

Using System Dynamics to Explore Risk Management in Light of Business Model Boundaries

25.07.2020

A case study undertaken as a master thesis project in the System Dynamics program at the University of Bergen, conducted by Stina Ihle Amankwah

Frameworks for business models

This thesis uses system dynamics to critically examine the definitions and frameworks that govern our understanding of what a business model is and isn't as well as how one should approach generating a business model for a new business. By using simulation based modeling this study aims to contribute with insight as to what using different definitions, frameworks and their model boundaries entails in the practical aspect.



The Business Model Canvas		Designed for:	Designed by:	Date:	Version:
Key Partners Who are we partnered with? Which partners are we depending on? Which partners do we depend on? Why are we partnered with them? What do we expect from them? What do they expect from us? What are the risks of this partnership? What are the benefits of this partnership?	Key Activities What key activities do we have to perform to make our business model work? What are the most important activities to perform? What are the most difficult activities to perform? What are the most time-consuming activities to perform? What are the most costly activities to perform? What are the most risky activities to perform? What are the most valuable activities to perform?	Value Propositions What value do we offer to the customer? What are the most important value propositions to offer? What are the most difficult value propositions to offer? What are the most time-consuming value propositions to offer? What are the most costly value propositions to offer? What are the most risky value propositions to offer? What are the most valuable value propositions to offer?	Customer Relationships What type of relationship does each of our customer segments expect? What type of relationship do we offer? What are the most important customer relationships to offer? What are the most difficult customer relationships to offer? What are the most time-consuming customer relationships to offer? What are the most costly customer relationships to offer? What are the most risky customer relationships to offer? What are the most valuable customer relationships to offer?	Customer Segments Who are we creating value for? What are the most important customer segments to create value for? What are the most difficult customer segments to create value for? What are the most time-consuming customer segments to create value for? What are the most costly customer segments to create value for? What are the most risky customer segments to create value for? What are the most valuable customer segments to create value for?	
Key Resources What key resources do we have to perform our business model? What are the most important key resources to have? What are the most difficult key resources to have? What are the most time-consuming key resources to have? What are the most costly key resources to have? What are the most risky key resources to have? What are the most valuable key resources to have?	Channels How do we reach our customer segments? What are the most important channels to reach our customer segments? What are the most difficult channels to reach our customer segments? What are the most time-consuming channels to reach our customer segments? What are the most costly channels to reach our customer segments? What are the most risky channels to reach our customer segments? What are the most valuable channels to reach our customer segments?	Cost Structure What are the most important costs to our business model? What are the most difficult costs to our business model? What are the most time-consuming costs to our business model? What are the most costly costs to our business model? What are the most risky costs to our business model? What are the most valuable costs to our business model?	Revenue Streams How do we generate revenue? What are the most important revenue streams to generate? What are the most difficult revenue streams to generate? What are the most time-consuming revenue streams to generate? What are the most costly revenue streams to generate? What are the most risky revenue streams to generate? What are the most valuable revenue streams to generate?		

DESIGNED BY: Business Model Foundry AG
THE PROPERTY OF BUSINESS MODEL FOUNDRY AG AND STRATEGYZER
STRATEGYZER.COM

STRATEGYZER
strategyzer.com

Innholdsfortegnelse

1. Introduction and problem presentation	3
1.1 Background for the research	3
2. Theoretical Framework and Hypothesis	6
2.1 Literature review	6
2.2 Business Model Generation Frameworks	12
3. Hypothesis	15
3.1 Case study	15
4. Model Presentation	23
4.1 Model Purpose and entailed assumptions	23

1. Introduction and problem presentation

1.1 Background for the research

When presented with the challenge of creating a new business, entrepreneurs are often asked to present their business model and, if the investors are intrigued by the business model, the entrepreneurs is asked to provide a business plan. There is a substantial amount of literature about theory surrounding business models as a basis for doing business, but the experts have not agreed on one common definition for the concept of “business model”(Al-Debei & Avison, 2010; Hedman & Kalling, 2003; Oosterwalder, 2004; Verrue, 2014). This represents a challenge where the investors and the entrepreneurs may use the same word, *business model*, but may refer to different conceptual understanding. Furthermore being able to understand and establish a good business model is essential to succesful entrepreneurship. Basing a business on faulty assumptions may lead to lost profits at best and a great business idea never leading to fruition at worst.

In order to meet the sustainable development we rely on the creation of jobs and sustainable technology through innovation and entrepreneurship worldwide. While innovation and entrepreneurship is happening at increasing rates, the business and trade environment in which it is supposed to happen is changing rapidly. It is prudent to ask the question of whether the methods of business model generation from the past will serve the entrepreneurs of the future who will likely operate in a market with higher volatility, higher risks and increasing pressure to shy away from business practices with negative effects.

When using the business model as the main framework for validating a business' ability to generate a profit it might serve all parties to have a common understanding of what a business model is as well as ensuring that the current modes of business model generation are appropriate in a context of frequent and drastic change. In system dynamics the term robustness is used to refer to the “ability of the business model to sustain its effectiveness over time” (Casadesus-Masanell and Ricart, 2010, p. 148). By approaching a business model as another system and examining its robustness in a similar manner one can also examine how closely it needs to be monitored or how fast it needs to be adjusted in the face of change to the environment. The robustness approach becomes an especially interesting point of research in volatile contexts . Whether or not a business thrives or even survives a situation of drastic and sudden change to its' business environment depends at large on the robustness of the business model, the management's insight into the impact of the context on the structure and how fast the business can change from one model to another. The robustness of a business model can only be examined through subjecting it to various scenarios and conditions.

The lack of a consolidated definition of a business model gives rise to questions as to what should be included and excluded from this representation of the business, and what is part of the “core” of the business, what are considered endogenous components and what are considered exogenous components. One common understanding however is that the scope of a business model created through a framework like

the Business Model Canvas is limited to the processes that are within the control of the business and does not cover environmental factors (Fritscher & Pigneur, 2015). The Business Model Canvas, hereinafter BMC, serves as the closest thing to a common conceptualization we have of a business model. This is not as much due to its' in-depth analysis of a business model, but more an ode to it being the most common framework for constructing a business model(Stenn, 2017).

The aim of using system dynamics is to gain insight into what type of behavior the assumed structure of a business model provided by a definition or a framework would produce. System Dynamics is a tool that facilitates testing the performance or behavior of a conceptual model over time under different scenarios. System dynamics is a theoretical framework built on the premise of that behavior is generated by the structure of the system. From a system dynamics perspective the business model is at large the primary driver of the behavior, meaning the performance of the company. System dynamics is a method to enhance learning in complex systems (Sterman, 2000). By applying this theory to the question of model boundaries in business model generation this study may add insight to the discussion of business model robustness and what should be included and excluded. Risks, defined as “the possibility of loss or injury (to your profits) or the chance that an investment such as a stock or commodity will lose value”, are considered a variation in behavior from that the structure should normally generate, should then be considered to fall outside the boundaries of a business model. System dynamics theory provides a basis for looking at policies which endogenizes the exogenous elements that makes the system unstable. Because the BMC does not consider system feedback, the question of endogenizing risks becomes somewhat obsolete, but a system dynamics simulation model provides a basis for experimenting with the margins of inclusion and exclusion.

2 Research Objectives

This study aims to form part of the discussion of how a business model should be defined and understood by questioning and testing the theoretical assumptions that underline the current dominant understandings. The main purpose for this research is to uncover the extent of the dynamics that can be read from a simple business model template such as the BMC or the Business Model Pattern, hereinafter BMP. This research will explore what information might be lost in the using simple business model presentation formats such as *Osterwalder's* BMC and the BMP Execution approach. This is based on the understanding that an enterprise which is “unable to distinguish the main components of its business model, and the dynamics that lie within, it is incapable of changing and adapting the model to the environment”(Romero et al., 2015). The first research question becomes as follows:

1. How does the business perform when it is driven by the assumed structure provided by a BMC and BMP and does this suffice in terms of being frameworks that should correspond with the definitions of what a business model should be

Kommentert [A1]: Teorutvikling for forståelsen av forretningsmodell i en startup kontekst?

While the BMC tries to identify *what* is needed to create economic value, this study will apply BMP and address *how* the elements identified in a BMC can create value. With the added insight of a dynamic simulation-based model this research aims to answer the following question:

2. What can experimenting with inclusion of risks mitigation strategies in the business model teach us about model boundaries for business models and as such define the scope of the concept of business model

Through examination of the involved dynamics, the weight attached to the different elements of the model and through examining the business under different scenarios this research aims to provide more insight into what should be regarded as the core of a business model and understanding of the extent to which the structure of the business drives behavior and when the behavior or performance of the company in turn changes the structure.

These two questions will be central in answering the final question which is

3. What are the added benefits of applying system dynamics to business model generation and how can the insights from this study contribute to build a consolidated definition of business model as a concept?

Kommentert [A2]: More robust business models

The nature of research questions 1 and 2 gives rise to question 3, and discussing what value system dynamics adds to the academic discourse on business models.

This thesis does not intend to provide a new or improved version of the BMC or BMP, but present which dynamics that are the result of the assumptions included in the BMC. Originally this study was meant to be carried out as a group model building process with actual start ups in Uganda, but this had to be altered due to COVID-19. The final study was thus carried out with a fictitious company based on conversations with the entrepreneurs behind Mama Lizzy Ventures in Accra, Ghana. By placing the fictitious business in a somewhat volatile context it allows for a more general discussion of the role of risk management in business model generation and looking at which performance the different assumptions would entail.

The structure of this thesis will

Chapter 2 will present the theoretic foundation upon which this research builds as well as the hypothesis. It will present how central concepts dicussed in this thesis are understood by the author and how they should be understood in the context of this study. Chapter 3 will demonstrate the approach and method of this study, as well as the validity of the output of this research meaning the construction of a system dynamics model along with how this model will be used to answer the questions set out in the paragraph above. Chapter 4 will present the model and present central findings. Chapter 5 will present and test the proposed policy, and the findings will be discussed in chapters 5 and 6.

2. Theoretical Framework and Hypothesis

2.1 Literature review

Understanding the concept of a business model:

The leading sources of the author's conceptual understanding of what a "business Model" is, are on "The Business Model Ontology" (Osterwalder, 2004), and "The Business Model: Recent Developments and Future Research" (Zott et al., 2011).

Kommentert [A3]: Hvordan komplementerer Zott Osterwalder?

The central work of Osterwalder utilized in this thesis precedes Zott by seven years, and is also a topic in Zott's work. The Business Model Ontology (Osterwalder, 2004) makes an in-depth analysis of the theoretical understanding of a business model by examining and synthesizing previous works' definitions of the concept. "The Business Model: Recent Developments and Future Research" (Zott et al., 2011) highlights the lack of a consolidated definition among scholars and provides a semantic and conceptual discussion of the term "business model". Beyond the definitions provided in the table below a key take away from Zott (2011) is that many research projects touching on business models do not define the term in their work. Both these works list a number of definitions applied to the concept business model, some of which are highlighted in the table below.

Definition of business model	Source	Comment
Business models are "stories that explain how enterprises work. (...) How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"	(Magretta, 2002) in Zott 2011	Process oriented
"The business model depicts "the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" Based on the fact that transactions connect activities, the authors further evolved this definition to conceptualize a firm's business model as "a system of interdependent activities that transcends the focal firm and spans its boundaries""	(Amit & Zott, 2001) in Zott 2011	Structure oriented
"The method by which a firm builds and uses its resources to offer its customer better value and to make money in doing so"	(Afuah & Tucci, 2001) in Zott 2011	Process oriented
"The means by which a firm creates and sustains margins or growth"	(Euchner & Ganguly, 2014)	

“How a company earns money, not describing the entire enterprise”	(Osterwalder 2004)	Goal oriented
The business model is the architecture for the product, service and information flows, including the various actors and sources of revenue	Paul Timmers (Timmers 1998) in (Osterwalder 2004) and (Zott et. Al 2011)	Structure oriented
The money earning logic of a business/ The business model is “the heuristic logic that connects technical potential with the realization of economic value”	(Osterwalder 2004) / (Chesbrough & Rosenbloom 2002)	Goal oriented
“A business layer (acting as sort of glue) between business strategy and processes”	(Osterwalder 2004)	Structure oriented, explicitly excluding processes
“Business models are a new unit of analysis that can be observed and compared, help defining measures and should therefore also improve and should therefor also improve decisions.”	Stähler (2002) in (Osterwalder 2004)	If a business model should be of help in policymaking it is necessary to understand the implied dynamics
“A description of a complex business that enables the study of its structure, of the relationships among structural elements and of how it will respond to the real world”	Petrovic, Kittl et al. (2001) & Applegate (2001) in (Osterwalder 2004)	“How it will respond to the real world” Structure oriented with a note on dynamic interaction with exogenous components
A simplification of the complex reality which helps to understand the fundamentals of a business or how a future business should look like	(Osterwalder 2004)	“A simplification of the complex reality” “How a future business should look like” <i>DOES THE BMC SUFFICE FOR THIS?</i>
The commercial relationship between a business enterprise and the products and/or services it provides in the market.	Hawkins (2001) in (Osterwalder 2004)	Relationship (Structure oriented)
The method of doing business by which a company can sustain itself	Rappa (2001) in (Osterwalder 2004)	Goal oriented
Business Models “Consist of four interlocking elements, that, taken together, create and deliver value”. (Value prop, profit formula, key resources and key processes)	(Johnson, Christensen & Kagermann, 2008) in Zott 2011	Structure oriented
“A business model articulates the logic, the data and other evidence that support a value proposition for	(Casadesus-Masanell & Ricart, 2010, Teece, 2010) in Zott 2011	Structure oriented

the customer, and a viable structure of revenues and costs for the enterprise delivering that value”		
“Business models (BMs) are simplified representations of the aspects—and the interactions between these aspects—that an organization considers when creating, delivering, capturing, and exchanging value”	(Khodaei & Ortt, 2019)	Process oriented
“The business model is conceptually placed between a firm’s input resources and market outcomes, and it “embodies nothing less than the organizational and financial ‘architecture’ of the business”	(Teece, 2010).	Structure oriented

The majority of the definitions presented by Osterwalder describe a business model as a structural tool, while quite a few define it by its goal which is profit revenue > costs. While the majority of the definitions presented by Zott also refer to the business model as a structural tool, some of the definitions also put significant emphasis on the processes of the business, a perspective that is absent from the definitions presented in Osterwalder. The definitions provided by Zott also diverge from the ones presented by Osterwalder in that they focus less on the business model as a tool to reach a goal, and more on the conceptual understanding of a business model.

Both Osterwalder and Zott also attempt to narrow down the conceptual understanding of a business model through exclusion. A business model:

- Does not involve “a linear mechanism for value creation from suppliers to the firm to its customers”(Zott et al., 2011)
- Is not a product market strategy (Zott et al., 2011)
- “Cannot be reduced to issues that concern the internal organization of firms”.(Zott et al., 2011)
- Does not aim at describing an entire enterprise(Osterwalder, 2004)
- Does not aim at “modeling and explaining business model success”(Osterwalder, 2004)
- Is not a strategy instrument (Oosterwalder, 2004)

Kommentert [A4]: To what extent does “logic” allow for non-success, can a business be “logical” but still not successful (generating profit)?

In light of the purpose of this study, the research will consider a business model a structural tool which aims at showcasing and validating the assumptions of value creation that the business is built on. This study will not discuss in depth how the definition of business model has evolved over time, but some key points are worth noting. A focal point of this study is that in the later years a major part of the critique of the BMC and traditional approaches to business model generation have not been dynamic enough and that the over simplification of the business model drives a need for more complementary (extra) work(Türko, 2016). Similarly Euchner and Gangulay (2014) have challenged Oosterwalder and Pigneur’s definition of business model through exploring business model innovation and comparing strong business models to ordinary business models. Their deliberations on competitive advantage and economic leverage are key reflections that serve as central points of discussion at the intersection of dynamic and conceptual analysis of business models. In line with the research objective of this thesis they also explore the margins of a business model, inter alia, through exploring the role of risk management in business model generation and innovation.

Understanding business model frameworks:

“Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers” (2010) has since been translated to 29 languages and sold over a million copies¹. This book provides in depth guidance on how to understand and apply the canvas as a tool for business model generation. In terms of this thesis this book provides the basis for applying the BMC and understanding the multiple levels of interpretation of the concepts presented in the canvas.

Romero, Sánchez and Villalobos present a more dynamic framework ontology for presenting a business model in their conference paper “Weaving Business Model Patterns: Understanding Business Models”(Romero, María Camila, Sanchez, Mario, Villalobos, 2016) from the 18th international conference on Enterprise Information Systems, also published in their self-published in their collection of selected papers from the conference. This paper also elaborates on how the various components that would naturally be included in a Business Model Pattern structure should be represented in terms of variables in a dynamic simulation-based model.

Understanding business model dynamics:

Sterman, John: “Business Dynamics: Systems Thinking and Modeling for a Complex World” (2000) is one of the most comprehensive works on system dynamics and provides in depth examinations of approaches to modeling complex systems and how to conceptualize real life elements to variables such as stocks, flows and converters, as well as how to identify and quantify cause and effect relationships.

“Simulating the BMC Using System Dynamics” by Romero, Sanchez and Villalobos (2015) examines how system dynamics can enrich the understanding of the business beyond what the BMC can convey. This article also goes into a detailed discussion on the nature of the different elements in the BMC and the rationale behind the representation of the various parts as auxiliary variables, stocks and flows.

“Business Model Robustness: A System Dynamics Approach” by Abdelkafi and Tauscher (2015) which explores how ignoring the dynamics contained in a feedback model is a prominent cause of lack of success for a business.

“Business Model Pattern Execution: A System Dynamics Application” by Romero, Sanchez and Villalobos (2017) presents business model pattern execution as a more dynamic approach to creating a business model as compared to the business model canvas. This project has utilized the business model pattern execution method as the framework for conceptualizing a dynamic simulation model of a generic business model.

“Capturing Dynamics in Business Model Frameworks” by Khodaei and Ortt (2019) argues why the static frameworks for business model generation and analysis are insufficient in creating lasting understanding of the company’s performance over time, and how a dynamic framework can provide added insight and reduce time spent. It also addresses the model boundaries of the business model concept, and their main criticism of the BMC are also tied to questions of model boundaries. The authors also present a

¹ Fritscher & Pigneur (2015)

framework for assessing the completeness of a business model, meaning “internal company aspects and external environmental aspects” presented in the table below.

Criteria	Degrees in Which Criteria can be Met
1) Completeness	A. Complete in internal company variables B. Complete in external company variables C. Complete in business model variables
2) Interrelationships	A. No interrelationships distinguished B. Relationships assumed but not specified C. Relationships specified
3) Interrelationships over time	A. No interrelationships over time distinguished B. Relationships over time assumed but not specified C. Relationships over time specified
4) Framework changes	A. No framework changes specified B. Framework changes assumed but not specified C. Framework changes specified

I am not the first and hardly the last to look at the BMC from a system dynamics perspective and the identification of appropriate system dynamics approaches to understanding the concepts contained in the BMC and the BMP takes into account the works of Romero, Sánchez and Villalobos (2011, 2015 and 2017) that relates to simulating the BMC and Business Model Patterns using system dynamics. Although this working group has laid foundations for exploring how these structures can be explored using system dynamics, this study goes further in addressing issues such as unit consistency, model cohesion and diverts from their conceptual presentation of the elements of the BMC founded on principles of system dynamics. The simulation model of Editorial de los Alpes’ BMC (Romero et al., 2015) does not contain any extra variables not explicitly provided in the static Business Model Canvas, except for the flows regulating the stocks. While the model can be simulated, it does not auto-generate any behavior and it has not established the causal relationships between all the sectors. The model that forms the basis for this study differs from any of the models mentioned or showcased in the mentioned literature. The rationale behind the divergent modeling is documented in the tables below.

Table 1

Canvas Element	Key Partner	Key Resources	Key Activities	Value Proposition
Romero, Sánchez & Villalobos	Converter	Converter	Stock	Converter
This study	Converter	Stocks	Flows	Stocks

Rationale	A variable is instantaneous rather than cumulative that marks the presence of a partnership, in a similar manner to a switch.	The key resources accumulate over time as the company develops, with the acquisition of new resources and scrapping of old ones with the delays those processes entail. These do not represent an instantaneous relationship and can be identified by the snapshot test (Sberman, 2000).	The key activities are continuous processes which could be accumulated, but in this model it is not the processes in themselves that “make the business logic”, but they are means to an end. Both key activities in this enterprise regulate the most central key resource, the products for sale. The validity of representing Key Activities as flows vs stocks will be elaborated on in chapter X	The strength of the value prop vis-à-vis the customer segment is the central determinant of competitive advantage as well as the attractiveness vis-à-vis the end customer. In order to capture the state of the system it is therefore necessary to be able to examine the accumulation and depreciation of the value props. These can also be identified using the snapshot test.
------------------	---	--	---	---

Table 2

Canvas Element	Customer Relationships	Channels	Customer Segments
Romero, Sánchez & Villalobos	Stocks	Stocks	Converter
This study	Stocks	Converters	Converter
Rationale	Customer relationships in this model are represented by the amount of customers in that given relationship level.	Channels in this model are defined as existing or not existing. The effect of the channel is disaggregated, and any change in the variable is instantaneous.	A decision rule, meaning exogenous input, that has a set constant value.

Table 3

Canvas Element	Cost structures	Revenue Streams
Romero, Sánchez & Villalobos	Converters	Converters

This study	Converters + flow	Stock + flow
Rationale	The converters represent the fixed unit prices, the total costs for the different cost segments and it is all summarized in the Cost Rate flow.	The revenue streams are represented by the Revenue Rate which is a result of the Sales Rate and the Price.

The above paragraphs demonstrates academia's commitment to exploring the theoretical understanding of what a business model is. The reality is however that most entrepreneurs do not interact thoroughly with the produced research and the most widely used tool to understand and approach business models is the BMC. This study wishes to explore the sufficiency of the BMC in the process of business model generation.

2.2 Business Model Generation Frameworks

This study will base it's understanding of business model generation on the BMC. Due to the lack of dynamic insight in the BMC the BMP will be used as a complementary tool to capture the necessary dynamics contained in the business model of the case company.

The Business Model Canvas:

A BMC is a visual format meant to capture and communicate the core tenets of a business model, "the moneymaking logic of a business", which makes up the skeleton of the business which will be subject to pressure and influence from external components. This approach to business model generation attempts to break down the business in smaller parts in order to identify what is needed in order to create value, what value should be created

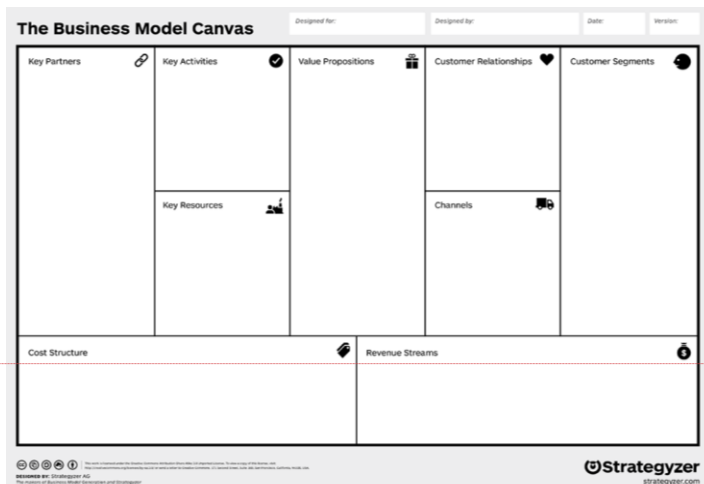


Figure 1

Kommentert [A5]: Source

and who wants it, what it costs and what will be brought back to the firm typically through sales. It does not however give any indications as to the sizes of any of these components or how they are interconnected.

The nine sectors of the BMC are meant to represent the nine core building blocks of a business. The building blocks containing the resources of the company are most commonly associated with costs and are placed to the left of the canvas. The building blocks that elaborate on the generation of value are most commonly associated with revenue and are placed to the right in the canvas. This placement is intentional so as to give an indication of the relationship between the building blocks. Example: Key partners facilitate key activities or key resources which strengthens the value prop, which means the company has more to display in their chosen channels so they can improve the relationships to their customer segments and as such increase their revenue stream.

The different building blocks are elaborated on in the documentation of this dissertation.

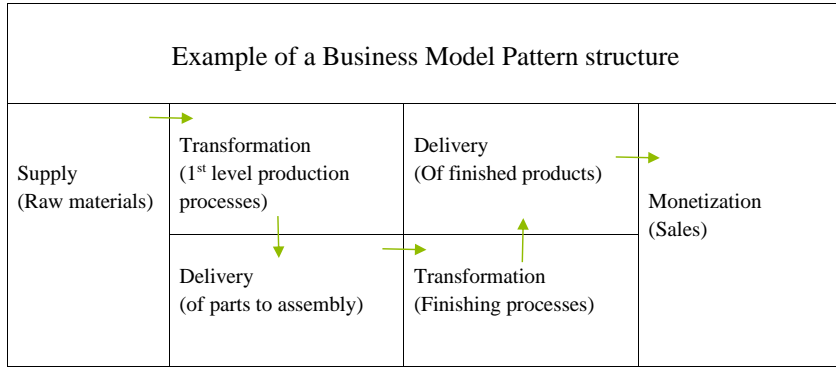
The BMC is supposed to present the most central components of the business, and should help entrepreneurs and companies to “understand the current business model and decide whether it needs to be tweaked or replaced” as a response to a changing environment (Türko, 2016). Each of the variables in the canvas can be presented only by label or with an explanation or remark, however as this is not supposed to be a strategy document it should contain current information. In light of the research objectives of this thesis Euchner and Ganguly’s critique of the BMC provides a good point of departure for dynamic analysis. “The canvas may be useful in representing a business model, but it misses the key dynamic elements of working businessmodels, it does not represent coherence (or the relationship among elements); it does not represent the competitive position (which is off the canvas); and it does not quantify the economic leverage points” (Euchner & Ganguly, 2014.). Pigneur promoted a similar critique of the BMC in 2015, claiming that the “usage itself of the model seems very basic and is limited to static analysis of one business model at a given time”(Fritscher & Pigneur, 2015).

Although Osterwalder and Pigneur elaborate on business model archetypes in their book “Business Model Generation” (2010), there is no inherent choice of archetype or focus area in the canvas. There is for example no instruction or facilitation to expand the “Cost Streams” building blocks if the business is cost based, this type of classification of the business can be assumed excluded from the business model ontology although Osterwalder himself considers it a relevant aspect of business model generation.

The format of the BMC is intended to assist the user in identifying and placing the central components of the business model, however the rigid framework can also make it difficult to place elements that may be central to the running of the company, but do not easily fit into one of the assigned squares. This format makes it quite impossible to contextualize the business model in any significant way, for example by referring to equity/debt balance or to indicate the relative quantity or quality of the different components which makes it difficult to make a BMC the basis of a system dynamics model.

Business Model Pattern:

The Business Model Pattern approach is based in part on a critique of that the BMC put too much



emphasis on the structural dimension of the business model, claiming that it can only provide a partial

Figure 2

understanding of the business (Romero, María Camila, Sanchez, Mario, Villalobos, 2016). The Business Model Pattern approach assumes that businesses too are complex systems of interconnected variables and components that depend on feedback which influences their behavior over time, similarly to the understanding that “There are many interrelationships between the different components of the business model” (Khodaei & Ortt, 2019). The framework of the Business Model Pattern helps understanding the behavior of the company and the added insight makes it easier to predict possible consequences of any alterations.

Unlike the BMC the BMP does not deal with elements in the structure, but with the flow of the value creation process. The method aims at breaking the business down to its core processes and place these in one out of four zones: Supply, Transformation, Delivery and Monetization. There could be more than one supply zone, and more than one delivery zone, depending on the nature of the company. In spite of having a more dynamic approach to business model generation than the Business Model Canvas, this framework does not imply any contents and as such provides merely a framework for mapping already identified components of a business, without classification.

The BMP and BMC are complementary approaches, while the BMC can help identifying elements and implies an exhaustive list of elements and as such also the boundaries for the model the BMP contextualizes the elements in the light of the value creation process.

3. Hypothesis

3.1 Case study

The business model generation tools below intend to present the company studied, while the documentation in the model elaborates on the process and background for quantification of the various elements in a dynamic context

MILLY DRESSHOUSE Ventures

Key Partners: Household Mechanics Ltd.	Key Activities: Production Sales	Value Prop: Design Price	Customer Relationships: Awareness Casual Shopper Frequent Shopper	Customer Segments: Women in Accra from the middle class between the age of 25 and 35
	Key Resources: Fabric Sewing machines Staff		Channels: Targeted Adverts Outlet	
Cost Structures: Staff Costs Machine Maintenance Costs Machine Acquisition Costs Electricity Costs Alternative Energy Costs Fabric Costs			Revenue Streams: Sales	

Figure 3

This BMC should represent a generic business model for a small holder dress maker in Ghana called MILLY DRESSHOUSE Ventures. Below you can find the same business presented using the Business Model Patterns. Note that due to the format of the canvas, it is not clear that this business requires electricity in order to create value. The BMP below provides for a little more liberty in terms of defining the relevant input.

Supply: (Fabrics + Staff + Sewing Machines)	→	Transformation: + ((Production*Electricity) + Design) = Finished Garments
Monetization: Price * Sales - (Staff costs+ Machine maintenance costs + Machine acquisition costs + Electricity costs + Alternative energy costs + Fabric costs)	←	Delivery: Targeted Adverts + Outlet + Potential Customers

Figure 4

3.2 Structural Assumption

With regards to question 1

The business model generation frameworks presented above are largely based on assumptions and do not take into consideration the dynamics provided by feedback loops in the system. The actual validity of a business model in a real and practical context depends on the *decision rules* of the company management. If the business model is invalidated by the circumstances it has to be adapted in order for the business to generate a profit in its real life environment. This means that the less comprehensive and inclusive a business model is of its environment, the more often it needs to be adapted by decisions of the company management, which is shaped by their level of information and insight about the system.

A business model presented as an open loop sequence of events is presented in the figure below.

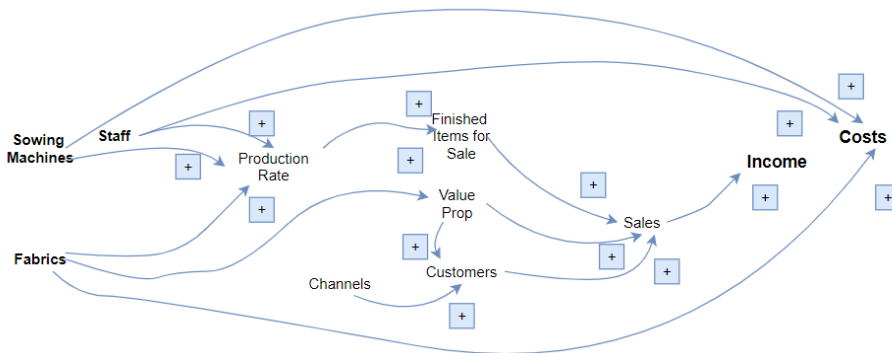


Figure 5

The input in this logical sequence is Fabrics, Sowing Machines, Staff, and customers. The first three are easier to acquire to the point where they can be considered part of the company through regular purchasing agreements etc, but the number of customers is more difficult to secure for this type of business. This means that the business logic can be secured by validating the causal chain of relationships between the factors of production, hereinafter FOP, and the income and costs. The BMC does not include profits or an equivalent concluding element, however generating profits, or being self-sustaining has been named the goal of the business model(Oosterwalder, 2004). This study thus assumes that

the BMC can be dynamically represented by an open loop system, hereinafter referred to as an OLS.

This study further assumes that should the OLS be subjected to power outages, the Production Rate would be adversely affected, and that the mitigation strategy will compensate for the effect on production. This study also hypothesises that if an OLS like this one was to be subjected to competition, that would impact the performance of the company.

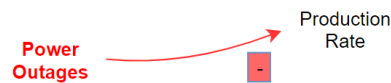


Figure 7

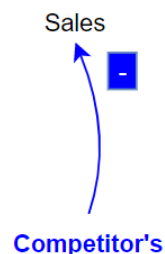


Figure 6

Both the BMC and the Business Model Patterns are tools that can be used to validate the business logic of a company. While business logic is not explicitly defined in the literature it has been described as the logic required to earn a profit (Teece, 2010). One of the central assumptions of these open loop systems is that it is always possible to acquire the input needed for production, and there is no feedback from the generation of profit to the acquisition of input to production. On that basis it is safe to assume that a linear approach to business model generation is incomplete. This finding finds various sources of support in literature (Khodaei & Ortt, 2019).

A selection of the definitions of a business model presented above refer to the value creation process. In order to reach income > costs the value creation process has to result in the production output being more valuable than the production input. While access to factors of production, such as raw material, staff or machinery often depends on third parties or exogenous forces, the extent to which these factors are utilized is largely up to the management of the company. The open loop approach provided by BMC and Business Model Patterns shows how f. ex 1 sewing machine, 1 seamstress and 50 m2 of fabric would be 50 finished products that could be sold, but it does not comprise enough information to assess whether or not the same company will be able to repeat this process in order to have a continuous production.

A closed loop system, hereinafter CLS, could showcase if the system could sustain productivity and the generation of profits over time. The dynamic hypothesis requires the re-negotiation of the model boundaries in order to create a business model that can generate profit over time including an assessment of non-linearities that form part of the dynamics of the system. The hypothesis builds on the assumed causal relationships deduced from the business model canvas, and the nature of these relationships are demonstrated below.

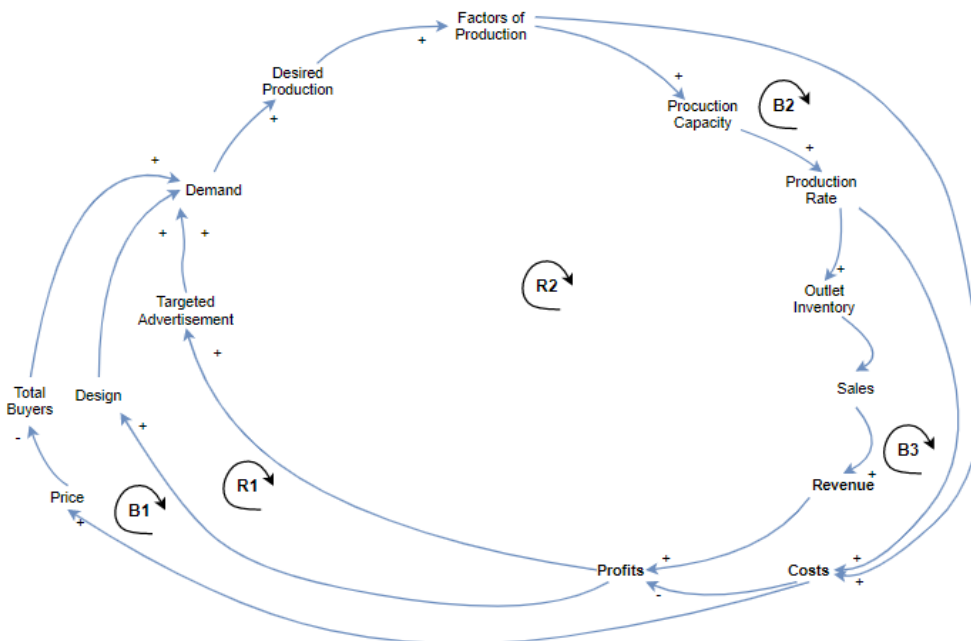


Figure 8

With regards to question 2

The dynamic hypothesis presented above builds exclusively on elements included in the BMC (except for Profits, which are only implied in the canvas) and still only represents a very limited

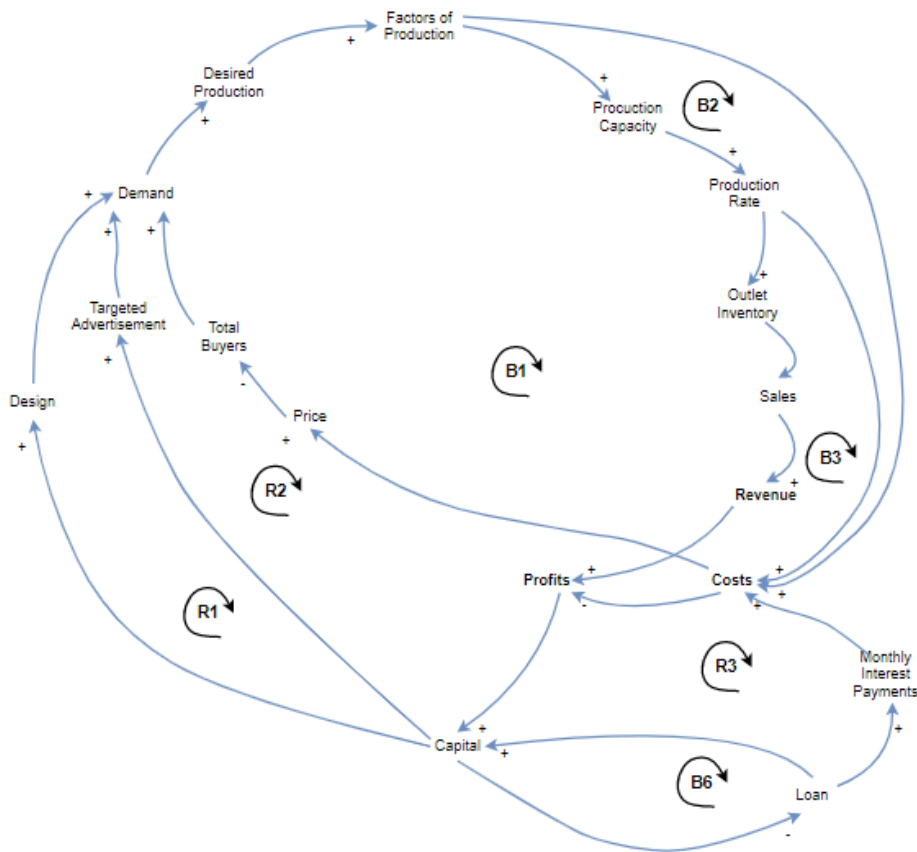


Figure 9

representation of the reality. This system will continue production only as long as profits can cover the it, and has an implicit starting capital. In this system there is a risk that the profits are insufficient to continue production. Many companies face a shortage in money during the first period of their business, and a common risk mitigation strategy is taking a loan, the dynamics of that is displayed below.

In observing that acquiring debt may activate a reinforcing debt loop (R4), it becomes necessary to ask whether excluding funding from the business model framework can give a misconstrued understanding of “business logic”, and as a consequence why the source of funding should be part of business model generation.

This thesis hypothesizes that the assumptions that are legitimized in business model generation tools such as BMC or BMP might not be valid anymore when the business model is contextualized in a real life

environment. The hypothesis above presents how the assumption of sufficient funds might drive the reinforcing debt loop and thus greatly undermine the company's profit making ability. In the same way that funding is excluded from the BMC and BMP, risks are also considered an exogenous element outside the boundaries of the business model. It is also considered an element to which the business model should adapt in order to maintain its logic.

Although this is a fictitious case it is assumed to have the same growth pattern as a majority of start-ups and micro, small and medium enterprises, an s-shaped curve. Initial constraint by few customers, debt and limited investment capacity, exponential growth after a tipping point when the company starts generating a profit and shifting to exponential decay in the maturity phase. **SOURCE?**

Often risk management is tackled as a separate issue from business model generation, but you would still see evidence of risk management strategies in the business model. An example of this is how electricity is an assumed input in most businesses, but doesn't find a natural place in the BMC. The key resources section, which is where you would think to put electricity is normally used for elements that could be owned, leased or acquired through key partners. However solar cell panels or generators, which are relevant risk mitigation tools fit perfectly into the business model frameworks under key resources, in spite of risk being explicitly excluded from the business model canvas (Oosterwalder, 2004) and these elements being acquired as risk mitigation strategies.

In this study two types of risk are considered, a production risk and a business risk. The production risk relates to a risk that would limit production or make sustaining production at the appropriate level much more expensive. The business risk relates to being overtaken by competitors. The specific example of production risks presented in this study is the risk of not being able to utilize all productive hours due to lack of electricity/power shortages. The business risk presented in this study relates to the price competition from a central competitor. Their dynamic impact on the system is presented in the CLD below.

The dynamic hypothesis is that loops R1 and R2 are the major drivers of growth which is balanced

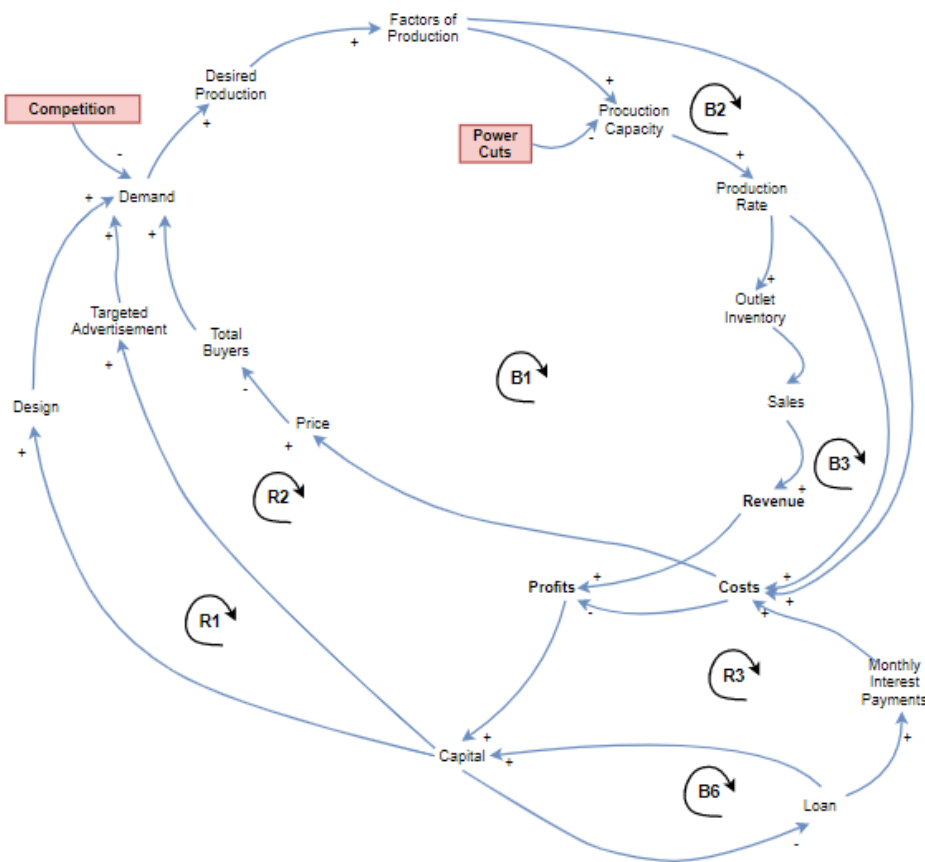


Figure 10

by all the other loops presented in the CLD. The two risk elements that are presented can be of such importance that they may invalidate the assumptions that constitutes the business logic of the company altogether. According to Sterman's Business Dynamics (Sterman, 2000) subjecting a system to unstable and sensitive exogenous parameters will generate unfavorable behavior.

From system dynamics theory we know that by endogenizing such elements it is possible to have more control in generating the desired behavior. A risk inclusive business model is presented in the CLD below.

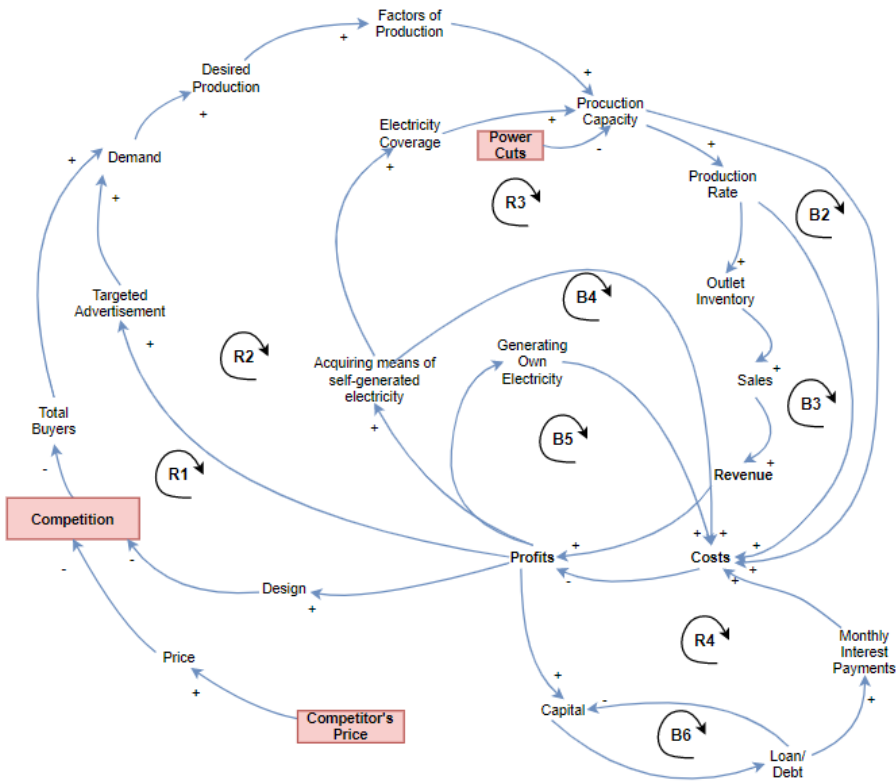


Figure 11

With regards to question 3:

Following the considerations displayed in the paragraphs above this study assumes that by using simulations to document the difference in results under the different results, it can highlight that structure drives behaviour and highlight structure that springs out of a BMC as well as the behavior that will result from such a structure.

3. Method

3.1 Understanding the BMC and the BMP from a dynamic perspective

This chapter will demonstrate the deconstruction and reconstruction of the BMC and BMP. Using a BMC to create a hypothetical or future business is a common point of departure for start-ups world wide and

this study has followed the procedure recommended by Osterwalder (Osterwalder & Pigneur, 2010) in order to identify what should be included in the Business Model Canvas. The first considerations in deconstructing a BMC through a dynamic lens are

1. Identifying the corresponding dynamic terms or language for the static concepts contained in the Business Model Canvas, f.ex does the dynamic term “sales rate” effectively capture the BMC concept of “Sales”?

2. Identifying causal relationships between the components and sectors in the Business Model Canvas. This does not only entail identifying that one component, f.ex Sowing Machines impacts another, f.ex Production, but also breaking the causal relationship down to its smallest steps, identifying the nature of the relationship and quantifying the impact of the former on the latter. Due to the fact that each conceptual causality must be represented through a causal chain that might be comprehensive, this study has not managed to provide a “simple” dynamic translation of a Business Model Canvas.

3. Deconstructing each element and relationship identified in the BMC to the necessary level of aggregation in order to maintain or achieve unit consistency

While the BMC deals with conceptual identification without “capturing unit margins, velocity and volume” (Türko, 2016) these elements are essential to constructing a valid system dynamics model. Looking at Figures 2-4 it can be said that $\text{Fabrics} + \text{Sowing Machines} + \text{Staff} = \text{Revenue} - \text{Costs}$, however each of the elements on the left side of the equation carry different units (m^2 , Machines, Person) which are all different from the two elements on the right side of the equation (\$) and none of which are quantified which makes it impossible to estimate the unit margins. Furthermore the information provided in Figures 2-4 does not imply any time frame for the value creation chain.

The conceptual framework of the model is built on the Business Model Patterns approach meaning that the identified elements from the BMC have been reorganized under the four categories Supply, Transformation, Delivery and Monetization. The categorization of the Business Model Framework is unsuitable for a dynamic model. The process-oriented approach of the Business Model Patterns is more suitable for dynamic simulations as it has greater emphasis on capturing and highlighting the processes within the firm. This model is thus built on the contents of the BMC presented in previous chapters and the structure of the Business Model Patterns (Camila Romero et al., 2017). Although Romero et al produced a business model canvas that can be simulated it fails basic model validation tests such as unit consistency tests and model patterns tests, meaning that although it is a product built on a system dynamics foundation the model is not a valid system dynamics model. Further discussion on model validation will be presented in [chapter 2](#).

Building on the foregoing paragraphs the system dynamics model OLS was built on the basis of Figure 4. The required level of disaggregation became clear through continuous scrutiny of unit consistency, the conceptualization of the idea of the business has happened in dialogue with the entrepreneurs at VibrantCreator and the proprietor at Mama Lizzy Ventures. A dynamic conceptualization of the assumptions contained in the BMC promotes a discussion of how expansive does the model have to be in order to be valid and an additional calibration of model boundaries in addition to the fact that it needs to satisfy at a minimum the lowest requirements for model completeness according to Khodaei’s framework presented in [chapter 1](#).

While the conceptual variables have been extracted from the BMC and the causal relationships have been extracted from the [Figure 5](#) the quantification of the variables have been estimated on a comparative basis looking at the business models of other comparable enterprises or estimated based on data. The method

of creating credible assumptions correspond to what entrepreneurs use to estimate the success of a not-yet-established or early phase start-up.

4. Model Presentation

4.1 Model Purpose and Presentation

This specific model is built in order to examine the dynamic outcome generated by the structure given by the defining framework of the BMC and BMP by explicitly highlighting the complex feedback structures included in a business structure. Additionally this model is designed in order to serve as a digital laboratory for the exploration of model boundaries. In the modelling process principal consideration has been given to secure a dynamically appropriate inclusion of the structural assumptions presented in the BMC and BMP particularly considering model boundaries and key variables and the causal relationships between them. The manner in which this has been prioritized will be elaborated under the sub-chapter on model validation below.

The model consists of four sectors, building on the work on executing business model patterns (Romero, María Camila, Sanchez, Mario, Villalobos, 2016). The elements listed in the business model canvas have been placed in the corresponding sector as provided in the table below.

Sector	BMC Element	SD Representation
Supply	Key Resources <ol style="list-style-type: none"> Fabric Sowing Machines Staff Solar Panels/Generators 	<ol style="list-style-type: none"> Fabrics Inventory Sowing Machines Staff in Workshop Solar Panels/Generators
Transformation	Key Activities <ol style="list-style-type: none"> Production 	<ol style="list-style-type: none"> Production Rate
Delivery	Key Activities <ol style="list-style-type: none"> Sales Customer Relationships <ol style="list-style-type: none"> Awareness Casual Shoppers Frequent Shoppers Channels <ol style="list-style-type: none"> Targeted Adverts Outlet Customer Segment	<ol style="list-style-type: none"> Sales Rate Aware Potential Visitors Casual Visitors Frequent Visitors Advertisement Campaigns N/A Total Addressable Market Staff in Outlet

	<p>7. Women in Accra from the middle class ranging from 25 to 35 years of age</p> <p>Key Resources</p> <p>8. Staff</p> <p>Value Prop</p> <p>9. Affordability</p> <p>10. Design</p>	<p>9. VP 2 Affordability</p> <p>10. VP 1 Design</p>
Monetization	<p>Cost Structures</p> <ol style="list-style-type: none"> Staff costs Machine Maintenance Costs Machine Acquisition Costs Electricity Costs Alternative Energy Costs Fabric Costs <p>Revenue Streams</p> <ol style="list-style-type: none"> Sales <p>Partners</p> <ol style="list-style-type: none"> Household Mechanics Ltd. 	<ol style="list-style-type: none"> Monthly Outlet Staff Costs + Monthly Ws Staff Costs Monthly Machine Maintenance Costs Monthly Machine Acquisition Costs Electricity Costs for Productive Hours Total Diesel Generator Running Costs OR Total Solar Generation Costs Fabric Acquisition Costs Revenue Rate Partnerships for Machine Maintenance

Kommentert [A6]: Check if Rent is included in both BMC and this table

Table 4

Table 4 highlights how the BMP complements the BMC as well as how the BMC places major emphasis on identification of the elements of the business model and less on examining the nature of these elements. The BMP outlines the value creation chain from FOP to profit balance. In the OLS this is represented as a chain rather than a loop, meaning the major feedback loops are deactivated. Furthermore the growth in consumers is based on exogenous assumptions rather than endogenous generation. This is based on the limited human ability to predict customer growth at an early stage in the business conceptualization.

The assumptions for growth in this model is based on assumptions including a 2% monthly growth in the Familiarization Rate and a 10% growth in the Entering to Buy Rate and the Returning to Buy Rate. The determinants for growth are the decision rules on how much to invest in the FOE. These are generic number based on a simple feasibility analysis and wishful thinking, similar to how assumptions are made in the ideation phase of a start-up. The business logic is secured by the profit formulation of

$$Price = UnitProductionCosts + ProfitMargin$$

The purpose of the model has been presented in this chapter as well as in previous chapters, but in order to answer the research questions set out in **chapter x** it is necessary to be able to subject it to different scenarios. The scenarios are described below:

Normal	Baseline Run - The behavior of the system without considering exogenous risks.
Power Shortage	Reduced ability to produce due to only having access to electricity 75% of the production time
Endogenized Power Generation	Full ability to produce in spite of power shortages due to electricity generated by solar panels or diesel generators
Exogenous Competition	Competitor has a lower price which affects the assumption of growth in customers
Endogenized Competition	The price structure is based on maintaining competitive advantage

4.1 Model Validation

The purpose for this model has been extensively described and the validation of the construction has been carried out with the purpose in mind. According to Yarman Barlas “no validity test can be carried out in the absolute sense, without reference to the specific purpose”(Barlas, 1996). As the case in question in this thesis is hypothetical and the questions are of a theoretical rather than practical nature, the emphasis in validation will be validating the structure. In terms of validation through reference modes, this hypothetical case has no reference mode of its own, but as stated previously most start-ups exhibit an s-shaped growth curve.

In order to create a model that serves the purpose of this research, by providing meaningful insight into the conceptual understanding of a business model, it is necessary to validate that 1. The structure comprises all the key assumptions and elements in a BMC/BMP and 2. That the endogenously generated behavior stems from the structure rather than the wishful thinking outcome. The primary concern thus becomes validating the structure through direct structure tests and structure-oriented behavior tests (Barlas, 1996), but also testing the assumptions through behavior pattern tests (Barlas, 1996).

Structure Confirmation Tests:

The structure of this model has been scrutinized on a continuous basis throughout the modeling process. The conceptual presentation of the structure was constantly scrutinized through extensive literature review on the composition and representation of BMC and business model structures and in dialogue with actors at VibrantCreator and affiliated partners. This dialogue has aided in understanding identifying and confirming the dynamic relationships between the different components of the business model canvas. The

choice of how each component of the BMC should be represented differs from the approach provided by Romero, Sánchez & Villalobos (2015) and the difference is explained in tables 1-3 provided in **chapter 2**.

The rationale for the input in the variables is further elaborated in the documentation, but the general source for defining the range of parameters has been literature.

Extreme Conditions Test:

Different parts of the model has been subjected to extreme conditions throughout the model building process, as well as subjecting the model as a whole to extreme conditions. This has been done by setting exogenous variables to extreme conditions to examine if the system reacts the way it should react to extreme conditions. The variables that have been manipulated to create extreme conditions are:

- Electricity Coverage Fraction: Set to 25 and 0
- Init Debt: Set to \$150 000
- Total Addressable Market: Set to 20

Model Pattern tests:

The model has consistently been subjected to model pattern tests in accordance with Barlas (1996), and these tests have been the main source of identifying flaws in the model that have been addressed and improved in the modeling process.

Unit Consistency Test:

This model has also continuously been subjected to scrutiny to dimensional consistency testing aided by the Stella Architect software.

5. Analysis

5.1 Behavioral Analysis

The initial acquisition of FOP as well as initial costs tied to Outlet Staff and Rent means that while costs start running from before the business is open, the revenues start from 0, as can be seen in all the runs presented in [Figure 12](#). By looking at the baseline run called normal we can start to understand why the system behaves with initial growth, slower growth and finally extreme negative growth. The initial profit development is negative for the first two quarters the company is operational due to $\text{Cost Rate} > \text{Revenue Rate}$ as shown in [Figure 14](#). The demand produces an s-shaped curve where the last growth phase of exponential decay is the dominant feature. Because the constant OL Familiarization Assumption is multiplied by what is initially the entire customer segment in the Unaware People in the Customer Segment stock. Demand exceeds Production Capacity at Yr_1Q_2 as can be seen in [Figure 13](#), and this is what causes the points of inflection at Yr_2Q_2 in time in [Figures 12 and 14](#). While Demand increased the Revenue Rate showed a sharp drop and the Profit Performance went from strong positive growth to moderate positive growth, because the Sales Rate was lower than the Demand due to a lack of manufactured products to sell. Although the profit generation grew slower after Yr_2Q_2 it was still positive. The difference between the Revenue Rate and the Cost Rate increases from Yr_2Q_2 to Yr_6Q_2 meaning that the not only is the profit accumulating every month, but the amount that it accumulates every month is also increasing. The gap between the Demand and the Production Capacity is also closing at Yr_6Q_2 meaning the company is able to have $\text{Sales Rate} = \text{Demand}$. However the FOP drives the level of production and because

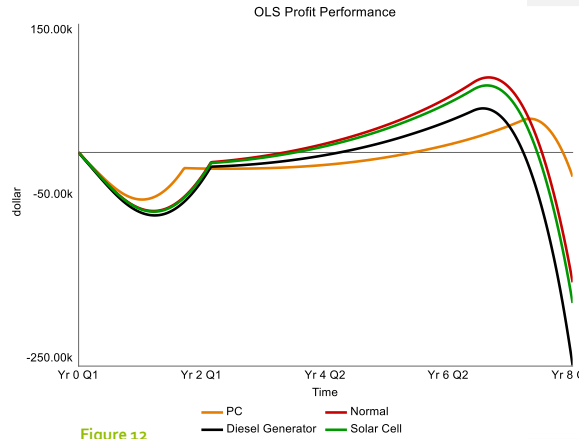


Figure 12

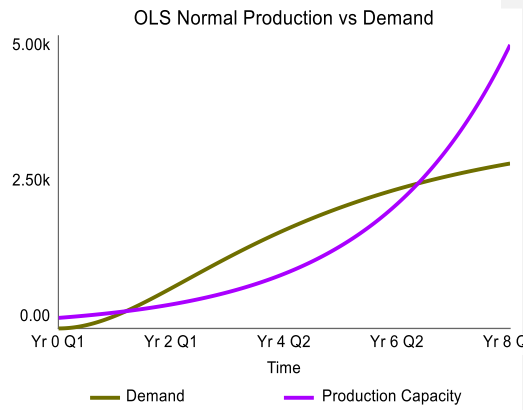


Figure 14

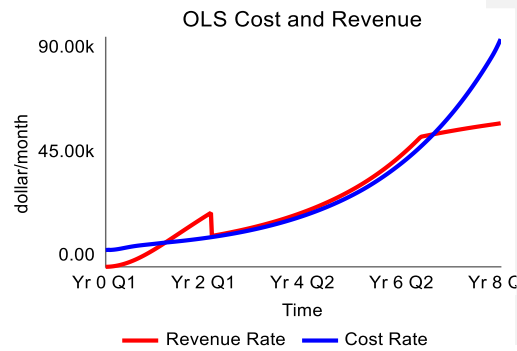


Figure 13

it is based on a continuous assumption it will continue to produce regardless of demand, which will drive the costs up while there is no new generation of customers.

The system generates more stable profits when it is subjected to power cuts. This is because when the production capacity is decreased due to power shortages Demand > Production Capacity for a longer amount of time as compared to in the baseline run, and because all the manufactured products are sold the price formulation secures that Revenue Rate > Cost Rate. The positive profit development caused by the modest profit margins and the low level of items produced leads to the point of breaking even occurring only at Yr₅Q₃. This run also ultimately ends in extreme negative profit development as shown in **Figure 12**, however the point of inflection is postponed from Yr₆Q₂ to Yr₇Q₃.

- Al-Debei, M. M., & Avison, D. (2010). Developing a unified framework of the business model concept. *European Journal of Information Systems*, 19(3), 359–376. <https://doi.org/10.1057/ejis.2010.21>
- Euchner, & Ganguly. (2014). Business Model Innovation in Practice. *Research Technology Management*, 57(6), 33–39. <https://doi.org/10.5437/08956308X5706013>
- Fritscher, B., & Pigneur, Y. (2015). Extending the business model canvas: A dynamic perspective. *BMSD 2015 - Proceedings of the 5th International Symposium on Business Modeling and Software Design, July*, 86–95. <https://doi.org/10.5220/0005885800860095>
- Hedman, J., & Kalling, T. (2003). The business model concept: Theoretical underpinnings and empirical illustrations. *European Journal of Information Systems*, 12(1), 49–59. <https://doi.org/10.1057/palgrave.ejis.3000446>
- Khodaei, H., & Ortt, R. (2019). Capturing Dynamics in Business Model Frameworks. *Journal of Open Innovation: Technology, Market, and Complexity*, 5(1), 8. <https://doi.org/10.3390/joitmc5010008>
- Oosterwalder, A. (2004). *The Business Model Ontology* (Vol. 2004, Issue 1).
- Romero, María Camila, Sanchez, Mario, Villalobos, J. (2016). Understanding business models. In F. Hammoudi, Slimane (Modeste/ESEO, Angers, P. Maciaszek, Leszek (Wroclaw University of Economics, M. (Institute of S. and T. of C. Missikoff, F. Camp, Olivier (Modeste/ESEO, & P. Cordeiro, José (EST, Instituto Politecnico de Setubal (Eds.), *Business Service Management* (Vol. 3, Issue 18th International Conference on Enterprise Information Systems, pp. 496–505). Springer, Cham. <https://doi.org/10.5220/0005838104960505>
- Romero, M. C., Villalobos, J., & Sanchez, M. (2015). Simulating the business model canvas using system dynamics. *2015 10th Colombian Computing Conference, 10CCC 2015, September 2015*, 527–534. <https://doi.org/10.1109/ColumbianCC.2015.7333469>
- Stenn, T. L. (2017). Social entrepreneurship as sustainable development: Introducing the sustainability lens. In *Social Entrepreneurship as Sustainable Development: Introducing the Sustainability Lens*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-48060-2>
- Sterman, J. D. (2000). *Sterman-Business Dynamics - 3.pdf*. Irwin McGraw-Hill.
- Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, 43(2–3), 172–194. <https://doi.org/10.1016/j.lrp.2009.07.003>
- Türko, E. S. (2016). Business plan vs business model canvas in entrepreneurship trainings: A comparison of students' perceptions. *Asian Social Science*, 12(10), 55–62. <https://doi.org/10.5539/ass.v12n10p55>

Verrue, J. (2014). A critical investigation of the Osterwalder business model canvas: an in-depth case study.

In Belgian Entrepreneurship Research Day, Proceedings.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research.

Journal of Management, 37(4), 1019–1042. <https://doi.org/10.1177/0149206311406265>