustrated that little is known academically about the business side of the serious game industry, even though many papers exist about the development of serious games. Hence, an exploratory research was set up, involving in-depth interviews with serious game developers in the Netherlands, to help achieve this objective.

In this concluding chapter, the research objective and research questions of this thesis project are evaluated. Additionally, the practical and scientific contributions of this thesis project are discussed. Then, a discussion about the limitations of this research as well as options for future research are examined in this chapter. Finally, this thesis project is reflected on.

5.1 Conclusion Research Objective and Questions

The research objective of this thesis project is developed into the following research question:

How can serious game developers use business models to remain robust in relation to various uncertainties in the serious game industry?

In order to answer this question, it was divided into three sub-questions, which each answer a part of the main question. In this section, the three sub-questions are answered using the results from the literature study and the in-depth interviews. Then, these insights are combined into an answer to the main question. The case example illustrates how this is applied to answer this main question.

The relation between the sub-questions is as follows. The first sub-question is aimed at identifying threats, opportunities, and trends that serious game developers are expected to have to face in the future. The second research question identifies what business model elements serious game developers currently use and what they might find interesting for their company. More importantly, however, is the reasoning why these business model elements might or might not be effective. Finally, the third sub-question combines the results of the first two to develop them into insights about how robust the business models are in relation to those uncertainties, hence also answering the main research question.

The first sub-question is formulated as follows:

What uncertainties does the serious game industry in the Netherlands currently face?

An exploratory literature study yielded one concrete, but unsubstantiated uncertainty: there is distrust about the effectiveness of serious game (Mayo, 2010). In addition, the in-depth interviews brought 25 uncertainties to light that serious game developers in the Netherlands should be prepared for. The full list of these uncertainties can be found in section 4.2.2. This included the uncertainty coined by Mayo. Insights have been developed about these uncertainties that help understand the different sides of these issues and how they would affect a developer.

The interviews had mixed views about the general view of potential customers about the effectiveness of serious games. One part claimed that they were becoming more accepting of serious games, whereas the other agreed with Mayo (2010) and feel that serious games are becoming less popular partly due to increased distrust of the games. From this research, it cannot be concluded which of the views will come to pass since interview participants argued both ways. Each view would have an opposite effect on the demand for serious games.

Mayo (2010) also claimed that too many serious game developers rely on subsidies. This did not seem to have merit according to the participants. Grants and subsidies were considered an issue by some, but not in the same way as Mayo claims it to be an issue. Mayo claims that many serious game developers rely on grants and subsidies and therefore have little incentive to develop their revenue model. However, the interviews demonstrated that this was not the case. Only one of the twelve participants actively used subsidies to develop their games and this was a conscious choice. The issue that the participants saw had to do with the limitations that subsidies impose on the company and the difficulty with obtaining them.

The second sub-question is:

What business model elements are currently used in the serious game industry in the Netherlands?

And also contains the following question

How do serious game developers in the Netherlands estimate the effectiveness of these business model elements?

Firstly, a literature study was done to lay the foundations for the research. This yielded four business model elements that were claimed as effective for serious game developers. However, these claims were largely unsubstantiated. These four business model elements were: (1) Anything-as-a-Service (Hauge et al., 2014), (2) Modularity (Xin, 2008), (3) Freemium (Georgieva et al., 2015), and (4) Advertising (Product Placement) (Georgieva et al., 2015). In addition, a brief review of the entertainment game industry revealed two additional business models element that is widely used there: (5) Pay-per-Use, and (6) Platform (Game Developers Conference report, 2019).

These and 27 other (34 in total) business models were discussed during the twelve in-depth interviews in order to gain insights about how these practitioners assess their effectiveness. See section 4.2.3 for the detailed results. Here, the relation between the literature and the results from the interviews is discussed.

Anything-as-a-Service was generally perceived as useful for non-custom serious games, as custom games would be difficult to sell as a service to a commissioning customer, who pays for the development of the game upfront. This view agrees with the literature, where serious games are assumed to be developed as a non-custom product.

Modularity was generally perceived as the most important business model elements within the Technology domain of the STOF model. The reuse of old work is the primary reason according to the interviews and the ease of changing things during or after a project is also considered very beneficial. Especially code is considered suitable for this. These views are in agreement with the literature.

The Freemium business model element was not considered to be a useful approach for serious game developers. This is primarily due to the small target group that serious games have and the large initial investment that would have to be made to develop such a game. This contradicts what Georgieva et al. (2015) claim as they describe the potential revenue gain and large reach for the game. What some

interviewees do mention is that a freemium model could be used as an introductory serious game for people who still need to be convinced of its effectiveness.

The Product Placement and Advertising models are received with a lot of criticism by the interviewees. They claim that these approaches would undermine the goal of the serious game because it distracts from the goal. Additionally, they claim and that these business model elements typically do not lead to enough revenue to cover the costs of development. These insights conflict with Georgieva et al.'s (2015) views and it suggests that they draw a parallel with the entertainment game industry that might not be valid.

Pay-per-Use models were typically well-received by the interviewees for non-custom serious games. The companies that only do custom work found this less appealing due to the high initial investment required to develop the game. The former view is consistent with the literature.

Finally, a Platform approach was viewed as interesting, generally. However, no successful implementation of this model has been developed as of yet, according to the participants. The other solutions did not accurately capture the needs of the users of such a platform. The interest in such a platform suggests that there is a parallel that can be drawn with the entertainment game industry. Still, considering that the participants mentioned that several attempts have already been made to this end, it seems a difficult model to set up.

In the evaluation of the different business model elements, a categorisation was used based on whether serious game developers are specialised or not and on whether they develop custom games for customers or not. The insights about the different business models did not seem dependent on the stratum that they were part of. As such, this categorisation is not considered effective.

The third and final sub-questions of this thesis is:

How do the business model elements from sub-question 2 hold up against the uncertainties from sub-question 1?

This was answered by doing a Business Model Stress Test with the answers to sub-questions 1 and 2 as input. The resulting tables (found in section 4.3 and appendices C to F) answer this question from the perspective of a company that is already employing those business models when facing those uncertainties.

As discussed just now, several business model elements are identified within the literature (Anything-as-a-Service, Modularity, Freemium, Advertising, Pay-per-Use, and Platform) that are supposedly effective for serious game developers. The Business Model Stress Test, however, illustrates that this claim will not hold over time for every uncertainty. Like the other business model elements that are discussed in this thesis, each business model element typically works well in relation to several specific scenarios but is less effective against others. Therefore, the conclusions about these business models cannot be that serious game developers should use a particular model, but rather that they should determine the uncertainties that they should be prepared for and choose a business model that can handle it well.

This is then also the answer to the main research question of this thesis. This question was:

How can serious game developers develop robust business models in relation to various uncertainties in the serious game industry?

An example of how a serious game developer could do this was presented in section 4.4. This illustrated the practical use of the results of this thesis project. Serious game developers can use the tool to test their existing business model for robustness or they could test a new one that they might want to implement. With this outcome, the goal of this thesis project is reached.

5.2 Scientific Contributions

This thesis project contributed to science in three ways. First of all, it lays a foundation based on empirical evidence about how business model approaches are applicable to the serious game industry. Secondly, several known methodologies are combined by using the results of some methods as input for others. The individual methods turned out to yield the desired input, meaning that this structure can also be used in future research where qualitative information about business model robustness is required. Finally, the Business Model Cards tool is used in a different setting than it is originally designed for. It turns out that this tool is also very useful to structure a discussion about business model robustness with. The remainder of this section discusses these individual points in more detail.

A literature study revealed a significant hole in academic knowledge about how robust various business models are within the serious game industry. Only a few papers discuss this topic but do not substantiate their claims within the domain of serious games. As such, this thesis project aimed to develop a foundation about this topic that can be used as a strong starting point for future research. This was done by doing exploratory interviews with practitioners to verify or contradict existing literature and develop new insights about the industry and the effectiveness of various business models, based on these interviews.

In order to do this, several methods were used to gather data and develop insights about business models within the serious game industry. One of these methods was a PEST analysis, which was aimed at finding uncertainties that the serious game industry faces and developing insights about their impact. This was generally perceived as an effective method by the participants. Considering that 25 relevant uncertainties were identified in this way across the different interviews, this seems like an accurate assessment. Hence, the PEST analysis is suitable for future studies that aim to identify uncertainties with practitioners.

Secondly, the STOF model was employed as a structure when talking about business models. Interviewees were generally positive about the approach and it allowed for the segmentation of results that made them easier to assess. In that way, the STOF model was a good fit and could therefore be used to structure similar future research as well.

The Business Model Cards complimented the model nicely. Many participants mentioned by themselves that they found the use of these cards very helpful and clear. However, three participants of the interview had trouble with the technology domain of the model. This was mostly because of the text on the Business Model Cards. Some of the cards described a method to make money, while others described how to structure an offering. This made it difficult for some participants to grasp what the technology domain was really about, hindering their capacity to respond to the questions. For researchers that want to use this method, it is advisable to spend more time on explaining the context of the technology domain. Otherwise, the method proved quite useful in gathering information in a structured way.

For this research, a new method of gathering information was developed where the Business Model Cards were used in an ordinal exercise during the interviews. The use of this exercise was not so much in quantifying the ranking of the cards, but more in stimulating the thought process of comparing the different models. That way, participants were challenged to find reasons why one would work better than another for them. Participants found this method very pleasant and helpful in structuring their thoughts. Indeed, the results gathered from this discussion were very useful. Hence, this method could be practical for other researchers that need in-depth information about business models from practitioners.

Finally, the Business Model Stress Test was used to test the robustness of business models in relation to several uncertainties. This method was effective in offering a structured approach for developing insights about business models within the serious game industry as a whole. It was used as a guideline throughout the thesis project. First, the focus was on finding the required input for the test and then on the execution of the stress test. Normally, the input of the stress test is one complete business model of

a particular company. In this thesis, it was used to test individual business model elements. The resulting analysis becomes cumbersome the more uncertainties and business model elements are included, but the conclusions are, as demonstrated, very useful and insightful. Therefore, it seems like the stress test is suited for this use as well and is then applicable for future research that needs to accomplish something similar. However, using it in this manner is more cumbersome and time-consuming.

The various methodologies are combined into a structure that proved effective in evaluating the robustness of business models. As such, this structure can be used in future research as well. Though, it is advisable to give more explanation about the technology domain or change the text on the Business Model Cards during the interviews in order to clear the intention up for the participant.

5.3 Practical Implications

This thesis project yielded many different kinds of useful insights that can help serious game developers test and improve their current business models as well as construct new ones. 25 Uncertainties were identified that could have an impact on such companies. Moreover, the impact that practitioners expect them to have is also described. These insights can help practitioners in their considerations about what to expect from the future and thus help them prepare for scenarios that they previously had not anticipated.

Additionally, 34 business model elements across the different STOF model domains have been discussed with practitioners in order to formulate insights about their applicability for serious game developers. This analysis gives developers a foundation from which they can contemplate whether a certain business model element would be a fit for their company. Furthermore, in combination with the 25 uncertainties that were analysed, companies can evaluate the robustness of their own business model as well as a potential new business model. In this research, an extensive business model stress test was done to that end.

Not all uncertainties were included because the approach would no longer be manageable. Even if all these uncertainties were included, it would not be an exhaustive analysis, nor would it yield a perfect business model for serious game developers. Instead, the analysis yields the collective considerations of the interviewees and the researcher about the robustness of the business models in relation to the uncertainties that are greater than the sum of its parts. As such, a serious game developer that is considering their own business model would find value in taking these considerations and conclusions into account. That way, this serious game developer will be able to make a better and more informed decision on what business model will be right for them.

They can do this by examining the different business models available, like the ones tested in this thesis, and decide for themselves whether these are robust enough in relation to those uncertainties that they find relevant, taking into account the considerations that this thesis presents.

Alternatively, a serious game developer that already has a business model may also find a use for the results. They can identify what business model elements they currently employ and select those uncertainties that they find worthwhile to explore. By examining conclusions and considerations related to their business model and the uncertainties they selected, they might find arguments for why they should opt for a different business model instead. Or these insights might further substantiate their reasons for using the business model in the first place.

Finally, while the conclusions of this thesis are not exhaustive, the same steps that were done during the interviews in this thesis present a structured methodology that can help with business model innovation. A PEST analysis as structured in this thesis would help a company identify new uncertainties that they feel they should be prepared for. Then using the Business Model Cards and the sorting exercise, they might

find reasons why certain business model elements might work better than others. Finally, relating these insights to each other can, then, fuel a new Business Model Stress Test that a company can use in the same way as the results of this thesis, preferably in combination with these results.

5.4 Discussion and Future Research

There are several points where assumptions have been made in this research that could influence the validity and reliability of this thesis.

First of all, it must be noted that, while the serious game developer database is constructed with care and great effort to be inclusive, it is possible that a number of relevant companies are not in there. This means that this research did not include companies that are less publicly visible or accessible. This is a bias since companies with a particular view of the industry might be more inclined to be less visible.

Secondly, the interviewed companies are those companies that were interested in being interviewed. Other companies were invited for an interview, but not all wanted to participate. It is possible that these companies have a different take on the market. For instance, they might be more competitively structured, or perhaps they already found a robust business model that they prefer not to share. One of the companies that refused to participate gave the reason that they were currently actively working on their business model and would rather not share. Hence, a bias is introduced because of this. Additionally, only one interview was possible within the custom/specialised stratum. As such, any conclusions about that particular stratum are possibly because of outlier data.

Finally, the Business Model Cards are numbered. As far as is known to the researcher, the numbers have no meaning and merely served as an easy way to document the ranking in this research. However, it is possible that, during the ordinal ranking exercise, the participants were (sub)consciously influenced by their presence.

These biases are important to note because they translate through the Business Model Stress Test. The stress test is only as valid as its input. Hence, if the input is biased, the output will also be biased.

As mentioned before, the categorisation used for serious game developers did not yield many significant differences between strata. But even though the categorisation proved ineffective, it helps identify some apparent similarities between different kinds of companies that could not be considered before the interviews. As such, a different categorisation might be of more use. Some differences of opinion about specific business model elements seem to come from the type of offering that the developer has. Within the interview participants, three types of offering were identified. (1) Many companies offered custom game design for customers who want to achieve a certain goal. These companies then design a custom game for that particular goal. (2) Other companies develop a game of their own initiative and then try to sell this game in one form or another. Finally, (3) some serious game developers develop the games as a means of augmenting a different service that they offer. A consultant might employ a game that they developed to reach a target group that they need information from to formulate an advice for a customer. A categorisation system based on these three strata might be more effective. However, it is more difficult to determine to which a company belongs based on its website, as was done in setting up the other categorisation. To complicate matters more, it is possible that a company does more than one of these. Hence, it might be more effective to not categorise the company itself, but rather the product or service that they offer.

The insights gained from this thesis project give a foundation upon which future research can build to further explore the robustness of business models within the serious game industry in the Netherlands. For example, it would be interesting to do a similar study about the remaining business model elements from the Business Model Cards as well as about different business model elements that this thesis did not consider. Such a study would do well to also include some of the business model elements that were researched in this thesis so that the results can more easily be compared to each other.

Three interviewees mentioned the international market for serious games. It would be very interesting to see whether the business model elements are expected to perform similarly in the international market. A study to that effect could help serious game developers in the Netherlands expand their reach.

In this thesis project, some industries that are similar to the serious game industry have been identified through the interviews. It could be useful for future research to identify what business model elements are considered useful in those industries and test whether they would also be robust in the serious game industry.

Finally, the results of this exploratory thesis project are qualitative in nature and are therefore not statistically significant. Doing a quantitative study to statistically verify the results of this thesis would be very useful.

5.5 Personal Reflection

While the thesis project went rather smoothly, there were a few points that proved to be difficult. At the very beginning, when I did the largest part of the literature study, it became clear that literature was not going to give me the foundation that I hoped to get. Having primarily found ungrounded claims, it became difficult to define a proper scope for this research. Hence, the research questions had to be reformulated several times. Because there was no basis about the topic of this thesis, there were many things that had to be tried for the first time. For instance, there was no research method that was verified to work in these circumstances and making a choice about on what information to focus is challenging. The first test interview went on for two hours and I still felt like more information could be gathered from it. However, two hours is simply way too long for an interview with practitioners and would inconvenience people. This could even mean that the length of the interview could be the reason for a significant number of practitioners to not participate, creating a bias in the process. Scoping the interview down so that it is possible to do in one hour was difficult and necessary, but it also was an interesting challenge and the results were rewarding.

During the interviews, it became apparent that it was not always clear what the technology domain entails for the participants. When a new research is done using the same structure as was used in the interviews of this study is a good option, with one change: expanding the explanation about the technology domain and rephrasing the business model element explanations on the Business Model Cards to create more uniformity.

Even though the target of doing at least ten in-depth interviews felt a bit ambitious at the start, it turned out that serious game developers were generally quite happy to be interviewed. It probably helped that I emphasised the value of the research for the companies in every contact with them and that I called the companies up if there was no response to the initial email. Some of the companies that I called were initially somewhat reserved about participating in a study about their business. Being able to speak to me on the phone allowed them to express their concerns and it allowed me to reassure them. In the future, these reservations could cause some issues when doing quantitative research about this topic, as such a level of personal contact would not be possible. Even in this research, these reservations, a lack of time, and/or a lack of interest from serious game developers also led to an underrepresentation of one of the categories.

In a possible future study, it would be more practical to use the new categorisation system as proposed in the previous section and test whether the different strata are different in the way that they do business. The use of the offering/specialisation categorisation in this thesis, while it turned out to be less applicable than initially believed, led to the formulation of a different, possibly more effective categorisation system.

6 References

Bouwman, H., Vos, H. de, & Haaker, T. (Eds.). (2008). *Mobile Service Innovation and Business Models*. Retrieved from https://www.springer.com/gp/book/9783540792376

Bradfield, R., Wright, G., Burt, G., Cairns, G., & Van Der Heijden, K. (2005). The origins and evolution of scenario techniques in long range business planning. *Futures, 37*(8), 795–812. https://doi.org/10.1016/j.futures.2005.01.003

Castronova, E., & Knowles, I. (2015). A Model of Climate Policy Using Board Game Mechanics. *International Journal of Serious Games, 2*(3), 41-60. https://doi.org/10.17083/ijsg.v2i3.77

Chesbrough, H. (2010). Business Model Innovation: Opportunities and Barriers. *Long Range Planning, 43*(2–3), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change, 11*(3), 529–555. https://doi.org/10.1093/icc/11.3.529

Cohen, H., & Lefebvre, C. (2005). *Handbook of Categorization in Cognitive Science* (2nd ed.). Retrieved from https://doi.org/10.1016/B978-0-08-044612-7.X5053-7

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661–686. https://doi.org/10.1016/j.compedu.2012.03.004

de Reuver, M., Bouwman, H., & Haaker, T. (2013). Business model roadmapping: A practical approach to come from an existing to a desired business model. *International Journal of Innovation Management, 17*, 1340006. https://doi.org/10.1142/S1363919613400069

Djaouti, D., Alvarez, J., & Jessel, J.-P. (2011a). Classifying Serious Games: The G/P/S Model. In P. Felicia (Ed.), *Handbook of Research on Improving Learning and Motivation through Educational Games: Multidisciplinary Approaches* (pp. 118–136). Hershey, PA: IGI Global. Retrieved from https://www.igi-global.com/gateway/chapter/52492

Djaouti, D., Alvarez, J., Jessel, J.-P., & Rampnoux, O. (2011b). Origins of Serious Games. In M. Ma, A. Oikonomou, & L. C. Jain (Eds.), *Serious Games and Edutainment Applications* (pp. 25–43). London, United Kingdom: Springer. https://doi.org/10.1007/978-1-4471-2161-9_3

Doyle, P. (2010). *Marketing Strategies for Corporate Growth and Shareholder Value* (2nd ed.). Chichester, United Kingdom: John Wiley & Sons, Ltd.

Dutch Game Industry Directory. (n.d.). Dutch Game Industry Directory. Retrieved 30 April 2019, from Dutch Game Industry Directory website: https://dutchgameindustry.directory/

El Sawy, O. A., & Pereira, F. (2013). *Business Modelling in the Dynamic Digital Space: An Ecosystem Approach*. Retrieved from //www.springer.com/gp/book/9783642317644

ENVISION. (n.d.). Business Makeover Tools. Retrieved 5 February 2019, from Business Makeover website: https://www.businessmakeover.eu/platform/envision/tool-overview

European Commission. (2012). 2012 - *European Commission - Evaluation SME Definition*. Retrieved from European Commission: Centre for Strategy & Evaluation Services website: https://web.archive.org/web/20150325013015/http://ec.europa.eu/enterprise/policies/sme/files/studies/evaluation-sme-definition_en.pdf

Faulkner, L. (2003). Beyond the five-user assumption: Benefits of increased sample sizes in usability testing. *Behavior Research Methods, Instruments, & Computers, 35*(3), 379–383. https://doi.org/10.3758/BF03195514

Fielt, E. (2013). Conceptualising Business Models: Definitions, Frameworks and Classifications. *Journal of Business Models, 1*(1), 85–105. https://doi.org/10.5278/ojs.jbm.v1i1.706

Foss, N. J., & Saebi, T. (2017). Fifteen Years of Research on Business Model Innovation: How Far Have We Come, and Where Should We Go? *Journal of Management, 43*(1), 200–227. https://doi.org/10.1177/0149206316675927

Game Developers Conference. (2019). *State of the Game Industry 2019*. Retrieved from http://reg.gdconf.com/GDC-State-of-Game-Industry-2019

Games Monitor. (2015). *Games Monitor 2015*. Retrieved from Dutch Game Garden website: https://www.dutchgamegarden.nl/project/games-monitor/

Georgieva, G., Arnab, S., Romero, M., & Freitas, S. de. (2015). Transposing freemium business model from casual games to serious games. *Entertainment Computing, 9–10*, 29–41. https://doi.org/10.1016/j.entcom.2015.07.003

Goodman, P. S. (2016, April 29). Europe's Economy, After 8-Year Detour, Is Fitfully Back on Track. *The New York Times*. Retrieved from https://www.nytimes.com/2016/04/30/business/international/eurozone-economy-q1.html

Haaker, T., Bouwman, H., Janssen, W., & de Reuver, M. (2017). Business model stress testing: A practical approach to test the robustness of a business model. *Futures, 89*, 14–25. https://doi.org/10.1016/j.futures.2017.04.003

Harteveld, C. (2011). *Triadic Game Design: Balancing Reality, Meaning and Play*. London, United Kingdom: Springer Science & Business Media.

Hauge, J. B., Wiesner, S., Sanchez, R. G., Hansen, P. K., Fiucci, G., Rudnianski, M., & Basanez, J. A. (2014). Business models for Serious Games developers - transition from a product centric to a service centric approach. *International Journal of Serious Games, 1*(1). https://doi.org/10.17083/ijsg.v1i1.10

Ho, J. K.-K. (2014). Formulation of a Systemic PEST Analysis for Strategic Analysis. *European Academic Research, 2*(5), 6478–6492.

Hussung, T. (2016, September 30). All About Advergames [University]. Retrieved 9 May 2019, from Concordia University, St. Paul Online website: https://online.csp.edu/blog/business/all-about-advergames

Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing Your Business Model. *Harvard Business Review, 2008*(December), 51–59. Retrieved from https://hbr.org/2008/12/reinventing-your-business-model

Laamarti, F., Eid, M., & El Saddik, A. (2014). An Overview of Serious Games. *International Journal of Computer Games Technology, 2014*, 1–15. https://doi.org/10.1155/2014/358152

Leacy, M. (2017, October 18). CIOs: 7 Ways to Deal with Talent Scarcity. Retrieved 20 May 2019, from The Ian Martin Group website: https://ianmartin.com/cios-7-ways-deal-talent-scarcity/

Magretta, J. (2002, May 1). Why Business Models Matter. *Harvard Business Review*, (May 2002). Retrieved from https://hbr.org/2002/05/why-business-models-matter

Mayo, M. J. (2010). Bringing Game-Based Learning to Scale: The Business Challenges of Serious Games. *International Journal of Learning and Media, 2*(3), 81–100. https://doi.org/10.1162/ijlm_a_00048

Michael, D., & Chen, S. (2005). *Serious Games: Games That Educate, Train, and Inform*. Boston, Massachusetts, USA: Thomson Course Technology PTR.

Morris, M., Schindehutte, M., & Allen, J. (2005). The entrepreneur's business model: Toward a unified perspective. *Journal of Business Research, 58*(6), 726–735. https://doi.org/10.1016/j.jbusres.2003.11.001

Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers (1st ed.). Hoboken, New Jersey: John Wiley and Sons, Inc.

Petridis, P., Hadjicosta, K., Guang Shi, V., Dunwell, I., Baines, T., Bigdeli, A., … Uren, V. (2015). State of the art in business games. *International Journal of Serious Games, 2*(1), 54–69. Retrieved from http://journal.seriousgamessociety.org/index.php/IJSG/article/view/54

ResearchGate. (2016). International Journal of Learning and Media. Retrieved 16 May 2019, from ResearchGate website: https://www.researchgate.net/journal/1943-6068_International_Journal_of_Learning_and_Media

ResearchGate. (2018). Simulation & Gaming. Retrieved 7 June 2019, from ResearchGate website: https://www.researchgate.net/journal/1046-8781_Simulation_Gaming

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: a Skill-Building Approach* (7th ed.). Chichester, West Sussex, United Kingdom: John Wiley & Sons.

Serious Play Conference. (2018). 2018 Award Winners. Retrieved 6 February 2019, from Serious Play Events website: https://seriousplayconf.com/2018-award-winners/

Siddiqui, M. W. (2018). *Journal Impact Factor 2018*. Retrieved from ResearchGate website: https://www.researchgate.net/publication/326016068_2018_Journal_Impact_Factor_2018

Siriaraya, P., Visch, V., Vermeeren, A., & Bas, M. (2018). A cookbook method for Persuasive Game Design. *International Journal of Serious Games, 5*(1), 37–71. https://doi.org/10.17083/ijsg.v5i1.159

Sonawane, K. (2017). Serious Games Market Global Opportunity Analysis and Industry Forecast, 2016-2023. Retrieved 7 February 2019, from Allied Market Research website: https://www.alliedmarketresearch.com/serious-games-market

Stapleton, A. J. (2004, January). *Serious Games: Serious Opportunities. January*, 1–6. Paper presented at Australian Game Developers' Conference, Academic Summit, Melbourne, VIC. Retrieved from https://www.researchgate.net/publication/228384342_Serious_games_Serious_opportunities

van Boeijen, A., Daalhuizen, J., Zijlstra, J., & van der Schoor, R. (Eds.). (2013). *Delft Design Guide* (4th ed.). Amsterdam, The Netherlands: BIS Publishers.

Van der Heijden, K. (2005). *Scenarios: The art of strategic conversation* (2nd ed.). West Sussex, United Kingdom: John Wiley & Sons Inc. Retrieved from http://www.untag-smd.ac.id/files/Perpustakaan_Digital_1/CREATIVE%20THINKING%20Scenarios,%20The%20art%20of%20strategic%20conversation.pdf

van Kranenburg, K., Slot, M., Staal, M., Leurdijk, A., & Burgmeijer, J. (2006). *Serious gaming* (pp. 1–60). Retrieved from TNO website: http://publications.tno.nl/publication/105193/A94SOJ/33866.pdf

Ward, A. F. (2013, July 16). The Neuroscience of Everybody's Favorite Topic. Retrieved 29 April 2019, from Scientific American website: https://www.scientificamerican.com/article/the-neuroscience-of-everybody-favorite-topic-themselves/

Weill, P., & Vitale, M. (2001). *Place to Space: Migrating to eBusiness Models* (1st ed.). Boston, Massachusetts, USA: Harvard Business School Press.

Xin, C. (2008, December 19). *Influence from the Serious Games on Mobile Game Developers' Commercial Strategies.* 207-209. Paper presented at 2008 International Seminar on Business and Information Management, Wuhan, China: IEEE. https://doi.org/10.1109/ISBIM.2008.224

Yoo, J. M. (2015). Perceived Value of Game Items and Purchase Intention. *Indian Journal of Science and Technology, 8*(19), 1–7. https://doi.org/10.17485/ijst/2015/v8i19/77148

Appendix A: Informed Consent Form and Information

	Yes	No
Participation in the research	◯	◯
1. I have read and understood the document *Information on the Research Serious Game Business Models*, or it has been read to me. I have had the opportunity to ask questions about the study and my questions have been answered in a satisfactory manner.	◯	◯
2. I freely give permission to participate with this research and understand that I may refuse to answer questions and that I may withdraw myself from the study at any time without giving a reason for this.	◯	◯
3. I understand that participation with this research involves that: (1) the interview will be recorded with an audio recording and that the data gathered during this interview will be saved on a password protected computer and in a Dropbox folder. (2) The data will be merged with the data from other interviews in the documentation of the research to allow for anonymous representation of the data. (3) The analysed data will be archived at a secure location and the data will be anonymised by replacing identifiable references with pseudonyms.		
Risks involved with the participation in the research	◯	◯
4. I understand that participation in this research will bring with it the following risks: (1) probing questions during the interview about the organisation and business of my company; (2) my identity may be divulged to close relatives and mentors of the interviewer; (3) audio recordings, transcriptions, or other data from the research could be stolen.		
Use of the information from the interview		
5. I understand that the information that I divulge during this interview will be used for the following research outputs: (1) documentation of a master thesis project and/or publication; (2) the sharing of generalised knowledge from the interview.	◯	◯
6. I give permission that the information given in this interview may be cited in the research outputs.	◯	◯
Future use of the information from the interview		
7. I give permission for the audio recording from the interview to be archived on secured devices of the interviewer so that it can be used for future research. The audio recording will be anonymised after at most 6 months after the research is finished by censoring personally identifiable remarks.	◯	◯

Information on the Research Serious Game Business Models

The research Serious Game Business Models is executed as a part of the master thesis project of Julien Estourgie at the Delft University of Technology, faculty of Technology, Policy, and Management.

The aim of the study is to gain insights into the different business models that are employed by serious game studios in the Netherlands and into the sustainability of these models. After the master thesis project has concluded, the participant will receive an uncensored digital copy of the thesis report on the email provided by the participant.

The complete research consists of several one-on-one interviews between the researcher, Julien Estourgie, and a variety of practitioners within the serious game industry in the Netherlands who are responsible for the business management within the company that they work for.

An audio recording and a transcription thereof will be made of this interview in order to analyse the data better. This data will be saved anonymously using a pseudonym, though the audio will remain unedited until at most 6 months after the research has concluded. After this time, the audio recording will be archived with any personally identifiable references censored and replaced with a pseudonym. After this edit, the recording will be archived for possible future research. In the case that the participant does not give permission for point 7 on the *Declaration of Informed Consent for Research: Serious Game Business Models*, the audio recording will be destroyed after at most 6 months after the thesis project has concluded.

The data will be saved on password-protected computers and on a personal Dropbox cloud folder owned by the researcher. After a period of at most 6 months after the thesis project has concluded, the anonymised data will be archived on secured external devices with no direct connection to the internet. If personally identifiable data is stolen, regardless of these precautions, the researcher will notify the involved parties within a reasonable timeframe to the best of his abilities, for when this is known to the researcher.

During the interview, business issues in relation to the participant's company will be discussed, which could potentially cause some degree of mental discomfort for the participant.

After the interview, it is possible that the identity of the participant will be disclosed to close relatives and mentors of the researcher.

Should the participant want to withdraw from the research, they will have to notify the researcher thereof before May 24th, 2019 via email. In the case that a participant makes use of this option, the physical data gathered during this interview will be destroyed within a reasonable timeframe.

Contact data of the participant will be saved for a maximum of 6 months after the thesis project has concluded to be able to ask possible follow-up questions and to send them the thesis report.

Should the participant have questions, complaints, want to withdraw from the study, or see the data stored about them, they can contact the researcher via REDACTED.

Appendix B: Business Model Card Explanations

This appendix gives four tables with brief explanations of the various Business Model Cards that were used during the interviews of this thesis project. The cards have been divided into STOF model domains. The full descriptions can be found on the cards themselves as presented by ENVISION (n.d.).

Business Model Elements (Service/Product Domain)

Business Model Element	Description
Mass Customisation	Meet the specific needs of the individual customer at a low cost
Solution Provider	Provide a complete package of services as a solution to a customer's problem
Experience Selling	The experience of a product/service is a main part of its (perceived) value
User-Generated Content	Content (and therefore value) is created by the users of a product/service
Open Source	The product/service (often software) is made available to anyone for free
Eco & Green	The product/service is environmentally friendly, which is increases its value
Anything-as-a-Service	Products are offered as a service, instead of sold as a product
Self-Service	Customers take over a part of the service, reducing delivery costs
Platform	A platform connects interdependent users, allowing them to interact
Leveraging Customer Data	Data about customers is collected and analysed and can also be sold by itself
No-Frills	The product/service has a minimal set of features, allowing for low prices
Data-as-a-Service	Data is collected, interpreted, and transformed. The result is the service
The Long Tail	A large number of different products with an individually low demand is sold
White Label	Products/services produced by one company are sold under another's brand

Table B.1. 14 Business model elements from the ENVISION (n.d.) Business Model Cards tool of the Service/Product domain.

Business Model Elements (Technology Domain)

Business Model Element	Description
Sharing Economy	Assets that are not used all of the time are rented out or shared with others
Cross-Selling	New products/services are sold to existing customers
Barter	Products/services are traded directly for other products/services
Lock-In	A customer is dependent on a product/service. Switching is very costly
Peer-to-Peer	Individuals exchange products/services directly with each other
e-Commerce Only	Products/services are sold online only. Physical contact is not necessary
Omnichannel	Online and physical channels are integrated seamlessly
Versioning	Different versions of the same product are offered to different customers
Behavioural Segmentation	The offering is focussed on groups of people with specific behaviour
Bricks & Clicks	Customers can buy online and pick up at a store
Modularity	Products are structured so that new components can easily be added

Table B.2. 11 Business model elements from the ENVISION (n.d.) Business Model Cards tool of the Technology Domain.

Business Model Elements (Organisation Domain)

Business Model Element	Description
Shop-in-Shop	A company can rent out some space within its store to another store
Business Alliance	Several businesses collaborate to achieve a common goal
Co-Creation	A community collaborates to develop a new product or solve a problem
Franchising	A company's processes and brand are used by independent parties
Outsourcing	Outside parties are contracted to do non-core business processes
Insourcing	Processes that were previously done by outside parties are done internally
Orchestration	A company coordinates several parties to provide a joint solution
Customer Analytics	Customer data is used to develop better products
Crowdsourcing	Ideas are collected from a large group of people
Content Curation	Customers are helped with finding and selecting relevant information
Fractional Ownership	Several parties jointly own an asset and share it with each other
Renting	Payments are made for the temporary use of a product/service/property
Leveraging Resources	Company resources are (partly) sold to other parties
Dis-Intermediation	Intermediate parties are removed from the supply chain

Table B.3. 14 Business model elements from the ENVISION (n.d.) Business Model Cards tool of the Organisation Domain.

Business Model Elements (Finance Domain)

Business Model Element	Description
Reselling	A company distributes another business' products and services
Crowdfunding	A large number of people invest in a project in return for specific benefits
Razor & Blade	The main product is cheap, while required extras are expensive
Add-On	The basic product is cheap, while additional features cost extra
Pay What You Want	The buyer determines how much they pay for a product/service
Freemium	Most users use a free product, while some pay for advanced features
Revenue-Sharing	Companies work together to provide a product and share the revenues
Licensing	One party authorises the use of a product/service to another for a price
Affiliation	A company creates sales for other companies for a part of the revenue
Pay-per-Use	A customer pays for the actual usage of the product, not the product itself
Auction	A product/service is sold to the highest bidder
Advertising	Marketing messages are shown to users, the advertiser pays for this service
Dynamic Pricing	Prices change based on external factors
Bundling	Multiple products are sold together for a single, attractive price

Table B.4. 14 Business model elements from the ENVISION (n.d.) Business Model Cards tool of the Finance Domain.

Appendix C: Business Model Stress Test Results (Service/ Product Domain)

In this appendix, the detailed results of the business model stress test for the business model elements of the Service/Product domain are presented. For each cell, the logical conclusion from combining insights about the focal business model element with insights about extreme outcomes (A and B) of the focal uncertainty are explained.

Business Model Stress Test Results (Service/Product Domain)

Business Model Element	*New Laws & Elections*		*Economic Growth & Decline*		*Availability of Experts*		*Acceptance of Serious Games*		*Physical & Digital Games*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Mass Customisation	1	2	3	4	5	6	7	8		
Solution Provider	1	2	3	4	5	6	7	8		
Experience Selling			3	4			7	8		
Eco & Green	1	2							9	10
Anything-as-a-Service		2	3	4	5	6	7	8		
Platform		2	3	4	5	6	7	8	9	10
Leveraging Customer Data	1		3	4			7	8	9	10
White Label		2			5	6	7	8		

Table C.1. Business model stress test results of the Service/Product domain with conclusions referenced per element using numbers.

Mass Customisation

1. The passing of new laws might mean that previous offerings no longer comply with these new laws. Therefore, a certain flexibility is required to change the offering to accommodate for these changes. A mass customisation approach typically does not give this flexibility.
2. Even though a mass customisation option is aimed at servicing small deviations in needs, it is not outfitted to service diverse needs. New laws generally cover new topics, as such a new mass customisation solution would have to be developed for the different laws, making this a less effective method to profit from these opportunities.
3. In a declining economy, budgets decrease. Offering a semi-standardised solution is therefore a cheaper option than completely customised alternatives. As such, a mass customisation option has an advantage.
4. In a growing economy, budgets and demand increase. A company that has a mass customised solution will be able to service many customers with a relatively smaller development team.
5. When experts become scarcer, a mass customisation offering requires fewer experts to maintain than completely customised solutions.

6. When experts become more available, the price gap between mass customised solutions and completely customised solutions becomes smaller. This weakens the advantages of mass customisation.
7. When serious games become less accepted, a mass customisation solution might no longer appeal to the customer in its current form. The initial investment to set up a mass customisation offering limits the needed flexibility to deal with changing customer needs.
8. A higher acceptability of serious games is beneficial to mass customisation offerings because it can easily scale to the increased demand.

Solution Provider

1. A certain flexibility is required for the developer to cope with changes in laws. Solution providers typically have this flexibility.
2. A solution provider can easily adapt its offering to customers with different wishes. Hence, offering a solution for new laws and elections fits the business model element.
3. Due to the flexibility of solution providers, adapting to the different customer needs that arise during a recession is one of their strengths.
4. A rapidly growing economy increases demand and budgets. Solution providers must hire new people to accommodate for these changes. For a solution provider, people do not scale well.
5. As experts become scarcer, the production capacity of solution providers becomes unsure. Current employees may find more attractive offers in different companies, endangering the viability of the business model element.
6. A solution provider's capacity depends mostly with its number of employees. Lower hiring costs makes it easier to expand and cheaper to produce.
7. If serious games become a less accepted tool, solution providers will have to change their solution to the wishes of their customers. The flexibility in making this change is one of the advantages of being a solution provider.
8. As serious games become a more accepted tool, so will people accept it more as a solution to their problems. Increased demand can be compensated with hiring more employees or increasing prices.

Experience Selling

3. Experiences are not generally considered to be part of a company's core business. As such, it is likely that developers that sell experiences drop in demand faster than other developers.
4. When the economy growths, the demand for non-crucial products increase. As such, experience sellers would benefit from a growing economy.
7. When serious games become less accepted as a tool, customers are more likely to switch to alternative solutions. In that case, the experience of a serious game would have to compete with the experience of other media, like entertainment games. Competitors in these markets generally have more funds available.
8. When serious games become more accepted as a tool, the experience of playing the game is a good way to differentiate from competitors.

Eco & Green

1. New laws and elections probably will not affect the eco & green business model element negatively. What might happen, however, is that new laws might boost interest in this business model element.
2. New laws and regulation could involve eco & green themes, which eco & green developers could use to their advantage.
9. It is more difficult to make a meaningful difference with digital products with an eco & green setup than with physical products because of the used resources in developing digital games. As such, action is required to redesign the viability of this business model element.
10. Eco & Green solutions are more effective for physical products, because the company can more easily change production methods to become eco-friendlier.

Anything-as-a-Service

2. Laws are usually short-term problems to which a company must adjust. A service-based offering is therefore most likely not a fitting strategy. However, an implementation wherein a company offers a service that spans a trajectory of laws might still be capable of exploiting this opportunity.
3. With decreased demand, a service offering will have difficulty covering the initial investment of developing the service.
4. With increased demand and budget, a larger number of customers can cover the costs involved with running a service-based offering.
5. For services, a limitation on company capacity is the available number of employees. As such, if it becomes more difficult to get these experts, the developer could get in trouble.
6. Having easy access to experts means it is easy to expand capacity.
7. With decreased acceptance comes decreased demand. This makes it more difficult for a company to cover its initial investment of developing the service.
8. Increased acceptance and demand mean more potential customers for the service. More active customers mean greater stability and it makes it easier for companies to cover its initial investment of setting up the service offering.

Platform

2. A platform can be aimed at servicing those interested in new laws and elections. As such, developers could use this platform to distribute their solutions to a customer group.
3. Platforms require some degree of use to run a profit. If demand and budgets decrease, due to economic constraints, it becomes more difficult to make enough revenue.
4. In a growing economy, demand and budgets increase, so interactions on the platform can also be expected to increase. This is good for the platform.
5. Maintaining a platform requires experts. As such, if they become scarcer, this becomes more difficult and costly. Additionally, the games on offer through a platform also require experts to maintain and develop. Therefore, the offering on the platform decrease as other companies struggle with finding experts as well. On the other hand, the scope of a platform means that few experts can service a larger number of users.
6. More experts mean cheaper maintenance and expansion of the platform itself. Additionally, the development of serious games will become cheaper, allowing for more games to be developed with the same budget. If these games are offered on the platform, its value for users would increase.
7. When serious games become less accepted, demand for them decreases. This means that fewer customers will use the platform, decreasing its value for developers. Hence, fewer developers will make use of the platform, further decreasing its value for customers, leading to fewer customers and possibly a downward spiral.
8. Increased demand for serious games would lead to more customers that use the platform. This makes the platform more valuable for serious game developers, who will in turn offer more games through the platform. This then leads to more value for customers and possibly an upward spiral.
9. Selling digital products through a platform is relatively easy due to the ease with which digital products can be uploaded and downloaded. As such, if digital games become the preferred medium, this would be beneficial for a platform. A platform that connects developers with customers without directly selling or distributing the games would not be affected by a digital or physical preference shift. This is because the platform would retain the same function.
10. Physical games could be sold through a platform in the same way as web shops work. There would, however, be a delay between ordering and receiving the game, which would not be the case with digital products. A platform that connects developers with customers without directly selling or distributing the games would not be affected by a digital or physical preference shift. This is because the platform would retain the same function.

Leveraging Customer Data

1. According to the interviews, privacy is becoming more and more important in politics. This makes data a more difficult to use business model element. Especially with serious games, where the data that can be gathered is sensitive, this can be problematic.
3. With economic decline, the number of users of the serious game would decrease. This means that less data is generated and the fewer data there is, the less valuable the offering becomes.
4. When the budgets and demand for serious games increase, it becomes easier to get more users. That means that more data is generated, making the offering more valuable for customers.
7. When serious games become less accepted, and therefore less widely used, the amount of data that can be gathered decreases. This makes the offering less valuable.
8. When serious games become more accepted as tools, making data part of that tool would be an easier step to make. Additionally, an increased demand means more users and therefore more data, making the offering more valuable.
9. Digital games can be programmed in such a way that data is automatically saved and processed.
10. Gathering the large amounts of data that is necessary to capitalise on it is more difficult when using physical games.

White Label

2. Employing a white label business model element might make it easier for developers to find customers in the government. According to the interviewees, the government prefers to use white labels.
5. Using a white label business model element means that the visibility of the company's brand decreases. This, in turn, makes it more difficult to attract experts.
6. If there are more experts available, development becomes cheaper. Since white-label companies do not often benefit from their product in a way that scales well, this will allow them to take on more projects or make better margins on them.
7. A white label company does not have a brand that they can use to differentiate themselves against competitors. This makes it more difficult to communicate proven excellence with new customers when demand from old customers decreases.
8. When serious games become more accepted, more companies might want to have their own serious game. A white label business could work well with this.

Appendix D: Business Model Stress Test Results (Technology Domain)

In this appendix, the detailed results of the business model stress test for the business model elements of the Technology domain are presented. For each cell, the logical conclusion from combining insights about the focal business model element with insights about extreme outcomes (A and B) of the focal uncertainty are explained.

Business Model Stress Test Results (Technology Domain)

Business Model Element	*New Laws & Elections*		*Economic Growth & Decline*		*Availability of Experts*		*Acceptance of Serious Games*		*Physical & Digital Games*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Sharing Economy			3	4			7	8		
Cross-Selling		2	3	4	5	6	7	8		
Lock-In	1	2	3	4	5	6	7	8		
e-Commerce Only			3	4	5		7	8	9	10
Omnichannel		2	3	4	5		7	8		
Versioning			3	4	5	6				
Behavioural Segmentation	1	2	3	4	5	6	7	8		
Modularity	1	2			5	6	7	8		

Table D.1. Business model stress test results of the Technology domain with conclusions referenced per element using numbers.

Sharing Economy

3. A declining economy decreases budgets and demand for serious games. As such, offering a serious game that is meant to be shared might appeal to customers. However, since many serious games are digital products, it is difficult to make sure that a sharing system is not abused.
4. A growing economy means more budgets and demand. As such, customers might not mind getting their own serious game instead of sharing it with others.
7. If serious games become less accepted, demand decreases and fewer people will want to share a serious game. As such, it becomes difficult to get sustainable revenue this way.
8. When serious games become more accepted, a sharing economy would service a group of customers that do not have the budgets for their own serious game.

Cross-Selling

2. Once a developer has sold a solution for a particular law or election, and the customer was satisfied with the result, it becomes easier to sell a new solution to a new law or election as well.
3. Economic decline means that fewer past customers will be interested in the offering again. But it might still be easier to convince past customers than to find new ones.
4. Economic growth means that budgets and demand increase. As such, it should be easier to convince past customers to buy a new offering.
5. The effectiveness of cross-selling is not affected by the scarcity of experts other than that it might be more difficult to deal with increases in demand, but this depends on the rest of the business model.
6. The effectiveness of cross-selling is not affected by the scarcity of experts other than that it might be more difficult to deal with increases in demand, but this depends on the rest of the business model.
7. When serious games become less accepted, it becomes more difficult to convince people to use it, making cross-selling less effective.
8. If serious games become more accepted, it becomes easier to convince people to use them. This makes cross-selling more effective.

Lock-In

1. When new laws and elections conflict with a locked-in offering, it becomes costly to change the offering to fit the new circumstances for both the developer and the customer. This change would lower customer satisfaction, due to the costs involved.
2. Being locked-in on a solution for dealing with new laws or elections is unlikely to be an attractive offering to customers.
3. When there is economic decline, it will become more difficult to find new customers. However, if previous customers are locked-in and generate revenue, the declining economy's impact is less problematic.
4. Increased demand increases the number of locked-in customers.
5. When experts become scarcer, it becomes more difficult to service the locked-in customers. As such, there is a danger of not being able to deliver what customers need even though they are locked in.
6. More available experts mean that it becomes easier to service locked-in customers at reduced costs.
7. When serious games become less popular and demand decreases, locked-in customers cannot easily leave. As such, revenue can be maintained longer.
8. Increased demand increases the number of locked-in customers. This increases the stability of the company further.

e-Commerce Only

3. In the case of economic decline, the lack of face-to-face contact with customers makes it more difficult to identify changing customer needs, which might be harmful.
4. Rapid economic growth means that more companies have the budget for serious games. e-Commerce increases the developer's reach, allowing them to service more customers.
5. The maintenance of the digital architecture for e-Commerce requires experts. As such, it can be problematic if these become less available. On the other hand, time is saved because they do not have to personally deal with customers.
7. If serious games become less accepted, the lack of personal interaction between developer and customer means that there is less rapport between the two parties. This makes it easier for customers to leave.
8. Increased acceptance of serious games increases the likelihood that customers are open to e-Commerce options because of an increased trust in serious games.
9. Digital games are more easily distributed via the internet. As such, the barrier is lower for customers to do a digital purchase when they immediately can access the product.
10. Selling physical games as e-Commerce complicates the logistics for the developer. As such, there might be additional costs involved with doing sales this way.

Omnichannel

2. Laws that affect difficult to reach target groups might be reached more easily with omnichannel structures. As such, developers that use this approach can service customers who are involved with such groups more easily.
3. Omnichannel approaches require many different disciplines to do effectively. So, when economic decline reduces demand and budgets, it might become too costly to maintain an omnichannel approach.
4. Increased demand means that more companies are interested in serious games. Using multiple channels to reach them would mean a developer can reach more of these potential customers.
5. Having fewer experts means it becomes more difficult to maintain each of the channels.
7. Having multiple channels means that a more diverse customer group can be reached. As such, a decrease in acceptance might reduce revenues less for developers that use omnichannel structures.
8. An increase in acceptance means an increased demand across different groups of people. As such, using an omnichannel approach could reach more potential customers.

Versioning

3. Maintaining different versions becomes more difficult when the demand for them becomes too low.
4. Increases in demand and budget mean that there is room for customers to invest in more expansive versions of a product and that new customers might be interested in the less expansive versions.
5. Developing and maintaining multiple versions of the same product requires additional experts. As such, if these become scarcer, this can cause issues.
6. Having more experts available makes it easier and less costly to develop different versions of serious games.

Behavioural Segmentation

1. Privacy laws could potentially limit the extent to which behavioural segmentation is possible.
2. Changing the offering based on the type of user is effective when inclusiveness is important. As laws can affect a large group of people, this can be especially effective.
3. If demand decreases, segmenting the different behavioural groups could mean that a developer is more likely to find different customers amongst the different segments. On the other hand, the loss of particular customers can make it more difficult to cover the costs of the behavioural segmentation. To make up for this, the offering becomes more expensive than that of competitors. This might be an issue with the decreasing budgets.
4. Due to increased demand across sectors, a developer can better reach these sectors as behavioural segmentation allows for a more personalised approach. However, doing behavioural segmentation requires the developer to have the skills to communicate properly with all the different segments. This creates a lot of overhead.
5. As fewer experts become available, it becomes more difficult to service the different segments separately.
6. The more experts are available, the less costly it will be to service different types of customers or users separately.
7. If certain target groups become less accepting of serious games, other segments might not. However, if this happens, the focus will shift away from certain target groups. The investments made to target those groups separately will no longer be beneficial. Lasting or long-term investments, like employees, would have lasting negative effects on the company.
8. As more people accept serious games as tools, behavioural segmentation becomes more and more difficult. This is because an increasing amount of segments must be serviced in order to be inclusive. However, inclusiveness is not a requirement of this business model, and it is possible to leave new segments out of scope.

Modularity

1. Modularity is probably not affected by new laws or elections.
2. Modularity can be used to easily add new laws or elections to existing products.
5. Having a modular architecture for serious games makes it so that less time is needed to add new components or make changes. As such, fewer experts are needed to achieve the same results.
6. When experts are cheaper and more readily available, it becomes less interesting to build a serious game modularly. This is because of the high initial investment in developing the modules. The time it takes to earn this back becomes longer and this increases the risks of the product becoming obsolete before the investment was earned back.
7. If serious games become less accepted, the initial investment of making a modular system is less likely to pay itself back due to decreased demand.
8. Modularity scales better than non-modular approaches. As such, if serious games become more accepted and demand increases, more customers can be serviced than when a modular approach was not employed.

Appendix E: Business Model Stress Test Results (Organisation Domain)

In this appendix, the detailed results of the business model stress test for the business model elements of the Organisation domain are presented. For each cell, the logical conclusion from combining insights about the focal business model element with insights about extreme outcomes (A and B) of the focal uncertainty are explained.

Business Model Stress Test Results (Organisation Domain)

Business Model Element	*New Laws & Elections*		*Economic Growth & Decline*		*Availability of Experts*		*Acceptance of Serious Games*		*Physical & Digital Games*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Business Alliance		2	3	4	5	6	7	8		
Co-Creation			3	4	5	6		8		
Outsourcing			3	4	5	6	7	8	9	10
Orchestration			3	4	5	6	7	8	9	10
Content Curation					5	6				
Fractional Ownership			3	4	5	6		8		
Renting			3	4	5	6	7	8		
Leveraging Resources			3	4	5	6	7	8		

Table E.1. Business model stress test results of the Organisation domain with conclusions referenced per element using numbers.

Business Alliance

2. A business alliance with governmental bodies or organisations that deal with policy change could be beneficial for serious game developers that would like to exploit the opportunities that lie in new laws and elections.
3. Business alliances create an interdependency between companies. While this has benefits in terms of capacity, reach, and expertise, there is also a risk when one of the companies gets into trouble or no longer thinks the cooperation is valuable enough. In those cases, they might stop delivering these benefits. This can happen when demand and budgets decrease.
4. By making business alliances, a company can use resources that aren't their own to deal with growth. They do, however, share the success with their allies.
5. Business alliances allow a company to use the resources of other companies. As such, they need to rely less on their own experts. It is, however, still necessary to maintain a number of experts. As such, there will be a negative effect, but possibly less so compared to other business model elements.
6. There is likely no large effect on the usefulness of business alliances if experts become more readily available. It would, however, mean that more of the capacity or capabilities can be insourced.

7. If serious games become less accepted, business alliances will lose their value to the companies that allied themselves with serious game developers. Hence, it might be more difficult to maintain old alliances and create new ones.
8. When games become more widely accepted, it becomes more valuable for companies to start alliances with serious game developers. As such, making these alliances would be easier and this extends the capabilities and reach of the serious game developer.

Co-Creation

3. Co-Creation allows developers to better suit their offering to the needs of their customers. As such, the customers should be happier with the results. However, the cooperation is expected to be more expensive and hence might not fit the lower budgets.
4. Co-Creation for custom projects does not scale well, and hence, serious game developers might not be able to deal with the growing demand as they need to hire more employees. However, when using co-creation for larger-scaled products, the offering might be qualitatively higher than that of competitors, making the offering more appealing.
5. When experts become scarcer, being able to rely on the customer themselves for part of the input means that a developer does not have to do this themselves. As such, fewer experts are required. However, other competencies must still be offered by the developer, and if these experts are missing, the company will not be able to deliver its value.
6. If experts become more available, it becomes more interesting to internalise some inputs that might otherwise be done in co-creation. This would allow a developer to also service companies that do not have these inputs internally.
8. Co-creation requires input from customers and users, if they accept serious games more, it will be easier to involve them in this process.

Outsourcing

3. In the case of economic decline, it is interesting to do outsourcing, because if less work is available, a developer would not have to keep paying for the outsourced capacity.
4. Outsourcing allows for a quick increase in capacity, which can help deal with increased demand and budgets. However, outsourcing is generally more expensive than having the production internally. As such, competitors could be cheaper.
5. If experts become scarcer, their costs increase. And so do the costs of outsourcing them. As such, the scarcity could decrease the capacity of the company.
6. When experts become cheaper, so does outsourcing them. Whether it becomes more or less viable to hire employees, however, is unclear.
7. The decreased demand for serious games means that less capacity is required from a developer. Therefore, outsourced capacity is no longer required.
8. When demand increases, outsourcing allows for a quick increase in capacity. However, outsourced work is relatively expensive.
9. If the preference changes to digital games, a developer that outsources part of their capacity could merely outsource to a different party.
10. If the preference changes to physical games, a developer that outsources part of their capacity could merely outsource to a different party.

Orchestration

3. Economic decline would make it more difficult to bring many parties together because there are fewer that might want to cover the related investments.
4. Economic growth would make it easier to bring many parties together because they might be more inclined to make cover the related investments.
5. As experts become scarcer, it becomes more interesting to involve parties to work together and share both the risks and the profits, instead of all these parties taking the capacity internally and competing.

6. When experts become more available and cheaper, it could become more interesting to hire them internally, rather than involve other companies.
7. A decrease in the acceptance of serious games would make it more difficult to bring many parties together because there are fewer that might want to.
8. An increase in the acceptance of serious games would make it easier to bring many parties together because they are more interested in participating.
9. If the preference changes to digital games, a developer must simply involve different parties than for physical games.
10. If the preference changes to physical games, a developer must simply involve different parties than for digital games.

Content Curation

5. Doing content curation requires the experts to pass judgement on the content. As such, an increase in costs for experts makes this more difficult.
6. Doing content curation requires the experts to pass judgement on the content. As such, a decrease in costs for experts makes this easier.

Fractional Ownership

3. Sharing intellectual properties means that all owners must be involved with any future project involving those intellectual properties. In an economy that declines, it becomes less likely that the owners' budgets allow for doing a joint project.
4. A shared intellectual property means that the benefits are shared. Hence, if a company wants to use such intellectual properties, they must negotiate with the involved parties. This can be very costly and harm the flexibility of a developer to respond to the growing market in time to service a growing demand due to economic growth.
5. The scarcity of experts does not influence the fractional ownership of intellectual properties.
6. The scarcity of experts does not influence the fractional ownership of intellectual properties.
8. As serious games become more accepted, and demand increases, scaling becomes an issue. Therefore, if intellectual properties are owned by multiple parties, it becomes more difficult to use them in other projects and coordinate the different parties.

Renting

3. When the economy declines, demand decreases. As such, it becomes more difficult to earn back the investment in the to be rented out hardware. However, this might compensate with the decrease in budgets, which would make it more interesting for companies to rent the hardware instead of investing in it themselves.
4. Renting out required hardware causes a lot of overhead. Therefore, in a growing market where demand increases, it can become more costly to continue doing this.
5. The scarcity of experts does not influence the renting of required hardware.
6. The scarcity of experts does not influence the renting of required hardware.
7. When serious games become less accepted, demand decreases. As such, it becomes more difficult to earn back the investment in the to be rented out hardware within the same industry. If the hardware is also interesting to other industries, it might still work.
8. Renting out required hardware causes a lot of overhead. Therefore, when demand increases, it becomes more costly to continue doing this.

Leveraging Resources

3. Leveraging resources in a declining economy is useful because it can be expected that the lower demand frees up the time of some employees or decreases uptime of other resources. Still, leveraging resources in this way means that they are not used to build the business itself. As such, it might not be sustainable for a longer period of time.
4. When the economy grows and demand and budgets increase, capacity becomes important and leveraged resources could be better spent on the company itself.
5. The scarcer experts become, the higher the likelihood that company resources will be necessary for a developer's core business to compensate for the decreased availability and increased expert costs.
6. As experts become more available and less costly, leveraging them as resources can become more profitable.
7. When serious games become less accepted and demand decreases, resources that are no longer in full-time use, could be leveraged. Still, leveraging resources in this way means that they are not used to build the business itself. As such, it might not be sustainable for a longer period of time.
8. When serious games become more accepted and demand grows, capacity is important and leveraged resources could be better spent on the company itself.

Appendix F: Business Model Stress Test Results (Finance Domain)

In this appendix, the detailed results of the business model stress test for the business model elements of the Finance domain are presented. For each cell, the logical conclusion from combining insights about the focal business model element with insights about extreme outcomes (A and B) of the focal uncertainty are explained.

Business Model Stress Test Results (Finance Domain)

Business Model Element	*New Laws & Elections*		*Economic Growth & Decline*		*Availability of Experts*		*Acceptance of Serious Games*		*Physical & Digital Games*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Crowdfunding			3	4	5		7	8		
Add-On		2	3	4			7	8	9	10
Freemium			3	4	5	6	7	8	9	10
Revenue-Sharing			3	4	5	6	7	8		
Licensing		2	3	4			7	8		
Pay-per-Use		2	3	4	5	6	7	8	9	10
Advertising	1						7	8	9	10
Bundling		2	3				7	8		
Subsidies	1		3	4	5	6	7	8		
Product Sales			3	4	5	6	7	8		10

Table F.1. Business model stress test results of the Finance domain with conclusions referenced per element using numbers.

Crowdfunding

3. In the case of economic decline, it might be easier to get a small amount of funding from many sources, rather than a lot of funding from a single source.
4. When the economy grows, budgets for serious games are expected to increase. As such, it might be more worthwhile to find funding in smaller groups or individuals rather than a crowd.
5. When experts become scarcer, their costs tend to increase. Therefore, the required funds for a project also increase, making a crowdfunding endeavour more difficult to achieve.
7. When serious games become less accepted, it becomes more difficult to involve individuals. As crowdfunding requires a lot of individuals to be convinced, this will become a lot more problematic.
8. If serious games become more widely accepted, convincing people to join a crowdfunding campaign would become easier.

Add-On

2. Using new add-on features for new laws could be an effective way to deal with these opportunities. However, new laws tend to affect only a portion of the population. Therefore, extra care is required to keep the offer valuable for all potential customers that might deal have to deal with different laws.
3. In a declining economy, an add-on structure might be appealing because customers can choose not to pay for functions they do not use.
4. In a growing economy, add-ons allow companies some degree of customisation in the functionality of the product they would like to use. However, companies might not mind paying for an all-inclusive product. Additionally, developing an add-on structure takes more effort than a single product.
7. Add-on structures would become more interesting than full product sales because the initial investment is smaller. However, the limited initial functionality that requires add-ons to solve might reinforce the decreased acceptance of serious games.
8. Developing new add-ons allows developers to service the new demand more rapidly.
9. Digital games allow for easy and quick distribution of the add-ons. The delivery can be almost instantaneous after placing the order.
10. Physical games allow for add-on structures as well. Distribution is more time consuming, however. Additionally, the materials of the add-on must be produced before they can be sent off. If demand is low, scalability and inventory management become an issue.

Freemium

3. When the economy declines, the demand and budgets for serious games will decrease. As such, the number of premium users will also decrease.
4. In a growing economy, the demand and budgets of customers increases. Hence, more customers have been willing to pay for a product, rather than using a freemium variant of it.
5. Maintaining a freemium product means that a large number of non-paying users will also be needing support. As such, if this support becomes more expensive, the associated costs can become very high.
6. Freemium products require maintenance for non-paying users. As such, if the costs of this maintenance decrease, this structure becomes more interesting.
7. A decrease in popularity means that the total number of users of the freemium structure also decreases. As such, the income will decrease with it.
8. Increased popularity means an increased demand without necessarily an increase in budgets. As such, a freemium structure could increase the user-base rapidly.
9. Distributing digital games is cheap, so targeting the large audience required for freemium games is easier with digital games. Upgrading from a free to a paid user is also fast and easy with a digital game.
10. Physical games would be very costly to distribute free of charge. Additionally, switching between a paid version of the game must be physically facilitated.

Revenue-Sharing

3. When there is economic decline, it becomes more difficult to generate a viable revenue. If this revenue is shared, it might prove too little for all involved parties.
4. In a growing economy where demand and budgets increase, a revenue-sharing structure might help make it easier to service, reach, or involve potential customers because of the extra resources that the other companies bring in.
5. When experts become scarcer, having a revenue-sharing structure with other companies would allow a developer to use some resources from those other companies, reducing the number of experts required for the developer internally.
6. As experts become cheaper, it might become more interesting to internalise some processes that were previously done by the companies with whom developers have a revenue-sharing structure.

7. When serious games become less accepted, companies with whom developers have a revenue-sharing structure might not be willing to put in as much effort into serious games anymore. Additionally, it would become more difficult to involve new companies.
8. When serious games become more accepted, companies with whom developers have a revenue-sharing structure might be more willing to put extra effort into the collaboration. Additionally, it becomes easier to involve new parties.

Licensing

2. According to the interviews, selling licences for serious games that deal with new laws is a well-scaling method to sell a product or service. This is true for both custom work and non-custom work.
3. Custom work might become too expensive for companies that lowered their budgets. Combined with a lower demand, a declining economy could impair developers. However, according to interviewees, it should be possible to adapt to this and shift the focus to the new topics that companies are more interested in. A large degree of flexibility is required for this. For licensed products, income is also expected to decrease due to lower demand and budgets. However, lowering the prices of these products might offer a solution to this. This is also dangerous because competing in this way could have detrimental effects in the long run.
4. For both custom work and licensed products, a growth in demand and budgets would be beneficial. For custom work, it means that more work is coming in and more customers are able to pay for the relatively expensive custom-made serious games. For licensed products, it means that more customers are willing to pay the price for it.
7. When serious games become less accepted, licences are one of the more expensive options and hence might suffer a larger decrease in demand than competitors.
8. An increase in demand means that it becomes easier to fill periods between projects for custom-work. For licensed products, sales are also expected to go up.

Pay-per-Use

2. A pay-per-use strategy works best for serious games where a large number of players are expected. For new laws, this is not often the case.
3. Economic decline decreases demand and budgets. Pay-per-use structures might be more interesting to customers because they do not pay for more than they really use. This also means that the lower budgets are efficiently used.
4. With economic growth, the demand for serious games increases and pay-per-use structures could facilitate this, but only if the delivery method scales well. If the delivery method scales poorly, a higher demand might become problematic.
5. When pay-per-use structures scale poorly due to the necessity of experts, their scarcity becomes problematic. If not, this is not an issue.
6. When pay-per-use structures scale poorly due to the necessity of experts, it becomes easier when experts are cheaper. If not, this is not an opportunity.
7. A lower demand for serious games means that fewer people will use them and a pay-per-use structure is directly affected by the size of its user-base. Hence, a decrease in the acceptance of serious games is problematic for pay-per-use structures.
8. A higher demand for serious games means more users. Pay-per-use structures directly reap the benefits from this.
9. Digital games are easy to distribute on a pay-per-use basis. Additionally, it is easy to measure how often the game is played.
10. Physical games sold on a pay-per-use basis often require a facilitator, otherwise it becomes difficult to measure how often a game is played. This means that experts in the form of facilitators are part of the distribution network, which does not scale very well.

Advertising

1. Trends in law see an increased interest in privacy protection. If more such laws are passed, it might conflict with certain advertising strategies.
7. If serious games become less accepted as a tool, demand decreases and the reach of advertisements within such games also decreases. This makes it less effective to advertise through serious games.
8. If serious games become more accepted as a tool, the demand increases and so does the number of users. As such, the reach of these games increases, and advertising becomes more attractive.
9. Advertising is most easily implemented through digital games because the content can be added dynamically.
10. Advertising in physical games requires the advertisements to be implemented before the game is delivered to the customer. As such, it costs a lot of effort to employ an advertising structure and requires a developer to convince an advertiser of the use before the product is finished.

Bundling

2. The bundling of several offerings to deal with new laws or even a variety of new laws could be of interest to customers.
3. In the event of economic decline, offering a bundle of offerings for an attractive price might be enticing. However, the offerings should also be separately available for customers that are not interested in the bundle, due to the need for more efficient use of customer budgets.
7. When the value of an individual element of a bundle decreases due to the game becoming less accepted as a tool, it devalues the bundle as a whole.
8. As serious games become more accepted as a tool, the individual elements of a bundle become more valuable to more parties. As such, the bundle as a whole becomes more valuable as well.

Subsidies

1. Changes in laws and new elections could stop subsidies for specific sectors. Developers that rely on government stimulation are therefore vulnerable to this uncertainty. Additionally, such developers have not had to establish a customer base that they can get alternative revenue from.
3. When there is economic decline, governmental stimulation can be an alternative source of income.
4. When the economy grows, governmental stimulation becomes a less interesting source of income compared to the commercial alternatives.
5. Often, subsidies do not cover much more than they need to. As such, if over time the costs of experts increase, the subsidy itself might no longer be enough to cover these extra costs.
6. With a decrease in the costs of experts, already allocated subsidies are more likely to cover the entirety of the project.
7. As serious games become less accepted as a tool, subsidies become more likely to decrease or fade away.
8. As serious games become more accepted as a tool, opting for commercial alternatives, rather than subsidies, becomes more interesting, due to the growing market.

Product Sales

3. Selling off games including the related IP means only a one-time income can be gained from a single game. This means that the game is relatively expensive for customers. Lower budgets and decreased demand can therefore cause issues for a developer.
4. Selling off games including the related IP means only a one-time income can be gained from a single game. Scaling to meet a higher demand becomes more challenging this way.
5. Increased costs due to expert scarcity must be earned back through an increase in the price of serious games, as no later income can be expected from a project. As such, the profitability of a company is highly dependent on the costs of experts. Additionally, the developer's ability to meet demand is directly related to the number of experts they have. As such, scaling becomes more expensive.
6. Decreased costs due to less expert scarcity mean that games can be developed more cheaply. Because every game is only sold once, the profitability of a company is highly dependent on the costs of experts. Additionally, the developer's ability to meet demand is directly related to the number of experts they have. As such, scaling becomes less expensive if experts become less expensive.
7. The decreased demand causes difficulty with the management of cash flow. Fewer projects are expected to be commissioned, making it more difficult to generate the income required to maintain the company and its employees as they are.
8. An increase in demand means that a developer would have to hire more experts in order to exploit this. These experts scale only as well as they can produce.
10. Physical games are suitable for product sales because they cannot be easily reproduced or copied. Additionally, it is difficult to keep track of a physical game once it is out of sight. As such, a product sale structure does not make this more complicated than it has to be. In the event that more copies of a game are needed, the customer could print them themselves, but it is also possible they would contact the original developers for this, generating additional income.