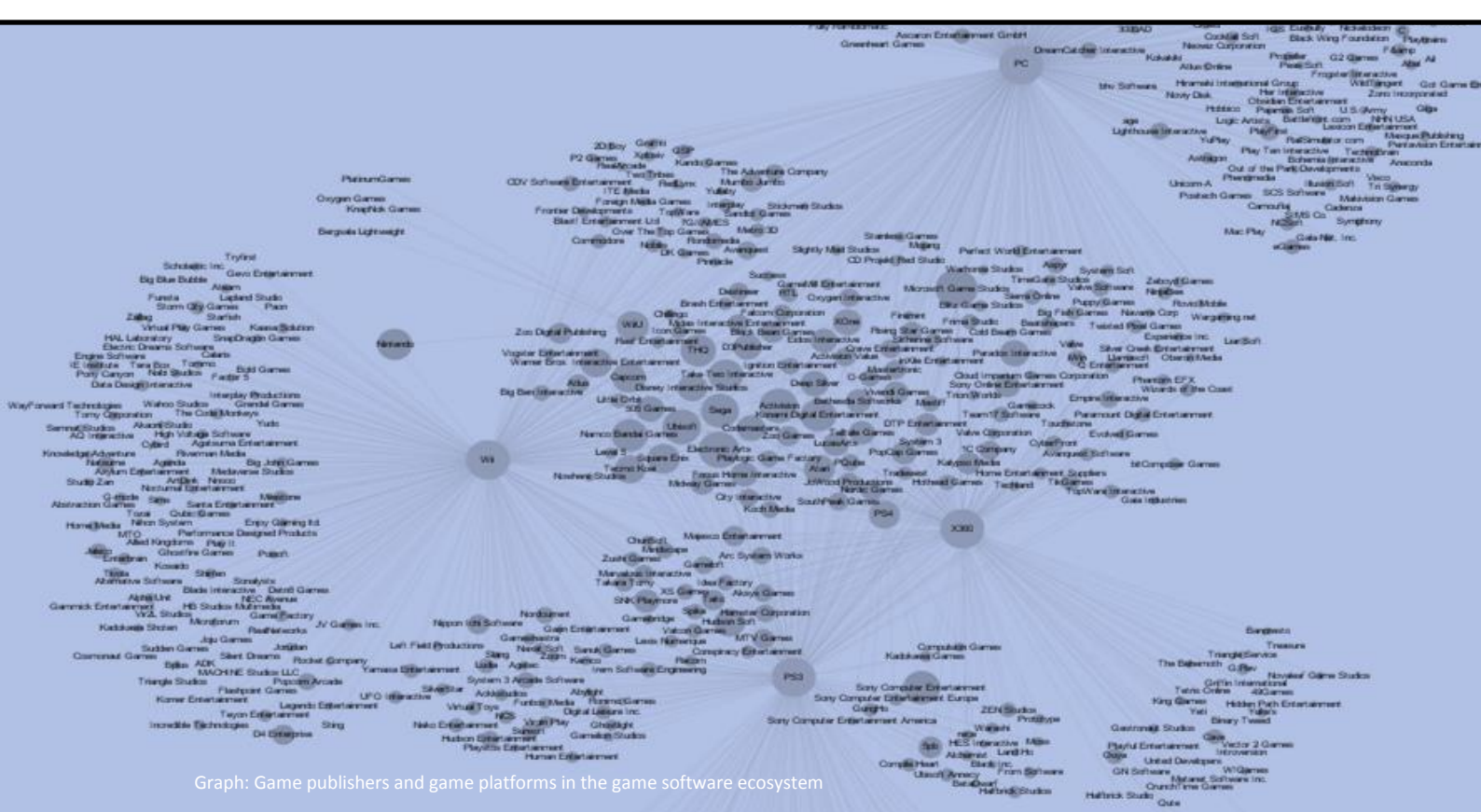# Business Model Evolution in the Game Software Ecosystem

Towards a method for modelling business model evolution

Graph: Game publishers and game platforms in the game software ecosystem

Master Thesis MBI

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Summary

More than ever, video game software companies operate within networks that share markets and services on common platforms. The Game Software Ecosystem (G-SECO) encompasses many different types of organizations, each maintaining a business model (BM) that enables them to effectively fulfill their role in the SECO. These BMs are not static. To assure a strategic advantage, organizations find themselves continually evaluating and adapting their BM. New technologies and changes in demand open up ways to conduct business and entice organizations to adapt their business models in order to secure or reposition their presence in the SECOs that they are part of. It remains what this evolution looks like and how software organizations influence one another by adapting their business model. Furthermore, we know little about what the G-SECO looks like and how it influences BM-evolution for its members. This exploratory research provides insight on the effects of BM-changes within the G-SECO by investigating the evolution of business models within the video game industry.

Contents

1 Introduction

Software companies have become increasingly dependent on other agents for software components and infrastructures (Jansen et al, 2013). Thus, a growing number of software companies are part of one or more Software Ecosystems (SECOs) (van den Berk et al, 2010). A SECO is a network of organizations and individuals that share a market for software and software-related services. SECOs are usually characterized by a technological platform that functions as a common exchange for information, resources and artefacts (Jansen et al., 2009). Examples of such platforms are Apple's iOS, Microsoft's Xbox 360 and Facebook, where external developers create apps and additional utility for platform users. Because software companies are so reliant on others for components, knowledge and customers, the notion of ecosystems is particularly relevant when acquiring insight into a software company's performance. Performance is not only measured by the capabilities of the organization itself, or its static position relative to competitors, customers and suppliers, but increasingly by its interactions with the encompassing SECO(s) it is part of (Iansiti & Levien, 2004). A main advantage for software companies to operate in a SECO is that it enables them to leverage the value that the network as a whole purveys for end-users, while only fulfilling a specialized role within that network themselves.

An example of a SECO that has been around for a long time is that which exists around games (G-SECO). From the mid-1970s video game consoles manufacturers (e.g. Atari) started opening up their platform for other game developers. By allowing other developers to publish games for their game console, companies like Atari and Nintendo became video game platform owners. These platform owners were able to indirectly provide more content to their customers than they could ever produce themselves, thereby gaining a competitive advantage over other video game console manufacturers that only offered their own games. This approach significantly increased the value of the game console to customers and drove growth of the platform's installed base (number of users). Since its inception, the G-SECO and its underlying technologies have gone through many more such changes, for instance more recently broad-band internet access becoming a standard for video game consoles creating a channel for online gaming and digital distribution, motion sensor input and virtual reality for new hardware types and games tapping into a new customer segment, or using high-end graphical rendering systems to fully showcase realistic graphics. Especially in the last couple of years, the diffusion of technological innovations led new businesses[1] into the game market, increasing the competitive intensity (Marchand & Hennig-Thurau, 2013)

Although technological advances often seem to lie at the basis of disruptive changes in the G-SECO, it is only when SECO-members exploit such technologies effectively that

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[1] Smartphones, tablets, alternative operating systems (e.g. OSX and Linux)

permanent change is made. By optimally configuring all aspects of their business, such as key processes, partnerships and targeted customers, businesses execute on their strategy. The matching configuration of key business aspects of an organization is generally referred to as its business model (BM). A BM qualitatively describes the rationale of how an organization creates, delivers and captures value (Osterwalder & Pigneur , 2010).

Our ability to systematically analyse changes in the G-SECO is impeded by the lack of insight in the nodes (participants) it contains and the relations they hold. The main problem is that even at a basic level, there is no formal categorization of the types of nodes that operate in the G-SECO. Moreover the plethora of business models patterns and roles any one type of agent can fulfil at a particular time is making analysis more difficult. As a consequence we know little about how these agents function as a group and how they influence one another with their behaviour over time.

This exploratory research aims to describe business model evolution in context of a Software Ecosystem. The goal is to create a solid base for future research into the G-SECO by categorizing and analyzing the types of organizations that operate in the G-SECO and denoting what their business models look like now, and how they were formed over time as a way to describe business model evolution. Furthermore, we explore how business model changes relate to a SECO as a whole. From a video game software organization's point of view these insights can help answer strategic questions about the organization's position in the G-SECO. It can be used as a tool for organizations to better comprehend opportunities and threats in their SECO and make more sense of how an organization's business model came to its current form, and might change in the near future. Finally these insights can be used to develop an academic approach to modelling the process of continuous change on the intersection of software ecosystems and business models.

The next section will go deeper into the research objectives of this study. Section 3 provides the applied research method. Section 4 provides a hypothetical model for BM-SECO interaction. Section 5 contains the theoretical background needed to position this research in its academic context and gives an introduction to the modelling tools needed to formalize findings. Results are provided in section 6, and then analysed in section 7. In section 8 we discuss results and conclude our research.

1.1   Research Scope and definitions

In order to answer the research questions, criteria regarding the scope of research need to be determined beforehand. Due to the varied nature of complementors in the G-SECO, the video game console platform-context needs to remain clear throughout the research process. The following concepts will occur frequently throughout this document and are thereforee briefly defined:

Business model (BM): The concept of business models will play a central role in this research project and is thereforee separately explained as part of a literature study in

section 5.2. In short Sorescu et al. (2011) define a BM as follows: "A business model is a well specified system of interdependent structures, activities, and processes that serves as a firm's organizing logic for value creation (for its customers) and value appropriation (for itself and its partners)."

Business model canvas (BMC): The BMC is a table-style model developed by Osterwalder (2004) that functions as a tool to lay-out the nine segments of business logic that make up a BM. The BMC is further discussed in section 5.2.1.

Software Ecosystem (SECO): "A Software Ecosystem is a set of businesses functioning as a unit and interacting with a shared market for software and services, together with the relationships among them. These relationships are frequently underpinned by a common technological platform or market and operate through the exchange of information, resources and artifacts." (Jansen , Finkelstein & Brinkkemper, 2009, May) Similar to BMs, SECOs are discussed in the theoretical background, in section 5.1.

(Video) games: The terms *video game* and *game* are often used interchangeably. In this research however the distinction is particularly relevant. Therefore we will refer to the term *game* as any game played on a digital device such as a game console (TV and or handheld), mobile device or PC. A *video game* is a particular type of game, namely played on game consoles only. Our research scope includes all types of digital games played on any platform.

Platform types: The focus will be mostly on video game console platforms as their market share is large, however other game hardware and software platforms such as handheld devices, mobile phones and PC-software platforms, are not excluded.

Complementors: Ahuja, G. (2000) shows that indirect ties can be of great value to a platform's network. A clear set of complementor types, through direct and indirect ties, to include in the framework is part of the research scope. Particularly interesting for the video game platform ecosystem is the significance of how platform owners and complementors are tied. In this complementors can be 1st, 2nd, 3rd party, or independent to a platform.

2 Research Objectives

We have little insight in what changes software organizations make to their business models and how these changes affect their software business environment. Vice versa: we know little about how a changing business environment translates to cues for business model change. In this research we reduce the focus from very broad definition of 'software business environment' to that of the game industry. The game industry is particularly fitting for investigating BM and SECO dynamics. It is characterized by a long history compared to most other software industries, meaning the industry has matured and endured, indicating a lasting relevance. Furthermore the game industry has always been driving the cutting edge in computing as its members enable themselves mainly by early adoption of technological advancements. This is underpinned by the many technologies used in other industries that have found origin or contributions from the game industry[2]. Because the games industry is largely comprised of software companies the SECO perspective fits well as a model of the business environment in which these organizations operate.

By restricting this research to a business model perspective and a software ecosystems context in the game industry, the three overlapping research domains depicted in Figure 1 are distilled.

Figure 1: Areas of domain overlap

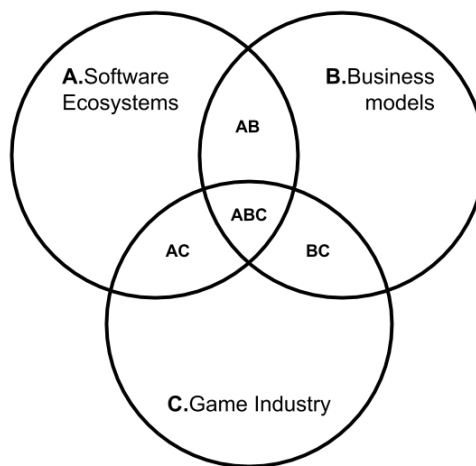[2] Some examples of game-technology applied outside the video-game realm: Serious games for dangerous simulation and training scenarios; Motion sensing (Kinect, Wii-mote) used for business applications; Graphics cards used for parallel computation, e.g. crypto currency mining; Graphical modeling and rendering applied in movie-production; Video game consoles functioning as media play-back devices.

Before continuing to hypothesise how these BM-SECO interactions take place in section 4, we first structure the research by discussing our goals, research questions, deliverables and envisioned contribution.

2.1 Research goals

The principal goal of this research is to advance understanding of business model evolution in the G-SECO. For this, the interplay between business models of individual organizations and their encompassing SECO needs to be formalized.

Conditionally, the second aim is to expand the body of knowledge on product software creation in the game industry. Although academic research focus on the game industry is growing[3], a basic product software centric deconstruction of the industry is missing. Preliminary research on business models provides structure to identify, classify and describe the various organizations creating, maintaining and capitalizing product software in the game industry. The SECO research framework helps describe the relations and interactions these organizations hold with one another in order to reach their business goals.

The third goal of this research is to enable platforms and the various types of complementors (organizations that add value to a platform's ecosystem) now operating, or planning to operate in the G-SECO, to make informed decisions about their position and strategy within the ecosystem and to recognize how the phenomena occurring in the G-SECO can impact their business models choices and vice versa.

2.2 Research questions

In order to reach our research goals we formulate the main research question as follows:

_RQ_: **How can Business Model evolution in the G-SECO be described?**

To answer the main research question, we derive four sub-research questions:

SRQ1: **How can the relation between Business Models and Software Ecosystems be described?**

SRQ1 leads to a conceptual framework needed to help abstract the general BM-SECO relation from any game industry specific dynamics.

SRQ2: **What does the G-SECO look like?**

The answer to SRQ2 encompasses a detailed description of the G-SECO and the typical G-SECO-member types. Furthermore it lays out their network relations as suppliers and consumers of software products and services.

SRQ3: **What do the current Business Models of G-SECO members look like?**

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[3] Articles published per year containing: "game industry" in title, found on google scholar: 2009: 2,850; 2010: 2,980; 2011: 3,230; 2012: 3,900; 2013: 4,320; 2014: 4,620.

The goal of SRQ3 is to create the anchor-point for business model evolution by observing common business model configurations of the SECO-member types identified by SRQ2.

<u>SRQ4</u>: **How can Business Model changes of G-SECO members be modelled?**

Finally, with SRQ4 we aim to devise and discuss a modelling technique for depicting business model evolution to help answer the main research question.

2.3 Relevance and contribution

As each context differs, firms need to possess strong sensing capabilities to identify the relevant changes in their environments, which require both investment in research and business (Wirtz et al., 2010). The game industry is a particularly fitting domain to investigate the interplay between BMs and SECOs because: (1) It is a large and rapidly growing industry, on the frontier of hardware and software developments. Shifting and disruptive business models arise frequently. (2) The game industry contains multiple dominant and directly competing SECOs that have been evolving for decades. (3) It contains a diverse, but distinguishable set of agents that carry their own expertise and strategies in relation to these SECOs.

3 Research Method

The research method applied in this project is subdivided into activities and deliverables. Table 1 summarizes the relations between the research questions, activities and deliverables. Section 3.1 and 3.2 further explain each activity and deliverable

Table 1: Activities and deliverables in regard to research questions

Research question	Activities	Deliverable
(SRQ1) How can the relation between Business Models and Software Ecosystems be described?	(II.) Formulating a hypothetical model. (V.) Further analysis and evaluation of the hypothetical model.	(1.) A model for business model–software ecosystem interaction.
(SRQ2) What does the G-SECO look like?	(I) Literature study on SECO-concept. (I) Literature study on the game industry. (III) Identification of SECO-members.	(2.a) Network relations in the G-SECO & G-SECO graph. (2.c) Historical overview of the game industry.
(SRQ3) What do the current Business Models of G-SECO members look like?	(I) Literature study on BM-concept. (III) Analyze common BM-configurations.	(2.b) G-SECO Business model overviews.
(SRQ4) How can Business Model changes of G-SECO members be modelled?	(IV) Modelling how these business models have evolved over time.	(3.) Timelines of business model evolution in the G-SECO.

3.1 Activities

The research method can be broken down in five main activities, namely:

(I)   A literature study that will discuss preliminary research and bundle existing knowledge on the topics of software ecosystems, business models, and the video game industry as a theoretical background to support and position this research.

(II)   The construction of a hypothetical model that describes the relation between the business models of organizations and their encompassing SECO.

(III)   Information gathering and classification of SECO-members by identifying and modelling the different the SECO-positions and business models of organizations currently present in the G-SECO.

(IV)   Modelling how these business models have evolved over time.

(V)   Further analysis and evaluation of the hypothetical model (II).

Each activity is broken down into the following sub-activities:

I.   Constructing theoretical background
   a. Literature study on *software ecosystems*: Compare available literature on definitions for SECOs and their components. Find what roles actors can assume in a SECO and how this can be captured and modelled.
   b. Literature study on *business models*: Study literature on the business model concept to explain their function and obtain a method for formalizing business models.

    c. Literature study on the *video game industry*: Describe scope and history of the game industry. Construct a chronologic basis of the industry for timeline modeling.

II. **Formulating a hypothetical model**
   a. Construct a hypothetical model that captures the relation between a SECO and the business models of its members.
   b. List and describe all elements that comprise the hypothetical model.

III. **Information gathering and classification of SECO-members**
   a. Identify entities in the G-SECO that adhere to the research scope: Identify the types of organizations that are involved in the creation and exploitation of software products in the game industry.
   b. Create an overview of the G-SECO: a general outline of the G-SECO by gathering data on a core node types and depicting their relations in a SECO-graph.
   c. Analyze common business models: Describe in detail the business model configurations of all node types identified in step II.a. through the modelling method described in step I.b. Data points are collected from literature and company websites.

IV. **Depicting business model evolution**
   a. Create a list of major trends that have occurred, or are occurring in the game industry by finding news articles and scientific publications describing such trends. Section 6.6 describes this step in more detail.
   b. Construct timelines for all node types laying out how business model segments have changed over time.

V. **Evaluation of the hypothetical model**
   a. Based on findings accrued during activities III and IV evaluate the validity of the hypothetical model by discussing each model-element identified in II.b.

3.2 Deliverables

The following artifacts are to be delivered as results of this research:

1- **A model for business model–software ecosystem interaction** – A graphical representation explaining how business model evolution and SECO- evolution are interrelated.
2- **Taxonomy of types** – A detailed categorization of the various organizations operating in the G-SECO. This categorization is done in two-fold, by applying a business model- and a SECO-perspective, resulting in an overview of typical business model patterns for the networked organizations in the G-SECO.
   a. **Network relations in the G-SECO** – Identification of the relations that these organizations hold with one another by mapping the common software supply networks (SSN) patterns that occur in the G-SECO.

b. **G-SECO Business model overviews** – A listing and analysis of archetypical business models that are applied in the G-SECO by the diverse types of organizations.

c. **Historical overview of the game industry –** A list of major events and important players that have been active in the game industry through its life.

3- **Timelines of business model evolution in the G-SECO –** A set of diagrams explaining business model segment allocation in the G-SECO over time.

4 A model for BM-SECO interaction

In order to picture the problem space mentioned in section 2.1, a hypothetical model is created based on the topics in Table 1. This model helps position the different processes that are presumably taking place in a SECO. Figure 2 depicts the hypothetical model as a series of events that occurs when SECO-members modify their business model. Organizations *A* to *I* operate as members of the same SECO. Member *A* decides to change its business model based on cues from the SECO, for example shifting to another customer segment that has better growth potential. This change can directly affect other SECO-members close to A, such as node D (which is, for instance, now a former customer) and even indirectly affect any node in the SECO through broader effects triggered by this action, such as changing end-user expectations of the SECO as a whole. These effects in their turn can trigger other SECO-members to adapt their business model, in order to improve their strategic position in the shifted SECO. In addition to these internal forces triggering reciprocal action, external forces steer the direction of SECO- and BM development as well. External influences like technological advancements in other SECOs or newly imposed legislation can change the playing field of a SECO and the way in which organizations behave in it.

In order to systematically analyse the reciprocal relation between BM-change and SECO-change and their relation with external forces, the model in Figure 2 is deconstructed into the respective numbered entities and processes listed in Table 2.
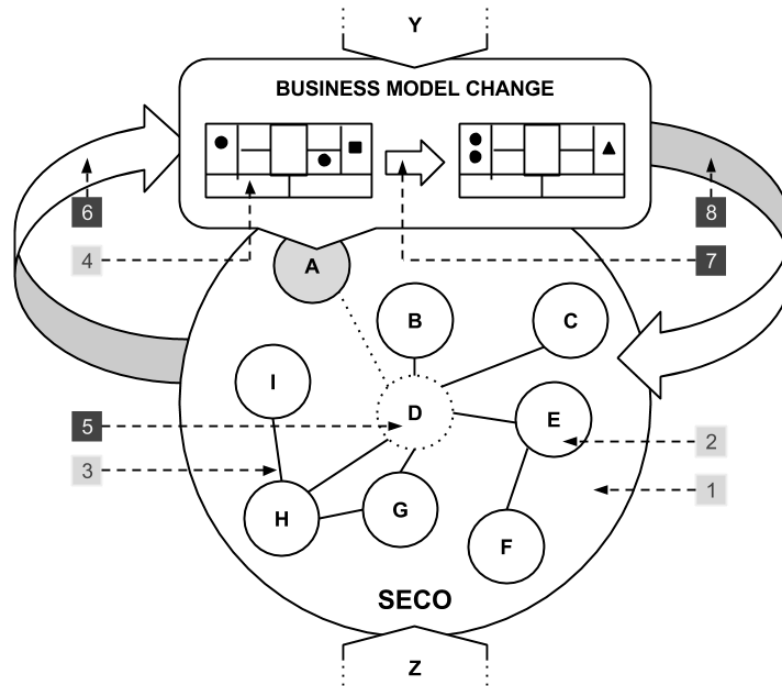
Figure 2: Hypothetical model of reciprocal change-effects between a SECO and the business models of its members.

Table 2: Entities and Processes in the BM-SECO-relation

Entities and processes in BM-SECO relation model	Description
1. SECO	The Software Ecosystem at hand. Briefly explained in the introduction as a network of interdependent actors cooperating and competing around a specific technical platform. The SECO-concept will be discussed in depth in section 5.1.
2. SECO-Member	An organization or individual that operates in the above-mentioned SECO. A SECO-member can be attributed a certain SECO-role, discussed in section 5.1 In addition to the SECO-role, the connections an organization has with its peers and the BM it applies allow for industry specific classification. Section 6.1 identifies in detail the types of organizations specific to the G-SECO.
3. SECO- Member Connection	A relation or 'edge' between two SECO members. A relation is formed when two SECO members share assets or services.
4. Business Model Canvas (BMC)	A schematic representation of how an organization's way of doing business is fundamentally structured by describing the nine different aspects that make up a BM. Section 5.2 elaborates on BMs and the BMC as a comprehension-tool. Section 6.4 looks at the various BMs applied in the G-SECO.
5. SECO-evolution	SECOs continuously change as new nodes and relations appear and existing ones change or disappear.
6. SECO Change Cues	SECO-members perceive SECO-changes as a continuous stream of cues. SECO-members distil actionable information from this stream to optimize their business model.
7. Business Model change	SECO-members change their business models based on the perceived threats and opportunities exerted by the SECO (6) and external sources (Y).
8. Business Model change leading to SECO-evolution	Business Model changes can directly affect the structure of the SECO but can also influence more qualitative aspects of the SECO such as its accessibility, diversity of members or the SECO's health.
Y. External factors influencing Business Model change	External factors that trigger organizations in the SECO to change their BM.
Z. External factors influencing SECO change	External factors that lead to SECO-structure change (5).

To elaborate on Table 2: a clear distinction is made between process (5) *SECO-evolution* and (8) *business Model change leading to SECO-evolution*. Process (8) only includes structural change to the SECO directly caused by business model change of individual SECO members. For example, when a node outsources a business process a new connection is made. In contrast, process (5) is generic and encompasses all structural changes indifferent to their cause, such as new SECO members entering the SECO.

Important to note is that the two cyclical counterparts (6) *SECO Change Cues* and (8) *Business Model change leading to SECO-evolution* are not direct opposites as the model might suggest. Both processes cross a layer of abstraction, (6) from the system (SECO) to the individual member and (8) in opposite direction. Process (6) describes how chaotic events in the SECO lead to information perceived by members on which rational decisions are made in the scope of the individual.

In order to determine to what extent internal changes in the SECO have an effect on its members and its members' BMs, external effects have to be accounted for. External effects are forces originating not from activity within the SECO, such as the organization's SECO-peers' BMs, but from sources outside the SECO. External influences can be deliberately targeted at organizations inside the SECO to incentivise particular BM-decisions, like governmental regulations to inhibit harmful practise or subsidies to catalyze a specific industry or market. Non-targeted effects are externalities originating from outside the SECO such as relevant technological developments in peer SECOs or more arbitrary dynamics such as global markets. In our model, external effects are twofold. (Y) External influences on BM-change are remote forces that steer decisions made by organizations about how to organize their business model. (Z) External influences on SECO-change similar to (Y) are effects that determine the shape of the SECO, originating from remote source.

5 Theoretical Background

The following subsections provide context to the three main topics that form the basis of this research, as mentioned in 2.1. Namely, Software Ecosystems (5.1), Business Models (5.2) and the Game Industry (5.3).

5.1 Software Ecosystems

Gone are the times of truly monolithic software, created by a single person or organization and used without the need of other software (Jansen et al., 2013). Today software vendors rely on products and services provided by other organizations to create, distribute and run software products themselves. Expertise from external parties is effectively applied in one's own product, enabling focus on the product's core while maintaining a high pace of product development. The external products software vendors use range from solutions to specific problems such as software infrastructure, development tools or libraries, to complete products or platforms where the software vendor's contribution is merely an extension e.g. video game mods as a product on top of an existing video game (Postigo, 2008).

Interaction between organizations regarding acquisition and interoperability of their software creates a network of interdependence. With this context in mind, software organizations are part of one or more networks that are clustered around a particular platform while sharing a common market of end-users. This network perspective for a shared market is expressed in the notion of a Software Ecosystem (SECO).

5.1.1 Software Ecosystem Definitions

The analogy for business ecosystems as a background for networked organizations was first posed by More (1996). SECOs can be seen as a subtype of business ecosystems (van den Berk, Jansen & Luinenburg, 2010) combining multiple interpretations and perspectives. Jansen et al. (2009) pose the following formal definition of a SECO:

"A **Software Ecosystem** is a set of businesses functioning as a unit and interacting with a shared market for software and services, together with the relationships among them. These relationships are frequently underpinned by a common technological platform or market and operate through the exchange of information, resources and artifacts."

This definition can be deconstructed into the following key characteristics of a SECO:

Group of actors – A SECO is a cluster of legally independent actors (organizations and/or individuals). The size of this group is not predefined, but we could argue that at least a minimal size is required to allow the coming and going of individual actors on the perimeter of the cluster without changing the SECO as a whole too much. When a smaller group is the subject a SSN-scope, as described by Jansen et al. (2009), is more appropriate.

Common platform – A common technological platform acts as the central point of access where actors' contributions converge and complement the artifact that the market perceives as the core-product. For example: Facebook is the platform of the Facebook SECO that complementors use to build their product against. In some cases the platform provides a large part of the functionality of an artifact (e.g. Farmville on Facebook). In other cases it is a minor feature or gateway for user convenience (e.g. Facebook integration on video game consoles).

Shared market – A SECO as a whole caters to a specific market. What this market looks like depends much on the central product (platform) of the SECO. A SECO's market can be as narrow as users of a specific software product, e.g. AutoCAD users or players of a niche game, to more broad variations such as Nintendo Wii owners, users and contributors of YouTube or software that has a very broad end-user market such as JavaScript, the Linux Kernel.

Exchange of assets – Within SECOs, the exchange of assets is what forms the relations among actors and what ties the whole as a group. These assets consist of information, resources and software artifacts (Jansen et al., 2009). The problem space of a SECO is largely defined by its market. Thereforee many of the assets used by actors in the SECO can be reused by their peers within the SECO, or in a SECO of a competing platform, creating submarkets for common solutions and an environment in which shared goals and dependencies instill cooperation. The core provider of assets is often the platform, and can thereforee steer much of the SECO's technical and functional boundaries, and demands a particular level of adherence of actors.

5.1.2 Software Ecosystem actors and common configurations

Members of a SECO perform a certain role within that SECO. Iansiti and Levien (2004) make a clear distinction between hubs and niche players as the two main roles.

Hub - A hub is an organization that plays a central role in the SECO, usually by providing and maintaining the SECO's platform. Each hub tends to have its own ecosystem, so larger SECOs, such as the G-SECO, that contain multiple hubs often contain an equal number of sub-SECOs. Iansiti and Levien (2004) identify two strategic approaches to characterize hubs.

Keystone – A keystone is a hub that acknowledges its dependency on the SECO and puts effort into increasing the SECO's performance for all participants.

Dominator – A dominator is a hub that assimilates or eliminates others members in the SECO. Often this is effective in the short term, but it is harmful as a long term strategy for it cripples the SECO's potential.

Niche player – A niche player, or 'complementor' from a network effects perspective, is an individual or organization that contributes to the SECO by fulfilling a specific need of the SECO's market. As a collective, niche players make up the largest part of a SECO when comparing total contribution to market value of the SECO with the hub. Niche players can

compete for certain sub-markets of the SECO, however they benefit from each other indirectly by growing the SECO as a whole, increasing the total market size for their product.

In the matter of forming new SECOs, Hagel, Brown & Davison (2008) explain three attitudes niche players can assume.

Hedger – A Hedger is a type of niche player that joins multiple competing SECOs with the same, or a very similar product. The main advantages of this horizontal spread are risk reduction and a larger market. A disadvantage is that hedgers usually need to redesign much of their product to assure cross-platform compatibility.

Disciple - A disciple does the opposite of a hedger and fully invests in a single SECO. An advantage herein is strategic focus and efficient allocation of resources. A serious risk lies in the dependence on a single SECO.

Influencer - An influencer can be either a disciple or a hedger, but is characterized by joining a shaping SECO early and heavily committing to it. This allows the niche player to have a strong market position within the SECO by the time it matures compared to (newer) peers competing for the same sub-market. Additionally an influencer can more easily get the hub to accommodate for its needs, in the early stages of SECO-forming as the hub values their commitment much more at that moment in the SECO-lifecycle. The risk influencers take however is similar to that of a disciple regarding heavy investments, also when the SECO-matures they can still end up with relatively little control.

These strategies not only relate to newly forming SECOs, but also help describe niche players joining large, existing SECOs as they overlap with the choices complementors face when assessing network effects (Srinivasan & Venkatraman, 2010), namely the balance between horizontal and vertical commitment involves a wide range of strategic effects.

The roles SECO members assert are not fixed across SECOs, for example an organization can be the keystone hub of one SECO, and a hedging niche player in another. An example of this is Google: keystone of its own SECO(s), but niche player in the Mozilla SECO with an add-on product on top of the Firefox platform. Furthermore, the role a member fulfills within a single SECO can change overtime as well, especially niche players becoming hubs of their own by opening up their business to potential partners.

5.1.3   Capturing Software Ecosystems

The SECO-research field is characterized by the many different modelling methods and languages created to describe the interactions between nodes (Jansen, Handoyo & Alves, 2015). For this research we attain a supply chain perspective to describe the G-SECO and its members. Further investigation of business rationale (such as included in the SECO modeling language i*) is deferred to our business model analysis in section 6.4 so that an objective SECO-structure can be created first, solely based on the observable flows of software and services between nodes.

In order to adequately model the network relations within SECOs as supply chains, the most suitable scope has to be determined. Jansen, Brinkkemper & Finkelstein (2009, September) categorize three scope levels in which SECOs can be deconstructed, namely that of SSN, SECO and SECOs. For this research the SNN and SECO scope are used to explore the G-SECO:

A **Software Supply Network** (SSN) is the most granular, low-level scope to depict inter-organizational relations within a SECO described as a series of linked software, hardware, and service organizations cooperating to satisfy market demands. (Jansen, Brinkkemper & Finkelstein, 2007). On this scope level a single actor is the point of interest, and its relations are grounded in transactions of financial or software-related assets and services with other actors in the SECO. Jansen et al. (2007) also indicate that SSN models serve as a tool to evaluate the strategy and risk of the subject for example by identifying the nature and interchangeability of key partnerships. Our hypothetical model in section 4 suggests such events can be the result of business model change.

To model SSNs we use the modelling SEM-technique formalized by Boucharas, Jansen, & Brinkkemper (2009, August). The SEM-model is an accessible diagramming method for depicting an organization's SECO-position relative to its suppliers and customers. The main elements of a SEM-diagram are the company of interest (CoI), suppliers, intermediaries, customers and customer's customers. Relations are depicted by lines, which represent the flow of artifacts or services accompanied with a trade relationship label.

The **SECO** scope looks at how SSNs are connected (Jansen et al., 2009, September) and form a network of connected organizations. SECO depictions (graphs) vary based on the variables of interest. For example node size can be used to indicate how many employees a node represents and edge thickness can represent the connection strength based on the number of project-collaborations among two nodes.

5.1.4 Software Ecosystem Characteristics

The vertical versus horizontal integration contraposition is frequently used to describe network strategies of organizations. In SECO-terms this consideration is equivalently applicable (Schmid, 2013). Vertically integrated SECOs are based on the platform of a single or small number of actors (hubs). Facebook, Apple's iOS or Microsoft's Xbox 360 are such platforms, as they are governed by single entities and must be built upon to access its underlying market. In contrast, horizontal SECOs do not have a platform that is governed by a single or small group of actors. Examples of horizontal SECOs are the Internet or the PC as they inherit their suitability as a platform mostly from open de facto standards. The G-SECO harbors an interesting mix of platforms covering both ends of this integration spectrum.

SECO governance has become a research topic of particular interest within the SECO-research community as SECO-focussed companies have become influential entities in today's economy and try to understand and actively orchestrate their SECO. Baars & Jansen (2012) outline a framework to analyse SECO governance by formalizing

qualitative SECO-aspects that can be deliberately influenced by a hub. This suggests organizations can influence their SECO with business model decisions. Our research focuses on how business model changes of hubs and niche players impact a SECO.

5.2 Business Models

With the dotcom bubble (1999-2000) a multitude of new business types sprouted and several rapidly grew by exploiting the opportunities of the internet as a new business domain. Without truly understanding what was happening, it was clear that the way in which these businesses worked was significantly different from what we already knew (Osterwalder, 2004). The term *business model* (BM) became a popular buzzword and a research agenda was formed.

Almost 15 years later the notion of a BM is still widely used in organizations and academic literature. 1,177 peer-reviewed articles related to BMs were published between 1995 and 2011 (Zott et al., 2011). Despite the interest in the subject, academic efforts have not led to a widely used formal definition of a BM. Zott et al. (2011) ascribe the lack of an agreed upon definition to the individualistic scope that research in this field has often maintained, creating segmented bodies of knowledge that are mostly applicable to one of three main themes: e-business, organizational strategic issues and innovation & technology management.

The lack of consensus put aside, a range of definitions exist that in most part overlap and are fit for the scope of this research project. Teece (2010) describes a BM as a means to concisely label the fundamental workings of an organization. In essence it depicts the way in which an enterprise delivers value to customers, how it entices its customers to pay for this value and how these payments are converted into profit. Similar to Teece (2010), Sorescu et al. (2011) emphasize value creation for customers and value capture by the organization that utilizes the BM: "A business model is a well specified system of interdependent structures, activities, and processes that serves as a firm's organizing logic for value creation (for its customers) and value appropriation (for itself and its partners)." In addition, the latter definition denotes the composite nature of a BM. By acknowledging business models as modular entities they become useful tools for making comparisons in variation and to describe innovation. The modular approach also helps to identify common business model configurations where one or more segments show a similar pattern across multiple different organizations. BM-research can be assigned to one of three abstraction layers; each with their own types of research questions (Osterwalder et al., 2005) as shown in Table 3.

Table 3: Business Model Layers of Abstraction

Layer of Abstraction	Typical research questions
Definition level	What elements make up a business model?
Taxonomy of types	How are two observed business models different?
Instance level	How does a specific organization implement a type of business model? How does a certain type of business model fair in different business environments?

This research will primarily adhere to the *taxonomy of types* layer of abstraction as we will categorize various organizations by their business models. For this categorization however, examples on the instance level are required to give this categorization foundation.

5.2.1   Capturing business models with the business model canvas

Even when the concept and value of business models are understood, it remains hard to express their characteristics in a comprehensible and repeatable way. This vagueness is mainly caused by the great number of possible combinations of components a business model can comprise as a consequence of their holistic nature. Especially when discussing business models on instance level the need to be able to formalize and compare becomes apparent. In order to systematically describe business models, a modelling technique is required.

Osterwalder & Pigneur (2010) pose a solution with their Business Model Canvas (BMC) which they describe as: "A shared language for describing, visualizing, assessing and changing business models". The BMC is a diagram-table that represents a visual framework of four main areas of business: customers, offer, infrastructure and financial viability. The four areas are subdivided in a total of nine segments, each representing a business area in which strategic rationale describes how that segment contributes to the business model as a whole.

Table 4 shows a BMC-template, meaning that no values have been filled in for a particular instance. As this research will extensively use the BMC, we provide a short description of each segment in the following subsections, summarizing the elaborate explanation given by Osterwalder & Pigneur (2010) supplemented with footnotes containing examples.

Table 4: Example Business Model Canvas (BMC)

Node Type - *Example organizations*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
	Key Resources		**Channels**	
Cost Structure			**Revenue Streams**	

5.2.1.1 Customer Segments

Customer segments represent a type of customer to which the rest of the business model is adjusted. Thereforee it is one of the most important segments that requires deliberate attention. Only a single customer segment is present when all customers of the organizations are served through the same business model. That is to say, in order to serve a second customer segment adjustments are made to parts of the initial business model. Examples of types of customer segments posed by Osterwalder & Pigneur (2010): **Mass market**: One very broad customer segment[4], **Niche Market**: Specialized customer with specific requirements[5], **Segmented**: Somewhat similar customer types that require slightly different business models[6]. **Diversified**: Unrelated customer segments of which one is usually added later in the organization's life cycle and served by means of the strategic position the organization has attained over time with its core assets, such as infrastructure, knowledge or business connections[7]. **Multi-sided platform**: When an organization serves two different customer segments by acting as an intermediary.[8] Section 5.4.7.1 will describe the latter in more detail as this customer segment is prevalent in the G-SECO.

5.2.1.2 Value Proposition

The value proposition in a business model describes the products and services that create value for a customer segment. In essence it highlights the features by which customer are attracted. Osterwalder & Pigneur (2010) give 11 examples of value propositions, of which the following are most relevant for this research: **Accessibility**: Making products available to more customer segments[9]. **Risk or Cost Reduction:** Products or services that alleviate costs or exposure to risk when compared to alternative solutions. **Price**: Similar value for a lower price. Price is different from cost reduction as it directly represents the price paid, where cost reduction comes through an alternative arrangement in business processes[10]. **Design**: features of a product that increase its aesthetics[11].

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[4] E.g. the grocery, retail and consumer energy sector serve the mass market.

[5] Suppliers of high-end PC-parts or assembly line partners for consumer electronics are examples of niche markets.

[6] Airline travelers and credit card holders are segmented based on service-level.

[7] For example: Specialized software companies start to do consulting on the side when they mature, Amazon.com providing PaaS and IaaS solutions to third parties as a byproduct of scaling advantages resulting from the size of its technical infrastructure.

[8] Video game consoles are an example of a multi-sided platform, serving gamers and publishers/developers as two separate, but interdependent customer types. This customer-arrangement is discussed in section 6.4.7.

[9] The Ubuntu distribution of the Linux operating system provides a value proposition with a high accessibility standard compared to other Linux distributions. The increase in the number of 'casual' games (e.g. for Nintendo Wii and Facebook), signals that new customer segments are being targeted.

[10] This is a value proposition held by companies across many sectors, e.g. cheap car-rental, low cost hotels or budget clothing.

[11] Design, beauty or aesthetics are relatively subjective, but can be used to distinguish a product from others. Especially in the entertainment sector (literature, music, movies and games) design is a very important factor in a product's success.

5.2.1.3 Channels

Channels are the ways in which companies interact with their customers and how the value proposition is delivered. These interactions play an important role in how customers perceive a company, and are part of all communication, distribution and sales activities. Channels can either be **owned** or of a **partner**[12].

5.2.1.4 Customer Relationships

The BMC-segment of customer relationships defines the types of relationships companies aim to uphold with their customer segments. Formalizing a customer relationship strategy for the various customer segments helps a company reach larger business goals, such as focusing on growth though customer acquisition or stability through customer retention. Depending on the product and specific needs of customers a fitting customer relationship can be made up of one or more of the following types: **Personal assistance**: direct human contact, for example a shop assistant or a waiter in a restaurant. **Dedicated personal assistance**: Similar to personal assistance, but with a formally dedicated contact. Account managers and real estate brokers are dedicated to a client. **Self-service**: Actually not a real customer relationship, but a way for customers to help themselves. Examples are catalogue browsing as in libraries or web-shops. **Automated services:** A more advanced form of self-service, where customer needs and actions lead to adjusted results. E-commerce relies heavily on automated services that use customer-specific variables to determine service levels and client-interaction. **Communities:** Having customers interact with each other in a facilitated environment to support and inform each other in context of the product. Online forums are a popular example. **Co-creation:** Direct input from customers in product creation[13].

5.2.1.5 Revenue Streams

The ways in which an organization receives cash from its customers segments is expressed in the revenue streams BM-segment. A customer can pay for products or services as a **one-time payment**[14] or **recurrently**[15] over the period of product/service use, or for additional services on top of the original product. Beside the one-time or recurring payment, another bilateral distinction is made in whether the pricing mechanism is **fixed** or **dynamic**[16]. Common ways for organizations to create revenue streams are as follows: **Asset sale:** directly selling physical ownership of a product. **Usage fees**: Pay in relation to quantity or time of use. **Subscription fees**: Pay for usage

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[12] Example: A purchase of an indie game from the developer's website is executed through the company's own channel. In contrast: purchasing the same game on Xbox 360 makes use of Microsoft's sales channel as a partner for the indie developer. Microsoft keeps a part of the indie developer's revenue in exchange for access to Microsoft's large Xbox 360 audience and download services.

[13] Kick-starter projects often incorporate a high level of co-creation by keeping a very short and informal style of interaction with backers (invested future users).

[14] A one-time payment for which ownership of a product is permanently transferred. For example: buying a carton of milk or a book.

[15] E.g. a newspaper subscription or car lease.

[16] Fixed prices are static variables, meaning the price per unit does not fluctuate based on other variables such as availability or demand. Dynamic prices are determined at the moment of purchase and by the act of purchasing, such as with auctions or real-time markets.

over a predefined time span. **Renting**: Transfer exclusive use rights for a product over a pre-defined period of time. **Licensing:** Similar to renting, but referring to usage of intellectual property as opposed to a physical product. **Brokerage fees:** Payment for mediation services between two customer segments. **Advertising**: Generating cash from granting exposure to external parties' products through one's own product.

5.2.1.6 Key Resources

An organization requires certain assets to make its business model function. These resources can be intellectual, physical, financial or human. The key resources needed depend heavily on other parts of the business model. **Intellectual**[17] assets are intangible and often copyrighted and based on proprietary knowledge or reputation. **Physical** key resources are material assets that organizations depend heavily on. These can range from a transport fleet to advanced production facilities. Key resources are regarded as being of **financial** nature when large amounts of cash, credit or stock options are required for a business model to function. Finally, **human**[18] key resources refer to situations where the presence of particular or uniquely talented employees is a prerequisite for the business model.

5.2.1.7 Key Activities

Similar to key resources, key activities are irreplaceable and needed to create and deliver the value proposition to the customer. Activities and processes needed for a business model to function can be categorized in: **Production**: Manufacturing and designing products efficiently or of very high quality. **Problem solving**: Helping customers solve their problems. This type of activity is usually customer service oriented in businesses such as healthcare or IT-consultancy. Osterwalder & Pigneur (2010) also regard **Platform/network** management as a key activity or set of activities targeted at optimizing the platform.

5.2.1.8 Key Partners

The key partners segment explains how particular external organizations are crucial to the business model of the organization of interest. Four types of partnerships are identified by Osterwalder & Pigneur (2010): **Strategic alliances** between non competing businesses. **Coopetition**: Competitors working together for mutual interest. **Buyer-supplier** relationships: To create a reliable supply of resources. **Joint-ventures**: When several organizations develop a new business together. Osterwalder & Pigneur (2010) also picture three main goals that strategic partnerships support: **Optimization and economy of scale** occurs when an organization deliberately does not invest in broad development of business functions but allows specialized partners to support their own highly optimized key activity. **Reduction of risk and uncertainty** is the goal of partnerships that increase stability in a competitive market. These can be supplier based agreements but can also exist between competitors. **Acquisition of resources and activities** like *optimization and economy of scale* relies on partners to supplement a product with essential parts or additional features.

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[17] Examples of intellectual assets are a company's brand, intellectual property or its patent portfolio.
[18] Creative or research driven industries rely heavily on talented, hard to replace, people.

5.2.1.9   Cost Structure

The cost structure is the opposite of revenue streams in a business model. Herein is defined what the costs of the operational business model entail. Most costs come directly from key resources, activities and partnerships (left side of the canvas). **Cost-driven** business models are designed around a cost structure that keeps costs as low as possible while still fulfilling customer needs. **Value driven** business models do the opposite, and develop their business model around maximizing value creation for customers at viable costs. Costs can be structured as follows: Costs are either **fixed** or **variable**, efficient attribution of variable costs contributes to an **economy of scale** where an increase in output leads to a decrease in cost per quantity of input. **Economies of scope** occur when costs of key resources and activities are shared by multiple output streams, such as additional new products or services created and distributed by an organization's existing infrastructure.

5.2.2   Business model innovation

Innovations in business models are increasingly critical for building sustainable advantage in a marketplace defined by unrelenting change, escalating customer expectations, and intense competition (Sorescu et al., 2011).

To profit from innovation, business model pioneers need to excel not only at product innovation but also at business model design, understanding business design options as well as customer needs and technological trajectories. (Teece, 2010).

5.2.3   Competitive advantage through business models

Competitive advantage lies in finding a business model that is differentiated and hard to replicate through unique assets such as partnerships, key activities or key resources. (Teece, 2010). Business models have a multivalent character as models. Business models are not recipes or scientific models or scale and role models, but can play any - or all - of these different roles for different firms and for different purposes and will often play multiple roles at the same time (Baden-Fuller & Morgan, 2010).

5.3 Game Industry

This section provides theoretical background on the game industry and an overview of its history.

5.3.1   The game industry, scope and definitions

The video game industry, over a 25-year period, has grown annually by between 9% and 15% in global revenues (Zackariasson & Wilson 2010). Global revenues were an estimated $67 billion for console and portable hardware and software, as well as for games for mobile devices (e.g., tablets and smartphones). Sales of so-called virtual goods within games generated an additional $14.8 billion in 2012. These figures are higher than the music and book-sales and on par with the movie industry in 2012 ($85 billion) (Zackariasson & Wilson 2010).

The video game industry is typically referred to as a creative industry to stress the importance of both creative human capital in the production process and the one-off

nature of the final product (Tschang, 2007). This one-off nature remark is somewhat mitigated by many of the larger game development companies that release multiple products from a single software product line, over a timespan of several years[19].

But the notion that creative aspects determine a large part of the quality attributes of the product software produced by the game industry sets it apart from other software (Terry & Babb, 2013). On top of the prevalent network effects, this creative aspect makes the game industry an interesting domain within product software research.

5.3.2 History of the video game industry

A historical timeline of the video game console industry can be segmented into technological generations that, on average, span half a decade. Each generation is characterized by a collection of competing contemporary video game consoles. With each iteration, platforms and their complementors exploit new technologies and evolve their business models, broadening the variety of actors and product types within the ecosystem.

Terry & Babb (2013) make a comprehensive account of historical progression in the video game console history. A shortcoming however, is that they explicitly do not include PC or other non-video game console platforms in their research as they consider their influence and market share marginal in the timespan of their research scope (2006-2011). In addition, developments in non-video game console markets are less tied to the console generations perspective. The release of Sony's PlayStation 4 and Microsoft's Xbox ONE in the last quarter of 2013 signaled the start of the current (eighth) generation of video game consoles. Table 5 contains an overview of the generational progression from the video game console perspective. For completeness other (non-video game console) platform types are also included.

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[19] Examples of Game Software Product Lines: Ubisoft's Assassin's Creed series (8 stand-alone game releases 2007-2014), Activision's Call of Duty series: 12 games over 12 years.

Table 5: Overview of game platform generations

Gen	Period[20]	Notable actors	Major developments & trends
1	1972-1977 *(1972-1976)*	**Hardware platforms:** Magnavox (Magnavox Odyssey) Nintendo (Color TV-Game)	• Home versions of arcade video games • Single screen games • Video game console market crash 1977
2	1976- 1992 *(1976- 1983)*	**Hardware platforms:** Mattel (Intellivision) Coleco (ColecoVision) Atari (Atari 2600) Apple (Apple II) IBM, Microsoft (PC) **Software:** Electronic Arts (games) Activision (games)	• Microprocessor implementation • Start of video game market: platforms & complementors. • Video game market crash 1983[21] • First handheld consoles
3	1983-1990 *(1983- 1987)*	**Hardware platforms:** Nintendo (NES) Sega (SG-1000, Master System) Atari (Atari 7800, Atari ST) Commodore (Commodore 64 Games System, Amiga) TurboGrafx PC (MS DOS)	• Arcade market depletes as the game market matures • Nintendo enters and dominates console market, strict licensing rules (2 year platform exclusivity) • PC most popular game platform • First d-pad game controllers
4	1987-1993 *(1987-1993)*	**Hardware platforms:** Nintendo (Super NES, GameBoy) SEGA (Sega Genesis) PC (Windows)	• Nintendo and SEGA compete with platform exclusive games
5	1993-2001 *(1993-2001)*	**Game platforms:** Sony (PlayStation) Nintendo (Nintendo 64, Game Boy Color) SEGA (Saturn) **Software:** Id-Software (Doom)	• 3D accelerated graphics and optical discs become standards • 64-bit architecture • Sony dominates console market
6	1998-2012 *(2001 - 2005)*	**Hardware platforms:** SEGA (Dreamcast) Sony (PlayStation 2) Microsoft (Xbox) Nintendo (Gamecube, DS)	• Advent of online gaming • Big increase in complementors • Alternative controllers and game peripherals

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[20] These time periods are approximations. Each generation includes multiple competing platforms that remain relevant in the next generation. In addition, the moment of new platform introductions, which together characterize a generation, can be spread out by several years. The actual (overlapping) timespans are stated first. The timespans formatted in brackets are contiguous, ending when a new generation starts.

[21] In 1983 the North American game market crashed (Sitrick, 1986) and was rebooted by Nintendo in 1983 (generation 3)

| 7 | 2005-2013 (2005-2013) | **Game platforms:**
Microsoft (Xbox 360)
Sony (PlayStation 3, PSP)
Nintendo (Wii, DS)
Facebooks (PC, Mobile)
Apple (Mobile)
Google (Mobile)

Software:
Valve (Steam)
Blizzard (World of Warcraft) | • Casual games[22]
• Market grows fast and diversifies through Wii, mobile games and handheld consoles
• Motion controls
• Western game companies take market share
• Online gaming becomes standard
• Online distribution on all platforms |
| 8 | 2013-… | **Hardware platforms:**
Microsoft (Xbox ONE)
Sony (PlayStation 4)
Nintendo (Wii U)
Software:
Valve (Steam (PC, Mac, Linux))
Facebook (PC, Mobile)
Apple (iOS(Mobile))
Google (Android(Mobile)) | • In progress during this research |

Generations normally overlap, meaning game consoles of a newer generation are produced and sold before the previous generation has come to a complete halt in sales and production. For timeline data needed in section 6.4.5, contiguous timespans are inferred.

The first generation of video game consoles was much different from today's market. Video game consoles had very few graphic capabilities and games were integrated in the platform, meaning there was no games market. The early stages, just after the crash of the North American video game market, were almost entirely shaped by Japanese companies such as Nintendo, SEGA and Sony.

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[22] (Vajk et al., 2007) Especially Nintendo successfully targeted the large untapped market for casual games through the DS and later Wii platform.

6 Results

The individual node types and their roles in the G-SECO are defined through a bottom-up approach in section 6.2. Prior to this analysis a top down overview of the G-SECO is discussed in section 6.1 to get a grasp of the SECO's size and basic structure. Further analysis of observations allows us to identify node types based on the connection patterns they display with their peers. Furthermore, a clear outline of the SECO's structure forms input for the business model analysis. In order to connect the following SECO analysis with the subsequent business model analysis, we focus on discussing how network effects manifest themselves in the G-SECO.

6.1 Video Game SECO overview

Game release data[23] gathered from www.vgchartz.com was used to create the G-SECO graph displayed in appendix 9.1. Gephi, an open source software tool for visualizing networks with graph-data was used.

The graph depicts relationships between parties that publish games and the targeted game platforms on which the games are played. A relationship means that one or more games were published on the target console by the publishing party. By using the Yifan Hu graph-layout, nodes are grouped based on their linkage behavior and centrality in the ecosystem. This helps to identify the various groups of complementors for each platform. The size of nodes correlates with the number of connections. By only including publishing parties and the platforms they target, a comprehensive overview of key players in the games market is created before defining any specific roles, business models or key activities. The interests of publishing parties and game platforms can conflict as both are trying to maximize their products' success in their respective competitive domains (games and game consoles). In a first impression we see many of the central nodes are larger well established multi-homing publishers, such as Activision, Electronic Arts and Ubisoft. Differences between the various platform sub-ecosystems are also visible. Mobile platforms have been excluded from the graph to increase legibility. After iOS, the PC-ecosystem is the largest, based on the number of individual publishers that are active in it.

Network effects described by Srinivasan & Venkatraman (2010) show how game platforms gain dominance among peers by attracting complementors. Furthermore, network effects explain the relations between a node's SECO-position[24] and a general competitive advantage (dominance) accrued by obtaining or maintaining that position. Thereforee, business model decisions are expected to be considered of network effects. The first two of these network effects are visible in the G-SECO graph.

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[23] Game releases as of 31-03-2014 displayed on http://www.vgchartz.com/gamedb/
[24] SECO-position is defined by the exact configuration of ties a node has within a SECO.

Table 6: Platform-Publisher Relations

Platform name	Number of games
iOS	22244
PC	8005
X360	3395
PS3	2908
Wii	2786
And	453
WiiU	187
PS4	148
XOne	105
Ouya	13

(1.) *Degree of linkages with complementors*: Platforms differ in the amount of links they have with the various game publishers. Table 6 lists the number of unique games per platform that were measured. The light gray platforms (mobile) have been left out of the graph for legibility. At this moment in time, iOS had the most number of unique game published by registered publishers, followed by PC.

(2.) *Degree of overlap with other platforms*: A diminishing effect on platform dominance arises from platform overlap of complementors (Srinivasan & Venkatraman, 2010). In other words, when complementors tie to more than one platform, the value per tie from that complementor decreases. To illustrate this with the G-SECO graph: Complementors only tied to one platform, located on the perimeters of the SECO, are the valuable connections for each respective platform, as these connections contribute to the distinctiveness of a platform's value proposition, discussed further in subsection 9.2.6.2. Complementors in the center of the graph are tied to multiple platforms, often by publishing the same game on different platforms (porting). The graph indicates that large publishers[25] are more likely to publish on more than one platform, as no large publishers reside on the perimeters of the SECO. Moreover, the largest publishers on the perimeter of the SECO are first party publishers[26] (subsidiaries of the platform-organization). As these subsidiaries are governed by the platform owner, they don't publish games on other platforms in order to lower the degree of overlap for the respective platform.

(3.) *Variety of linkages with complementors*: An increased variety of ties improves a platform's dominance (Srinivasan & Venkatraman, 2010). Although not depicted in the graph, our dataset categorized each game in one of eleven genres[27] including one '*misc.*'-genre. A low standard deviation indicates high spread across genres, which contributes to Srinivasan & Venkatraman's (2010) model of platform dominance.

(4) *Ties with dominant complementors*: Srinivasan & Venkatraman (2010) argue that ties with dominant complementors support a platform's dominance. They measured complementor dominance as a combination of network centrality and release frequency within a given time period. A critique on this measure is that a high release frequency is often present, but not necessary to maintain a dominant complementor role. Examples of

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[25] E.g. Activision, THQ, SEGA, Electronic Arts and Atari.

[26] For Example: Left: Nintendo, bottom-right: Sony Computer Entertainment. Microsoft would also fall in this category except it has many ties with the PC-platform, resulting in a centered position.

[27] Adventure, Fighting, Platform, Puzzle, Racing, Role-Playing, Shooter, Simulation, Sports, Strategy, Misc,.

dominant complementors with a relatively low release frequency: Rockstar Games, Valve, Kojima Productions. These complementor are highly esteemed as publisher/developers, but rarely release new games[28].

6.2 Identifying node types in the G-SECO

In order to have a clear reference point for classifying nodes participating in the G-SECO, a basic understanding of the software products (games) around which the SECO revolves is required. Ultimately all business activity in the G-SECO is related to games that consumers purchase and play. In contrast to game specific technologies, the game industry or psychological effects of games the idea of games as software products has gotten little research attention.

For describing games as software products, we differentiate between an economical and a technical viewpoint. The combination of both viewpoints provides insight in how the product is related to the SECO: namely by how it is comprised of modules, or sub products, and how the final product as a whole is enriched by service providers and other aftermarket actors that partake in the G-SECO.

Firstly, the number of competing platforms in the G-SECO is higher than in typical SECOs such as that of regular business software products (PC, Mac and Linux) or mobile software (Android, iOS). This brings about segregation, of what is typically regarded as a single game, into multiple platform specific releases enforced by the multitude of different platforms in the G-SECO. These platform-tied instances of multiplatform games are usually not compatible with other platforms, as a result of the various constraints imposed by the platform's technical framework and to some degree artificial segregation. This relation is expressed in Figure 3.

Figure 3: Platform-Game Relation
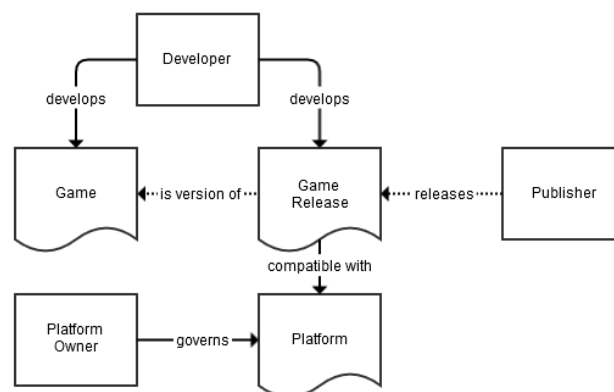
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[28] Rockstar, Kojima, Valve: 2-5 year release cycle, 5-30 million sales per game.
http://www.vgchartz.com/gamedb/?name=grand+theft+auto,
http://www.vgchartz.com/gamedb/?name=metal+gear,
http://www.vgchartz.com/gamedb/?publisher=15546

Artificial segregation is clearly present with higher level software platforms. A game like SimCity is exclusively available on EA's Origin platform and not on Valve's Steam or Ubisoft's Uplay while running on the same hardware and operating system. Following from this multiplatform pattern is an increase in releases of a game, which retailers and consumer see as separate products. The need to identify these game releases separately becomes even more apparent when different game developers or publishers are responsible for the instances of a single game[29].

Now that we have a clearer understanding of the core products in the G-SECO, organizations that are present in the G-SECO are identified in Table 7. These types of nodes are generalizations of the types of roles that these organizations play. Many of the larger organizations, especially in the current generation, fulfill multiple roles. This is discussed in section 6.4. The node types listed in Table 7 found their origin mostly in the early stages of the game industry and are today still used in the industry and media as relevant classification.

Table 7: Nodes operating in the G- SECO

Node type	Description	Examples of actors and products
Middleware developer	*Develops software (tools) for game developers such as game engines, sound modules or graphics libraries*	Game Engine: Epic Games, Crytek, Unity, Valve, BigWorld, Idea Fabrik, Terathon, BioWare, YoYo Games. Add-ons/plug-ins: Havok, Autodesk, IDV, Side Effects Software, Allegorithmic, Umbra Software, Nvidia, Vivox, Geomerics.
Game developer	*Designs and develops video games*	Naughty Dog, Blizzard Entertainment, Mojang, Bungie, Rockstar, Insomniac Games, Criterion Games, Gearbox Software, Paradox Interactive, Splash Damage, Square Enix, Valve, Guerrilla.
Game publisher	*Publishes video games developed by a developer*	EA, Ubisoft, Activison Blizzard, Codemasters, Konami, Microsoft Games Studios, SEGA, Disney Interactive, Bandai Namco, Square Enix, Nexon, Capcom, Warner Bros. Interactive Entertainment, Nintendo, Deep Silver, Kalypso Media, Take-Two interactive, Sony.
Retailer	*Sells games directly to consumers*	Online Digital: Valve, Origin, Amazon, Desura, Good old Games, PlayStation Store, Xbox Marketplace, Gamersgate, Gamefly, Apple AppStore, Google Play. Online Physical: Amazon, Gamestop, Best Buy. Offline Digital: Walmart, Gamestop. Offline Physical: Gamestop, Walmart.
Game platform owner	*Develops and governs a video game hardware/software platform for which games are published*	Hardware platforms: Sony (PlayStation 4), Microsoft (Xbox One), Nintendo (Wii U), Ouya (Ouya), Apple (iPhone & iPad). Software platforms: Apple (Android), Google (iOS), Valve (Steam), EA (Origin).
Game Service Provider	*Caters services to game publishers and developers*	Game server hosting: I3d.net. Online Distribution: Steam, Desura.

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[29] Developer Infinity Ward developed Call of Duty 4 for most platforms except for Nintendo Wii. The Wii-version was built by Treyarch.

Consumer Service Provider	*Caters services directly to game consumers.*	Video broadcasting: Twitch.tv. Voice chat: Teamspeak, Ventrillo. E-Sports organization and commentary: ESL, MLG, DreamHack, beyondthesummit.tv, Evil Geniuses, TeamLiquid. Game journaslism: IGN, Gamespot, Kotaku.
Consumer	*End-user that purchases and plays games*	iPhone owner, Xbox One owner.
Content Provider	*Creates additional content for existing games, middleware or services*	Game streamer (Twitch). Game reviewer (IGN). Game character model creator (Dota2, Steam). Game script creator (Unity marketplace). Game mod creator (Counterstrike 1).

The relations among the node types listed in Table 7 are modeled in Figure 4. These relations are further described in Table 8. For brevity all relations in are mentioned only once.
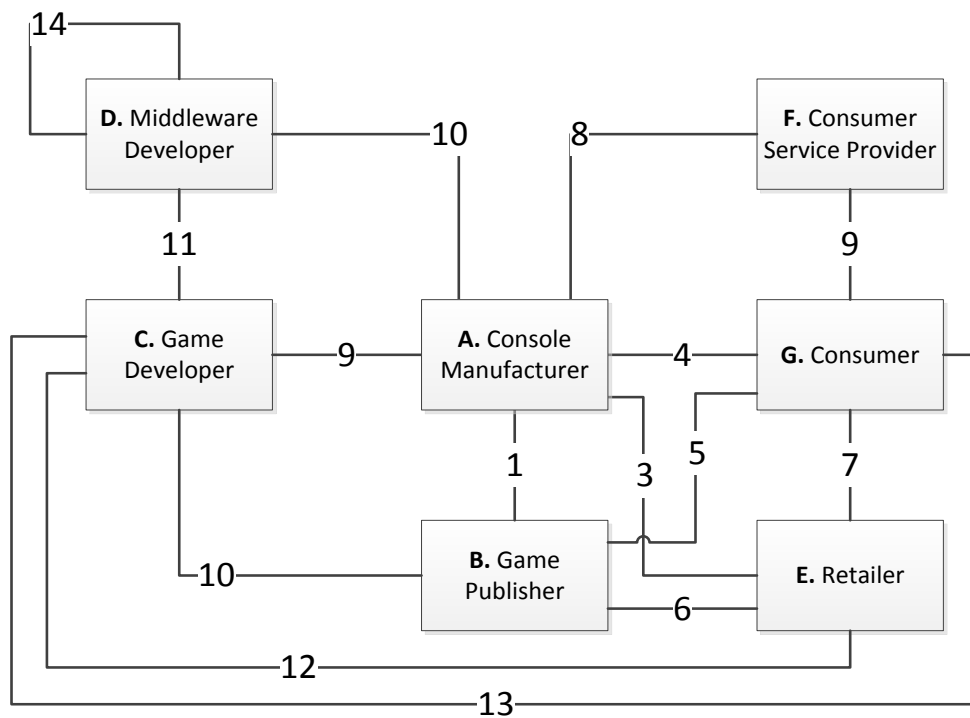
Figure 4: Node types and their relations

Table 8: Descriptions of Node Type Relations in the G-SECO

Node type	Relations
A. Game platform owner	To B. Game Publisher: Get publishers to publish games on their platform. To C. Developers: Help game developers design games for their platform. To E. Retailer: Console manufacturers sell video game consoles to retailers. To F. Consumer Service Provider: Platform owner integrates consumer software in platform. To G. Consumer: Console manufacturers design video game consoles for consumers. The number of consumers owning a particular console is referred to as the installed base.
B. Game Publisher	To A. Console Manufacturer: Game publishers release a version of a game for a particular platform that is governed by a console manufacturer. To C. Game Developer: Publishers often hire a game developer to create the game they want to publish. To G. Consumer: Publishers can sell game directly to consumers. To E. Retailer: Game publishers sell games to retailers.
C. Game Developer	To A. Console Manufacturer: Develop games that work on a platform manufacturer's console. To B. Game Publisher: Develop a game commissioned by a publisher. To D. Game Middleware Developer: Use or incorporate game middleware. To E. Retailer: Sell game to/through retailer. To G. Consumer: Sell game to consumer.
D. Middleware Developer	To D. Middleware Developer: Game middleware developers can integrate other game middleware in their product. To A. Console manufacturer: To make their products compatible with different platforms, middleware developers need to be aware of platform specific development standards and guidelines. To C. Game Developer: License game middleware products to game developers.
E. Retailer	To G. Consumer: Consumers buy games from retailers.
F. Consumer service provider	To G. Consumer uses consumer services.

6.3 Software Supply Network (SSN) Diagrams

The subtle differences by which actors in the current G-SECO vary can partially be described by identifying the direct network relations of each of the different node types. Insight in these network relations forms a foundation to explore the underlying business models of these actors (in section 6.4) as an organization's closest partners are in fact part of its business model (Boucharas et al., 2009; Osterwalder & Pigneur, 2010). Describing these network relations is done by modelling the software supply network (SSN) of each node type following the SNN modelling guidelines as part of the SEM-modelling technique described in section 5.1.3.

The following SSNs are generalizations of frequently occurring patterns found in analyzing the value chains of multiple example organizations. Each SSN is depicted as a diagram, accompanied with a legend, explaining the various elements (products, services and financial connections) and a table containing examples of the specified elements.

6.3.1   Game Middleware Developer SSN
Game middleware developers are producers and suppliers of game development resources. Their position in the SECO is often the furthest away from the central nodes (platforms) as they hardly interact with the end-users of the G-SECO. Game middleware products are used by game developers to develop their games more efficiently by incorporating a pre-built solution to a common problem. Game middleware can be supplied to game developers directly, or through game engine developers that integrate

game middleware into their own middleware product, increasing the complexity of the software stack. This pattern will be discussed in the next sub-section. Game middleware developers themselves incorporate little existing software from third parties in their products as the scope of their products is often very specific. Inputs game middleware developers do rely on are factors such as the API or platform libraries that customer software must utilize, often provided by the platforms.
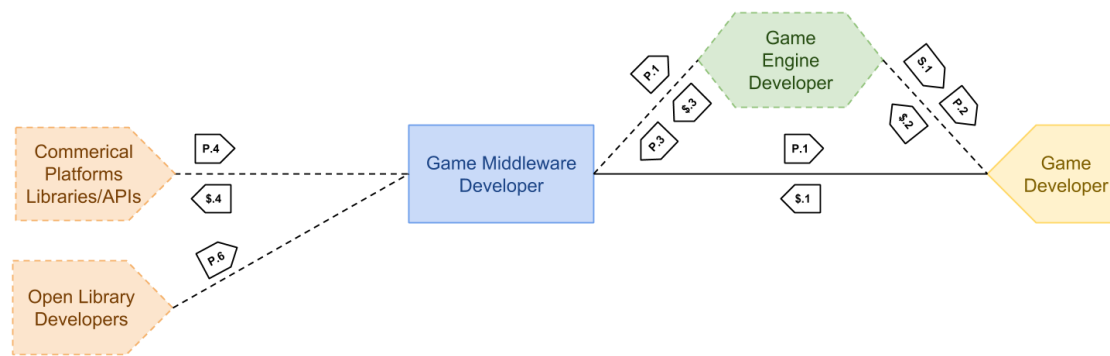

Figure 5: Game Middleware Developer SSN

Legend - Game Middleware Developer SSN

Products	Services	Money
P.1 Middleware software package	S.1 Game engine as a Service	$.1 Payment for P.1
P.2 Game engine with P.1 integration	P.1 integration	$.2 Payment for P.2 and/or S.1
P.3 Game engine libraries/APIs		$.3 Royalties for P.2 / S.1
P.4 Commercial platform libraries, APIs, dev-kits and tools		$.4 license for P.4
P.5 Other (open) libraries		

Product and services	Examples
P.1	AiLive: LiveMove 2 NaturalMotion: morpheme & euphoria NVIDIA: PhysX and APEX Xoreax: IncrediBuild-XGE IDV: SpeedTree Xaitment: xaitControl Oculus VR: Oculus Rift Autodesk: Autodesk Gameware Audiokinetic: Wwise RAD Game Tools: Bink Video and Telemetry Performance Visualizer Umbra Software: Umbra 3 Donya Labs: Simplygon
P.2	Autodesk Gameware is an integrated partner of Epic Games': UDK engine Umbra middleware is intergrated in Epic Games': UDK engine Umbra 3d dataset manager is integrated in: Unity engine IDV Speedtree is integrated in UDK, BigWorld, HeroEngine, Vision engine and Ogre engine.
P.3	Unity engine provides a framework for building plugins, graphical assets and scripts.
P.4	DirectX: Microsoft's graphics library

	Sony Computer Entertainment's Authoring Tools Framework contains PlayStation 4 specific libraries and drivers. Microsofts': Xbox Development Kit Nintendo Web Framework	
P.5	OpenGL: Largest open graphics library, Audiere for Audio	
S.1	Crytek's: CryEngine has a subscription based option	

6.3.2   Game Engine Developer SSN

Game engine developers are special middleware developers that create multifaceted game software and even complete game building environments. The primary clients of game engine developers are game developers which license an engine to incorporate into their product. The extensible nature of game engine software allows for expansion through integration of third party modules, developed by game developers themselves, or other game middleware developers. In Figure 6 game middleware developers are modelled as intermediaries as they also expand on existing frameworks. Other suppliers are console manufacturers that need to provide guidelines, development kits and APIs of their platform to which game engines must adhere. The last supplier of software artefacts are labelled as content providers. Game engines such as Unity act as a platform for which individuals can publish and sell in game assets like 3-D models to game developers. This is discussed in more detail in the section 9.2.2.
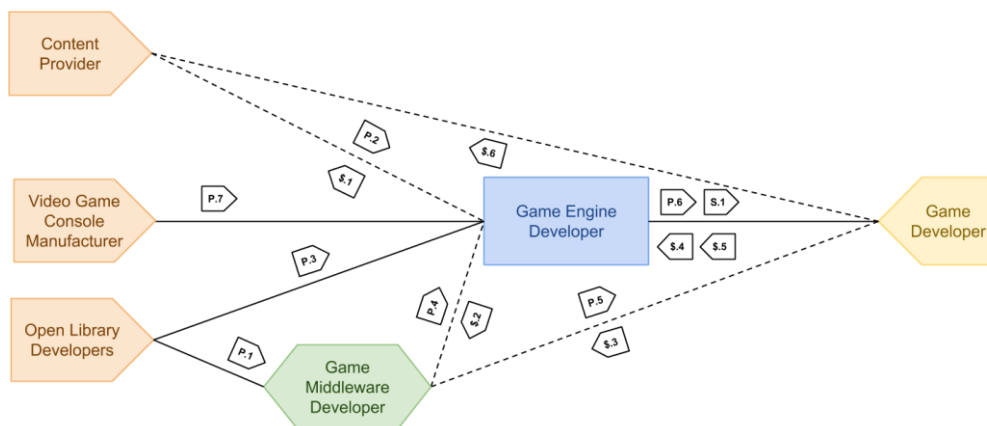

Figure 6: Game Engine Developer SSN

Legend - Game Engine Developer SSN

Products	Services	Money
P.1 Open Libraries or API	S.1 Engine as a Service	$.1 Payment for P.2
P.2 Game content (e.g. sounds & models)		$.2 Royalties per unit for P.5
P.3 Libraries for API		$.3 License fee for P.3
P.4 (Integrated) game middleware		$.4 Payment for P.4
P.5 Game middleware		$.5 Subscription Fee S.1
P.6 Game engine		$.6 Payment for P.2
P.7 Platform specific libraries		

Product and services	Examples
P.1	OpenGL: Largest open graphics library, Audiere for Audio
P.2	Complementors selling game assets on UDK or Unity marketplaces
P.3	Same as P.1
P.4	Autodesk Gameware is an integrated partner of Epic Games': UDK engine Umbra middleware is intergrated in Epic Games': UDK engine Umbra 3d dataset manager is integrated in: Unity engine
P.5	Game middleware directly delivered to the developer: See 6.3.1.
P.6	RAGE Engine, CryENGINE, Naughty Dog Game Engine, Unreal Engine, Gamebryo, Source Engine, FrostBite 2
P.7	Microsoft: DirectX graphics library Sony Computer Entertainment's Authoring Tools Framework contains PlayStation 4 specific libraries and drivers. Microsoft: Xbox Development Kit Nintendo: Web Framework

6.3.3   Game Developer SSN

Game developers are the largest group of node types in the G-SECO, as many publishers release games of multiple developers and independent developers supply directly to customers or retailers. The game developer SSN in Figure 7 displays the many channels games developers can appeal to, to get their product to customers. This can be direct, via a retailer, publisher or publisher to retailer. As was described in section 5.4.6., the retailer business activity can be incorporated by other node types as well, such as the platform owners. For clarity sake, the retail business process is depicted as a single entity type: retailer. On the supply side of the game developer game middleware plays an important role, both through game engines as through specialized plug-ins from middleware developers. Video game console owners, as with most other node types, supply the necessary platform APIs and modules in order for the developers' product to be compatible with its target platform.
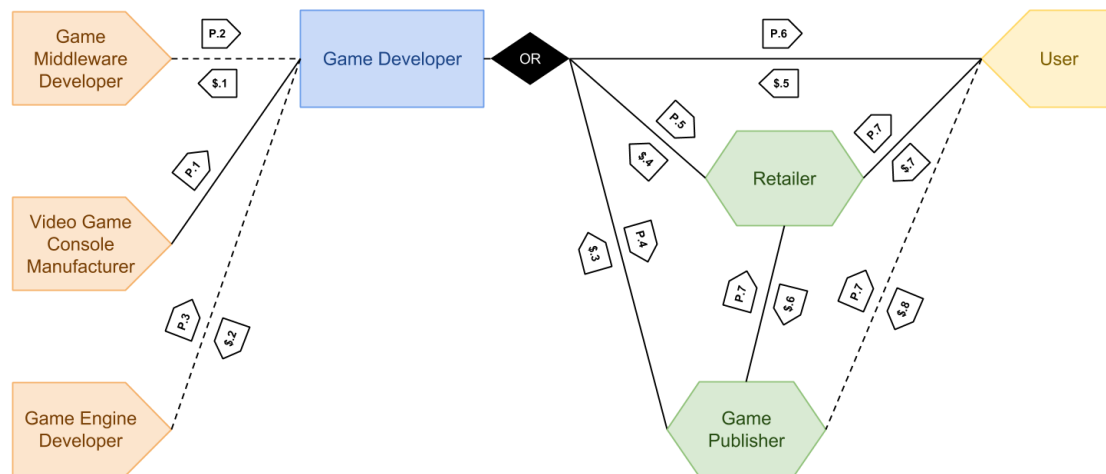

Figure 7: Game Developer SSN

<table>
<tr><td colspan="2">Legend - Game Developer SSN</td></tr>
</table>

Legend - Game Developer SSN

Products	Money
P.1 Platform specific libraries	$.1 License fee for P.2
P.2 Game middleware	$.2 License fee for P.3
P.3 Game engine	$.3 Payment for P.4
P.4 Video game source code/build	$.4 Payment per unit for P.5
P.5 Video game	$.5 Payment per unit for P.6
P.6 Video game	$.6 Payment per unit for P.7
P.7 Video game	$.7 Payment per unit for P.5
	$.8 Payment per unit for P.7

Product and services	Examples
P.1	DirectX: Microsoft's graphics library Sony Computer Entertainment's Authoring Tools Framework contains PlayStation 4 specific libraries and drivers. Microsofts': Xbox Development Kit Nintendo Web Framework
P.2	AiLive: LiveMove 2 NaturalMotion: morpheme & euphoria NVIDIA: PhysX and APEX Xoreax: IncrediBuild-XGE IDV: SpeedTree Xaitment: xaitControl Oculus VR: Oculus Rift Autodesk: Autodesk Gameware Audiokinetic: Wwise RAD Game Tools: Bink Video and Telemetry Performance Visualizer Umbra Software: Umbra 3 Donya Labs: Simplygon
P.3	RAGE Engine, CryENGINE, Naughty Dog Game Engine, Unreal Engine, Gamebryo, Source Engine, FrostBite 2
P.4	Depending on the contract game publishers hold the rights to a game developed by a game developer. The game is exchanged for a payment.
P.5	Consumers can buy Minecraft directly on the developer's website
P.6	Third party games sold on Valve's Steam, Amazon or Walmart
P.7	First Party games sold on Steam (Valve), Origin (EA) or Uplay (Ubisoft)

6.3.4   Game Publisher SSN

Figure 8 depicts the SSN for Game publishers. Game publishers together with game platforms play the central role in the G-SECO even though their direct contribution to the software product is often marginal. The software products a game publisher puts forth to its customers are a complete game, or add-ons to an existing game. These software products are developed by game developers that are contracted for the project. The three supplier-buyer relation types a game publisher can have with a game developer are explained in subsection 9.2.3. On the demand side a publisher, much like an indie game developer, caters directly to customers or through retail channels. Game hosting providers are depicted in Figure 8 as intermediaries for supporting the online infrastructure of released games.
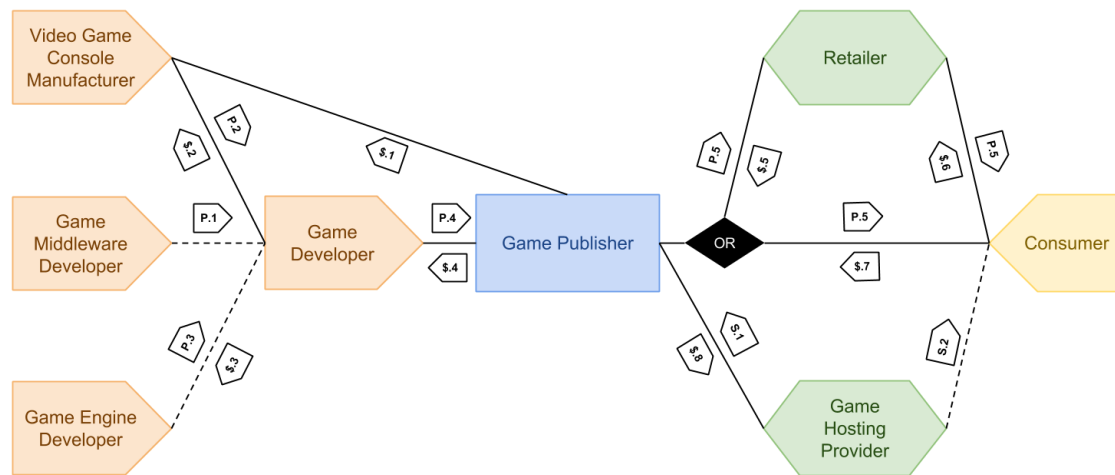
Figure 8: Game Publisher SSN

Legend - Game Publisher SSN

Products	Services	Money
P.1 Game middleware	S.1 Game Hosting	$.1 License fee for P.1
P.2 Console specific libraries	S.2 Online Gaming	$.2 Royalties per unit for P.5
P.3 Game engine		$.3 License fee for P.3
P.4 Video game source code		$.4 Payment for P.4
P.5 Video game		$.5 Payment per unit for P.5
		$.6 Payment per unit for P.5
		$.7 Payment per unit for P.5
		$.8 Service fee for S.1

Product and services	Examples
P.1	AiLive: LiveMove 2 NaturalMotion: morpheme & euphoria NVIDIA: PhysX and APEX Xoreax: IncrediBuild-XGE IDV: SpeedTree Xaitment: xaitControl Oculus VR: Oculus Rift Autodesk: Autodesk Gameware Audiokinetic: Wwise RAD Game Tools: Bink Video and Telemetry Performance Visualizer Umbra Software: Umbra 3 Donya Labs: Simplygon
P.2	Microsoft: DirectX graphics library Sony Computer Entertainment's Authoring Tools Framework contains PlayStation 4 specific libraries and drivers. Microsoft: Xbox Development Kit Nintendo: Web Framework
P.3	RAGE Engine, CryENGINE, Naughty Dog Game Engine, Unreal Engine, Gamebryo, Source Engine, FrostBite 2
P.4	Depending on the contract game publishers hold the rights to a game developed by a game developer. The game is exchanged for a payment.
P.5	Games sold to consumers directly from the publisher though their own channels: Steam (Valve), Origin (EA) or Uplay (Ubisoft). Or through a retailer: Steam (Valve), Amazon or Walmart
S.1	I3D.net provides hosting solution for publishers to host large games. Microsoft provides hosting for Xbox live games of third party publishers.
S.2	Consumer play online games on the servers of the hosting provider

6.3.5   Game Retailer SSN

With digital distribution becoming more popular[30] in the games market and physical retail of entertainment products moving towards e-commerce, the way in which games are sold and distributed is changing rapidly. As a result of the ease of distribution and global reach of the internet, organizations that formerly only developed or published games are now selling games themselves directly to consumers with marginal added costs. This makes the SSN model (Figure 9) for game retailers more complex, but more interesting as well. The only product in the SSN for game retailers is the finished product considering no modules are added after the game developer reaches gold status[31] in the product development lifecycle. However, there remain various points in the chain where actors can add value through services. For example, a digital game retailer like Valve or EA adds many different services to a video game purchase by providing product information, download options a community and save game management, similar to video game consoles. The parties present in this SNN have been discussed in the previous SSNs except for distributors. Distributors are typically used by publishers to manage a games' supply and demand in a foreign region or as a wholesale partner so that publishers do not have to deal with too many smaller retailers.
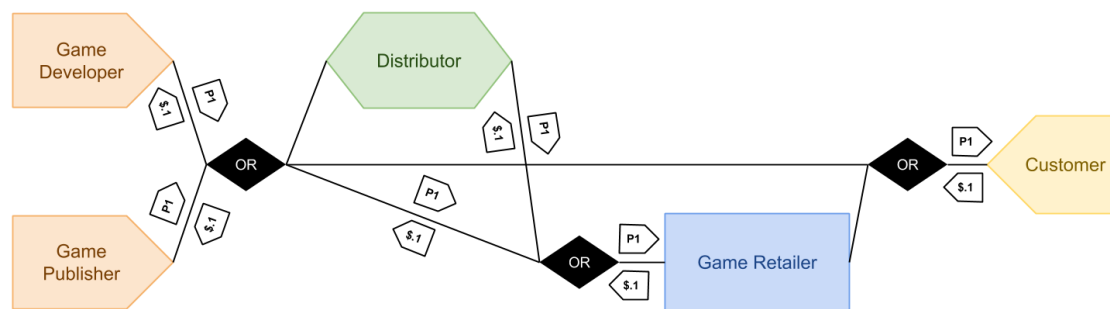

Figure 9: Game Retailer SSN

Legend – Game Retailer SSN		
Products	**Services**	**Money**
P.1 Game	-	$.1 Payment for P.1

Product and services	Examples
P.1	Game Developer – Customer: Consumers can buy Minecraft directly on the developer's website Game Developer – Distributor: Developer Valve had EA handle the physical distribution of Team Fortress 2. Game Developer – Game Retailer: Shining Rock Software (Indie developer) sell game via Steam as a retail-channel. Game Publisher – Customer: Games sold to consumers directly from the publisher though

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[30] Ubisoft reports 96.8 percent growth selling digital-only goods in 2014.
[31] Gold Status: The finished product as shipped to customers

their own channels: Steam (Valve), Origin (EA) or Uplay (Ubisoft).
Game Publisher – Distributor: Square Enix handled distribution in Japan of Blizzard's Diablo III game.
Game Publisher – Game Retailer: Amazon sells Ubisoft's *Assassin's Creed* games.
GOG.com sells CDPROJEKT's *Witcher* games.
Distributor – Game Retailer: Smaller retailers buy physical games from local distributors.
Game Retailer – Customer: End-users buy games from retailers: e.g. Amazon.com, Steam or BestBuy

6.3.6   Game Platform Owner SSN

Platform owners play the central role in the G-SECO. Game platforms are the hub of their own console-SECO and jointly a collection of hubs within the G-SECO. Several distinctions can be made for the types of platforms that exist, and are discussed in subsection 9.2.6. Figure 10 shows the SSN of a video game console platform owner, for completeness essential hardware suppliers are incorporated.
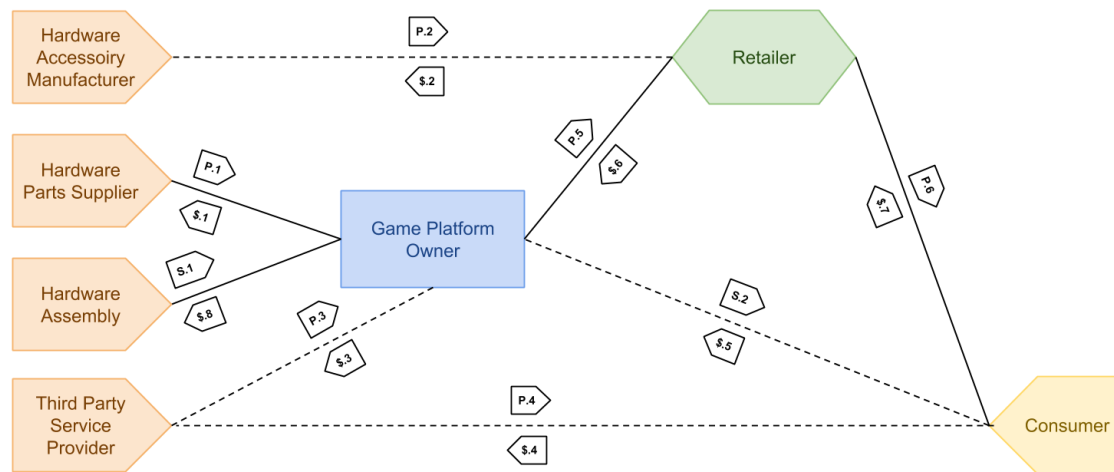

Figure 10: Video Game Console Manufacturer SSN

Legend - Video Game Console Manufacturer SSN

Products	Services	Money
P.1 Hardware parts	S.1 Hardware Assembly	$.1 Payment for P.1
P.2 Hardware accessories	S.2 Additional Services (e.g. Multiplayer gaming, Free games, etc.)	$.2 Payment for P.2
P.3 Integrated service		$.3 License fee for P.3
P.4 Direct Third party service (e.g. Netflix, Twitter)		$.4 Subscription fee for P.4
P.5 Video Game Console		$.5 License fee for S.2
P.6 Video Game Console		$.6 Payment per unit for P.5
		$.7 Payment per unit for P.6
		$.8 Fee for S.1

Product and services	Examples
P.1	PlayStation 4 and Xbox One CPU and GPU: AMD. SK Hynix manufactured Xbox One Memory and storage. IBM built the Wii U processor.
P.2	Logitech, TurtleBeach, Steelseries and Razor are organizations specialized in creating hardware

	accessories like headsets and controllers for PC- and console-gaming. These accessories are sold through retailers.
P.3	I3D.net provides hosting solution for publishers to host large games. More visible for the consumer are integrated products like Twitter, Twitch, Netflix, Spotify and Amazon instant video.
P.4	P.3 product integrations are a service towards the platform's consumers.
P.5	Platform owners sell Xbox One, Wii U and PlayStation 4 to retailers.
P.6	Retailers sell Xbox One, Wii U and PlayStation 4 to consumers.
S.1	Foxconn assembled PlayStation 4, Xbox One, Wii U and iPad.
S.2	Video game console manufacturers sell subscription to additional service on their platform: Xbox Live, PlayStation PLUS.

6.4 Business models and evolution

This section describes the business models applied by the organization types identified in section 6.2. Business models, for an important part, define organizations' current strategies. Thereforee, privately held companies often do not disclose information about their BM deliberately without any further incentive. For publicly held companies openness in their business strategy is common, as they need to inform shareholders on their goals. However, a concise summary of their business model is not regularly shared.

Before looking at individual types of organizations we first take a product-perspective by looking at how end-users pay for games produced by the video game industry we can identify many different revenue streams that organizations apply as part of their business model. These revenue streams can tell a lot about the underlying business model. Revenue streams form one of the few business model segments that is clearly visible to outsiders, as pricing is communicated clearly and openly for most game-related products facing end-users[32]. Osterwalder & Pigneur (2010) pose two basic categories of revenue streams: Transaction revenues from one-time payments and recurring revenues from ongoing payments. Both categories can be subdivided into several types. Table 9 lists a short description of each revenue stream type and to what payment method it applies from a customer's (video game end-user) point of view.

Table 9: Types of Revenue Streams

one-time payments	ongoing payments
1. Asset sale • Customer pays once to permanently own a product 2. Lending/Renting fee • Customer pays once to temporarily use a product 3. Usage fee • Customer pays once for a single use of a service • Price correlated to amount of use	4. Subscription fees • Customer periodically pays a fixed amount for the use of a service. • Price not correlated to amount of use. 5. Licensing fees • Customer can reuse intellectual property 6. Brokerage fees • Customer pays commission for successful transactions • *Customer is not (always) the end-user* 7. Advertising • *Customer is not the end-user* • Customers pays to advertise

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[32] An exception are license-arrangements held between middleware developers and larger game developers, or game developers and publishers as these prices can vary a lot per project.

6.4.1 Applying the business model canvas

For each node-type listed in section 6.2 a typical business model pattern is depicted upon a business model canvas (BMC) in appendix 0. The goals and use of the BMC-diagram has been explained in section 5.2.1. If very different business model patterns exist among a single node-type multiple BMCs are created to illustrate differences. For each BMC-segment a description is given to elaborate on the findings and to determine what segment characteristics as described in sub-section 5.2.1 are pertinent. These characteristics are shown in *italics*.

The remaining part of this subsection contains a summary for each of the common business model configurations in appendix 0.

Game middleware developers (9.2.1) are complementors in the G-SECO that develop and commercialize plug-ins, add-ons and libraries for other games or game-software tools. Their business models are typically focussed on larger clients, such as major game development studios, however we find examples of game middleware developers that also target smaller game developers with software-integration through platforms such as game engines. Game middleware developers focus on specific, reusable, often highly complex, functionality that game developers do not want to build themselves such as a large scale networking frameworks for online games or a realistic physics component. Game middleware developer BMs differ from other G-SECO BMs. Key observations:

- Complementor role
- Dependent on product integration with platforms
- Complex, IP-heavy products

Game engine developers (9.2.2) are deliberately distinguished from other middleware developers as their business models are generally different. Although both game middleware and game engine developers deliver software solutions to game developers, game engine developers function more as a platform for suppliers and a general game development framework and tool-set for customers. Key observations:

- Platform role (on the G-SECO supply side)
- Focus on accessibility and completeness for users
- Integration of middleware and end-user assets

Game developers (9.2.3) show three types of BM-configurations each based on their level of independence. The most dependent development studios are publisher-owned and have little autonomy in the G-SECO. The most independent (Indie) game developers, are self-sustaining and have incorporated many non-development business functions into their BM such as publishing, marketing and funding. Key observations:

- BM is very dependent on publisher relation
- Distinguishes from peers by creative excellence
- Key complementor in G-SECO: creates the actual products

Game publishers (9.2.4) are consumer focussed. Their BMs are adjusted to deliver mass-market products to end-users, backed by market research and marketing efforts. Game publishers maintain strong ties with game platform owners and retailers to maximize exposure of their products. Game publishers operate in relatively large (multi-year) project development life cycles exposing them to more investment-risk than other G-SECO-members. As a result is can deliver the most successful games (GTA V, Call of Duty, FIFA) or are forced to close their subsidiary development studios (EA – Westwood, Bullfrog) when projects fail, or can even default after a year of disappointing sales (THQ). Key observations:

- Consumer (end-user) focussed
- High diversity in revenue models
- High risk/reward balance
- Largest supplier of capital and funding in the G-SECO

Game retailers (9.2.5) are tied to the G-SECO, by the degree that games are part of their catalogue. For example Amazon.com and BestBuy are major retailers, but not very dependent on the G-SECO with respect to their BM. Dedicated (digital) game retailers such as Desura and Valve are very dependent on the G-SECO. Online game retailer BMs focus on their costs on advantages of scale from large sales-numbers. Online game retailers compete heavily on price and need to distinguish themselves in the customer relationships segment with useful features such as download-management, friends-lists and recommender systems to make their catalogue most accessible. Key observations:

- Price driven competition
- Competitive advantage through scale
- BMs vary depending on physicality of stores and products

Game platforms owners (9.2.6) are the central hubs of the G-SECO. The game console manufacturers apply a two sided market BM in order to generate income from both the supply and demand side for games published on their platform. Hardware agnostic software platforms, such as Valve's Steam and Google's Android do not govern proprietary hardware and distinguish their BM through customization options and freedom for the end-user. Both types of platforms attract additional complementors by the number of users on their platforms. Hardware-only platforms, such as game consoles, do not tie software products to platform users which allows for a second-hand games market as opposed to software-platforms where purchases are tied to a single user account. Game platforms are not only a platform for game publishing: they've integrated many other services and business activities such as online retail and music/video streaming services. Key observations:

- Two sided market model
- Ownership of software and or hardware platform determines BM-options
- Expanding key activities: retail, self-publishing

6.4.2   Trends as markers for Business Model change

Organizations within the G-SECO cooperate and compete with each other in different ways that have been partly uncovered by the SSN- and BM-diagrams in sections 6.3 and 6.4. Competition can be expected when two organizations of the same node type apply the same business model. However, we can also reasonably suspect that two organizations of different node types have started to compete in certain areas of their business even though it is not directly derivable from these prior results. This section aims to depict the interplay among all business model segments of the G-SECO over time.

In order to establish a timeline that displays the general evolution of business models in the G-SECO resulting in its current state, precursory changes need to be identified in an effective and repeatable fashion. In an industry where most players reveal little information about their current strategies and BM-arrangements, industry wide indicators and descriptive retrospects are most suitable.

When looking top-down at BM-change in a SECO, industry *trends* can be seen as significant increases or decreases of similar SECO- and/or business model changes in a given time period. From this perspective we define trends as collections that contain mutations of the same type and direction, initiated by individual organizations. Not every collection of changes can be considered a trend. Only when the size of the collection in a particular time period deviates significantly from the same collection in other time periods, a trend is occurring. Furthermore the direction of all changes in a collection has to align for it to be a trend, as this direction describes the start- and end-position of a BM-change. Collections containing similar changes in arbitrary directions are not considered trends. Finally, each trend is characterized by the typical changes that organizations make to their business model or changes in the structure of the SECO as described in the hypothetical model in section 4.

To illustrate the above with an example: A number of publishers and developers in the G-SECO are changing the business model patterns of their games to 'free2play' (F2P) or 'freemium'; meaning these games[33] can be installed and played by users for free[34], whereas it was more common to charge a fee before the game could be installed and played. Although the exact BM-changes to reach the envisioned F2P BM pattern vary slightly per organization, they all share commonalities and an overarching goal. Meaning: (1) The many changes in business model patterns to reach a F2P-pattern can be grouped as a distinctive collection because they share common characteristics. (2) The changes occurred much more frequently in the time period 2009-2014, compared to earlier periods of that timespan. (3) Relatively many organizations make the change to F2P and

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[33] Examples of games that have changed to a F2P business model: Valve's: Team Fortress 2; EA's: Star Wars - The Old Republic; Funcom's: Age of Conan - Unchained; NCSoft's Aion and Trion Worlds': Rift.

[34] Free-2-play games often withhold certain features by default; players can choose to unlock them in exchange for a fee (micro transactions). The initial playability (the game before any payments are made) of free-2-play games varies greatly. For example: Valve's Dota2 only provides cosmetic upgrades to users willing to pay for them so non-paying users can still use all features of the game itself can experience no disadvantage over paying users.

not vice versa, giving this collection of changes direction. (4) Typical BM-segments affected changes made to the business models of organizations following this trend are: Revenue streams: Shifted from previous payment method (upfront fixed price or subscription) to in-game purchases. No payment is made for the game itself. Channel: The channel through which sales are generated is now layered, as the game itself becomes a channel. Customers need to obtain the game and then engage in micro transactions from within the game's store. As all requirements are met we can define this collection of changes as a trend.

To summarize, we define a trend as: *The collection of comparable BM -changes by actors in the SECO aimed at reaching similar strategic goals.*

Each trend has:

1. A general description of the change
2. A set of characteristic BM-changes
3. A defined timespan
4. Direction

6.4.3   Identifying trends in the game industry

Although no structured data sources containing trends and business model changes exist for the game industry, a wealth of unstructured resources is available. These resources range from ad-hoc industry reports by market watchers to critical analyses by game industry experts and media outlets. Following the method described in section 3 IV, a structured list of trends according to the abovementioned criteria is constructed (Table 10). The business model changes comprising these trends function as the branch and merge points in the timeline-diagrams and are listed in Appendix 0.

Table 10: List of trends occurring in the game industry

Time referred to in publication	Generation	Trend/event name	Example
2005	6	Online console gaming	
2006	6	Accessoirized console games	Guitar hero, Singstar
2012	7	Cloud Streaming	PlayStation Now
2013	7	PC Software platforms	Succes of Steam triggered Origin and Uplay; Greatly increased number of games on Steam
2013	7	Virtual Reality	Oculus Rift; Sony Morpheus, Virtuix Omni
2013	7	Converting to Free-to-Play	Converted to F2P: Team Fortress 2, League of Legends, PlanetSide 2, and Star Wars: The Old Republic
2013	7	Hit Driven (AAA series)	Grand Theft Auto V, Gears of War: Judgment, God of War: Ascension, Dead Space 3, Dark Souls II, Metal Gear Rising: Revengeance, Bioshock: Infinite, Crysis 3, Tomb Raider, DmC, Pikmin 3, and Dragon Age III: Inquisition
2012	7	Indie 'hits'	Hotline Miami, Mark of the Ninja, Fez,Spelunky, FTL
2013	7	Companies suppressing used games	Digital distribution, ID-bound physical copies
2013	7	Game streaming/broadcasting	Twitch and Twitch integration in games and consoles, (2014) Steam streaming.
2013	7	Indie games to consoles	Xbox One self publishing

2013	7	Secondary Screens For Gaming	
2013	7	Open source gaming	Steam OS, Ouya
2012	7	Crowdfunding	
2013	7	Mobile gaming	
2013	7	Digital games	
2012	7	Cross platform	
2012	7	Consoles as entertainment hubs	
2012	7	Digital distribution	
2013	7	Midcore users	
2011	7	Social games	
2014	8	Free-To-Play Comes To Consoles	Angry Birds, Warframe, World of Tanks
2014	8	Single Player And Multiplayer Begin To Merge	Destiny, The Division and Watch Dogs
2014	8	Early acces games	DayZ, Starbound, Dungeon Defenders II
2014	8	Aquisitions	Facebook -> Oculus Rift; Microsoft -> Mojang, Amazon -> Twitch
2014	8	Devaluation of games	
2014	8	Review authority	YouTube, Metacritic, Steam user reviews
2014	8	Media convergence TV	

6.4.4 Constructing a timeline-diagram

The y-axis of each diagram lists all unique observations made across all node types defined in section 6.2, in a particular business model segment in the current (8th) generation. Hence the current state (frontier) of the evolution tree determines the possible paths available for evolution. This will provide enough insight to display per node type, in what trajectory their current state has been reached, what branching and merging took place, on what areas of the business model segment at hand competition takes place, whilst maintaining a relatively high-level perspective.

The console generations (detailed in Table 5, section 5.3.2) are used as time intervals on the x-axis and represent the possible points of change. The primary reason for this generalization based on time periods is to remove the appearance of exactness that might otherwise be derived from a continuous timeline. As trends are considered collections of BM-changes by different organizations, their lack of exact (shared) start and end dates is inherent. Moreover, this generational division optimizes between simplicity and overgeneralization. As each console generation heralds a period of new trends and developments made possible by the technological capabilities of its platforms, it simultaneously sets a barrier to those possibilities. These barriers are usually conquered by the next generation, creating clear periods across which change is most likely to occur, while maintaining a comprehensible and manageable set of possible change points.

6.4.5 Timeline-diagrams of business model segment evolution

6.4.5.1 Customer segments evolution

Looking at the business model descriptions in section 6.4 we see that the current end-user customers segments display small variations and are labelled differently by each organization. These can range to relatively large customer segments, such as iPhone users that like puzzle games, to small segments like online sci-fi RPG-fanatics with high-

end PCs. Although gaming has grown to become a mainstream part of pop-culture, most games cannot be considered mass market products as they clearly target a specific niche and are dependent on the platform a player needs to own, meaning these customer segments are by definition a subset of the platform's target demographic.
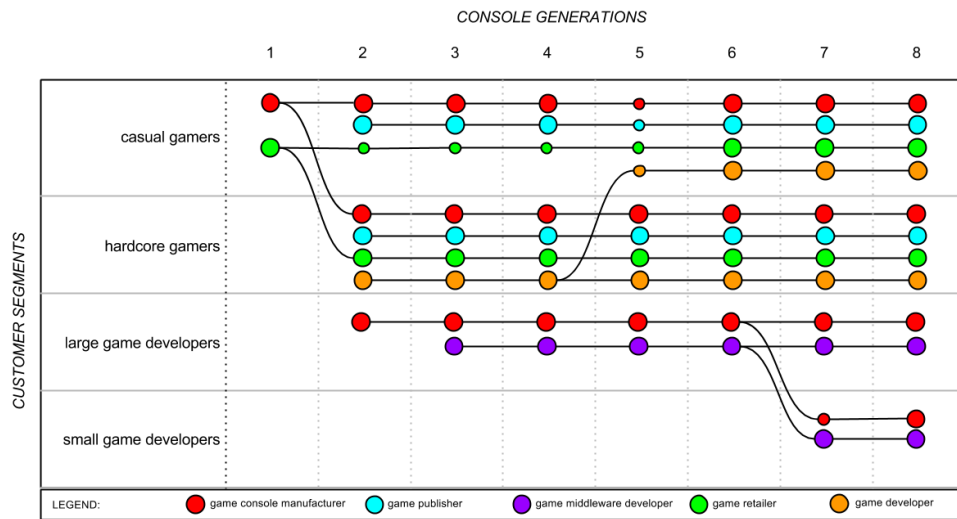
As the game industry matured, so did its understanding of customer segments. This understanding gave rise to games suited for a wider range of target audiences. Simultaneous to this development, the initial target audiences literally matured. During the first generations games were mostly targeted at children and young adults. Today these children are adults, now in their twenties and thirties often still playing games. In addition to this older audience, a new type of customer has been drawn in as more accessible games became available to anyone with a web browser or smartphone around the start of the sixth console generation. Moreover, the deliberate distinction between game-savvy and non-gaming target audiences has become more overt in starting in the sixth generation as smartphones opened up a new market for game developers and company's like Nintendo fully committed to serving the casual gamer market with their Wii and DS platforms growing the games market as a whole, and creating a gateway for people that have never played games into playing games regularly.

As the G-SECO expanded, so did the number of archetypical node types and the middleware they use to fulfil their business functions, this is displayed in the analysis of the key activity segments in sub-section 5.6.4.6. From the SECO viewpoint discussed in section 5.3, software products within the game industry do no not only target those that play games, but also those that create and/or sell games as their customer segments.

Leading to the following four customer segments:

- Gamer
  - o casual gamer
  - o (hard)core gamer
- Game developer
  - o large game developer
  - o small game developer
- Game retailer

Each customer segment finding in section 6.4 can be placed in one of these general segments. A nuanced case can be made for individuals operating on the border of consumption and production, usually in the form of core gamers that modify and create content for the games they play. For example by creating new game modes, maps, or character models. Subsequently they distribute these freely or through a managed marketplace such as Valve's Steam Workshop. For clarity this case is left out.
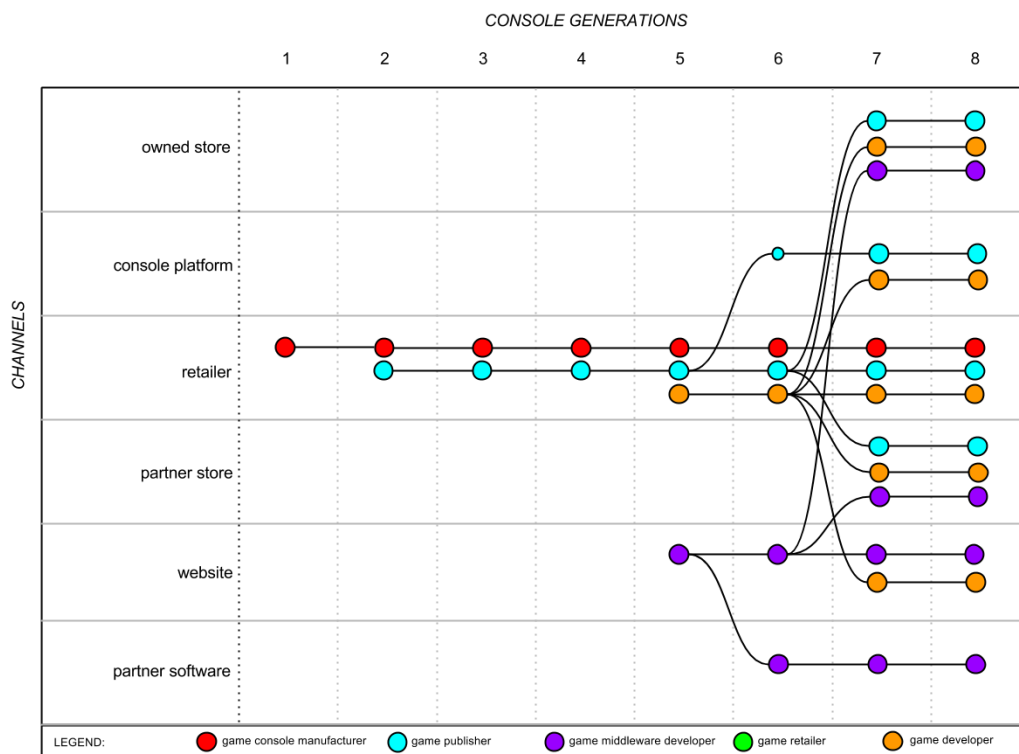
CONSOLE GENERATIONS

Customer segments evolution		
Generation	**Evolutionary milestones**	**Trends affecting customer segments**
1	The first game console (Magnavox) was released in 1978, along with the first commercial video games. Customer segmentation was almost absent compared to the 8th generation. Neither video game-savvy audiences nor middleware developers existed yet. Thereforee we regard the first target customer segment as casual gamers, mostly young males. The first node types consisted only of console developers and retailers for the 'platforms' were closed as explained in section 4.3.2.	
2	Table 6 in section 4.3.2 shows that the second generation spawned two new node types (publishers and developers) along with two new but completely different customer segments, namely: an extra segment of end-users, what we now call (hard)-core gamers and the new internal customer type of large game developers. Game developers are directly reliant on a platform's specifications to create games, therefore game console manufacturers need to alleviate the game development process of any impediments from their side to increase the platform's attractiveness, which leads to more published games and directly contributes to beneficial network effects. As console developers created a two-sided-market for games on their platforms. Game publishers started creating games, using their own development studios.	
3	Casual gamers become a less important audience.	
4		
5	The mobile and social market open up new opportunities for game developers. Especially smaller developers can reach a large audience with relatively easy games and accessible publishing options.	
6		
7	Small game developers become an important factor in the game SECO. Middleware developers start to target smaller developers (through accessible license structures)	
8		

6.4.5.2   Channels evolution

A shared characteristic of all B2C (business to consumer) channels of the eighth generation, discussed in section 6.4, is their dependency on consumer internet access for digital distribution and retail. Like in other SECOs the advent of the internet gave rise to new opportunities for software developers and –vendors to deliver their goods to

consumers faster, more frequent and completely digital, in result decreasing the need to create physical products for consumers. The G-SECO is taking a similar journey. The game industry, because of its age, harboured no internet-empowered business models in its first generations. All channels inside the G-SECO were founded on physical products and logistics. These channels are almost all still intact: Physical games sales, although declining, are still a large chunk of the SECOs revenue stream. These old channels such as physical retailers coexist along new channels like platform stores create an interesting channel-landscape.

B2B channels (business to business) are changing too. New channels directed at small complementors such as independent developers start to remove the need for the middleman (publisher) for distribution, retail and marketing. Adding the democratization of financial capital through kick-starter-like C2B platforms shows the empowered status smaller (often start-up) organizations can currently enjoy in the G-SECO. Six channel types are distilled from section 6.4 and displayed in the channel BM-segment evolution diagram.
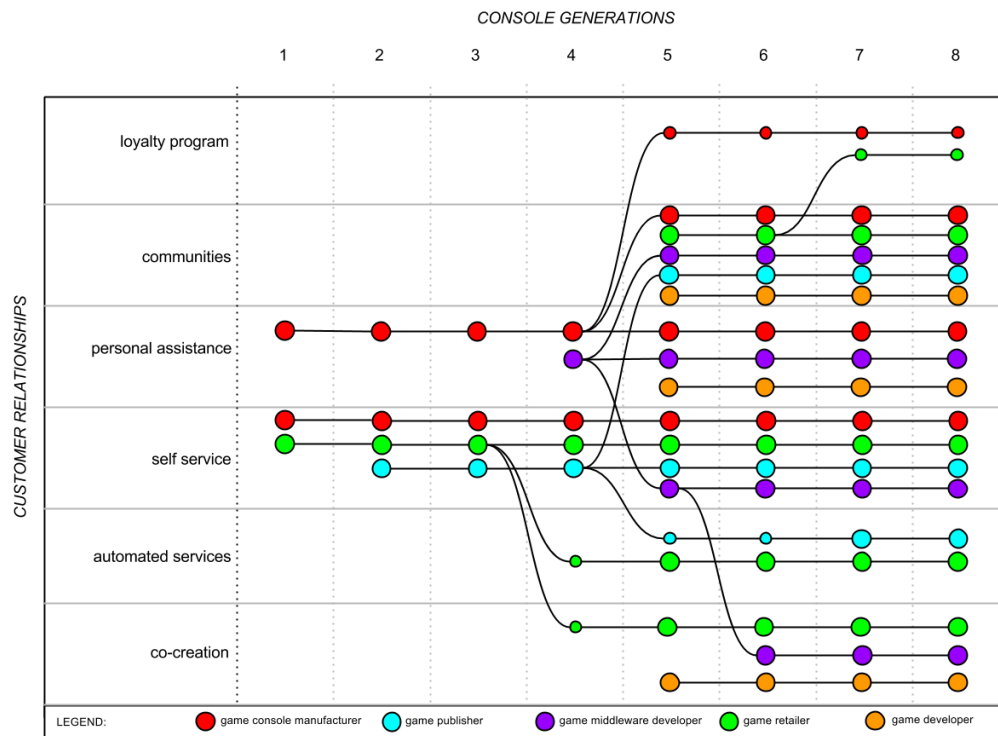

Channels evolution		
Generation	**Evolutionary milestones**	**Trends affecting channels**
1	Retailers started out and remained the only where game consoles are sold.	
2	When publishers emerged the only channels were retail stores.	
3		
4		
5	The advent of internet and the world wide web opened	
6	When the 6th console general matured, the first online games started to appear. Although for PlayStation 2 and Xbox were	T.1 Online console gaming

	equipped with networking modules, online multiplayer emerged quite slowly, by no an indication of its future. Game engine developers start to integrate software options of other middleware developers in their game engine. Functioning as a channel for more specialized middleware developers.	
7	All three major platforms of the 6th generation (Xbox 360, PlayStation 3 and Nintendo Wii) fully incorporate an online store providing a new channel for the sales and distribution of games and other digital products. In a similar way Valve's Steam grows and takes a large part of digital distribution in the PC games market. Other games publishers such as Ubisoft, Blizzard and EA create their own retail channels as digital game libraries, allowing users to download the publishers' games mostly exclusively through this channel. Middleware developers do not stay behind. The most iconic example of a platform-mindset for game development is the unity game engine. Providing an accessible development environment and a channel for digital game assets distribution.	T.3 Cloud Streaming T.4 PC Software platforms T.6 Converting to Free-to-Play T.8 Indie 'hits' T.9 Game companies suppressing used games T.16 Digital games T.18 Consoles as entertainment hubs T.21 Social games
8	The trend that consoles have become entertainment hubs is carried though in the 8th generation. Xbox One and PlayStation 4 broaden their channel options by pointedly including TV and game streaming services in the platforms software and user interfaces (T.28).	T.22 Free-To-Play Comes To Consoles T.28 Media convergence TV

6.4.5.3 Customer relationship evolution

Even more so than in the case of channels, the BM-segment of B2C customer relationships has been greatly influenced by internet-access to become what it is today. Early online retail traded in personal assistance for choice, price and speed. Today however we see many of the perks of offline retail such as personal advice, becoming emulated and even improved by automated systems included in market platforms like the Google Play, Steam and PlayStation Store. Recommender systems, price compare and product-reviews are examples of value adding customer relationship elements that offline retail cannot provide effectively. Apart from the customer relationships directly managed by organizations the SECO, delegated and remote relationships are present too. Co-creation through game-modification by end-users and third party online communities about games are examples of organic SECO-activity that shape an organization's relationship with customers (Postigo, 2007).

The customer relationships between different node types in the G-SECO have not changed much over time. Except from larger organization's that deal with many smaller ones, for instance Valve dealing with hundreds of small game developers, a need for (dedicated) personal assistance remains. The need for personal assistance is due to the highly technical nature of most B2B products in the G-SECO. Self-service through documentation is often not enough for larger projects.
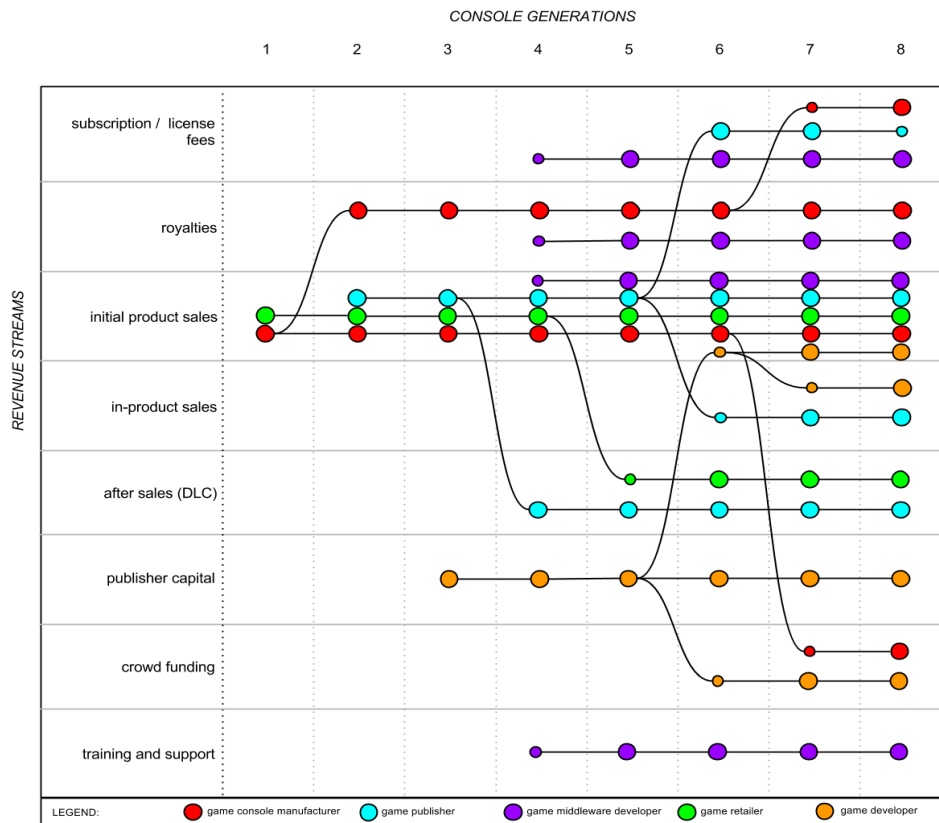
Customer segments evolution		
Generation	**Evolutionary milestones**	**Trends affecting customer segments**
1	Game console developers have little direct contact with end-users. Game retailers. Game retailers	
2	Game console manufacturers retain a close relationship with the few game publishers (and developers) and provide dedicated personal assistance. Game publishers rely on self-service for end-users through product manuals for their games.	
3	No notable changes in customer relationships	
4	Video game internet communities start to form, creating a new way of consumer interaction and opening up new types of customer relationships for all node types.	
5	Game mods for pc games help co-creation for these games (Postigo, 2008). Up until this point game developers have mainly functioned as subsidiaries of publishers. Now that independent game developers start to finance and produce games without intermediaries there customer relationship strategies begin to matter.	
6	Nintendo loyalty program	T.1 Online console gaming
7	Online game retailers have various loyalty programs. Automated services become better. Online game retailers like Amazon and Valve benefit greatly from user data and can provide targeted offerings based on customer preferences. Co-creation is no longer applies to game developers and publishers, but also to middleware developers that let individuals create content for their middleware platform (Unity). Game retailer also apply co-creation tactics by creating communities around the stores and even allow users to sell game assets they've created themselves to other consumers.	T.4 PC Software platforms T.8 Indie 'hits' T.10 Game streaming/broadcasting T.11 Indie games to consoles T.14 crowd funding T.16 digital games
8	Nintendo stops its loyalty program	T.24 Early access games T.27 Review authority

6.4.5.4   Revenue streams evolution

Revenue streams are a business model segment that has seen a lot of growth in variety through the G-SECO's maturing process. With the early implementation of a two sided market model by platform owners, complex revenue streams have been present from the start. Royalties on game sales are a game console platform's main income stream, but when internet connection became used on the game consoles, new income streams such as subscriptions and direct game sales became possible. Direct sales to consumers, not only by platform owners, but also by developers, publishers and even middleware developers, created new revenue streams for all node types.

Section 5.4 shows revenue streams correlate with key business activities. This follows from the fact that activities that generate relevant income are important. From this perspective we can argue that the ability for any node type to perform a particular activity in the G-SECO has become increasingly easy. Developers can sell games, game console manufacturers distribute games. Middleware developers distribute their software automatically through partners. The dispersion of business activities results in a greater variety of income streams.

Moreover, the way in which games are sold to consumers is continuously expanding. Revenue in retail is currently created from full priced single games, game expansions, downloadable content, subscriptions, pre-orders, early-access, micro-transactions or combinations of these.
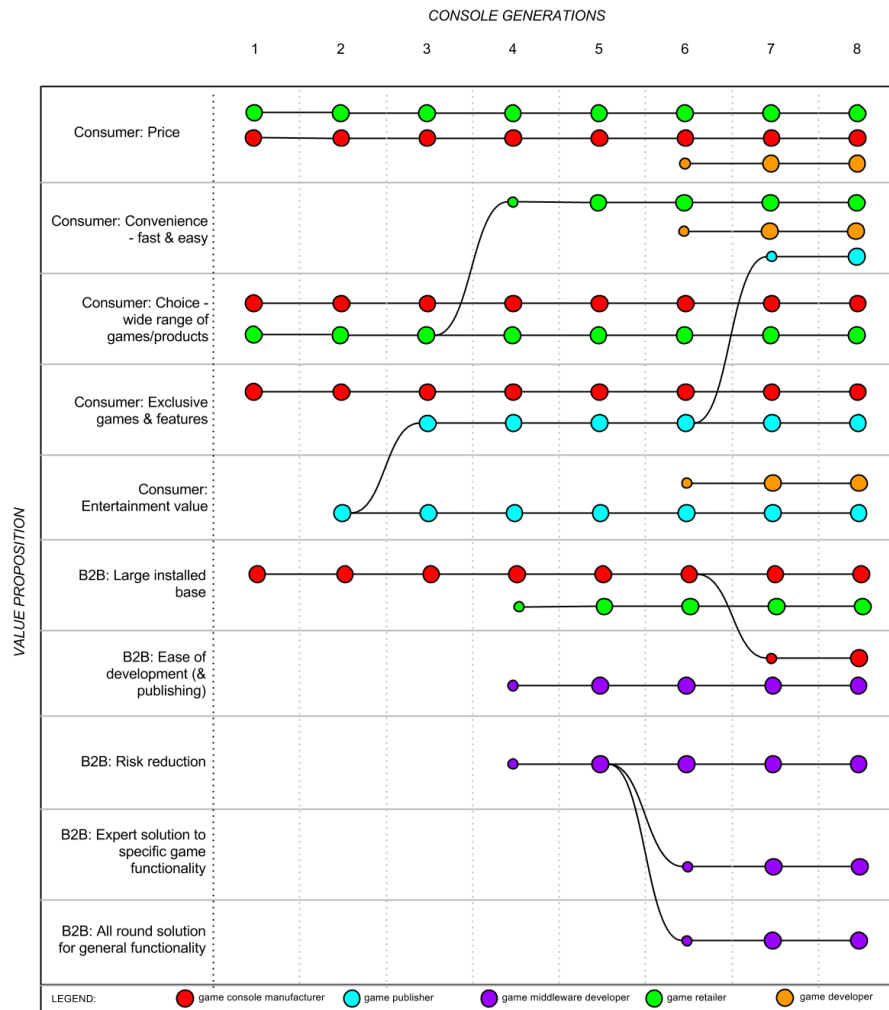
Revenue stream evolution		
Generation	Evolutionary milestones	Trends affecting revenue streams
1	Initial product sales (selling a product once) are the only form of income for retailers and video game console manufacturers in the first generation.	
2	Publishers also only sell single games to consumers	
3	Revenue streams of developers owned or contracted by a publisher come directly from that publisher	
4	The first expansion packs appear for PC games. Creating an income stream after sales options based on initial sales made earlier.	
5	Online retailers start to profit from selling additional content for games	
6	Subscription based online games become popular on PC, exemplified by World of Warcraft, reaching 12 million subscribed users in 2010. Some indie game developers sell games directly to consumers without any intermediary, e.g. Minecraft.	
7		
8	Subscription games lose ground as the free-to-play income model takes over.	

6.4.5.5   Value proposition evolution

The value proposition for complex entertainment products such as games is not straight forward and completely different for each side of the two-sided market model, or B2C/B2B-customers. Value that end-users experience when consuming games is explained in subsection 9.2.4.2, yet for example price is a value proposition dimension of retailers, and ultimately of the whole SECO. The minimum selling price is dependent on the efficiency of the SECO as a whole. Subsequently the G-SECO as a whole competes with other entertainment industries, e.g. books, music and film for the consumers' time and money.

On the B2B side the value propositions applied by node types like game engine developers and video game console manufacturers are clearer, because they can be expressed in financial gains or risk reduction. In the early generations nodes types like game console manufacturers and publishers cooperated in symbiotic fashion, by aligning their key activities in order to reach shared goals. Today this cooperation is accompanied by competition from newer overlapping key activities that many node types have adopted such as retail and distribution. In this sense different node types compete for the same customer with similar value propositions.
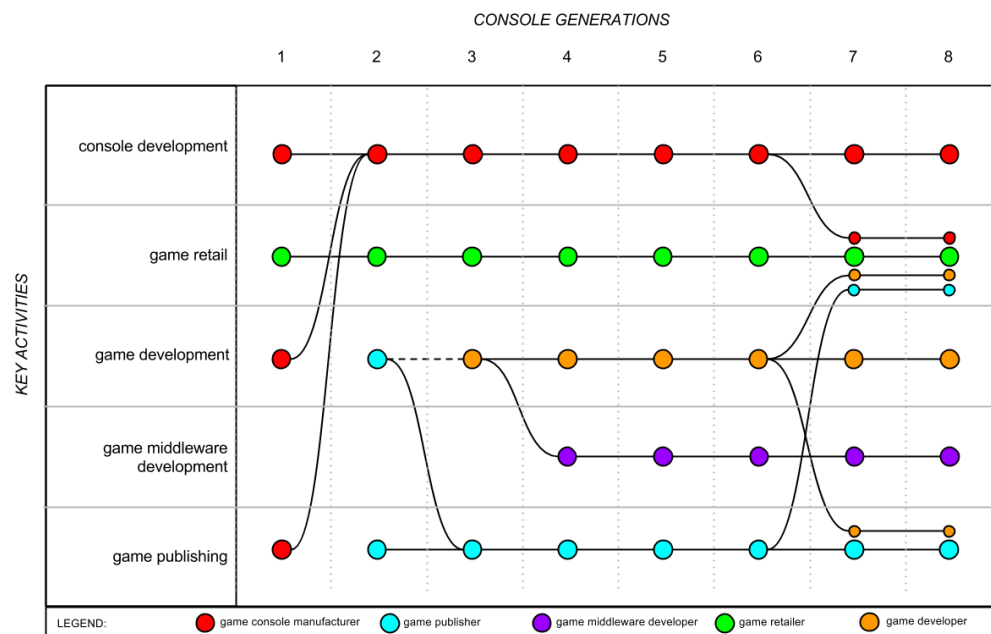
CONSOLE GENERATIONS

Value proposition evolution		
Generation	**Evolutionary milestones**	**Trends affecting value proposition**
1	The first generation of video game consoles was marketed as something totally new towards consumers; publishers were not yet a customer segment. Price however quickly became an important factor as competition was plenty. Another important factor in the video game console value proposition towards consumers is the availability of a wide range of preferably exclusive games.	
2	The need for a large selection of games is satisfied by allowing publishers to create games for the platforms of video game manufacturers.	
3	Publishers need to differentiate their games by creating new features and genres.	
4	As the software industry matures, B2B companies start to emerge catering to the needs of game development and publishing companies.	
5	Video game console manufacturers attempt to differentiate by providing additional non-gaming features with their console. Such-music cd-playback for PlayStation.	
6	The first independent developers start to market games directly to end-users themselves. Dvd-playback on consoles.	
7	Peripherals and accessories for game consoles become popular with games like Rockband, Singstar and Scene it. Digital game distribution requires publishers to attend to the need of this convenience. In addition Sony's blu-ray playback	T.2 Accessorized console games T.4 PC Software platforms T.7 Indie games to consoles T.15 Mobile gaming

	on consoles wins as Microsoft hedged its bets on HD-DVD, which did not become the de facto standard. The adoption of mobile platforms grows rapidly and older game publishers and developers start to create mobile games. Social games become popular as the mobile platforms and facebook provide new customer segment.	T.16 Digital games T.21 Social games
8	Game console manufacturer try to increase the attractiveness of their platform towards developers by lowering development and publishing entry barriers. Consumers are to be attracted to the video game console by the increasing number of non-game options, this time the cable-tv management and online game video streaming are core features on both PlayStation 4 and Xbox ONE.	T.28 Media convergence TV

6.4.5.6   Key activities evolution

As described in the previous sub-section, node types in the G-SECO have diversified their key activities over time by taking on key activities originally performed by other node types. Examples of this are publishers directly selling games to end-users and game developers self-publishing their games on large retail platforms like Steam or Xbox Marketplace. The y-axis on this evolution diagram contains all the main key activities of all node types identified in section 6.2 to show how node types moved in to and/or away from their defining business activities. Moreover this shows how new node types emerged, when key activities get delegated to specialized, newly formed node types. Delegation of business processes is also shown in the key-partners evolution diagram in 6.4.5.8.
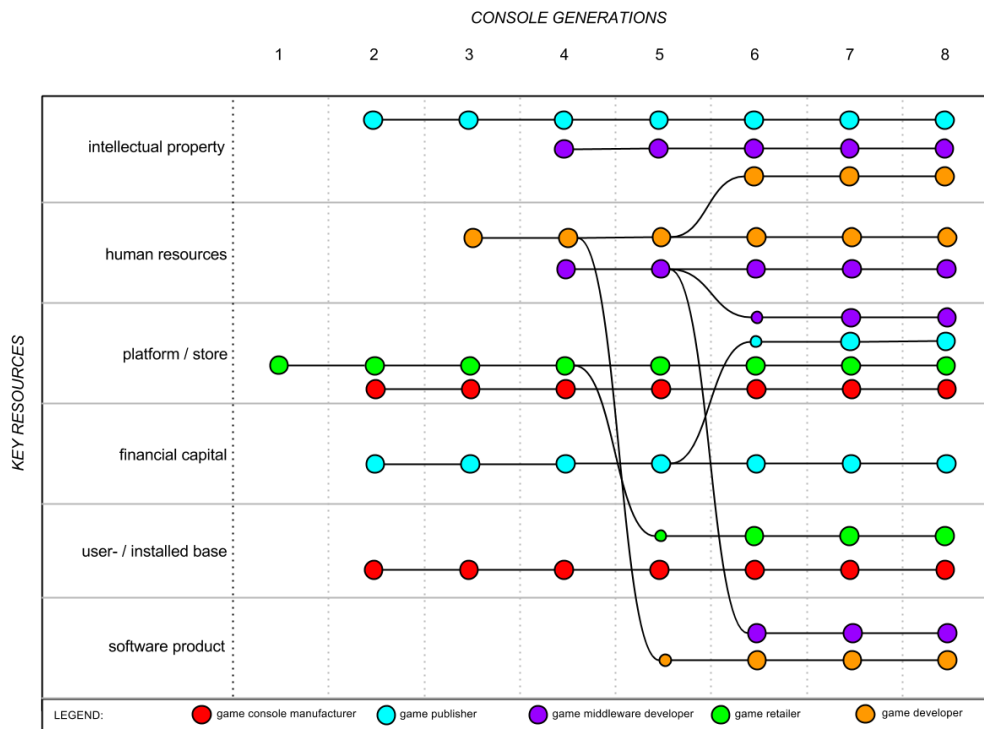

Key activities evolution		
Generation	**Evolutionary milestones**	**Trends affecting key activities**
1	Video game console manufacturers are the first node types of the G-SECO and start of the video game industry. Retailers have existed before game console manufacturers, but did not sell video game related products. During the first console generation video game console manufacturers were also the content (game) developers and	

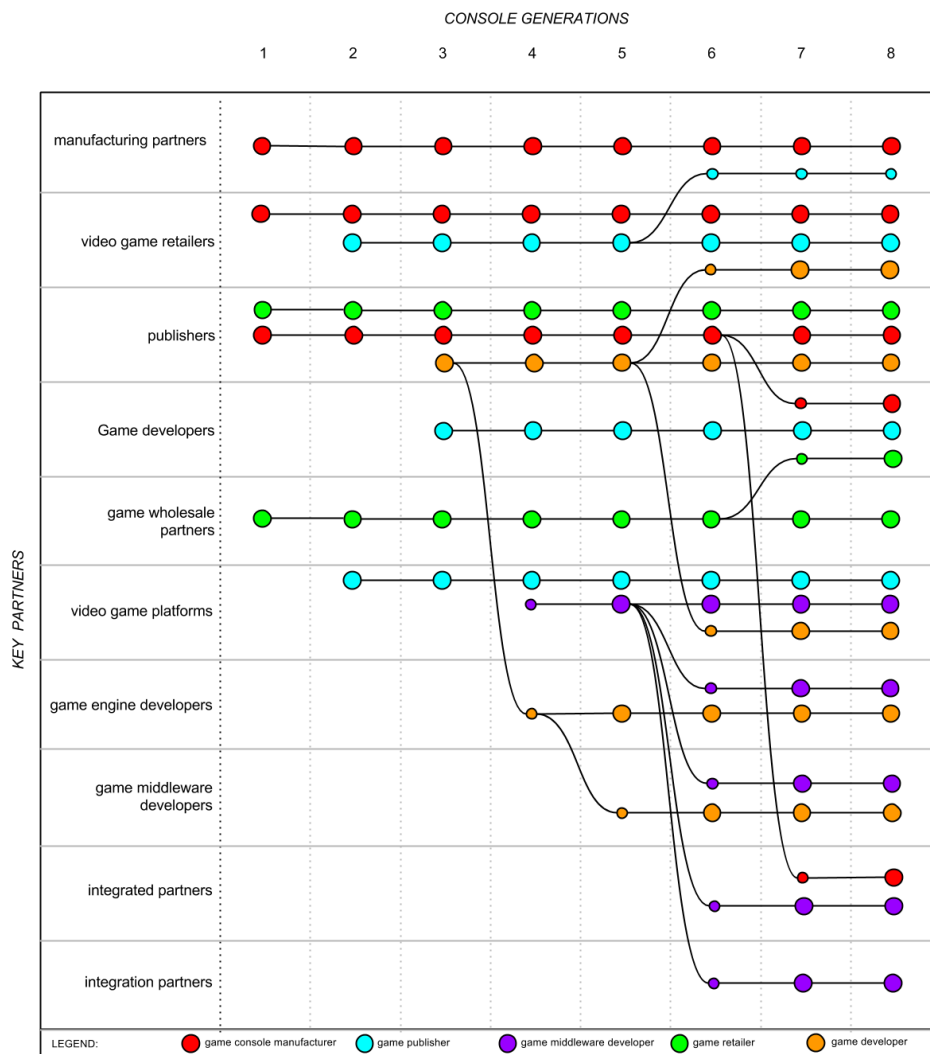|		
	publisher. The latter two key activities will be outsourced in the coming generations as part of the platform-business model.	
2	Video game console manufacturers open up their console to external game developers. At this moment all developers also published the games, or rather, publishers developed their own games. In the coming generation these companies start to outsource development so they can focus on publishing and marketing and run multiple projects simultaneously.	
3	Video game developers are now an established entity but remain related to publishers as described in sub-section 5.4.4.	
4	Developers start to create their own middleware, as part of the software product lines that allow them to reuse complicated but trivial components. These video game middleware packages can evolve to game engines and are be made available to other game development companies through licensed arrangements.	
5	The key activities of all node types remain the same during the fifth generation.	
6	The first internet connected game consoles appear on the market. Online games however remain niche products on game consoles. On PC online gaming has taken off.	T.1 Online console gaming
7	Internet connectivity is the standard on video game consoles of the 7th generation (Xbox 360, PlayStation 3, Wii). In addition to online gaming, this opens the market for digital game retail, distribution and publishing, creating new opportunities in key activities for most node types. All major platforms develop their own store and attain a part of the retail market for digital games. Simultaneously the need for online video game stores on PC is covered by Valve's Steam, and other newly formed retailers. Some larger game publishers (EA, Ubisoft) choose to develop their own stores to gain a piece of the retail market. In addition self-publishing becomes a viable for PC game developers, as popular distribution channels pose attractive revenue sharing options. Game publishing only still works for smaller game developers with small game projects as financing without a publisher's capital remains hard, although the first crowd funding projects start to appear.	T.4 PC Software platforms T.7 Indie games to consoles T.14 Crowd funding T.16 Digital games
8	Game console manufacturers support the potential of independent developers and improve the development and publishing options of their platforms. Game console manufacturers also start to do more SECO orchestration tasks since new third party products and services like TV, apps and streaming become an important part of the value proposition.	T.28 Media convergence TV

6.4.5.7 Key resources evolution

Publishers greatly benefit from reputation gained by successful games that they have released earlier like Halo 3 benefits from Halo 2's success. Other value exploited by publishers comes from creative intellectual property such as a Nintendo game that includes the Mario character will benefit from that character's legacy. Creative intellectual property is an important asset in the game industry that shows its value over a longer period of time. Human resources are the most important asset in the game development process. Highly specialized creative talent greatly defines the quality of a game. Platforms and stores have become important assets for more than just the game console manufacturer node type, now that mobile devices and software platforms have taken market share. Financial capital and investment experience in the game industry has remained an exclusive asset for publishers, but is now being contested by crowd-funding initiatives. Users and/or installed base remains an important asset for game console manufacturers unlike IP however, an installed base has to be built up from scratch with every new console release, typically every generation.

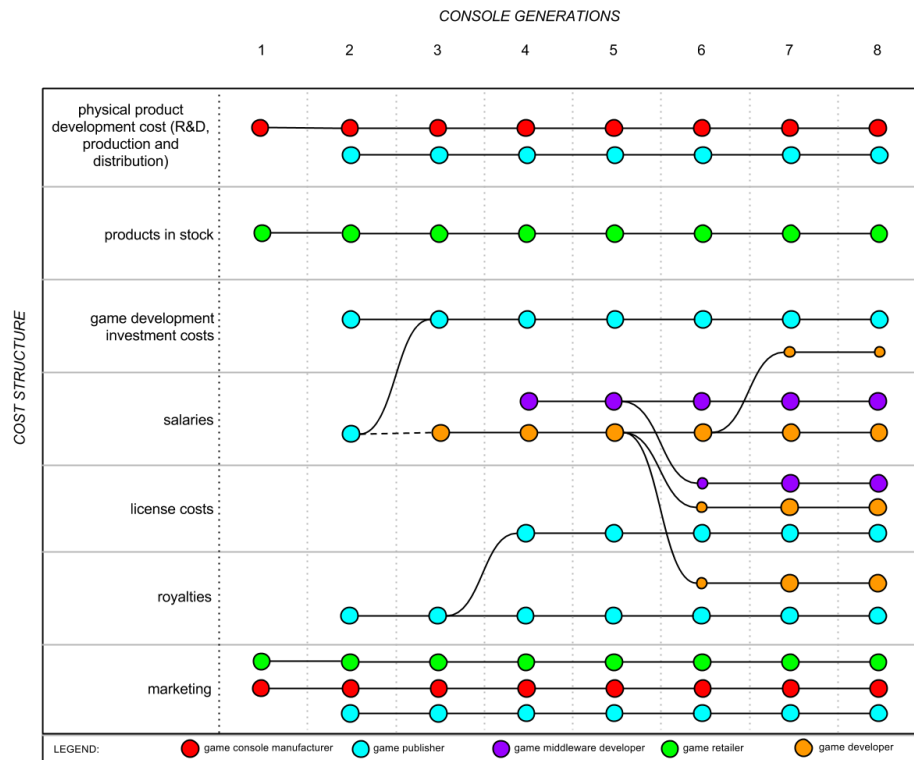| Key resources evolution		
Generation	**Evolutionary milestones**	**Trends affecting customer segments**
1	The first game consoles are innovative, but independent entertainment products. In this sense the most important key resources are internal, namely human resources and intellectual property.	
2	Game console manufacturers open up their platforms to other publishers, starting of a new dimension of competition in network effects. The installed base becomes a platform's driving resource and is required to maintain a positive feedback loop to attract more games published on the platform.	
3	Human resources remain the largest key resource of development studios. Their ability to attract and maintain creative talent increases their success.	
4	Human resources for middleware developers focus more on the specific knowledge employees have about certain products and problem types, for most game middleware products are highly specialized.	
5		
6		T.1 Online console gaming
7	Games themselves now can become important assets, when they function as a channel for in game sales.	T.3 Cloud Streaming T.4 PC Software platforms T.7 Hit Driven (AAA series) T.8 Indie 'hits' T.13 Open source gaming T. 14 Crowd funding
8		T.25 Acquisitions

6.4.5.8   Key partners evolution

Growth of the G-SECO is not only demonstrated by the increasing number of nodes it contains, but also by the increasing variation among them. The different node types identified in section 6.2 show the different key activities in the current (8th generation). Niche creation, as referred to in section 5.1.4, is a dimension of SECO health that indicates continuous opportunity to start new business types within the SECO. The creation of new node types is a continuous process in the G-SECO. Almost all generations produced a new node type that specializes in a business activity of another node type, making them a strategic partner. For example, video game console manufacturers first outsourced game development to publishers. Then publishers outsourced game development to game developers and game developers outsource parts of game development to middleware developers. This chain of key partners is established over time and visualized in a tree-like structure as niche creation in the SECO created more specialized key partners.

Key partners evolution		
Generation	Evolutionary milestones	Trends affecting key partners
1	Retailers are valuable partners for console manufacturers, and largely determine sales numbers.	
2	Publishers enter the market, platform owners are important partners that provide the channel and guidelines for their products. Publishers are also reliant on retailers to co-market their games.	
3	Game developers become important partners of publishers and vice versa. Publishers that own, or contract the best design studios create successful games.	
4	Like for developers, video game platforms are partners of middleware developers as their platforms determine many of the specifications and performance of middleware products.	
5	Game middleware developers increase their importance by providing more than just game engines to developers. Specialized middleware allows game developers to integrate solutions to common problems in their own engines, for example specialized physics or lighting modules can add value to game engines developed in-house.	
6	Game middleware has become an important factor in the process of game development. Integration options of third party middleware in game engines help developer quickly get up to speed in the development process, as compatibility issues are prevented.	
7	The advent of digital distribution makes game retailers find game indie game developers' game attractive products to sell. Online game stores like GoG.com focus on this niche.	
8	Non game online partners become relevant for game console manufacturers as their services become integrated. Examples are Twitch.tv, Skype and Twitter.	

6.4.5.9 Cost structure evolution

Section 6.2 shows the main costs of organizations in the G-SECO: Salaries for highly skilled developers and artists make of up the core costs of most game development projects. Node types like publishers and game console manufacturers make no direct costs in game development, but investments costs and surrounding spending on marketing and distribution make up overhead costs. A newer cost type is the upkeep of supporting systems that run the online components of games. Changing revenue models from middleware developers change costs for game developers as they are their client.

Cost structure evolution		
Generation	**Evolutionary milestones**	**Trends affecting cost structure**
1	Retailers deal with typical shop-keeping costs, such as buying and keeping stock and marketing. Game console manufacturers pay most for product development and marketing.	
2	Publishers join the game SECO and incur many different costs related to game development. During the second generation the number of separate (none-publisher) developers where negligible, and almost all games were made in-house by publishers. An important costs for publishers are the royalties they pay to game console manufacturers in order to publish a game on their platform.	
3	Developers become a separate entity from publishers and thereby publisher no longer have salaries as a defining cost hence this is now included in the investment costs of a game development project.	
4	As game middleware begins to be used by game developers, licensing costs are paid by publishers.	
5		
6	The first independent developers start to form and have to pay the license costs for middleware and royalty costs for publishing on game consoles themselves.	T.1 Online console gaming
7	Although many independent game development projects are financed by external sources, for example through crowd funding, some internal capital might be required.	T.6 Converting to Free-to-Play T.7 Hit Driven (AAA series) T.8 Indie 'hits' T.14 Crowd funding
8		T.23 Single Player And Multiplayer Begin To Merge T.26 Devaluation of games

7 Analysis

Section 4 poses a hypothetical model to ultimately describe the cyclical relation between SECO-changes and BM-changes. Various entities and processes included in the model have been discussed in the previous sections. This section congregates findings in order to evaluate and further elaborate the model.

7.1 Evaluating the SECO-BM evolution model

Basic evaluation of the model's structure is done by discussing the accuracy and relevance of the model's elements based on findings from sections 5 and 6. Evaluation is done per entity and process which listed in the following two sub-sections, these are the model's building blocks that have initially been defined in section 4 and referred to by their number.

7.1.1 Evaluation of entities in the SECO-BM evolution model

1. **SECO:** The theoretical background in subsection 5.1 describes how SECOs are more than just networks of organizations. A key aspect of SECOs is that they explain organizational cooperation in a *software* market. The game industry, although enabled by hardware is driven by a continuous demand for software products, namely: video games as end-user products and the various components and software tools to design, deploy, run, distribute and sell them. Another fitting feature of a SECO that is missing in other organizational network models is the notion of a common platform. We've shown that platforms play a leading role in the game industry and shape the market on various levels. For example, sub-section 9.2.6 explains how video game consoles function as platforms for developers to self-publish games on. Some developers (section 9.2.3), in their turn create games that allow third parties, such as consumers to create and publish extra content, creating a nesting of SECOs. Game engine developers (section 9.2.2) are starting to apply platform strategies in their business models (Unity: Unity Game engine, Epic: UDK). The demonstrated prevalence of platform based business models confirms that the SECO-viewpoint is a relevant basis for our hypothetical model.

2. **SECO-Member:** From the SECO-viewpoint follows that we can identity SECO-members as active participants in this software domain. Section 6.2 categorizes these SECO-members as types based on their contribution in the SECO towards the end-user products. These types are described by positioning them in typical SECO-configurations in section 6.3. Finally section 6.4 explains in detail how these types of organizations work by deconstructing their business processes and defining typical business model configurations based on industry examples.

3. **SECO- Member Connection**: Like members, the connections among them are an integral part of SECO-structure. All node types that are defined in section 6.2 fulfil a role in one or more of the software lifecycles in the G-SECO either by creating, distributing or

selling software products. The SSN-models in section 6.3 explain how members in the G-SECO cooperate in terms of exchanging software assets, services and funds. Section 6.4 furthers understanding of these relations as BMs explain the nature of connection to other nodes as either key partners, customers or third party channels.

4. **Business Model (Canvas)**: Preliminary research discussed in 5.2 shows that BMs can be described with the BMC as a comprehension-tool. In section 6.4 BMs of identified node types have been deconstructed. The business model concept proves to be a valuable way to concisely describe the various aspects of conducting business, enabling comparison among types of organizations. Exactly this segmentation of business aspects comprising a business as a whole allowed for a granular comparison of changes in these different segments over time (section 0).

7.1.2   Evaluation of processes in the SECO-BM evolution model

5. **SECO structure evolution:** Nodes and relations in a SECO change over time. From a SECO structure point of view this means the most basic unit of change is either the appearance or disappearance of a node or relation. These four units of change can ultimately describe every change in the structural evolution of a SECO.

Osterwalder's (2004) description of key partners as a defining business model segment corresponds with the concept of relations in SSNs by Jansen, et al. (2007), namely that a relation is a formalization of an exchange in assets, services and/or funds between two organizations. Subsection 6.4.5.8 contains the time line diagram of evolution of key partners in the G-SECO. This timeline shows a steep increase in the number of different partners a type of organization is likely to have in G-SECO.

A similar comparison can be made for nodes and the key activities segment of their business models. Key activities define the crucial business processes an organization must perform to make its business model work (Osterwalder, 2004). An organization's key activities define its initial type (section 6.2) as shown in the diagram in subsection 6.4.5.6.

If structural SECO-changes are mutations to the internal structure of the ecosystem, the structure of the ecosystem can be defined as all the nodes encompassed by the SECO and the connections among these nodes. Structural SECO-changes are agnostic of intentions and do not specify functions of nodes or connections.

6. **SECO Change Cues:** SECO-members perceive SECO-changes as a continuous stream of cues. SECO-members distil actionable information from this stream to optimize their business model. This behaviour is best demonstrated by comparing an organization-type SSN over time. For instance: In the current form the game developer SSN (section 6.3.3) shows how game developers can choose to distribute their game through either a publisher or a by self-publishing on a retail platform. The latter option only became available about a decade ago in the G-SECO on proprietary platforms (iPhone). Today many self-publishing platforms such as Nintendo Wii, Facebook, Microsoft Xbox and Steam allow game developers to reach an audience at their discretion. The emergence of

these new platforms (node type) in the G-SECO is experienced by SECO-members as cues for possible adaptations of their business model to optimally deal with their changed business environment.

7. **Business Model change:** SECO-members change their business models based on the perceived threats and opportunities exerted by the SECO. Section 6.6 shows how business models of the node types in the G-SECO have changed over time.

Examples of business model change:

An interesting process visible in the evolution diagram of key activities is that from the start of the game industry key activities are increasingly outsourced to more specialized node types. However, in later stages (>7th generation) an opposite trend starts, where established node types diversify their key activities. For example: Platform owners, game publishers and game developers start to obtain retail as a key activity.

8. **Business Model change leading to SECO-Evolution:**

Platform owners proactively steer for differentiation of their game console by introducing innovations that the competition does not have. An example of this is Nintendo Wii's drastic change in player input through motion controls. When such deviations are considered successful, competitors react and provide similar features for their platform. In this example both Sony and Microsoft responded by introducing their take on motion controller support

These reactive strategies are prevalent in all console generations and are not just a result of internal competition within the ecosystem. Many innovations that are introduced in the console ecosystem are influenced externally, such as by the PC-gaming ecosystem or standards in the home-entertainment industry (Blu-ray, HD-TV). Examples of these are the fast growing support for indie-games on the 7th and 8th generation through easier ecosystem accessibility and the advent of downloadable games, replacing physical copies. Especially the last two generations were characterized by some important technological advances that lay way for drastic changes in how customer facing nodes interact in the ecosystem, in regard to their business models and ways of generating income. Two of the most important innovations herein are access to high speed internet and local storage on video game consoles. With these two options becoming widely available, game publishers were no longer forced to publish and sell standalone software products through retailers. Furthermore, new ways of user input (controller types), HD-televisions and external devices (second screens) allowed many niche or external complementors to join the ecosystem with their products and services. Users were now able to expand an initial game with additional content on demand for a small fee, which became known as downloadable content (DLC). Furthermore a subscription based service as Xbox LIVE enabled platform owner Microsoft to finance permanent availability of centrally organized game servers.

In order to argue that changing business models affect the structure of a SECO, a relation between the concepts of business models and SECOs must first be demonstrated.

As explained in section 5.1.3 a SSN effectively depicts how an organization is connected to its peers through input- and output streams in terms of software assets, related services and financial transactions within a SECO. Subsequently section 5.3 shows how the same organization creates value by describing, from a business model perspective, the nine business segments that constitute and support value creation by that organization.

By comparing input- and output steams described by SSNs in the G-SECO (section 6.3) with the business model segments of the same organization (section 6.4) we can define the relation between business model arrangement of an organization and its SECO-position. Table 11 maps each BMC-segment to zero or more SSN-components as described by Brinkkemper, Van Soest & Jansen (2009).

Table 11: Business Model Segment - Software Supply Network Component Relation

	Business Model Canvas Segment	Software Supply Network Component
1	Customer Segments	Customer
2	Value Proposition	*Customer*
3	Channels	*Intermediary*
4	Customer Relationships	-
5	Revenue Streams	Financial Flow
6	Key Resources	-
7	Key Activities	-
8	Key Partnerships	Supplier *Intermediary*
9	Cost Structure	Financial Flow

The four underlined SSN-components: customer, financial flow (2×) and supplier can be directly related to the respective BMC-segments, where financial flows can be both incoming and outgoing as revenue or costs (5, 9). A more divided relation exists between the SSN components in *italics* for these do not map as clearly to one business model segment and need further clarification. The BM-segment of value proposition (2) describes how an organization's product or service attempts to resolve a customer need or problem (as described in sub-section 5.2.1). An explanation of the value proposition must thereforee support the customer segments of the business model, thereby tying the value proposition (BMC) to the customer (SSN).

Intermediaries are SSN-components that map to BMC-segments based on their function in the SSN at hand. Brinkkemper et al. (2009) pose distributors, resellers, and hosting providers as example intermediaries. Such intermediaries fit the key partnerships description of the BMC. In the G-SECO an example of an intermediary is the video game engine developer, who can be key partner for game developers (as a supplier of software). But also a key partner that provides a channel for middleware developers to reach game developers and vice-versa by providing a platform or incorporating partner-

software. In the SSN-diagram of a game middleware developer this is depicted (section 6.3.1).

The remaining three BMC-segments: key resources, key activities and customer relationships cannot be reasonably tied to specific SSN-components. Key resources and key activities are internal affairs of the organization at hand and thereforee not present in a network perspective. Only when important activities and assets are outsourced or of external origin, they become visible in the corresponding SSN, but these assets and activities will then be categorized in the key partnerships segment in the BMC. Ultimately the customer relationship-segment is not mapped to SNN-components for it describes the nature of a relation, not so much its existence. This qualitative aspect does not directly translate to a SSN diagram.

The SSN component that depicts the company of interest (CoI) (Brinkkemper et al., 2009) cannot be mapped to a business model segment as it is the entity within a SSN that applies the business model as a whole. Finally, in contrast to financial flow, the remaining flow-components (product flow, content flow and service flow) cannot be mapped to any BMC-segments, and only serve to denote key partnerships.

Graphically overlaying the SSN and BMC models, shows how an organization's SECO-position is interdependent with its business model. Figure 11 represents the BMC-SSN relation of the game engine developer node-type.
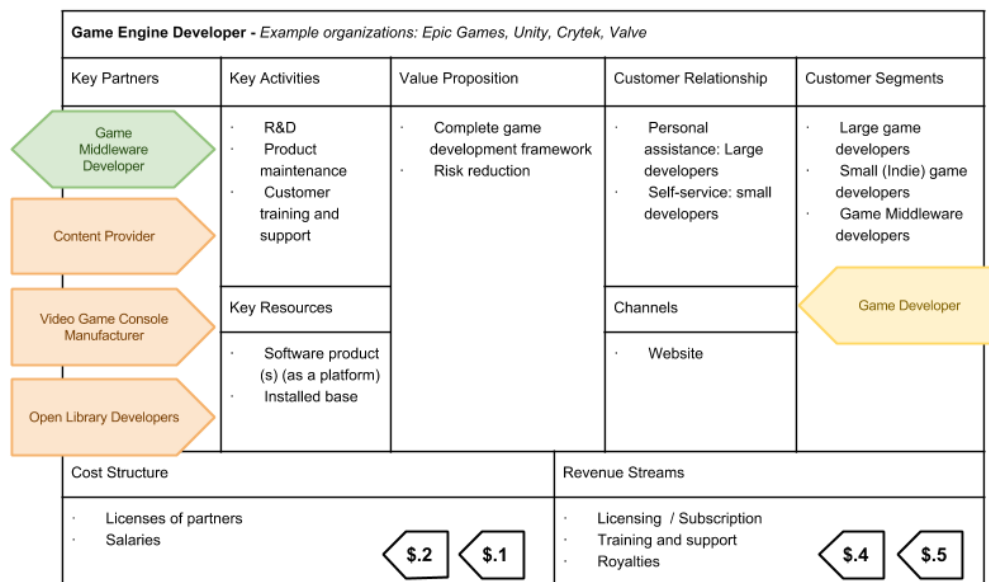
Figure 11: Mapping Software Supply Network Components to a Business Model Canvas

From the business model – SECO-structure relation follows that SECO-members can therefore directly affect the structure of the SECO by altering their business model. Moreover SECO-members can influence more qualitative aspects of the SECO such as its accessibility, diversity of members or the SECO's health (section 6.4).

Business models of hubs have a greater influence on the SECO than business models of complementors. Depending on the number of relations the hub has its influence can affect many other SECO-members directly.

Y. **External factors influencing Business Model change:**

This research has looked extensively at how internal dynamics influence SECO-members in their SECO-positions and business models. Even though external influences are not the focus of this research they need to be clarified in order for the model to be comprehensive.

External factors can trigger organizations in the G-SECO to change their BM. The SWOT analysis is a common technique to classify factors influencing strategic business decisions. Factors are considered threats or opportunities and can be classified as internal or external, Dyson, R. G. (2004). Looking at external threats and opportunities we can identify the following list:

Opportunities	Examples
Technological advances	New technologies from remote SECOs are continuously implemented by G-SECO-members to gain a competitive advantage over competition. These can be subdivided in: • Continuous improvements: e.g. more realistic graphics, smoother gameplay and more concurrent players in an online game. • Paradigm shifts: e.g. HDTV, Internet connectivity, motion sensing[35] or virtual reality.[36]
Threats	
External competition entering the G-SECO	• Existing non-game companies entering the G-SECO[37] competing for a part in the product lifecycle and value chain of games.
External product-types entering G-SECO	• Netflix, Spotify and Twitter are examples of non-game products that are now used within the G-SECO to enrich products and extend services.
Policy & Legislation	• Consumer protection directive[38]

Z. **External factors influencing SECO change:** Unlike BM-change, SECO-structure change itself is not a deliberate process but a result of decisions made by individual SECO-members. SECO-hubs can give direction to SECO change by effective orchestration, but not control it like it can control its BM. Dyer-Witheford, & Sharman (2005) argue that a highly educated workforce and a fast growing technology sector have greatly benefited the game industry in Canada. In addition they credit some growth to local subsidising of game-development companies. This is an example of the external factors of policy influencing a SECO as more nodes join the SECO.

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[35] Xbox One Kinect: http://www.xbox.com/en-US/xbox-one/accessories/kinect-for-xbox-one

[36] Oculus VR: https://www.oculus.com/

[37] Apple entering the G-SECO with iOS (2007), Amazon web services tailoring services to game development, deployment and operation: *http://gameservices.s3-website-us-east-1.amazonaws.com/*

[38] Consumer protection directive by European Council: *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0083&from=FR*

8 Discussion & Conclusion

The business model canvas and SSN do not always map directly on the segments as illustrated in Figure 11. For example, a game publisher's customers to whom their value proposition is configured are usually not directly buying from the publisher. Sales are mostly propagated through the channels of retailers. This explains why the BMC shows end-users as a publisher's customers, while a SSN shows retailers as customers.

On the topic of node types: the categorization of node types in section 6.2 is a generalization that was needed to structure this research and provide starting points for exploration. This categorization has proven to be a useful framework by which various key activities in the G-SECO are assigned to specific node types. By further analyzing these pre-assigned node type-key activity relations in section 5.2 we see that an increasing number of organizations are fulfilling tasks that would fit multiple node types. The primary example is Valve Software, an organization that started out as a *game developer* while also being the *publisher* of its own games. Valve's open attitude toward game-modding formed the basis of some of the most popular game mods ever[39]. To support its games and vibrant community, Valve invested heavily in its software *platform* Steam and commercialized its *game engine*. Through Steam, Valve is now the largest digital *retailer* on PC, currently creating a Linux based operating system to support hardware platforms that can directly compete with video game consoles. This illustrates how one organization can compete on almost any key-activity within the G-SECO. Even though Valve Software is an extreme example, trends like self-publishing, end-user game asset development and digital distribution question the longevity of the generalized classifications that are widely used in the game industry.

Another classification problem we've encountered, originating from the SECO-perspective, is how we can distinguish hubs, meaning hardware from software platforms and software platforms from online retailers. The concept of an installed base (the users of a game platform) differs from a retailer's customer base. An installed base requires investment from the customer as he/she needs to purchase a game console before being able to play games. A retailer's customer base is not founded on this type of customer investment. Customers can go to any other retailer whenever they want, as opposed to members of the installed base, who cannot switch to any other platform without an additional investment. This investment barrier makes the installed base per video game console more stable than a retailer's customers. An installed base, more than a customer base, postulates that its members are committed as the entry barrier dictates future choice by creating a lock-in. An interesting case lies with that of retailers that also function as a software platform[40], this ties the customer to their platform in terms of product use, by eliminating cross-platform compatibility of products purchased through

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[39] Half-Life mods: Counter-Strike, Team Fortress, Natural Selection, Day of Defeat.
[40] Origin (EA), Uplay (Ubisoft), Steam (Valve)

the platform. The difference with hardware platforms is that customers do not invest in the software platform itself as it is usually free. Furthermore the platform owner has nearly zero marginal costs for individual users, as opposed to hardware platform owners.

Based on our findings in section 6 we can touch on larger trends occurring in the game industry. Interestingly in the more recent generations individual node types have started to incorporate BM-segments of other node types with a focus on disintermediation of customer facing parties. When looking at the evolution of key activities in section 6.4.5.6 we can see how retail and publishing are becoming activities no longer exclusive to their initial node types (retailer and publisher). The exact reason for this trend remains unclear, but we expect that the following criteria contribute to this behaviour.

- Availability of internet connections on all devices. Through internet accessibility and automation of retail entry barriers to both activities have been lowered as the physical constraints of products and stores are removed.
- Local storage and access to streaming services on almost all game related devices further remove the need for physical carriers of digital games.
- Improvements in online retail of games comprise self-publishing and community driven recommendation systems, helping smaller unknown game developers reach a large audience with minimal marketing budgets.
- Wider range of accessible and affordable software tools for game development.
- Alternative ways of financing game development projects, such as crowdfunding remove the need for publisher investment for large games.

This research explored how the evolution of business models in the G-SECO can be described. This was done by formalizing the underlying relation between changes in SECOs and the evolution of BMs in our model of BM-SECO change reciprocity. Identifying the types of organizations in the G-SECO from both a SECO and a BM perspective allowed for structured gathering and comparison of their commonalities and distinctions. The scope of this exploration was broader than preliminary research by including PC and mobile as game platforms.

To answer our main research question: This research shows that the evolution of business models in a SECO can be effectively described by comparing changes in BM-segments of identified SECO-node types over time. This approach has shown multiple benefits:

- Comparing BM-segments instead of BMs as a whole removes much of the highly varied nature that BMs display. Our approach removes ambiguity and creates room for direct comparison.
- As a result of BM-segments can be compared across all node types, revealing competitive behaviour is displayed among node types that were traditionally not considered competitors.
- The segment approach shows how the SECO matures as niche creation is made visible by organizations outsourcing BM-segments to SECO-peers.

- Involving the SECO-configurations of node types (by SSN modelling) supports describing their business models, creating a complete richer account of partners, customers and channels.

The secondary objective of this project has been to model the relation between a SECO and the BMs of its members. This also leads to answering the first sub research question: 'How can we describe the relation between Business Models and Software Ecosystems?' Our BM-SECO change model displays how cyclical BM-SECO interaction takes place by describing the various elements and processes it comprises. The BM-SECO change model helps illustrate the direct connection between organizational strategic decisions shown in the BM evolution diagrams, and the effect thereof on an organization's network of partners. The use of BMC and SSN models (to respectively describe an organization's BM and SECO-position) furthered the understanding of this relation, as we have shown how BM-segments map to corresponding SNN-relations in the evaluation of the model.

To answer our second sub-research question 'What does the G-SECO look like?' an overview of the publishing parties and game platforms was created to give an indication of the G-SECO's size. Subsequently with the SEM-technique SSN models we created to show how common node types are typically positioned in relation to their suppliers and customers.

The third sub-research question was: 'What do the business models of G-SECO members look like?'. The same common node types used to answer the previous question were used to denote business model configuration using the BMC method described in the theoretical background. By looking on BM-segment level at many different examples of organization of the same node type, a well-rounded set of common business model configurations was established to arrive at our next question.

'What do business model changes of G-SECO members look like'? We have illustrated how business model changes can be captured by identifying the most recent state of BMs present in the SECO at hand, followed by deducing from industry trends, the paths of evolution toward the current state on BM-segment level.

Our findings on the relations between BMs and SECOs contribute to the academic body of knowledge of both concepts individually. Firstly the evaluation of the BM-SECO change model has shown how we can use entities in a SNN to describe the nature of relations in the BMC segments of key partners, channels and customer segments. Similarly, financial flows present in the SSN are mapped to the cost structure and revenue streams in the BMC providing content in both ways. Vice versa a more informed SECO-structure model can be created with SSNs if information about their BM is already known.

The detailed identification of node types, their BMs and SECO-configurations, provide an up-to-date account of the product software market in the game industry. We showed how the game industry is increasingly diversifying its BMs creating new areas of competition on BM-segment level. Furthermore

This research has a couple of limitations. The exploratory nature of this research allowed for the broad scope that was needed to involve the different concepts from various research domains (business models, software ecosystems, game industry). Consequentially this limited the structure of gathering empirical evidence that underlies each relation proposed by the model. We have discussed how exceptions to generalizations become more prevalent as G-SECO members diversify their business models. Categorization of node types is such a generalization that was needed to structure this research. Although this categorization is not problematic, an increasing number of organizations are fulfilling tasks fitting multiple node types. This high variety in node types is caused by business models that are increasingly overlapping in areas that used to see only competition from a single type of node. As a result we compared all identified BM-segments over time, thereby creating a meaningful overview of progress and competition. Granting a configuration of these segments together forms a particular business model, our results do not allow direct comparison of complete business models. A final limitation of this research is that the significance of proposed relations in the BM-SECO change model is not measured. Therefore significance is not established nor rejected. The broad research method and scope that were needed to construct a complete model to underlie BM-evolution of nodes in relation to their SECO, did not allow for constructing the datasets needed to support measuring these relations. Efforts in underpinning these relations with more structured data form the objective of future research.

To expand further on future research: This research has laid a foundation for exploring the evolutionary sides of BMs and SECOs. We have shown that common business model configurations can be deconstructed and modeled as a comparative timeline depicting an evolutionary-tree structure. A next step would be to formalize a method for creating general business model evolution timelines. Similarly the evolution of SECOs has high potential for further research. SECO-graphs such as in section 9.1 represent a snapshot of a SECO at a given moment in time. A graphical way of capturing SECO-evolution either by animation or tree-like stills could reveal the interesting effects of group-behavior occurring in the SECO over time and could more clearly denote the effects of business model changes by individual nodes on the SECO. More so, if this group-behavior can be described in rules, simulations to predict the SECO-effects of business model change become the next objective. Apart from tackling the graphical representation; constructing datasets containing every transformation in a SECO in terms of present nodes and relations is a challenge currently unanswered.
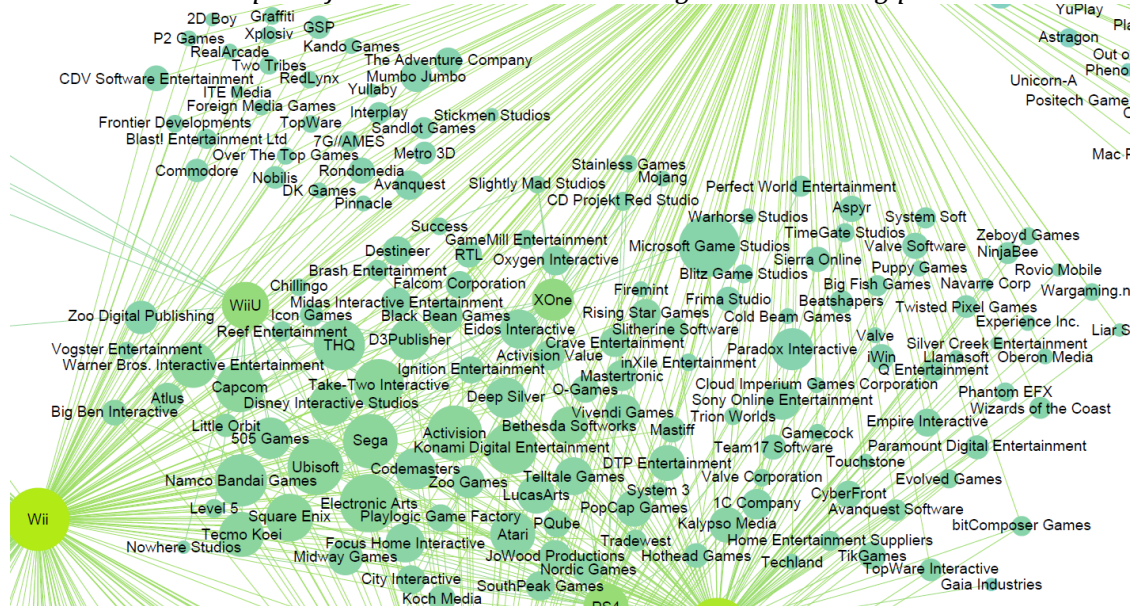
9 Appendices

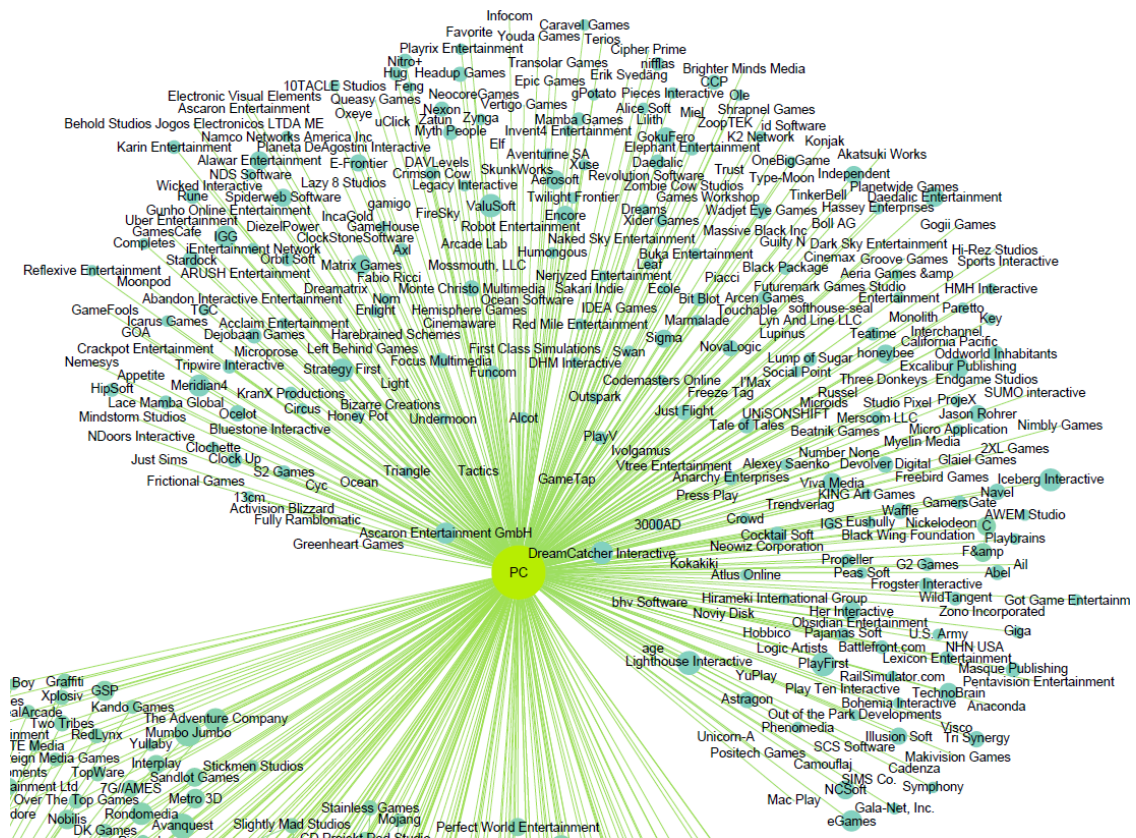## 9.1 G-SECO publisher relations graph
Overview:
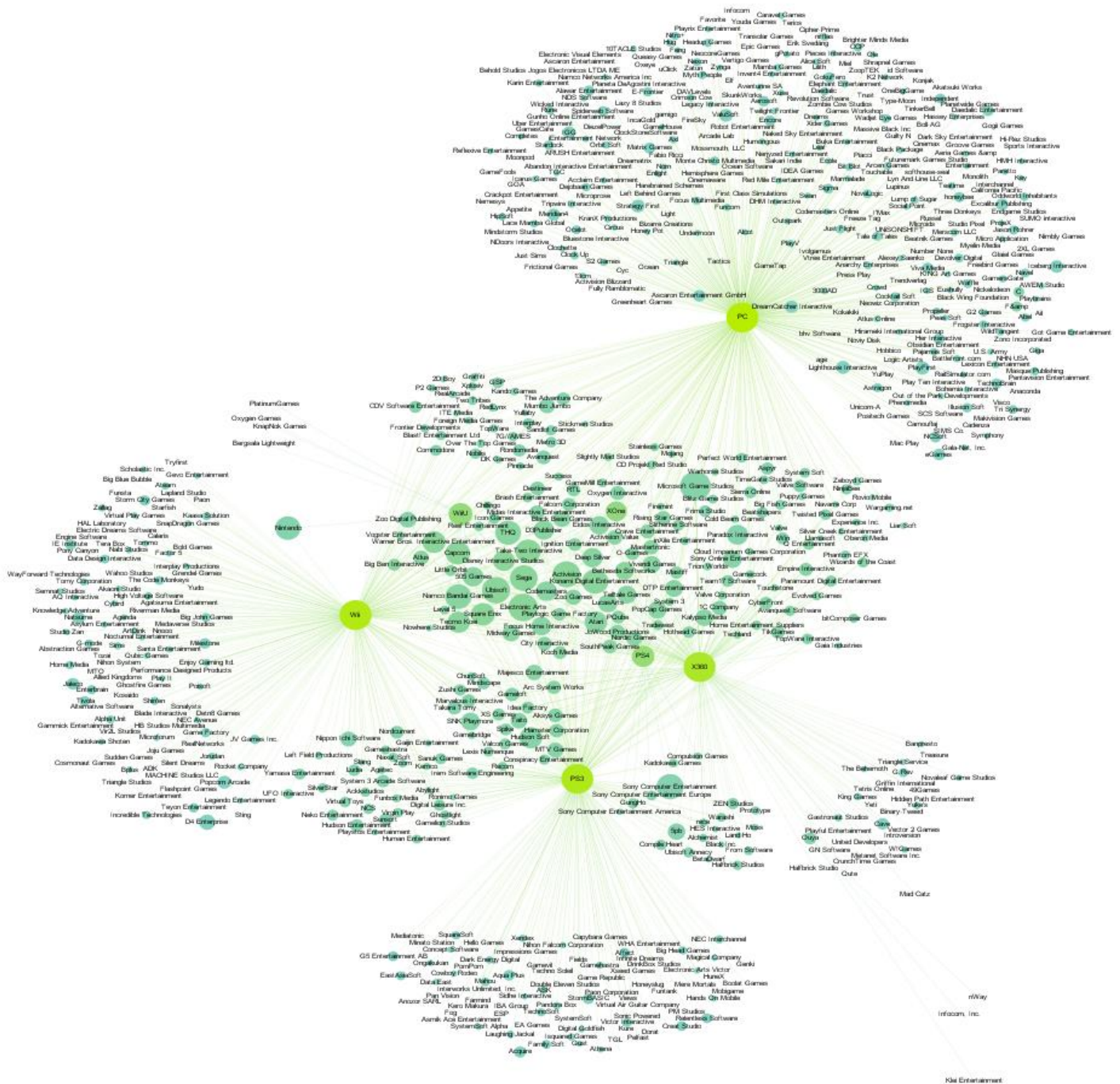
Center: *The center-part of the G-SECO contains the larger multi-homing publishers*

PC sub-SECO: *The PC-G-SECO has the largest number of dedicated publishers (apart from iOS, not depicted)*

Game console sub-SECOs: *Wii, Xbox 360 and PS3 show many similarities. The major first party publishing subsidiaries are also identifiable, as they are very large, but with a low number of connections: only to the 1st party platform.*
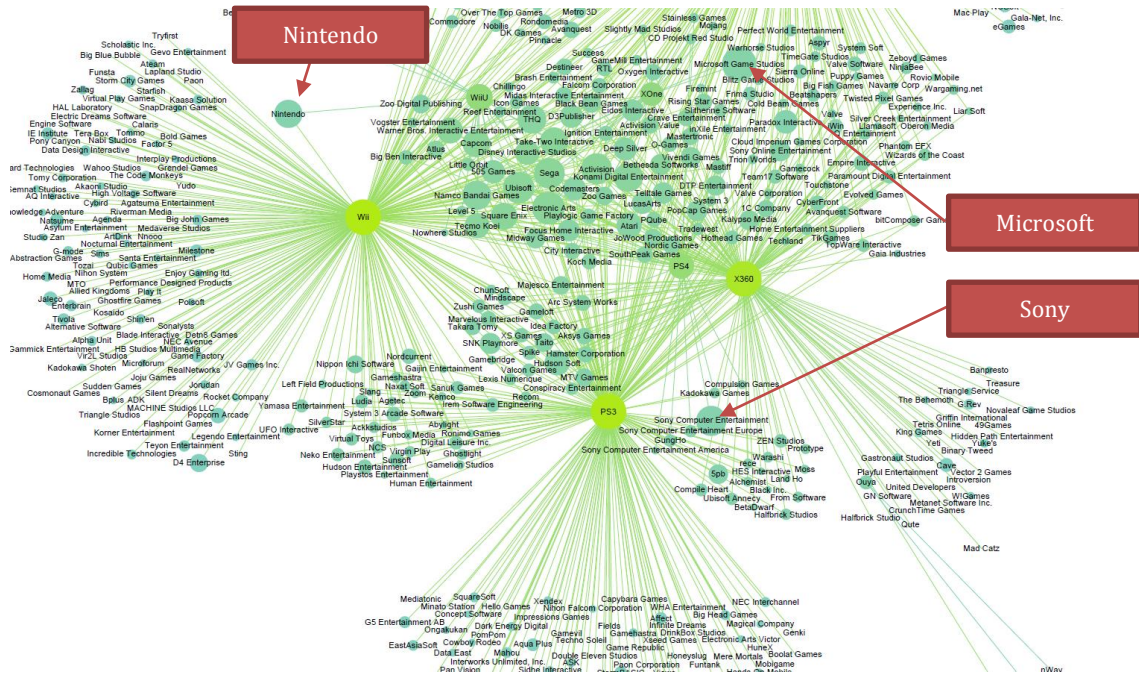
9.2 Business model observations

This appendix contains observations of business model patterns in the G-SECO. Section 6.4.1 summarizes these findings.

9.2.1   Game Middleware Business Models

Game middleware developers create software tools that facilitate game developers in product development or are a component of a game's software stack. These tools can range from complete game-building software IDE-frameworks (Game Engines), to very specific integrated solutions for niche functionality. For example: modules that contain graphics[41]-, physics[42]-, sound[43]- or networking[44] technology. An increasing number of commercial game engine developers such as Epic Games and Unity is promoting incorporation of third party middleware in their product through their own sub-ecosystem. This is illustrated by SSN-examples for P.3 in section 6.3.1. This makes their business models stand out from other game middle ware developers because they function as a SECO platform hub. Game engine business models are discussed separately in the next section as they are too different from other middleware.

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[41] For example: Umbra Software's Umbra 3 occlusion culling plugin enhances graphical game performance of many top-selling game titles.

[42] Havox' plugins are a populair option for realistic-game physics solutions

[43] Audiokinetic powers games with wwise game sound solutions. Their plugin is advertised as compatible with popular game engines such as UDK and Unity.

[44] E.g. Bigworld's Bigworld server for massive online games.

Table 12: Game Middleware Developer BMC

Game Middleware Developer - *Example organizations: IDV, Autodesk, Audiokinetic, Donya Labs, Geomerics, Intel, Oculus, Havok, RealD, Umbra Software, Xoreax, Exit Games, Kii, Mixamo.*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Integration partners	• R&D • Product development and maintenance • Consultancy and customer training & support **Key Resources** • Software product(s) • Intellectual property	• Expert Solution to specific game functionality • All round solution for Arbitrary/general functionality needed for game development	• Personal assistance • Self service • Communities **Channels** • Website • Conferences • integration in partner software	• Large game developers • Small (Indie) game developers • (Non-gaming customer) • Game engine developers
Cost Structure		**Revenue Streams**		
• Development costs		• Licensing • Royalties • Training and support		

9.2.1.1 *Game Middleware Business Model:* ***Customer Segments***

Game middleware developers cater to a *niche* market that needs pre-made configurable solutions to specific video game functionality. The most common customers are game developers. These can be segmented into two groups. Large development companies[45] and small, independent (indie) game developers. Some game middleware developers also have customers outside the video game ecosystem, such as in the movie, simulation and 3d-modeling industry[46]. We see that middleware developers lean toward a *segmented* customer audience (large vs. small developers), with partly overlapping needs but different pricing models. An example of this is IDV's SpeedTree. A game engine integrated

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[45] Plug-in developer Autodesk has their *gameware* products integrated in many popular games made by the biggest publishers and developers: http://gameware.autodesk.com/
[46] IDV supplies Tree-rendering software (Speed tree studio) to the movie industry

solution (UDK/Unity) is available for a small monthly fee, as opposed its complete standalone package 'Speed Tree Cinema', costing 250 times more[47].

9.2.1.2 Game Middleware Business Model: Value Proposition

Both types of customers are targeted with a different value proposition. Larger developers value mainly *newness, performance,* personal support and *customization* aspects of the solutions game middleware developers offer, this is derived from how game middleware developers promote their products on their company websites often mentioning its exceptional performance, robustness and how many released games have it integrated. An example of this segmentation is present Havok's website (Figure 12).
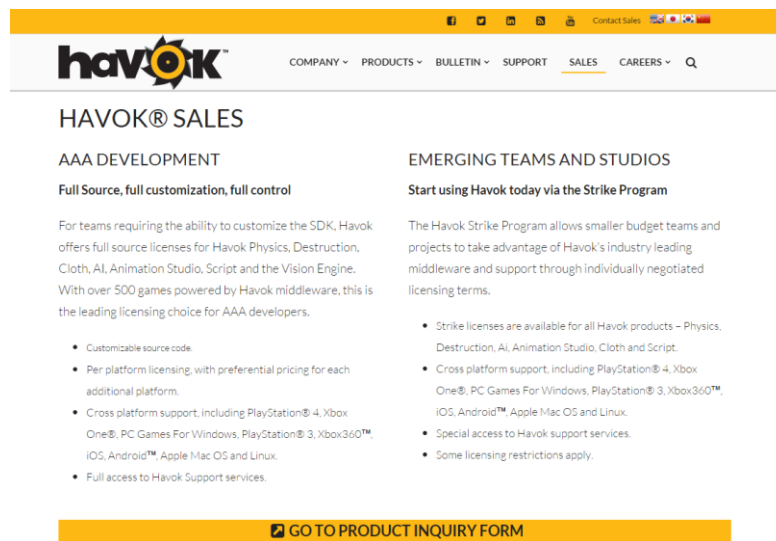
Figure 12: Game Middleware Developer Havok's sales page targeting both large established and small start-up companies with different value propositions (16-05-2015)

Indie developers are targeted by *Accessibility* and *"Getting the job done"* for specific parts of game development in which they lack expertise or see no advantage to building their own version of trivial functionality. Middleware developers like Algorithmic provide bundles with slimmed-down versions of the software products characterized by complete, accessible and convenient solution to common development problems. Indie developers typically have less to no budget to invest in game middleware.

9.2.1.3 Game Middleware Business Model: Customer Relationships

With traditional, larger clients, game middleware developers acquire and maintain a *personal assistance* relationship. Because of the complex nature of their products and relatively small number of customers, game middleware developers can effectively guide and support individual customers. Training programs and code review & analysis are often not only part of the value proposition, but a way to maintain a personal relation with clients. For smaller, mostly indie developer clients, *self service* solutions are provided. These range from elaborate wiki-documentation to online training video's.

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[47] https://store.speedtree.com/product/speedtree-cinema/

Additionally the latter customer segment is often supported by a small online *community* around the middleware developer's products.

9.2.1.4 Game Middleware Business Model: **Channels**

Game middleware developers transfer their value proposition directly to customers through their own channels and sales people. Their main channel is their website often combined with an online community. Middleware developers that have their software integrated in partner software also reach clients through these partners as channels. Distribution is done online. Most variety in this segment exists in the *after sales* part where large customers receive different treatment than indie developers.

9.2.1.5 Game Middleware Business Model: **Revenue Streams**

A *dynamic licensing model* is the most common way in which game middleware developers generate revenue streams from customers. A variety of extensive and basic options is usually available to not exclude developers with a lower budget. For example Autodesk sells their Scaleform plug-in as a Unity (game engine) plug-in with a perpetual license[48]. In addition to licensing fees, some middleware developers like IDV separately *sell assets* such as 3d-models[49] or libraries.

9.2.1.6 Game Middleware Business Model: **Key Activities**

Key activities that middleware developers perform are two-fold. *Production* through product development is important to keep their product functioning and up-to-date in a rapidly advancing industry. *Problem solving* is a key activity when dealing with larger clients that need advice and support on integrating and configuring the middleware product in their game. Some middleware developers invest heavily in integration of their software in game engines. Maintaining integration with external parties becomes more complex as the number of compatible hardware platforms and game engines increase. Developing software at a high level of abstraction, to keep the core products singular, without losing performance becomes the area of interest. Finally finding and keeping the industry's specialists through effective human resource management can become an important activity,

9.2.1.7 Game Middleware Business Model: **Key Resources**

The most important resources for game middleware developers are *intellectual*, namely proprietary knowledge, copyrights and (informal) partnerships. Furthermore human resources are an important factor because employees in this sector often hold very specific knowledge and unique creative talents.

9.2.1.8 Game Middleware Business Model: **Key Partners**

Two types of key partnerships are identified: Game middle developers integrate third party software in their product or their software is integrated in third party software. The latter are game engines as described in subsection 5.3.1, but can also go beyond the scope of this research, to for example digital movie studio's. Game engine integration is

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[48] http://www.autodesk.com/store/scaleform-unity-plug-in
[49] https://store.speedtree.com/

important for most smaller game middleware developers as their products can be relatively unknown. When users of a particular game engine look for a solution for a problem that is not directly supported by the basic engine, compatible or 'plug-in' middleware provide expert solutions.

9.2.1.9   *Game Middleware Business Model:* **Cost Structure**

The largest part of costs is comprised of *fixed costs* of salaries that are part of development costs. A *value-driven* cost structure is maintained towards large clients, a *cost-driven* towards small clients.

9.2.2   Game Engine Business Models

As discussed in section 6.4, game engines are a specific type of game middleware that qualify for a separate business model analysis.

Table 13: BMC of Game Engine Developer

Game Engine Developer - *Example organizations: Epic Games (UDK), Unity (Unity Engine), Crytek (CryEngine), Valve (Source Engine), YoYo Games (Game Maker: Studio), Idea Fabrik (HeroEngine)*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Integrated partners	• R&D • Product maintenance • Customer training and support	• Complete game development framework • Risk reduction	• Personal assistance: Large developers • Self-service: small developers	• Large game developers • Small (Indie) game developers • Game Middleware developers
	Key Resources		**Channels**	
	• Software product(s) (as a platform) • Installed base		• Website	
Cost Structure			**Revenue Streams**	
• Licenses of partners • Salaries			• Licensing / Subscription • Training and support • Royalties	

9.2.2.1   *Game Engine Business Model:* **Customer Segments**

Customers of game engine developers can be grouped into two segments: game engine plugin developers and game developers. As with game middleware developers, the latter can be divided in two sub-segments: large game developers involved in relatively complex game development projects and smaller, often indie developers, creating

simpler games. Not every game engine developer addresses all three segments because they're attracted by different value proposition. Addressing both content-providers and content-users as customers, allows for the game engine developers to form a two sided market, similar to the video game console model. In subsection 9.2.6.1 this is explained in more detail.

9.2.2.2 Game Engine Business Model: **Value Proposition**

Unlike most software products the value proposition of video games towards end-users is largely based on subjective qualities such as fun-factor, appealing graphical design and replay value (the period for which a game keeps players interested) (Hamari, Keronen & Alha, 2015). The software quality attributes of games are thereforee more complex than business software.

From a financial point of view, game developers compare the costs of building a game engine themselves (from scratch or from earlier artifacts), to incorporating a third party game engine that fits their needs.

The first option is often chosen by large development studios where a game engine is used as a software product line that forms the basis of multiple games over a longer period of time[50]. Another element that creates value for game developers is *newness* of the product. Therefore game engine developers must keep their product up-to-date and compatible with modern platforms. Like game middleware developers, game engine developer create different value propositions for each customer segment (Figure 13).
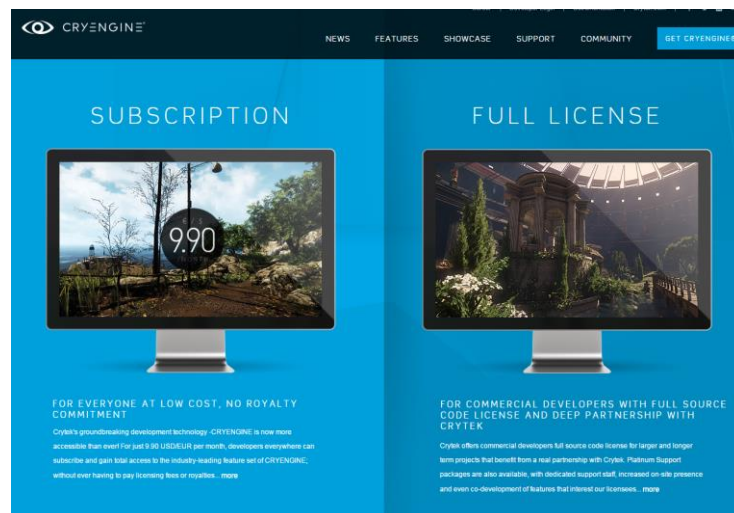

Figure 13: CryEngine Customer Segmentation on Crytek's website (16-05-2015)

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[50] Examples of game engine SPLs are Ubisoft's Anvil Engine for the Assassin's Creed series, EA's Frostbite engines that power the battlefield games, and Rockstar's RAGE engine used for the GTA series.

9.2.2.3   *Game Engine Business Model: **Customer Relationship***

The methods for acquiring and maintaining customer relationships for game engine developers are often the same as with developers as discussed in 9.2.1.3. An exception we see is that game engine developers that explicitly target smaller developers provide more self-help resources, such as tutorial video's, discussion boards and extensive online documentation as such resources scale well with a larger customer base.
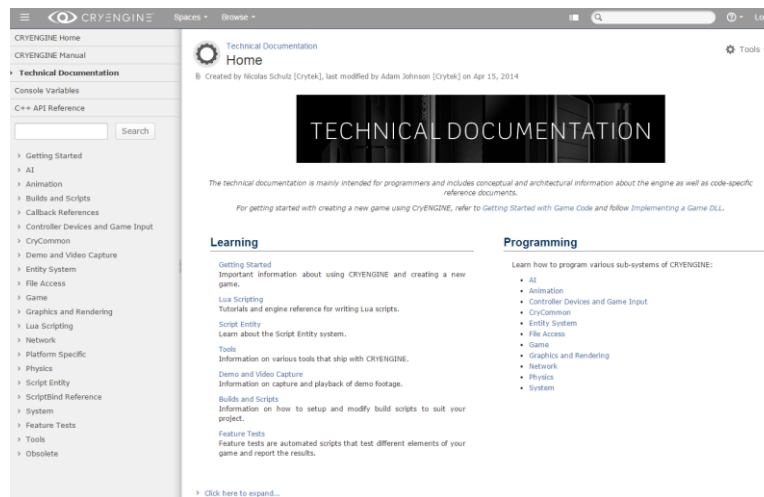

Figure 14: Crytek provides extensive documentation for CRYENGINE on its website (16-05-2015)

9.2.2.4   *Game Engine Business Model: **Channels***

Game engine developers transfer their value proposition directly to customers through their own channels such as their website and through sales people. By building strong relations with integrated middleware developers game engine developers can rely on them to promote compatibility or integration of their middleware product into the game engine. Game engine developers that see accessibility as an important part of their value proposition often create their own end-user market channels[51], or access that of others[52] to reach smaller and less specialized customers. Some engines are also available on digital retailer platforms[53] (Figure 15).

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[51] The unity asset store is an example of an accessible self-owned channel of a game engine developer: https://www.assetstore.unity3d.com/en/

[52] Crytek sells entry-level subscriptions to their game engine through Valve's Steam: http://cryengine.com/get-cryengine/eaas

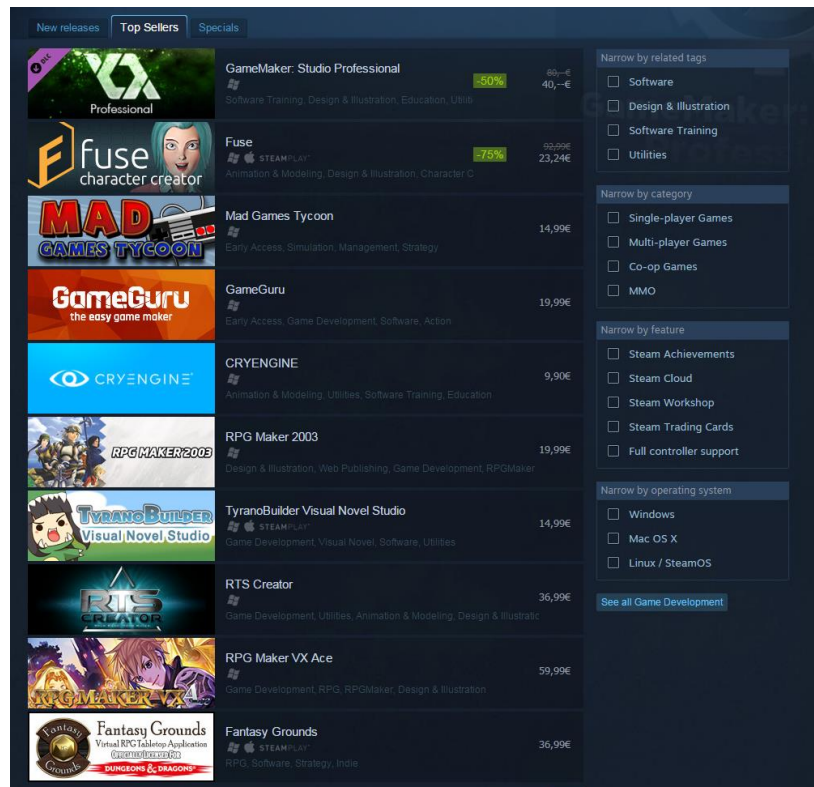[53] Cryengine (Crytek) is sold on Steam (Valve)

Figure 15: Game Development Tools available on Steam (Valve) (16-05-2015)

9.2.2.5 *Game Engine Business Model: **Revenue Streams***

A revenue streams is a business model segment in which game engine developers show more diversity than other game middleware developers. The main reason is that game engine developers can apply a two-sided market model, by functioning as a platform between game developers and game engine plugin developers. A good example of this is Unity, which allows complementary products from third party developers to be sold on top of the Unity game engine though their asset store.

9.2.2.6 *Game Engine Business Model: **Key Activities***

Even though key activities of game engine developers are partially dependent on the maintained value proposition and customer segments they serve, maintaining and developing their main asset, the game engine, is their most important task. Differences exist in for example the level of direct support and consulting they provide to customers or the need for management of their own platform and ecosystem. Product management is also an key activity for larger engine development in order to create the right product features at the right time.

9.2.2.7 *Game Engine Business Model: **Key Resources***

On the point of key resources, game engine developers do not differ much from other game middleware developers. Meaning *intellectual* and *human* resources are paramount. For larger game engines that function as a platform in a two-sided market, such as Unity, the user base itself can be considered a key resource as it will attract users from opposite

parties. Content providers are attracted to platforms with a large user base and users are attracted to a platform that offers a lot of content.

9.2.2.8   Game Engine Business Model: **Key Partners**

Video game middleware developers can be considered partners, when the engine developer does not maintain a two-sided market pattern. In this case they are an important supplier on which the product (heavily) depends, rather than a user. Other partners are the platform owners who provide support for platform compatibility and optimization of their game engines. The Unity game engine has a large 'Asset Store' where middleware and asset developers can sell their products to Unity customers (Figure 16).
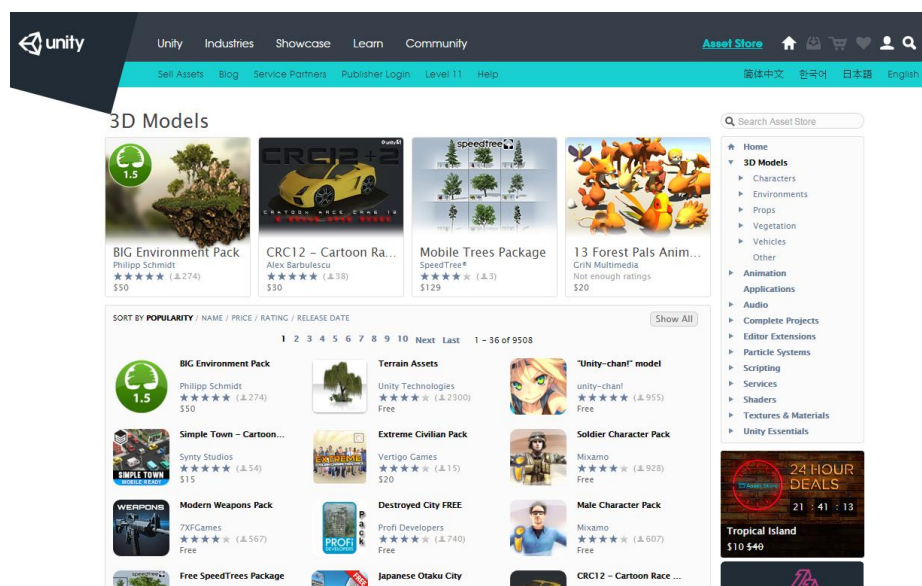

Figure 16: Unity's Asset Store is a marketplace for game assets and middleware usuable within Unity Engine (17-05-2015).

9.2.2.9   Game Engine Business Model: **Cost Structure**

Costs for game engine develops incur mainly to support their key activities such as product development and product management by salaries for employees Some costs may be related to licensing of integrated software, but this varies much between game engine developers.

9.2.3   Game Developer Business Models

Game development studios can be tied to a game publisher. This relation can have one of the following three forms:

1. A game developer is owned by a publisher:

This type of relation means that a development studio was founded or acquired by a publisher and functions as its subsidiary. These first party development studios design games exclusively for their publisher[54].

2. A game developer has a development contract with a publisher:

Contracted game developers have an exclusive working agreement with a publisher based on a certain project or time period[55].

3. A game developer has no legal ties with a publisher

Independent (Indie) game developers design and publish games themselves and do not work projects for a publisher or find a publisher for their own project.[56]

These three forms of developer-publisher relations dictate three different business models. Namely the Indie developers need to incorporate activities a publisher would normally do, such as financing and marketing into their business model. Another characteristic difference between indie games and publisher funded games is that the games are usually visually and technically less complex, as there is no budget for a large development team. The exceptions to this are the larger crowd funded projects[57], but these are not only reserved for games[58].

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[54] Examples of first party developers: Sony (Naughty Dog, Guerilla Games, Media Molecule), Micosoft (Lionhead Studios, Rare Ltd., Turn 10 Studios), Nintendo (Retro Studios, Nd Cube, Intelligent Systems)
[55] Developer Bungie (Halo series) had an exclusive publishing contract with Microsoft from 2000 until 2007 in which they created the populair first-person shooter series: Halo. Publisher Devolver publishes games for various smaller developers.
[56] For Example: Developer Mojang developed, published and soled *Minecraft* to consumers without publisher or retail support before being acquired by Microsoft in 2014.
[57] The crowd funding process for 'Star Citizen' raised over a 50 million dollar budget to develop the game.
[58] Oculus Rift and Ouya are crowd funded games hardware platforms.

Table 14: Game Developer BMC – Publisher Owned

Game Developer - *Example organizations: Maxis (EA) Massive Entertainment (Ubisoft), Infinity Ward & TreyArch (Activison Blizzard), Take-Two Interactive (Rockstar), Relic Entertainment (SEGA, formerly THQ)*

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segments
• Game engine developer • Game middle ware developer	• Game development	• Entertainment value • Creative talent • Experience & track record	• Website	• Publishers • Casual gamers • Hardcore gamers
	Key Resources		**Channels**	
	• Creative talent		• Partner store • Website	

Cost Structure	Revenue Streams
• Salaries • Third party licenses	• Publisher capital

Table 15: Game Developer BMC – Publishing Contract

Game Developer - *Example organizations: Bungie (contract with Activision Blizzard), Firefly Studios (contract with 2K Games), Frictional Games (contract with THQ), Keen Software House (contract with Headup Games)*

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segments
• Game engine developer • Game middle ware developer	• Game development	• Entertainment value • Creative talent • Experience & track record	• Dedicated personal assistance	• Publishers • Mass market with casual games • Hardcore gamers
	Key Resources		**Channels**	
	• Intellectual property • Creative talent		• Publisher	

Cost Structure	Revenue Streams
• Salaries • Third party licenses	• Development contract with publisher • Publisher capital investment

Table 16: Game Developer BMC - Indie

Game Developer - *Example organizations: Mojang(<2014), Bohemia Interactive (DayZ), Amanita Design, The Chinese Room, Double Fine Productions, Playdea. Coffee Stain Studios, croteam. Zynga (Farmville)*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Game engine developer • Retail channel	• Game development **Key Resources** • Developers	• Entertainment value • Unique game experience • Price • IP & track record	• Close relationship • Direct feedback **Channels** • Digital only • Website	• Mass market with casual games • Hardcore gamers
Cost Structure			**Revenue Streams**	
• (Salaries) • Third party licenses • Sales commissions			• Game sales to consumers • Crowd funding	

9.2.3.1   Game Developer Business Model: *Customer Segments*

Larger game developers have a development contract with a publisher, who gives them an 'order' to develop a game. These publishers are not just a channel but also a customer segment.

In the case of independent developers end-users are the customer as they publish games themselves and thereforee cater directly to end-users. Towards customer segments, they act similar to publishers in section 9.2.4, but with fewer different customer segments because developers specialize in a certain (type of) game.

9.2.3.2   Game Developer Business Model: *Value Proposition*

The value proposition for game developers is harder to grasp then for other organizations in the G-SECO because the quality attributes of games as software products are largely determined by customer taste. Hamari, Keronen & Alha (2015) indicate that attitude, subjective norms, perceived enjoyment, flow and playfulness, are relatively strong predictors for adoption and use of video games. When targeting an audience the latter three are usually covered by good game design.

 It is however in the interest of a game developer to adequately target its game to a clear customer segment such as casual gamers of hardcore gamers as their tastes significantly vary and don't find the same characteristics appealing. The general quality attributes on which games are reviewed by critics give an indication on what grounds game developers compete. For example: gameplay, graphics, sound and originality are considered important measurements of quality for the hardcore gamer segments. Like

consumer electronics prices correlate heavily to newness as the technological innovations rapidly outclass older products. Interesting differences herein however is that games that score very well on (innovative) gameplay aspects, and less on graphics retain popularity much longer.

9.2.3.3   Game Developer Business Model: **Customer Relationship**

Game developers can have a wide range of customer relationship. Many developers, large and small have a forum where people can talk about their products, report bugs and ask questions. These *self-service communities* are also used by the developer to derive critical bugs or new feature requests. Some indie developer carry out that they listen to their audience during product development, especially crowd funded projects run on user input for the developer as a form of *co-creation*. Moreover game developers can create tools as subpart of the game that enables user to change and create more content for the game. This co-creation strategy can greatly increase the longevity of a game, as a modding community can remain very active years after the games initial release[59].

9.2.3.4   Game Developer Business Model: **Channels**

Channel used by game developer to publish their games van be owned, such as their website. Or through a publisher; the publisher then handles sales and marketing and supplies retailers. Directly to retailers is also an option, in this case platform owners also function as retailers as their platform stores are used to sell games.

9.2.3.5   Game Developer Business Model: **Revenue Streams**

Depending on the partners, channels and customer segments, game developers can have very different revenue streams. When developers deliver their game directly to the end-user, one time asset sale or subscriptions are both viable options. In case a publisher mediates, the publisher pays the developer largely in advance, to finance the project. The publisher can reward bonuses depending on the success of the game to ensure commitment of the development in delivering the best possible product for end-users. For publisher owned development studios this works similarly, but then the developer acts more as a subsidiary of the publisher and employees and projects are funded directly.

9.2.3.6   Game Developer Business Model: **Key Activities**

The key activity for game developers is designing and maintaining games. Game development entails many different creative and technical disciplines such as writing, creating art-work, 3D-modelling, animation, programming, level design, game testing and product management. When a game is released a period of maintenance, after care or product iteration begins, depending on the type of game. Online multiplayer games need permanent maintenance to fix bugs, resolve gameplay balancing issues and keep the

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[59] Some examples of games that benefited greatly from user modding options: Blizzard's Warcraft III (DotA mod), Valve's Team Fortress (Counter-Strike mod). Colossal Order provides special modding tools with their game Cities: Skylines, resulting in a continuously updated set of additional content for end-suers.

infrastructure on which the game servers are running working. The latte can also be outsourced to specialist organization, or platform owners.

9.2.3.7   Game Developer Business Model: **Key Resources**

Creative talent is the most important resource for a game design studio. As subsection 5.4.4.6 described, the many creative and technical activities require experienced experts. When a developer has released multiple successful games their brand and game IP becomes a key resource too. This is explained by the large user base around successful games that anticipate a new version of that game and are likely to purchase it. Intellectual property such as famous game character and proprietary digital assets can become very valuable for the developer or the publisher that owns the rights.

9.2.3.8   Game Developer Business Model: **Key Partners**

Key partners of a game developers are: Platform owners because game developers need their tools and support to create compatible and performing products for their platform and eventually need platform owners to function as a sales channel. Game middleware developers can be key partners too, but this depends on the game at hand. Custom built engines and no other utilization of third party middleware implies that a game developer has no middleware key partners. Game engines however tend to be either third party, or part of an internal products line. Publishers are the final, but optional, key partner for a game developer.

9.2.3.9   Game Developer Business Model: **Cost Structure**

Salaries make up the largest part of costs. The costs are financed by a budget that is provided by a publisher, crowdsourcing or through own capital. Game developers aim to maintain a value driven cost-structure but do this by explicitly trying to keep costs as low as possible as the risk for poor returns is high. Economies of scope are reached when developers utilize previously developed assets in a new game.

9.2.4   Game Publisher Business Models

Table 17: Game Publisher BMC

Game Publisher - *Example organizations: Activision Blizzard, EA, Ubisoft, Valve*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Game developers • Video Game Platforms	• Marketing • Distribution of games	• Entertainment value	• Communities	• Gamers
	Key Resources		**Channels**	

	• Intellectual property • Financial resources		• Retailers • Partner store • Direct sales (owned web-store)	
Cost Structure			**Revenue Streams**	
• Game development costs • Marketing • Distribution			• Direct game sales • Subscription fees • In game sales • Extra content	

9.2.4.1 Game Publisher Business Model: **Customer Segments**

The customer segments for game publishers overlap with those of the game developers. However game publishers often try to diversify their portfolio by including games geared toward different customer segments. They can do this by contracting different developers for each type of game. Retailers could be seen as customers of publishers as well as they directly buy products to sell to the end-user. However, as the value proposition of game publishers is solely targeted towards end-users and not retailers, we regard retailers only as a channel (5.4.5.4).

9.2.4.2 Game Publisher Business Model: **Value Proposition**

In value propositions of publishers also overlap with the business model of developers as they supply the same product. Publisher however can upgrade the product with surrounding services such as those present on their publishing/retail platform. The type of value a customer can get from a game varies per type of game, and from person to person but can usually generalized to the overarching goal of entertainment. The entertainment value for a game can be expressed as a combination of the amount of fun and engagement for money, in combination with the game's replayability. A highly replay able game entices players to play it over and over. Providing a different experience on each play-through or challenging the player to become better at the game are examples of factors that drive replayability. Games that are not particularly replayable, for example single player, story driven games, can still hold a lot of value for customers.

9.2.4.3 Game Publisher Business Model: **Customer Relationship**

Much like Video game console manufacturers, publishers have a self-service customer relationship with their customer. Also online communities form an important part in the dialogue publishers have with customers. Large retailers will find personal assistance from publishers in the form of account managers, as large retailers contribute significantly to the performance of publishers.

9.2.4.4 Game Publisher Business Model: **Channels**

Retailers are an important channel for game publishers, as they not only provide the largest connection to sell games to consumers, but also cooperate in the marketing efforts publishers have to perform. Larger publishers also sell games directly through own online store (e.g. Valve, EA, Ubisoft) (Figure 17)
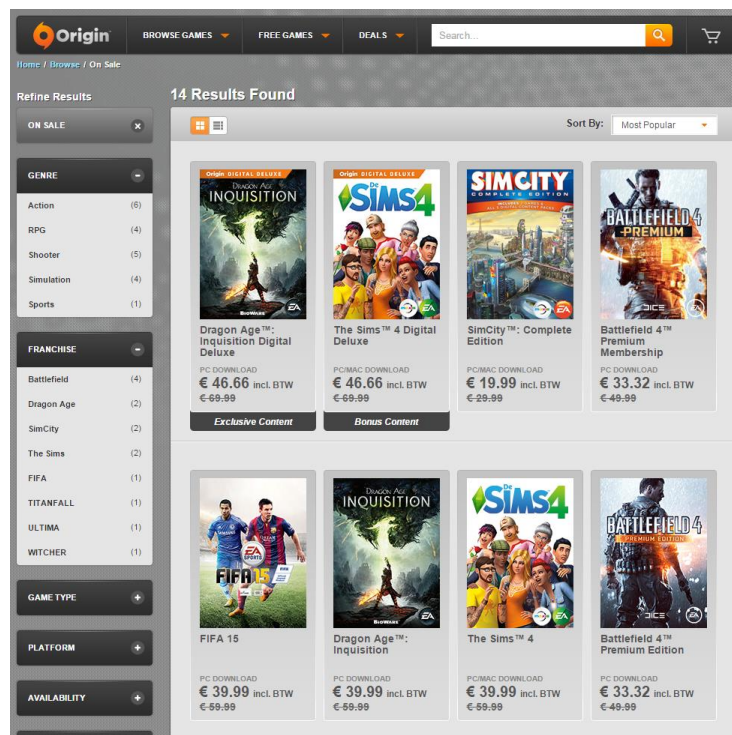
Figure 17: Origin, a Publisher (EA) owned retail channel, selling mostly first party games.

9.2.4.5 *Game Publisher Business Model: Revenue Streams*

The largest source of income of game publishers are game sales to consumers[60]. These income streams differ based on the type of game. Most AAA-titles require a onetime consumer purchase. In addition, as games have been released for a certain period, publishers often sell packages of extra content (DLC, downloadable content) to provide an extra source of income and to increase the games' longevity.

In contrast to one time consumer purchases, two other income models are seen relatively often: Monthly subscriptions and free-to-play. Free-to-play games provide a source of income though their in-game content stores, that allow players to purchase low priced pieces of in-game content.

9.2.4.6 *Game Publisher Business Model: Key Activities*

Through marketing activities publishers create interest in their games. Especially before a game launches, a hype around its anticipation can greatly increase sales. Distribution of their products is an important operational activity for game publishers. To achieve a steady world-wide supply, publishers need to sell games to retailers, or sell game directly to consumers through their own channels.

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[60] Activision's income statement: http://investor.activision.com/reports.cfm

9.2.4.7   Game Publisher Business Model: Key Resources

Intellectual property is the most valuable key resource for most publishers. Especially the older and larger publishers maintain a portfolio of game related IP that enables them to exploit the exclusive rights to particular stories, characters and game-worlds. Some notable examples are Nintendo's Mario character, Blizzard's Warcraft universe, EA's Command & Conquer or Lara Croft (Tomb Raider). These IPs are sometimes traded as assets.

Another key resource at a publisher's disposal are their first party development teams (referred to as studios). A Development studio like Maxis is an important asset for EA for current and future game releases. These development teams are often tied to a certain IP, or game series). For example Infinity Ward and Treyarch develop Activision Blizzard's Call of Duty games. Such experienced development teams are not easily replaced.

Larger publisher such as EA, Valve, Blizzard and Ubisoft maintain their own digital store on PC, Mac and/or Linux. This asset functions as an owned channel. EA's Origin and Ubisoft's Uplay stores were initially not more than gateways DRM gateways to counter piracy.

Finally, publishers function as capital investors in the game SECO, taking risk by investing in multiannual game development projects.

9.2.4.8   Game Publisher Business Model: Key Partners

Game developers are important partners for video game publishers. Without a development studio, a game publisher would not be able to bring products onto the market. As discussed in 5.4.4 a game development studio can also be owned by a game publisher, making game development an integrated key activity instead of an outsourced task for key partners. Game console manufacturers are also important partners of game publishers since they create and market the platform on which games are published and played.

9.2.4.9   Game Publisher Business Model: Cost Structure

Cost publishers endure are product costs, capital investments and or development costs for games produced by game developers. Running and distribution of games are considered product costs. Interesting is how publishers sometimes have to pay license costs when using external intellectual property as is the case with games based on movies or comics. For each video game console sold, publishers pay a royalty fee to the platform owner. An example of cost structure is found in quarterly reports released by publicly held publishers such as Activision Blizzard. In their case the cost breakdown is as follows for Q1 2014 (as a percentage of net. revenue): Total cost of sales: 32%, Product development: 11%, Sales and marketing 7%, general and administration: 7%, interests: 4%, tax: 19.9%.

9.2.5   Game Retailer Business Models

Consumer retail has been a key factor in the video game industry since its inception, both as marketing and a distribution channel. In the last decade with the advent of online

shopping and digital distribution of product software the range of business models game retailers can apply has grown significantly. Because of these changes video game retail has also become more accessible as an integrated business activity for many originally non-retailers like publishers (like EA's Origin, Valve's Steam and Ubisoft's U-Play) video game console manufacturers (Sony's PlayStation Store, Microsoft's Xbox Marketplace) and even developers (e.g. Mojang's selling Minecraft for PC directly to players through their website). Four quadrants can be identified that depict the combinations of constraints and requirements on the business model, as shown in Figure 18. For each quadrant the typical consumer use case is pointed out.
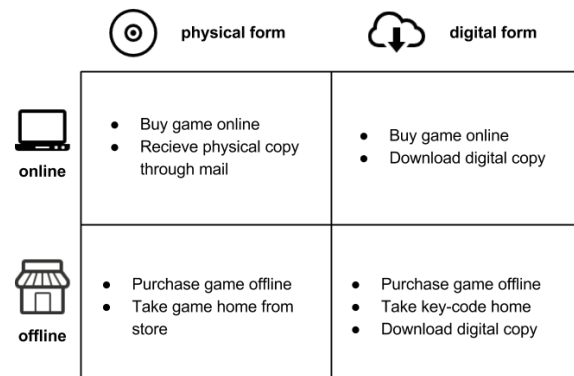

Figure 18: Product form vs. retail type

Table 18: Game Retailer BMC

Game Retailer - *Example organizations: Amazon.com, GameStop, Sony, Valve, GOG.com*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Game publishers • Wholesalers	• Marketing • Shop management • Procurement of games	• Price • Convenience	• Website	• Hardcore gamers • Casual gamers
	Key Resources • Store(s) • Customer base		**Channels** • Store	
Cost Structure			**Revenue Streams**	
• Purchasing games			• Game sales	

9.2.5.1   *Game Retailer Business Model: Customer Segments*

The customer segment video game retailers adhere to is mostly *niche market*. Targeted advertisement campaigns show that retailers try to reach a specific audience for games. However, games have become broadly known as a form entertainment and an increasing

number of games such as World of Warcraft, Call of Duty and Grand Theft Auto are well known among casual- and non-gamers, making them more a of *mass market* product, much like mobile game market.

A customer segment distinction can be made as follows:

- o Hardcore gamer, generally targeted by game-only retailers: e.g. GameStop, Valve, GoG.com
- o Casual gamer (Mass market), targeted by general retailers: BestBuy, Walmart, Amazon.com

9.2.5.2   Game Retailer Business Model: Value Proposition

The value proposition for video game retailers revolves around a combination of newness, price and convenience. Video games are a commodity product meaning a competitive advantage through exclusive supply is unlikely to occur. Price elasticity of video games is high (Chintagunta et al., 2009) meaning the demand for a videogame is highly correlated to its price. Newness however plays an important role in the pricing of video game. New AAA-titles are similarly priced among competitors since margins are quite low and consumer advice price is leading. Speed and convenience are part of the value proposition for online digital retailers.

9.2.5.3   Game Retailer Business Model: Customer Relationship

Game retailers maintain their customer relationship completely based on self-service for customers. Some retailers like Valve, Amazon and Apple can provide recommendations with *automated services* based on collected customer preferences. Some of the online retailers actively drive communities, giving users more reason to visit their store. These communities provide a form of *co-creation* as they provide reviews, tutorials and guides and even game assets such as game character models and maps.

9.2.5.4   Game Retailer Business Model: Channels

The types of customer relationship game retailers' can maintain do not vary much from other retailers. One notable distinction can be made for the PC-platform where multiple online digital retailers such as Valve and EA have incorporated selling games through their own channels as a major business process, effectively creating a store with many added benefits for users, such as game libraries, multiplayer game hosting, friends lists and save game management.

9.2.5.5   Game Retailer Business Model: Revenue Streams

Game retailers gain revenues through direct sales of assets. Subscription fees for games are not incurred by retailers because these imply an agreement between the game provider that is the publisher or developer. Attempts to use subscription fees for playing streaming[61] games have not proven to be successful yet.

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[61] OnLive lets users play games on remote hardware though a streaming service.

9.2.5.6 *Game Retailer Business Model: Key Activities*

Managing their store is the main activity of game retailers, this relates to acquisition through effectively marketing products. These marketing outings can be co-advertising constructions with publishers. Managing product pricing is a large part of the marketing activities that game retailers have to perform in order to compete as game prices do not vary much between retailers. Effective partner management is another key activity in which retailer strike purchase or advertising deals with game developers and publishers.

9.2.5.7 *Game Retailer Business Model: Key Resources*

Stores and partnerships are the key resource for game retailers. Online retailers benefit from a very large customer base and this can be seen as a key resource too. Retailers can negotiate prices with publishers better, when backed by a large user base.

9.2.5.8 *Game Retailer Business Model: Key Partners*

Game retailers have three main partners: Game publishers (or developers if they publish themselves), console manufacturers and suppliers that sell games as a middleman between publishers and retailers.

9.2.5.9 *Game Retailer Business Model: Cost Structure*

The cost structure of game retailers is in large made up procurement of stock, marketing activities and store maintenance.

9.2.6 Game Platform Owner Business Models

Video game console manufacturers (VGCMs) are the platform owners in the VGC-SECO, a sub-SECO within the G-SECO.

Table 19: Game Platform Owner BMC

Video Game Console Manufacturer - *Example organizations: Nintendo, Sony, Microsoft, Ouya, Alienware*				
Key Partners	**Key Activities**	**Value Proposition**	**Customer Relationship**	**Customer Segments**
• Manufacturing partners • Video game retailers • Publishers • Game developers • Integrated partners	• R&D • Marketing • SECO-management **Key Resources** • Customer base • Store	• Wide range of games • Exclusive features • Exclusive games • Large Installed base • Ease of development (& publishing)	• Loyalty program **Channels** • Retailers	• Gamers • Publishers • Indie developers
Cost Structure		**Revenue Streams**		
• Development cost		• Royalties per game sold • Subscriptions for services. • Direct game sales		

9.2.6.1 Video Game Console Manufacturer Business Model: **Customer Segments**

Video Game Console Manufacturers maintain a *Segmented:* two-sided market model. (Eisenmann, Parker & Alstyne, 2006). Two different types of nodes namely consumers (gamers) and publishers interact through the video game console as a platform for games. This two sided model results in separate business model elements for each side. Both sides of the two sided market are also segmented as illustrated in Figure 19.
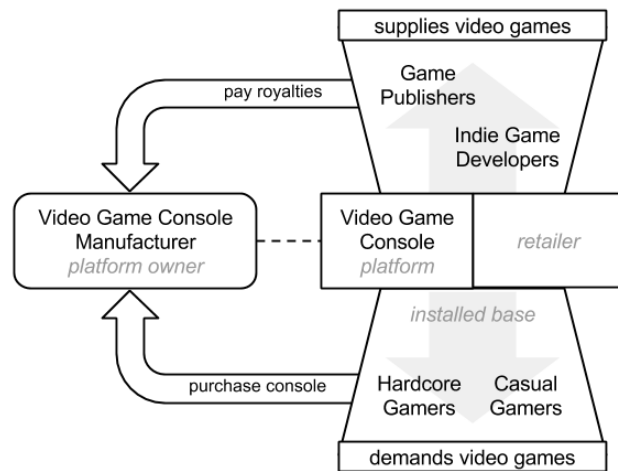

Figure 19: Two sided market model for video game consoles

For example Sony's PlayStation 3 is targeted more to a seasoned gamer audience with high end graphics and mature types of games. Nintendo's Wii is more family-oriented, seeking to entertain a broader audience with accessible games and alternative controls.

A similar segmentation is starting to become present on the supply side as video game consoles have started to function as a publisher and retailer for independent (indie) developers removing the need for separate publishers and a retailers.

9.2.6.2 Video Game Console Manufacturer Business Model: **Value Proposition**

Srinivasan & Venkatraman (2010) show that platform dominance is positively related to the number, variety and exclusiveness of games offered by the platform. Furthermore, games designed by well-known developers and publishers contribute more effectively. The following four drivers constitute the value proposition towards the consumer side of a video game console.

Towards consumers:

Large number of games

A platform that offers a larger selection of games is more attractive to consumers than a platform with fewer games. By including indie games in their catalogue a VGCM can quickly increase the number of available games.

Variety in game genres

A greater variety of game genres is more likely to appeal to a broader customer base (Srinivasan & Venkatraman, 2010)

Games exclusive to the platform

Offering exclusive games plays an important part in the value proposition of VGCMs. Venkatraman & Lee (2004) show that publishers who offer a game exclusively on a particular platform increase the value of that platform for its users. To maintain a significant portfolio of platform-exclusive games VGCMs apply two strategies: (1) Subsidiary, or *first party* publishers supply games exclusive to the platform. Sony, Microsoft and Nintendo all have their own publishing branches[62] and dedicated development studios that create games only available on their platform. (2) VGCMs seek deals with third party publishers to serve their products exclusively (for a particular time period). The latter can also be beneficial for a publisher from a development standpoint as it allows them to focus on one platform at a time.

Towards publishers and developers:

The value proposition of a video game console manufacturers is both targeted at publishers and developers. Publishers value a large number of customers using the target platform (installed base), as this increases the potential audience for their games.

Development costs of a video game are related to the ease with which games can be ported to, and created for a video game console. A balance between powerful hardware and accessible system software to leverage the hardware's power is key. Two different examples of this are PlayStation 3 and Nintendo Wii. Where the latter had weaker hardware and performance capabilities, but was much easier to develop games for. The PlayStation 3's architecture was powerful but so complicated and led to a weak line up of games when the console was released (Mark Cerny, 2013).

9.2.6.3   *Video Game Console Manufacturer Business Model: Customer Relationship*
VGCMs announce most of their product releases at game conferences[63], informing both consumers and publishers about future products that will come available.

Towards consumers:

A s*elf-service* customer relationship is maintained in the form of wiki-structured knowledge banks[64]. This approach scales well for mass market consumer products. Furthermore console owners rely heavily on online communities for customer troubleshooting and discussions about their products[65]. Even though all video game console manufacturers have their own online community, many fan-based online communities exist not governed by VGCMs.

Towards publishers and developers:

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[62] First party publishers: Sony Computer Entertainment, Microsoft Studios and Nintendo

[63] E3: http://www.e3expo.com/ , GameCom: http://www.gamescom-cologne.com/

[64] Knowledge banks: Sony: https://support.us.playstation.com/, Microsoft: http://support.xbox.com, Nintendo: http://support.ninentdo.com.

[65] Communities: Sony: http://community.eu.playstation.com, Microsoft: http://forums.xbox.com/, Nintendo: (only tech support) http://techforums.nintendo.com/index.jspa

- *(Dedicated) personal assistance*: Both publishers and console owners try to benefit from exclusivity deals on AAA-titles.
- Mostly *self-service*, with some *personal assistance* for more successful indie developers

9.2.6.4 *Video Game Console Manufacturer Business Model: Channels*

Towards consumers:

All current (7th and 8th) generation video game consoles have an online store component accessible directly through the console[66]. This allows video game console manufacturers to retail games to directly to their installed base, eliminating the need for retail.

Retailers however still play an important role. At least the game console has to be physically purchased by gamers and game console manufacturers sell them through retailers. In addition physical retail for games is still relevant as many gamers prefer physical copy's.[67] [68]

9.2.6.5 *Video Game Console Manufacturer Business Model: Revenue Streams*

From gamers: VGCMs generate revenue through royalties from publishers per game that is sold for their platform. In addition other products such as hardware accessories and subscriptions[69] for extra services VGCMs also sell digital games directly to consumers.

Video game console sales

The main product a VGCM sells (its game console) is in most cases sold at loss. An example of this are PlayStation 4[70] and Xbox 360. The reason no profit is made on the console itself is that it functions as a hook for a long time relationship with the customer, who on average will purchase multiple games[71] that more than compensates this loss. A lower price also increases the installed base, increasing the platform's value as perceived by the supply side.

9.2.6.6 *Video Game Console Manufacturer Business Model: Key Activities*

Research and development is a key activity a VGCM performs. To stay competitive VGCMs have to create and maintain their game platform. Even within a single video game console generation multiple versions are released to upgrade performance and decrease

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[66] PlayStation Store: https://store.sonyentertainmentnetwork.com, Xbox Marketplace: http://marketplace.xbox.com/ Nintendo eShop: http://www.nintendo.com/wiiu/eshop

[67] http://www.digitalspy.co.uk/gaming/news/a573214/72-percent-of-consumers-prefer-boxed-games-over-digital-says-report.html#~oHlJngOcu8WVZf

[68] http://www.gamesindustry.biz/articles/2014-05-14-three-out-of-four-us-gamers-prefer-physical-games-npd

[69] Xbox LIVE: http://www.xbox.com/en-US/live/ PlayStation Plus: http://us.playstation.com/playstation-plus/

[70] PlayStation 4 hardware costs: http://press.ihs.com/press-release/design-supply-chain-media/sony-nears-breakeven-point-playstation-4-hardware-costs

[71] Average number of games sold per platform (2008): http://www.gamasutra.com/view/news/111663/Exclusive_US_GamesPerConsole_Ratio_Shows_Xbox_360_Shooting_Ahead.php

the device's size[72]. In addition to the hardware iteration cycle, a much shorter cycle is present for the software VGCMs run on their products. These updates include bug fixes and performance optimizations, but also completely new features and integrations with other software products as apps.[73]

9.2.6.7   Video Game Console Manufacturer Business Model: **Key Resources**

A video game platform owner's main asset is its installed base. Through the network effects explained in section (9.2.6.5) a large this installed base drives all other segments of a video game platforms owner's BM. From gamers: Direct sales through owned retail channel (console store), (-) loss on console hardware, Sales in accessories. From publishers and indie developers: Royalties per game sold.

9.2.6.8   Video Game Console Manufacturer Business Model: **Key Partners**

Manufacturing partners[74] fulfill an important role in the product creation of video game platform owners. These organizations operate specialized facilities for assembling electronic devices such as camera's, mobile phones and video game consoles. Through contracted projects with video game platform owners, manufactures create batches of the product based on forecasted demand.

9.2.6.9   Video Game Console Manufacturer Business Model: **Cost Structure**

The main costs a VGCM makes can be assigned to the development and production of their game consoles. As stated in subsection 9.2.6.5 video game consoles are often sold at a loss as part of the business model.

9.3   Business model segment per node type

The following tables contain all business model observations made in section 5.4 for all node types in their current situation (8th generation). These observations are grouped by business model segment in order to be displayed in the business model segment evolution diagrams in 0.

Customer Segments		
Customer type	**In current BM of node type**	**Observations & Trends**
Casual gamers	Game platform owner Game retailer Game publisher Game developer	• 1980 Namco Pac-man arcade • 1989 Game boy (tetris) • 1990 Solitaire Windows • 2000 Flash games • 2006 Wii • 2008 Facebook games
(Hard)Core gamers	Game platform owner Game retailer Game publisher Game developer	• Permanently addressed by all node types during all generations, except gen 1.

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[72] PlayStation 3 counted 6 different SKU's through its lifecycle.

[73] Software integration on Xbox ONE http://www.xbox.com/en-US/live/apps/xbox-one?xr=shellnav PlaySation 4: http://us.playstation.com/ps4/entertainment/

[74] Foxconn Technology Group is an example of an important contracted manufacturing partner for Sony, Microsoft and Nintendo. Respectively manufacturing and assembling their PlayStation 4, Xbox One and Wii U game platforms in China.

Large game developers	Game engine developers Game middleware developer	
Small game developers	Game middleware developer Game engine developer Game platform owner	• (Gen 7) Game middleware/engine developers start targeting the growing number of small/indie developers • Platform owners start alleviating publishing hurdles for small developers

Channels		
Channels type	**In current BM of node type**	
Retailers	Game platform owner Game publisher Game developer	• (gen 6) Developers have started to directly sell through retailers
Console	Game publisher Game developer	• Xbox store 2006 • First iPhone 2007 – app store
Owned store	Game retailer Game publisher Game middleware developer	• Valve Steam (gen 6) small at first • EA Origin (gen 7) • Unity (game engine) asset store
Partner store	Game publisher Game developer Game middleware developer	• Game developer sells through publisher's store
Website	Game developer Game middleware developer	• Indie game developers sell games through own website (minecraft) • Game middleware developers sell software & services through own site
Partner software	Game middleware developer	• Game middleware developers sell software and assets through partner software. E.g. plug-in developers sell though/with game engine

Customer Relationship		
Customer Relationship type	**In current BM of node type**	
Loyalty program	Game platform owner -> users Game publisher -> users	
Communities	Game publisher Game retailer Game middleware developer Game platform owner Game developer	
Personal assistance	Game middleware developer -> developers Game platform owner -> larger publishers	
Self service	Game middleware developer -> developers Game platform owner -> user Game platform owner -> indie developers	
Automated services	Game retailers	
Co-creation	Game developers -> users Game retailers -> users Game middleware developers -> users	

Revenue Streams		
Revenue Stream type	**In current BM of node type**	
Subscription/ License fees	Game platform owner Game publisher Game engine developer Game middleware developer	
Royalties	Game platform owner Game engine developer Game Middleware Developer	
Initial product sales	Game middleware developer Game platform owner Game retailer Game publisher Game developer	
In product sales	Game publisher Game developer	
After sales (DLC)	Game publisher Retailer	
Publisher capital	Game developer	
Crowd funding	Game developer Game platform owner	
Training and support	Game engine developer Game Middleware Developer	

Value Proposition		
Value proposition type	**In current BM of node type**	
Consumer: Price	Game retailer Game platform owner Game developer	
Consumer: Convenience - fast & easy	Game retailer Game platform owner Game publisher	
Consumer: Choice - wide range of games/products	Game platform owner Game retailer	
Consumer: Exclusive games & features	Game platform owner Game publisher	
Consumer: Entertainment value	Game publisher Game developer Game platform owner	
B2B: Large installed base	Game platform owner Game retailer	
B2B: Ease of development (& publishing)	Game platform owner Game middleware developer	
B2B: Risk reduction	Game engine developer	
B2B: Expert solution to specific game functionality	Game middleware developer	
B2B: All round solution for general functionality	Game middleware developer Game engine developer	

Key Activities		
Key activity type	**In current BM of node type**	
Console development	Game platform owner	
SECO-management	Game platform owner	
Marketing	Game platform owner Game retailer Game publisher	
Shop management	Game retailer	
Procurement of games	Game retailer	
Distribution of games	Game publisher	
Game development	Game developer	
Product maintenance	Game developer Game engine developer Game middleware developer	
Consultancy, training & support	Game engine developer Game middleware developer	

Key Resources		
Key Resource type	**In current BM of node type**	
Intellectual property	Game publisher Game middleware developer Game developer	
Human resources	Game middleware developer Game developer	
Platform or store	Game middleware (engine) developer Game developer Game publisher Game retailer	
Financial capital	Game publisher	
User/installed base	Game retailer Game platform owner	
Software product	Game middleware (engine) developer Game developer	

Key Resources		
Key Resource type	**In current BM of node type**	
Intellectual property	Game publisher Game middleware developer Game developer	
Human resources	Game middleware developer Game developer	
Platform or store	Game middleware (engine) developer Game developer Game publisher	
Financial capital	Game publisher	
User/installed base	Game retailer Game platform owner	
Software product	Game middleware (engine) developer	

Key Partners		
Key partner type	**In current BM of node type**	
Manufacturing partners	Game platform owner Game publishers (hardware)	
Video game retailers	Game platform owner Game publisher (Indie) game developers	
Publishers	Game platform owner Game retailer Game developers	
Game developers	Game publisher Game platform owner Game retailer	
Game wholesale partners	Game retailer	
Video Game Platforms	Game publisher Game Middleware (engine) developer Game developer	
Game engine developer	Game developer	
Game middle ware developer	Game developer	
Integrated partners	Game engine developer Game platform owner	
Integration partners	Game middleware developer	

Cost Structure		
Cost Structure type	**In current BM of node type**	
Physical product development cost (R&D, production and distribution)	Game platform owner Publisher	
Products in stock	Game retailer	

Game development investment costs	Game publisher	
Salaries	Game developer Game middleware & engine developer	
License costs	Game developer Game engine developer Game publisher	
Royalties	Publisher Developer	
Marketing	Publisher Game platform owner Game retailer	

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