THE DISRUPTIVE POTENTIAL OF DIGITAL CONTRACEPTIVES

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AN ANALYSIS OF DIGITAL CONTRACEPTIVES AND THEIR POTENTIAL TO DISRUPT THE CONTRACEPTIVE MARKET

ABSTRACT

Digital contraceptives[1] have emerged as a disruptive innovation that can potentially transform the contraceptive industry and empower women to take greater control over their reproductive health. This thesis explores the disruptive potential of digital contraceptives by analyzing the changing consumer mindset in regard to contraceptives, the business model of digital contraceptives, and the competitive landscape in which they operate. The research methodology includes 6 qualitative semi-structured interviews, a quantitative questionnaire with 460 respondents, and desk research.

The study reveals an increasing demand among female consumers for personalized and convenient contraceptive options with minimal side effects. The rise of femtech[2] and digital contraceptive options offer women greater autonomy over their reproductive health. The pioneers in the digital contraceptive industry have used the value innovation strategy to create a new, uncontested market space in the form of a blue ocean. Digital contraceptive companies provide superior user experiences through personalized platforms, valuable content, and strategic collaborations.

Clayton M. Christensen's concept of disruptive innovation reveals that digital contraceptives can be seen as a disruptive innovation in a new-market foothold, addressing the needs of millions of women seeking options to better suit their wants, needs, and lifestyles, and prompting a behavioral change.

The rise of digital contraceptives and changing consumer demands require pharmaceutical companies to embrace digital innovation to remain competitive. Market players must adapt to changing market conditions and buyer behaviors in this rapidly growing industry.
To this end, a synthesized business model framework has been developed to equip entrepreneurs and investors with a valuable tool to navigate the complexities of the digital economy and stay ahead of competition. The framework emphasizes the need to adapt traditional models to emerging industries like femtech and can help companies achieve greater success in such nascent markets.

1 A type of technology-based contraception that use digital tools, such as apps, wearables, or connected devices, to track fertility and prevent pregnancy.
2 Abbreviation for female technology: electronic devices, software, or other technology relating to women's health.

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1. Introduction

1.1 Problem Field and Research Area

A new industry has emerged at the intersection of healthcare and technology, which has until recently been largely unknown in academia and business (Menking & Kaplan, 2020). This new industry is referred to as “femtech” – an abbreviation for female technology – and was first coined in 2016 by the Danish entrepreneur Ida Tin (Cambridge Dictionary, 2022). Femtech refers to a subset of “medtech” or “health tech” products and services that address issues that are conventionally related to the reproductive health of cisgender women (Menking & Kaplan, 2020). In the course of just a few years, femtech has grown to encompass a wide variety of tech-enabled solutions to improve healthcare for women, including but not limited to menstrual health, maternal health, pelvic and sexual health, contraception, fertility and menopause, as well as a variety of general health conditions that are especially prevalent among women (McKinsey, 2022; CB Insights A, 2022).

What started as a small and specialized niche within the larger medtech market, the femtech industry has now grown to encompass 821 companies worldwide, experiencing double-digit compound annual growth rate (CAGR), and is projected to reach a market size of $100 billion by 2030, according to CB Insights (2022). Despite increasing interest, the femtech industry remains underfunded when considered in the overall medtech industry; having received $1.9 billion in funding in 2021, accounting for merely 5% of the global medtech funding that year (The Economist, 2021; Deloitte, 2022). Nevertheless, venture capital funding for femtech has tripled over the past five years, and according to expert opinion, the potential of this industry is immense (The Economist, 2021; Deloitte, 2022; McKinsey, 2022; Frost & Sullivan, 2018).

In addition to femtech targeting 50% of the world’s population, women drive or influence more than 70% of global consumer spending, with their purchasing power rising rapidly. Further, they are 75% more likely to adopt digital tools for health care compared to men, and in aggregate, the female population represents a growth market more than twice as big as India and China combined (Frost & Sullivan, 2018; Brennan, 2020; The Economist, 2021). Moreover, the proportion of women enrolled in colleges and universities in the United States and Europe has reached nearly 60%, suggesting that there may be a higher number of highly skilled and qualified women in the workforce compared to men in the future (Das, 2019). Hence, paired with the growing influence that women have on spending globally, Western economies are, according to Reenita Das (2019), turning into SHEconomies.

As stated by Michelle Tempest, partner at the healthcare consultancy Candesic (Nayeri, 2021);

"There's definitely an increasing appetite for anything in the world which is technology and a realization that female consumer power has arrived — and that it's arrived in health care"

According to a report by Frost & Sullivan (2018), the increasing interest, funding, and potential, as well as a positive regulatory environment sets femtech up as the next big disruptor for the global healthcare market, urging medical device-, biopharmaceutical-, and clinical diagnostics companies to capitalize on this growing market.

The rise of femtech happens in the wake of a growing dissatisfaction with a healthcare system that has largely ignored women's specific needs, particularly in terms of contraception (CB Insights A, 2022). According to Chamberlain et al. (2020),

> *"Women's contraception preferences are "simply under-studied and under funded, and unmet needs are ignored and misunderstood by those who could work to address these issues".*

Several unfavorable factors contribute to this historical neglect of women's health, including medical research being primarily targeted at men, and women being largely excluded from clinical trials, often due to their hormonal cycles or childbearing responsibilities (CB Insights A, 2022; Perez, 2019; Das, 2019). Still today, merely 4% of global healthcare R&D funding goes into research specifically targeted at women's health (Das, 2019). Considering that women represent almost half of the global population and possess significant purchasing power, it is alarming that they are underrepresented to such a degree in healthcare.

Traditional contraceptive options are increasingly being questioned due to the growing awareness of their varied side effects and lack of innovation over the years (Butkovic, 2021). Hormonal contraceptives, despite being an understudied area, have not seen significant changes since the development of the oral contraceptive pill in the 1960s (Le Guen et al., 2021; Callahan et al., 2020). Moreover, a large Danish study that involved over a million young women demonstrated a statistically significant correlation between hormonal contraceptive use and the risk of depression (Skovlund et al., 2016). Recently, an American study found that 43.6% of women experienced mood changes as a side effect of hormonal contraceptives. In addition, over 3600 French women stopped taking the pill due to minor yet problematic side effects, such as loss of libido, weight gain, and mood disorders (Martell et al., 2023; Debusquat, 2017). Yet, despite these statistics, hormonal birth control is considered safe and effective by the pharmaceutical industry, why little effort goes into developing new methods to circumvent patient concerns.

Over the past decade a growing number of women in Western countries have taken to social media to share their dissatisfaction with the contraceptive options currently available, raising the issue of the adverse physical side effects as well as depression and mood changes of hormonal contraception (Le Guen et al., 2021). This shift in attitude can be attributed to several factors such as the rising awareness of potential side effects, as well as a heightened understanding of how our choices affect our overall health (Butkovic, 2021). Furthermore, the lack of innovation in the field of contraception has led to a sense of dissatisfaction, prompting a call for more diverse options that better meet the needs of women. As a result, there is now a strong demand for a wider range of products that can offer more personalized choices based on individual needs and lifestyles (Butkovic, 2021).

As a response to these needs, dozens of apps to track women's fertility have been introduced in the past years, helping women track and calculate their cycle and fertility windows as well as better understand the effects that their cycle has on their skin, mood and energy levels (CB Insights A, 2022). In the survey conducted for this thesis with 460 women, 71% state that they use or have used a mobile app to track their menstrual cycle and/or fertility window (Survey). Adding to this, in a similar survey from 2017 with 500 women using the hormonal contraceptive pill, 78% stated that they would be interested in an effective non-hormonal alternative (Bull et al., 2019). Hence, the popularity of these applications has highlighted a significant unmet need for effective non-hormonal alternatives to traditional contraceptive options. These apps go under the term 'digital contraceptives', which is essentially the calendar-based or fertility awareness method updated for the digital age (Interview 1). When in contraceptive mode the app provides a binary output ('yes' or 'no') indicating whether there is a significant chance of pregnancy at the current time or not. The app relies on daily temperature readings of the basal body temperature, that is, the body temperature at rest, as measured by the connected thermometer or wearable technology (Händel & Wahlsström, 2019). This lets the user know which days she shall abstain from sexual intercourse (abstinence or condom use), so-called 'red days', to stay safe and which are so-called 'green days'.

Recently two of these digital contraceptive apps Natural Cycles and Clue were CE certified in the EU and cleared by the FDA. in the US as medical devices – a first for the femtech industry. Terri Cornelison, chief medical officer at Health of Women - FDA, states:

> *"Consumers are increasingly using digital health technologies to inform their everyday health decisions and this new app can provide an effective method of contraception"*

In line with this, the FDA simultaneously inaugurated "software application for contraception" as a new category of birth control under which similar products can apply to be classified going forward (FDA, 2018).

This is a major step for the femtech industry, being properly recognized and equated with the pharmaceutical industry for the first time. Adding to this, these apps enable the collection of large datasets of women's health, can be used to improve women's health, and make health solutions more accessible to women (Frost & Sullivan, 2018). Hence, femtech businesses provide a platform for advocating for women's health, breaking taboos and addressing needs that were previously overlooked by the pharmaceutical industry and mainstream markets (Menking & Kaplan, 2020; CB Insights A, 2022).

1.2 Purpose Statement and Gap Analysis

Being a relatively new industry, femtech is a largely understudied area of entrepreneurship. To date, the adoption, use, and efficacy of femtech products and services and their effect on the pharmaceutical market are understudied topics (CB Insights A, 2022; McKinsey A, 2022). This is a research gap in innovation and entrepreneurship literature that this paper intends to narrow. For instance, the academic cross-database search EBSCOhost shows merely 178 scholarly articles and academic journals about femtech, 94% of these being published after 2019 (EBSCOhost, 2022). This is further supported by a McKinsey (A, 2022) study on the topic, which includes all articles from academia, business, and journalism and shows a graph with a steep upward trend from 2018 to 2021, during which 700 articles were published. Looking at digital contraceptives specifically, this is an even narrower field, for which a combined 19 relevant scholarly articles appeared in EBSCOhost and Google Scholar searches for "Digital Contraceptive" or "Digital Birth Control", all published after 2019 (EBSCOhost, 2022; Google Scholar, 2023). Adding to this, 185 journalist articles were found on these keywords via Pressreader with the oldest article published in 2017 (Pressreader, 2023).

Furthermore, there is a clear gap in the research on the business model of femtech and digital contraceptives. To date, only one book has been published that explains the business model of medtech, which femtech can be seen as a part of (Piester & Rosager, 2017). Nevertheless, as medtech covers a wide array of products and femtech, and specifically digital contraceptives have their unique characteristics, there is arguably a need for further investigation into these phenomena.

Furthermore, as evidenced by the growing number of news articles mentioning femtech and digital contraceptives/birth control, the increasing funding and investments in the industry, and the number of femtech deals, interest in femtech has continuously increased over the last decade (McKinsey A, 2020; CB Insights, 2022). Thus, indicating its rising importance and relevance.

1.3 Digital Contraceptives Explained

A digital contraceptive is a new form of contraception in the form of a mobile app used in combination with wearable technology (watch or ring) or a thermometer to record one's basal body temperature and thereby identify the fertile window. Digital contraceptives are based on the fertility awareness method, which has been used for centuries to prevent pregnancy. With advancements in technology, this method has been updated for the digital age, resulting in improved accuracy and user-friendliness.

How it works: Ovulation causes a slight increase in the basal body temperature, and when measured on a daily basis it can be used to predict the monthly window in which a woman is most fertile (Wetsman, 2021). The temperature is measured either during the night with a wearable technology or by measuring manually first thing in the morning and entering the temperature into the app.

The temperature data is then combined with other metrics that can be added by the user including dates of one's period, changes to cervical mucus and various symptoms such as spotting, sex (protected, unprotected), sex drive, different pain indicators (cramps, backache, ovulation pain, sore breasts, headache), and how the user is feeling (happy, confident, calm, energetic, PMS, mood swings, irritable, anxious, stressed, etc.) (Appendix 3). For optimal accuracy, the user should also add whether she is sick, hungover, or slept differently, as these are factors that can affect the basal temperature. Finally, the app may suggest that the user takes a fertility test on certain days to get a more precise ovulation calculation, which can also be recorded in the app (Appendix 2).

The algorithm and underlying technology use the temperature readings as well as the complementary parameters and uncertainties such as ovulation day, luteal phase, follicular phase, cycle irregularities and temperature fluctuations to detect ovulation and fertility. It then produces so-called red and green days, which indicate the chance of pregnancy, and thereby which days to use protection (red) and not (green) (Appendix 1).

Consistent data is required for the algorithm to learn about the user's cycle and improve prediction accuracy. The more entries, the more precise the algorithm will become at predicting fertility status. This means that the number of red days decreases, while green days increase, which equals more sexual freedom. The app offers user-friendly data visualizations such as calendar view, status- and temperature graphs, which allow women to make better sense of their cycle data and their bodies (Appendix 1).

This is accompanied by push notifications, reminding the user of her commitments as well as informative content on the phase the user is currently in, which is also collected in a wide-ranging in-app learning section or blog (Appendix 2; Appendix 3).

Digital contraceptives thus provide a natural alternative to traditional hormonal contraceptive mehtods, and a drastically enhanced user experience compared to traditional fertility awareness methods, condoms and other non-hormonal alternatives. Digital contraceptives are all around health- technologies for women, that track various metrics, allowing the user to understand her body, skin, mood and energy levels in correspondance to the various phases of her cycle (CB Insights A, 2022).

1.4 Research Question

The aim of the proposed research is to provide an answer to the research question (RQ):

What is the disruptive potential of digital contraceptives?

To analyze and discuss the above RQ, the following sub RQs will help to guide this thesis:

1. *How is the female consumer mindset changing in regard to contraceptives and the potential for digital contraceptives?*
2. *Does the femtech business model facilitate disruption?*
3. *How shall pharmaceutical companies react to these changing consumer demands and the rise of femtech?*

To thoroughly answer the research questions, this paper employs the following structure. First, the research methodology is presented, which involves a combination of interviews, a survey, and secondary data analysis. The theoretical foundation for this thesis is then presented, with subsections corresponding to each of the sub RQs. The theoretical foundation covers; first the digital contraceptive market and its competitive dynamics, then investigates the business model of digital contraceptives, and finally defines the concept of disruption from different perspectives.

The data results are then presented, followed by a combined analysis and discussion of the research questions, employing the theoretical foundation and the findings from the research. Finally, practical implications, concluding remarks, and limitations are presented. Throughout the paper, the theoretical foundation is linked explicitly to the sub RQs, highlighting its relevance to the research questions.

2. Methodology

This chapter provides a comprehensive overview of the methodology and research methods employed in this thesis. The Research Onion diagram by Saunders et al. (2021) was employed to guide the selection of data collection techniques and analysis procedures used to answer the RQ. The following subchapters focus on each of the six layers of the Research Onion diagram, namely research philosophy, research approach, research strategy, time horizon, data collection methods, and data analysis methods.

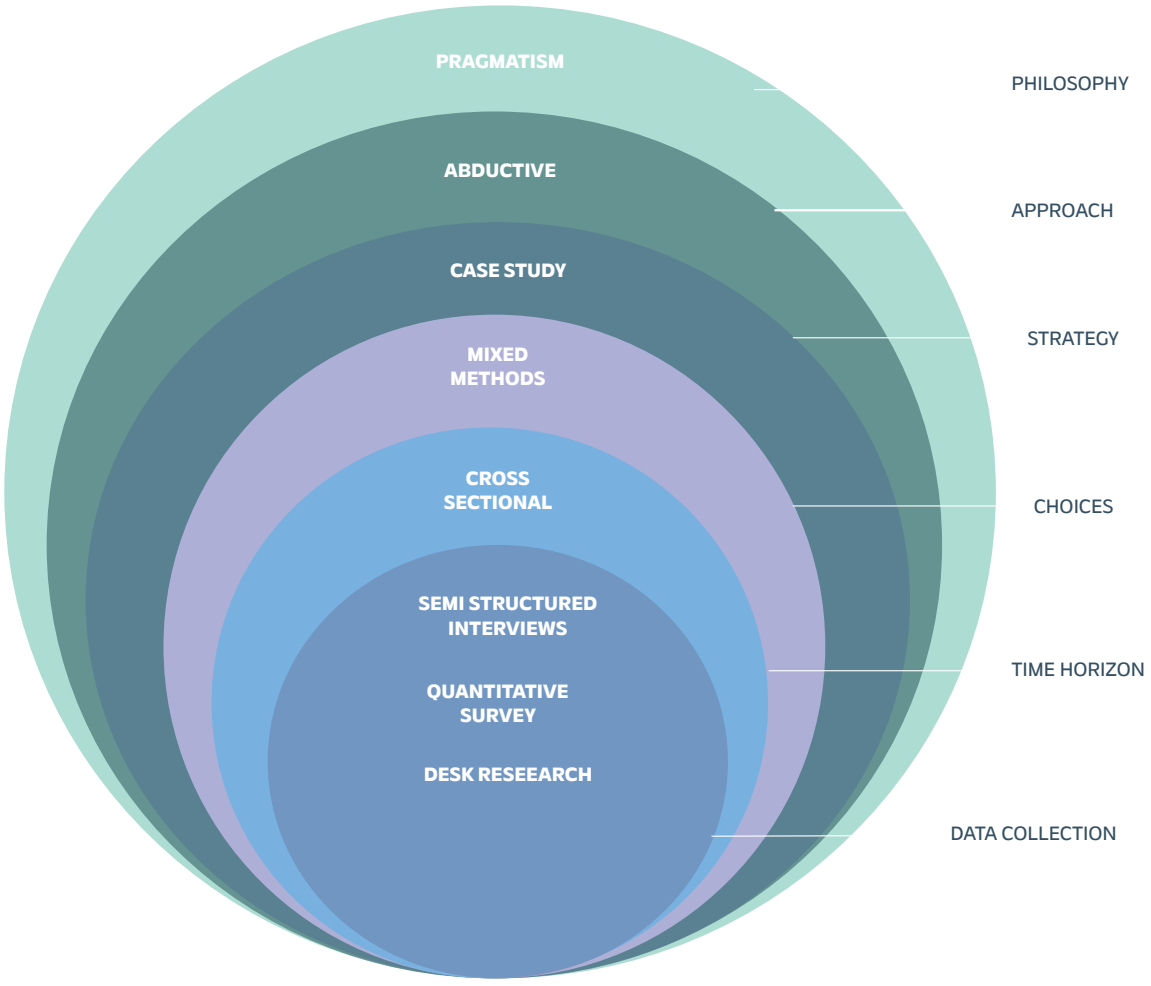

Figure 1: Research Onion depicting the methodology of this thesis. Source: Own contribution, adapted from Saunders et al. 2021

2.1 Research Philosophy

The first layer of the research onion focuses on the overall research philosophy. Considering the purpose of this research, the pragmatic research philosophy is the most appropriate, since it is not rooted in a specific philosophy but rather adopts a multidimensional approach (Saunders et al., 2021). The pragmatic approach focuses on practical applied research and emphasizes that concepts only have relevance when they support action. In this thesis, a problem is initially identified, and it concludes with practical implications offered for future practice. Furthermore, pragmatism reconciles objectivism and subjectivism, values and acts, rigorous and accurate knowledge, as well as different contextualized experiences (Saunders et al., 2021). In the following section, the epistemology, ontology, and axiology are examined to gain an in-depth understanding of the pragmatic nature of this thesis.

Ontology refers to the assumptions underpinning the nature of reality. Following the pragmatist's approach, the ontological assumption considers that reality is external, multiple, and complex (Saunders et al., 2021). Reality in this study is shaped by both objectivist, measurable data and subjective meanings of social phenomena.

Epistemology refers to what constitutes legitimate and acceptable knowledge. As per the epistemology of pragmatism, theories are considered to be true when they work as enablers for successful action. Hence, in this thesis, in the context where practical subjective meaning of knowledge contributes to the answering of the RQ, it is considered to constitute knowledge (Saunders et al., 2021).

Axiology examines how and to what extent the values of the researcher affect the research process. The axiology of this thesis is value-bound knowledge (Saunders et al., 2021). As a researcher, I am a master's student and do not work with digital contraceptives or in the pharmaceutical industry; hence, in this sense, no conflict of interest can be identified. Nevertheless, I identify as a woman and thus naturarlly have my thoughts and perceptions on the topic of contraceptives, which can influence my research to some extent. Since I am aware of this bound to my values and that they might influence my research, this thesis follows an integral and reflexive practice to counter these perceptions. As such, I use reflexivity to form my analysis by utilizing various methods, such as reviewing codes, and discussing my research with external people as well as my supervisor to ensure that my thoughts are not biased by my own perceptions.

2.2 Research Approach

This thesis employs the abductive research approach. This approach lies within deduction and induction. According to Bell et al. (2022), abduction starts with observing a “puzzle” and then moves back and forth between theory and data to explain this puzzle. The puzzle of this thesis was expressed in the disruptive potential of digital contraceptives. The thesis then aimed at solving this puzzle through a combination of theory and data, moving back and forth between these two. In terms of theory, this approach allows the thesis to investigate literature and form propositions, while induction allows the research to generate data and observe patterns in the “puzzle” (Bell et al., 2022; Saunders et al., 2021).

2.3 Methodological Choices

Research methodology is commonly divided into quantitative and qualitative approaches, based on the type of data collected. However, many organizations combine elements of both approaches in their research (Saunders et al., 2021). This thesis follows a pragmatic philosophy and employs a mixed-methods research design to address the RQ.
The quantitative approach is used to collect quantifiable data from a larger group of participants and analyze it in an objective and unbiased manner. In contrast, the qualitative approach provides a more in-depth and thorough understanding of the issues at hand by listening to the views of participants in a more comprehensive way, gaining unique insights. The mixed methods design integrates the benefits of both approaches to address the research question more completely. The methods are applied in both single and sequential forms to deepen the elaboration and expansion of the findings. (Saunders et al., 2021)

2.4 Research Strategy

A research strategy links the research design to the selection of data collection methods and can be seen as the logic of the thesis (Saunders et al., 2021). In this thesis, the case study approach is followed to explore the disruptive potential of digital contraceptives in depth within its real-life context (Yin, 2018; Saunders et al., 2021). This approach allows for rich, empirical descriptions and the development of theory based on rigorous research into the phenomenon.

To enhance the reliability of the findings and fully comprehend the dynamics of the case, a mixed methods research design is employed, drawing on both qualitative and quantitative data.

The single, embedded case study is utilized as it involves more than one unit of analysis while investigating a single case (Saunders et al., 2021). Single case studies can provide valuable knowledge about practical contexts through generalization, as argued by Flyvberg (2011). By following this research strategy, this thesis offers a comprehensive understanding of the disruptive potential of digital contraceptives in its real-life context, with rich empirical descriptions and theory development (Dubois and Gadde 2002; Yin 2018; Saunders et al., 2021).

2.5 Time Horizon

For the time horizon, this thesis adopts a cross-sectional approach, which means it examines a phenomenon at a specific moment in time – here the current state of the digital contraceptive market (Saunders et al., 2021). As a result of the time constraints, this thesis project can be considered as a "snapshot" of the current digital contraceptive market and the overall contraceptive field in which the data collection is conducted. The semi-structured interviews are conducted between December 2022 and January 2023.

2.6 Techniques & Procedures

This thesis applies both primary and secondary data for data collection. The primary data comprises 6 qualitative semi-structured interviews and a quantitative questionnaire in 4 languages with 460 respondents. The secondary data consist of desk research:

2.6.1 Desk Research

Secondary data has been collected through desk research to aid in answering the RQ and build ing a profound knowledge base about the digital contraceptive market. Public, reliable, and available secondary data has been gathered, reviewed, and analyzed, including newspaper articles, websites, industry statistics, reports, and databases (including CB Insights, Statista, Frost & Sullivan) relevant to the femtech industry and digital contraceptive market. Particularly the industry analysis relies heavily on this pre-existing data.

2.6.2 Semi-Structured Interviews

For this thesis, 6 qualitative semi-structured interviews were conducted, providing interactive and interpretative insights into subjectively lived experiences and understandings (Saunders et al., 2021). The interviewees included industry participants and experts: Co-CEO at Clue Carrie Walter, VP of Product at Flo Ilia Kuznetsov, Global Marketing Director at Natural Cycles

Sofie Askervall, FemTech Focus Founder & Podcast Host Brittany Barreto, and Co-founder and Investment manager at Heartcore Capital Christian Jepsen (Interview 1-5). Additionally, Natural Cycles user Laurie Kirby was interviewed to provide user insights (Interview 6).

By utilizing the semi-structured technique, the interviewer was able to digress from the interview guide and probe the interviewees to add depth and significance to the data obtained by asking them to elaborate or further build on their previously shared thoughts (Appendix 6; Saunders et al., 2021). This flexible approach allowed for unique questions and structures to emerge, fitting the flow of each interview and adapting to new insights as they appeared throughout the data collection process.

To overcome geographical constraints, all interviews were conducted online via Microsoft Teams and lasted around 30-40 minutes due to time constraints on the side of the interviewees. To ensure high-quality data and enhanced interpretation, each interview was prepared for individually, and an initial email was sent to all interviewees providing an overview of the research project, research question, and general information about the interview (Saunders et al., 2021).

These interviews provided important insight into industry dynamics and context, as well as specific insight into the three largest companies in the digital contraceptives space, which may have been difficult to observe otherwise (Saunders et al., 2021). Overall, the exploratory nature of this thesis was supported by the interview process, allowing for flexibility and adap-

Sampling of Interviews:

The participants were chosen on the basis of purposive sampling, a “non-probability sampling procedure in which the judgement of the researcher is used to select the cases that make up the sample” (Saunders et al., 2021, p. 315). This approach to sampling is widely used in qualitative research design. Respondents were selected according to criteria that allowed the researchers to address the RQs in the most effective way. When sampling relatively small samples, purposive sampling is valuable as it allows the researcher to select cases that are particularly informative to the research area (Saunders et al., 2021). Accordingly, four selection criteria are used to select interviewees:

First, in line with the research objective of this thesis, the interviewees must work with or be a user of digital contraceptive technologies. Secondly, they must be in a position relevant to the research area – this includes being in the leadership of the company, the technology/product side, marketing of the product, an expert in the field of femtech, or a customer/user.

Third, to increase the diversity of the sample as well as achieve a comprehensive overview of the digital contraceptive space, there must be at least one participant from each of the three most prominent companies in the category: Natural Cycles, Clue, and Flo. And finally, to increase further variation, the sampling should not be confined to a particular geographical area, but instead show a diversified and international picture of the research area. Nevertheless, still unavoidably focused to some extent on the geographical areas where digital contraceptives are most prevalent, namely Europe and Northern America.

Based on the selection criteria, several femtech professionals were identified and contacted via email, LinkedIn, contact forms or Facebook. While there were a number of negative or no responses, 6 participants that meet all the criteria were successfully acquired and listed in Table 1:

NAME	COMPANY	POSITION	COUNTRY
Carrie Walter	Clue	Co-CEO	Germany
Brittany Barreto	Femtech Focus	Founder & Investor	United States
Sofie Askervall	Natural Cycles	Global Marketing Director	Sweden
Ilia Kuznetsov	Flo	VP of Product	England
Christian Jepsen	Heartcore Capital	Co-founder & investor	Denmark
Laurie Kirby	-	User of Natural Cycles	England

Table 1: Interviews conducted for this thesis .

2.6.3 Self-Completed Questionnaires

Quantifying consumer behavior in terms of contraceptive use and digital apps for fertility and cycle tracking was achieved through a web-based questionnaire designed using Qualtrics Research CORE. This self-completed survey method has been employed to capture data in a straightforward and unbiased manner, where the questions are presented in a closed form with predetermined response options (Saunders et al., 2021; Survey). The survey strategy provides an efficient and time-effective way to collect responses from a large sample and can suggest possible explanations for particular relationships between contraceptive use, side effects, satisfaction rates, and mobile apps to track cycles and fertility windows (Saunders et al., 2021).

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This method has certain advantages, including ease of administration, low observer subjectivity, and the ability to capture large amounts of data. However, a challenge of this data collection method is ensuring high internal validity, as respondents may not always interpret the questions as intended, and there is no way to ensure they have read the questions or answer options thoroughly before responding. Additionally, self-completed questionnaires do not allow researchers to obtain additional information in the form of more detailed answers from respondents, and it may be difficult to assess whether respondents are answering questions sincerely (Saunders et al., 2021). Yet, the questionnaire complements the semi-structured interviews by offering a different perspective on the topic, as it captures a larger sample size and avoids any influence from the observer's body language, tone, or facial expressions.

Sampling of Questionnaire:

The questionnaire for this study was distributed using convenience sampling, a non-probability sampling method where cases are selected haphazardly due to convenience (Saunders et al., 2021). While this method has limitations and is prone to bias and external influences, it was deemed appropriate for this study, as it allowed for gaining diverse perspectives from individuals across multiple countries in a short amount of time. Additionally, Saunders et al. (2021) suggest that samples chosen for convenience can often meet purposive sample selection criteria relevant to the research aim.

The questionnaire was distributed through various social and professional networks of the researcher, including Facebook, LinkedIn, and Instagram, as well as international Facebook groups for women and the FemTech Focus community platform. The goal was to obtain a large sample size to minimize potential errors in generalizing to the target population. A total of 460 respondents between the ages of 18-56 were gathered for this project, which is considered a high number of respondents according to the general rule of thumb that a sample size

of 30 or more is usually sufficient for a normal distribution of the mean. Moreover, a sample size of 100 is considered statistically significant (Saunders et al., 2021).

To accommodate for cross-country language barriers, the questionnaire was translated into four languages: English, Danish, German, and Swedish. As argued by Saunders et al. (2021), this requires a great level of care to ensure that the questions have the same meaning to all respondents. The researcher was fluent in Danish, English, and German, and had a good understanding of the Swedish language. The Swedish questionnaire was also cross-checked with individuals of Swedish origin. A total of 460 respondents between the ages of 18-56 were gathered from various countries including the U.S., Denmark, Germany, the UK, Canada, Australia, France, Netherlands, Sweden, Mexico, Colombia, Italy, Slovenia, Finland, and New Zealand (Survey). While some of the countries may not align with the current target group of digital contraceptives, those with the most respondents and the targeted age group are indeed well represented, thus being representative of the target population and providing valuable insights for the research area.

2.7 Data Analysis

To analyze the primary data collected, a Computer-Assisted Qualitative Data Analysis Software (CAQDAS) method was employed. The use of CAQDAS offers several advantages, such as aiding continuity, increasing transparency, and ensuring a higher degree of methodological rigor (Saunders et al., 2021). Specifically, the NVIVO tool was used to support the process of coding the qualitative data.

The three sub RQs were used as guiding themes to develop relevant codes. This was done in an iterative manner, where the codes were modified and added to better organize the data and extract insights more efficiently. The themes were reviewed to emphasize the main ideas from the interviews and exemplify important relations. The resulting codes are presented in Table 2 below.

RQ	CODE	DESCRIPTION
RQ 1	Changing consumer mindset	The changing mindset of consumers regarding hormonal contraceptives and the move towards digital solutions.
RQ 1	One size doesn't fit all	Digital contraceptives will not be for everyone due to individual circumstances and needs applicable to different women.
RQ 1	Value of digital contraceptives	The value proposition and benefits of digital contraceptives compared to other offerings.
RQ 1	Sexual Education & Empowerment	The feminist movement behind digital contraceptives, and why they simultaneously help to empower and educate women.
RQ 2	Lack of reimbursement & insurance	How the financing of digital contraceptives differentiates from other medtech, due to lack of reimbursement options.
RQ 2	Lack of female health research	The historical lack of research into women's health – especially reproductive health.
RQ 2	Cultural barriers	Cultural barriers that possibly hinder the growth of digital contraceptives.
RQ 2	Disruptive potential	Reflections on the disruptive potential of digital contraceptives
RQ 2	Personal stories	Personal stories of founders and employees for joining the femtech movement – an industry driven by passion over profits.
RQ 3	Pharmaceutical's reaction	The general historical lack of involvement and innovation in contraceptives solutions by the pharmaceutical industry.
RQ 3	Pharmaceutical collaboration potential	Potential collaboration opportunities between pharmaceuticals and femtech.

Table 2: Codes and descriptions extracted from NVivo.

3. Theoretical Foundation

To support the empiricism, the theoretical framework defines and evaluates the theories and models applied in each part of this thesis. The theoretical foundation will be divided into three sub-parts, covering first the digital contraceptive market and its competitive dynamics, second investigating the business model of digital contraceptives, and finally defining the concept of disruption from different perspectives.

3.1 The Digital Contraceptive Market

The following section provides the theoretical foundation for analyzing the underlying characteristics of the digital contraceptive market and the competitive environment present.

3.1.1 Competitive Dynamics of the Digital Contraceptive Market

To uncover the competitive environment of the digital contraceptive market, this section employs Michael E. Porter's (2008) Five Forces framework. While several frameworks are applicable to determining competitive dynamics, Porter's framework is widely used for understanding the underlying factors of competitiveness, which are critical for gaining deeper insight into the digital contraceptive market. The framework suggests that the state of competition in an industry is a function of the intensity of competitive rivalry, threat of new entrants, bargaining power of suppliers and buyers, and the threat of substitute products (Porter, 2008).

3.1.1.1 Intensity of Rivalry

Porter (2008) argues that competitive pressures within an industry manifest themselves in price competition, product positioning, advertising campaigns, and differentiation. Competition can be either positive or negative depending on the intensity and basis of competition. A high level of rivalry can be destructive to the profitability of an industry if it drives down prices. Unlike price competition, competition over product features, brand image, or service improvements is less likely to have an adverse impact on profits since these factors increase customer value, which, in turn, can justify higher prices (Porter, 2008).

3.1.1.2 Threat of New Entrants

New entrants bring new capabilities and a desire to gain market share, putting pressure on prices, costs and the amount of investment needed to compete, and thus a cap on the profit potential for incumbents (Porter, 2008). This depends on the presence of entry barriers like

(1) Supply-side economies of scale, (2) Demand-side benefits of scale, (3) Customer switching costs, (4) Capital requirements, (5) Incumbency advantages independent of size, (6) unequal access to distribution channels, and (7) Restrictive government policy (Porter, 2008).

3.1.1.3 Threat of Substitutes

This force refers to the threat of substitutes. According to Porter (2008), a substitute constitutes a product that "performs the same or a similar function as the industry's product by a different means" (p. 84). In an industry where substitute products are available, high prices may induce buyers to switch to substitutes, in turn, inducing a price ceiling. Industry competitiveness may decline if it fails to differentiate itself from substitutes through superior performance, marketing or other means (Porter, 2008).

3.1.1.4 Bargaining Power of Suppliers

The leverage that suppliers have over industry firms is determined by their bargaining power. Powerful suppliers can significantly affect the profitability of industry players if they raise prices considerably. According to Porter (2008), suppliers are powerful when they are large and few, have high switching costs and have highly differentiated products or products that are of such importance to industry participants that alternative products are not a threat.

3.1.1.5 Bargaining Power of Buyers

Buyer bargaining power determines how much leverage buyers have over vendors. When buyers have high bargaining power, they usually demand lower prices. According to Porter (2008), buyers have negotiating leverage when the following circumstances apply: there are few large buyers within the industry, the offerings are homogenized and standardized, there are low switching costs, and buyers are able to integrate backwards into the industry.

3.1.1.6 Sum-Up

Porter's Five Forces framework is particularly useful for understanding the competitiveness of an industry and its potential for profit. Depending on the strength of the 5 forces, an industry's profit potential can range from low to high. Furthermore, Porter suggests that it is important to consider hidden sources of competition that may exist beyond the traditional definition of an industry focused on products. Given this perspective, the framework is particularly relevant for analyzing the digital contraceptive market, which may present a hidden source of competition for the traditional contraceptive market.

3.1.2 The Blue Ocean of Femtech

Porter's theory follows traditional economics and states that competition among companies is based on market structures and the level of competition. Companies seek competitive advantage through either differentiation and/or price in the value-cost tradeoff. However, as competition increases, profits and growth opportunities may decline. This scenario induced Kim and Mauborgne (2005) to create the Blue Ocean framework which emphasizes finding and taking advantage of untapped markets to increase profits and growth, and thereby making existing competition less relevant. Combining the Blue Ocean strategy with Porter's Five Forces can provide valuable insights into the competitive dynamics of the digital contraceptive market from two different perspectives.

In their book Blue Ocean Strategy, Kim and Mauborgne (2005) developed the Blue Ocean theory, which focuses on the differentiation between red and blue oceans in a market environment. The authors argue, that the "red ocean" refers to the known market space where competition is cutthroat, causing the sea to turn red, whereas the "blue ocean" refers to the unknown market space that is untainted and holds untapped potential (Kim & Mauborgne, 2005).

The strategic approach consistently distinguishes winners from losers in creating blue oceans. Market players stuck in the red ocean follow a conventional approach to competition, competing within the existing industry order and building a defensible position. In contrast, blue ocean creators follow the value innovation strategy. This strategy refers to creating a leap in value for buyers and your company, thereby creating a new, uncontested market space, and making the existing competition irrelevant (Kim & Mauborgne, 2005). Kim and Mauborgne (2005) place importance on the distinguishment between value innovation and technological innovation or market pioneering. They argue that rather than the timing of entry or bleeding-edge technology, what really separates winners from losers in the blue ocean is when companies succeed in aligning innovation with price, utility and cost – creating value innovation.

While Kim and Mauborgne (2005) present a number of different models and frameworks, this thesis' focus will be more so on the overall idea of blue oceans, and how the digital contraceptive market can be seen as one in comparison to the red ocean of traditional contraceptives.

3.1.3 Five Forces and Blue Ocean Interplay

While at first sight, Porter's Five Forces framework and the Blue Ocean strategy may seem somewhat contrasting, Burke et al. (2010) argue that businesses should indeed consider a combination of these two theoretic approaches. In this thesis, the Blue Ocean framework will be used to assess the blue ocean characteristics of the digital contraceptive market, which is then followed by a Porter's Five Forces analysis of that market, to gain a more in-depth understanding. Hence complementing each other in this sense.

3.2 The Business Model

The following section provides the theoretic foundation for answering the sub RQ "Does the business model of digital contraceptives facilitate disruption?". Due to the digital contraceptive market's young age, there is a gap in the research of its business model, why there is a need for further investigation into this phenomenon.

The following section has four main objectives. First, it provides an introduction to the concept of business models using Osterwalder and Pigneur's (2010) widely used framework, with an adaptation suitable to the entrepreneurial nature of digital contraceptives. Second, it will explore the unique characteristics of the medtech business model proposed by Piester and Rosager (2017). Third, it will incorporate the digital dimension to better understand the dynamics of digital contraceptives and navigate the digital economy, using Weill and Woerner's (2018) Digital Business Model framework. Finally, there will be a comparison and synthesis of these three business model frameworks, which results in a suggested business model framework for digital contraceptives.

3.2.1 Business Model Building Blocks

According to Osterwalder and Pigneur (2010), a business model can be described as "(...) the rationale of how an organization creates, delivers, and captures value" (p. 14). In 2010 Osterwalder et al. and Osterwalder and Pigneur proposed the Business Model Canvas (BMC) – a visual representation of the business model logic and its processes. This is a widely used and agreed-upon framework for the analysis of business models in academia and business. Osterwalder and Pigneur (2010) emphasize that the business model must be simple, relevant, and intuitively understandable without oversimplifying the complexities of how companies operate.

This tool helps managers visualize the concept and relationships between nine key building blocks of their business model and facilitates real-time decision-making and adjustments. The nine blocks comprise customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (Osterwalder & Pigneur, 2010).

Given the entrepreneurial nature and startup environment, currently characterizing the digital contraceptive market, it is relevant to consider Trimi and Berbegal-Mirabent's (2012) work on emerging developments in business model design within entrepreneurship. Building further on and adapting Osterwalder and Pigneur's (2010) BMC, Trimi and Berbegal-Mirabent (2012) suggest that the nine building blocks can be grouped based on ontology into four main areas: (1) product, (2) customer, (3) infrastructure, and (4) finance. (1) Product refers to the value proposition offered to the customers – that is the product or service and how it is delivered. (2) Customer covers customer relationships, customer segments, and channels and focuses on identifying a company's targeted audience, its demands, how customers perceive the value delivered, and what kind of relationship they maintain with each segment. (3) Infrastructure concerns key partners, key activities and key resources and is hence concentrated particularly on production, logistics as well as the relationship between key partners and the company. Finally, (4) finance refers to the cost structure and revenue streams of a company, referring to the sustainability of a company and how the company is going to earn a return (Trimi and Berbegal-Mirabent, 2012). According to Hulme (2011), the canvas is a valuable tool for the learning cycle of startups and can help entrepreneurs consider each of the elements of their business both individually and as a whole, ensuring that essential elements are not ignored.

As the BMC's popularity among entrepreneurs has grown, improvements have been made to the model. The variation generating the most interest is arguably the Business Model Framework (BMF) developed by Hulme (2011), which includes two additional complementary blocks: Growth Strategy and Competitive Strategy (Trimi & Berbegal-Mirabent, 2012). These blocks enable entrepreneurs to consider not only the internal workings of their business but also its position in the market and the competitive landscape. The growth strategy block provides a framework for how a business plans to achieve its desired level of growth, while the competitive strategy block focuses on how it can differentiate itself from competitors and gain a sustainable competitive advantage. By considering both internal and external factors, entrepreneurs can develop effective strategies that increase their chances of success in the market.

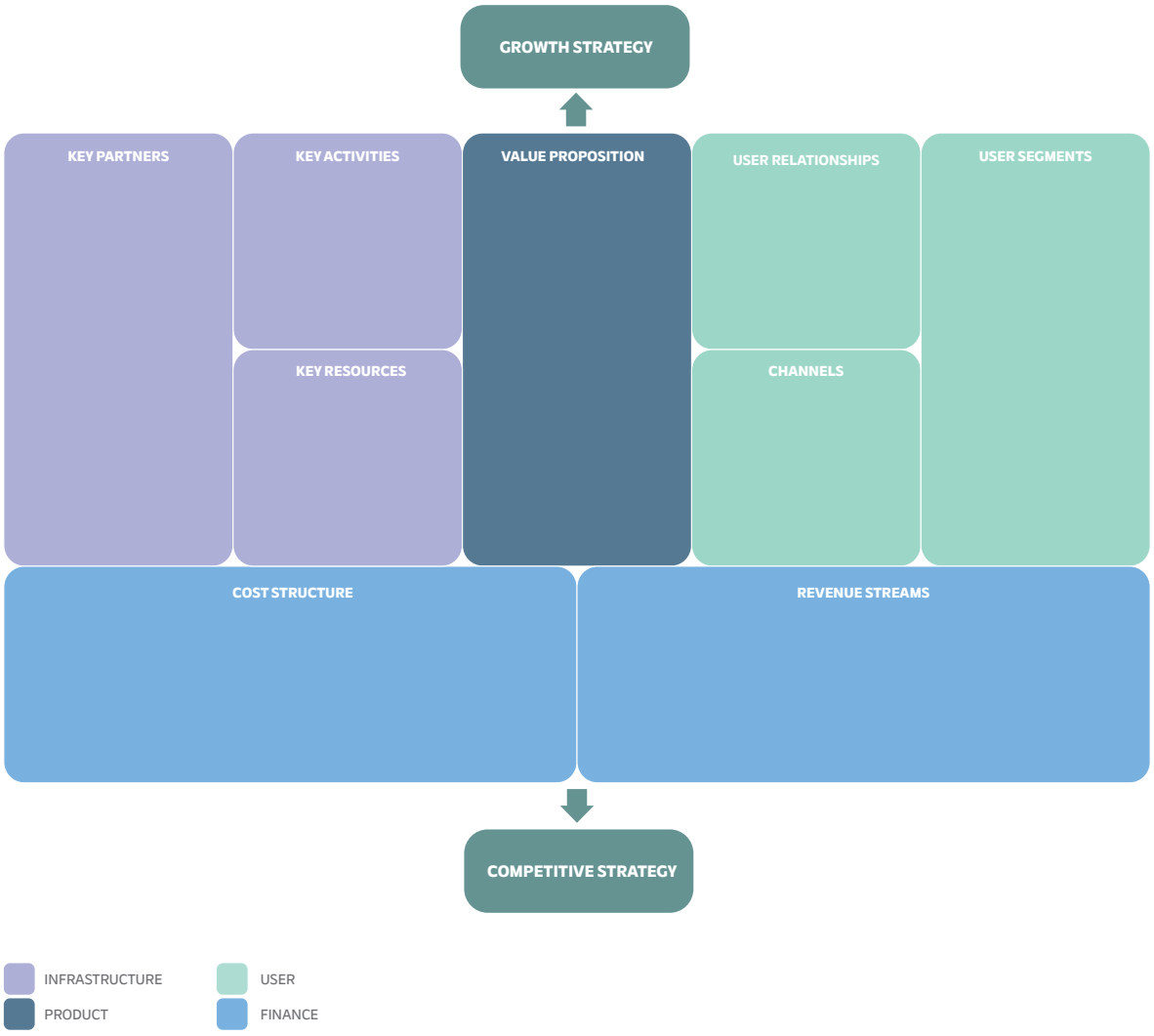


Figure 2: Business Model Canvas adapated to startup companies. Source: Own contribution, adapted from Osterwalder & Pigneur (2010), Trimi & Berbegal-Mirabent (2012), and Hulme (2011)

3.2.2 The Medtech Business Model

Digital contraception falls under the category of femtech, a subcategory of medtech, which encompasses medical technologies and devices. In order to gain a deeper understanding of the digital contraceptives business model, it is necessary to examine the underlying characteristics of the broader medtech business model.

To accomplish this, this section will employ the insights presented in Charlotte Piester and Marianne Rosager's 2017 book, 'Medtech Marketing - A Business Model for Medical Technologies and Medical Devices'. The authors define medtech as healthcare equipment that includes both software and hardware components, as well as medtech apps, data collection, and related services. Medtech companies are those organizations that develop and market these products and services (Piester & Rosager, 2017).

Working with medtech presents new complexities in terms of navigating the healthcare market. Therefore, Piester and Rosager (2017) present the Sinua MedTech Marketing model – an iterative business model shaped as a heptagon with seven phases:

(1) Idea – *What is the innovation?*
(2) Business – *Business model, business case, and market information.*
(3) User – *Who are the users/customers?*
(4) Positioning – *Positioning in the market & value proposition.*
(5) Legislation – *regulation & registration*
(6) Documentation – *documents/evidence to support regulatory/market approval.*
(7) Communication – *where and how do you communicate to customers?*

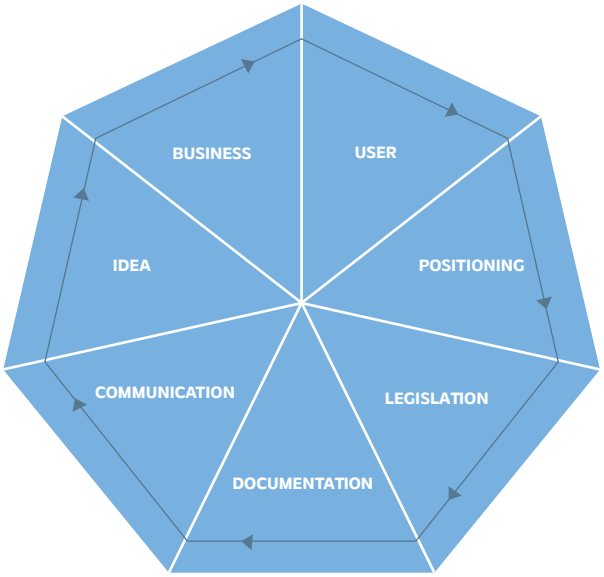


Figure 3: Sinua Medtech Model. Piester & Rosager (2017)

Comparing the Sinua model to the BMC in Figure 2, several components can be directly linked. The Idea block corresponds to the Product block, as they both pertain to the product and its value proposition. The Business block aligns with the entire BMC, particularly the Growth Strategy and Competitive Strategy blocks, as it concerns the business case in relation to the market. The User block is directly linked to the Customer Segments block. Positioning relates to the Value Proposition, Competitive Strategy and Growth Strategy blocks, as it refers to value proposition and positioning in the market. The Legislation and Documentation blocks fit into Key Activities, as they involve activities to ensure compliance with regulations and market acceptance. Communication is related to the Customer Relationships and Channels blocks, as it pertains to the methods and channels used to communicate with the users.

While all blocks can be integrated into the BMC in Figure 2, the Sinua model's emphasis on medtech unique characteristics highlights the importance of especially two blocks, Legislation and Documentation. The medtech industry is subject to extensive regulations and legal requirements, and thus a robust legal strategy is essential. Moreover, the documentation process required to meet regulatory requirements can be complex and time-consuming, requiring specialized expertise. Therefore, these two parts are added to the canvas under Key Activities - see Figure 6. Finally, to provide more clarity and specificity regarding the people who use digital contraceptive products, the term User will be utilized instead of Customer in the BMC.

3.2.3 Digital Business Model

While digital contraceptives fit into the medtech business model, their foundations are rooted in digital applications, making them digital business models as well. In this regard, Weill and Woerner's 2018 book "What's your Digital Business Model?" offers helpful frameworks for creating effective business models and transformation strategies to thrive in the digital era. The authors present the DBM framework – a matrix of four types of digital business models – as well as the Digital Competitive Advantage model to assess a company's competitive advantage in this digital marketspace (Weill & Woerner, 2018).

3.2.3.1 Digital Business Model Framework

According to Weill and Woerner (2018), the DBM framework is a framework for becoming a model for success in the digital economy. The digital transformation has led to rapidly changing customer needs and behaviour, increasing the demands for what a business has to offer to remain competitive. Weill and Woerner (2018) argue that the key is in differentiating your business by offering customers something new and compelling, enabled by digital channels – building the next-generation enterprise. The below DBM framework is a tool for creating that enterprise.

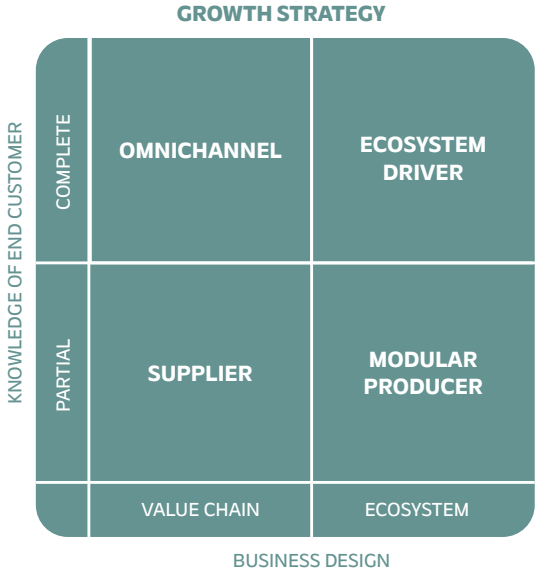


Figure 4: Digital Business Model Framework. Source: Weill & Woerner (2018)

Weill and Woerner (2018) argue that digitization is changing business models in two dimensions: firstly, from controlled value chains to more complex, digital ecosystems, and secondly from less familiarity with customer needs to a deeper, more insightful understanding.

The DBM framework combines these dimensions in a two-by-two matrix, resulting in four distinct digital business models, each with different capabilities and financial performance levels. The four business models are: Supplier, Omnichannel, Modular Producer, and Ecosystem driver. To evaluate in which quadrant a business is, one must examine, firstly the extent to which it operates within a controlled value chain or a complex digital ecosystem, which involves building, using, and maintaining networks. Secondly, the business' depth of knowledge of its consumers and how much it could obtain. Once a business has found its quadrant(s), the framework can be used to figure out if it should stay in this position or move to another quadrant. It is clear, that pressure is growing for companies placed in the supplier model for instance, whereas the companies with the highest net profit margins, revenue growth, the best customer experience and the shortest time to market operate in the ecosystem driver model (Weill & Woerner, 2018).

3.2.3.2 Digital Competitive Advantage

In today's consumerist and complexly networked environment, business leaders need to understand where their competitive advantages lie (Weill & Woerner, 2018).

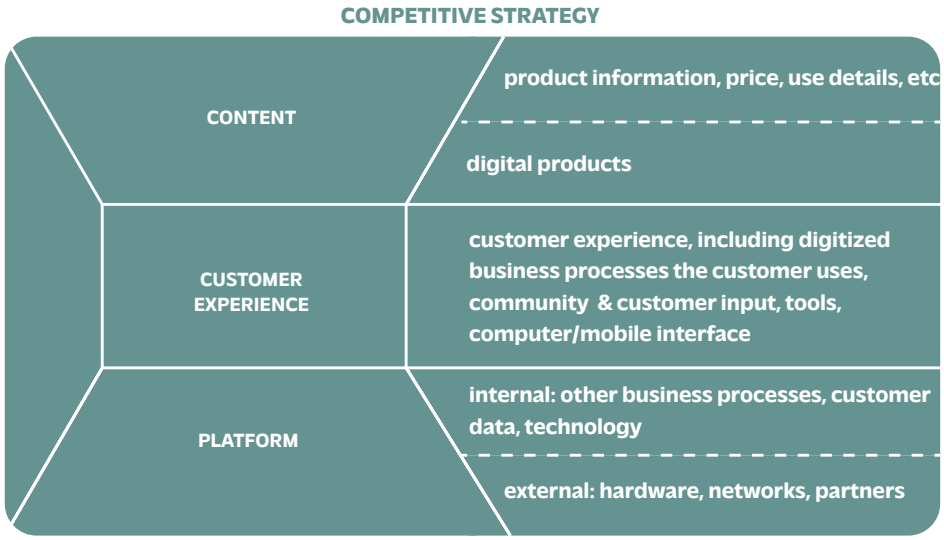


Figure 5: Digital Competitive Advantage Model. Source: Weill & Woerner (2018)

In their research, Weill and Woerner (2018) found that competitive advantage derives from one (or more) of three sources: content, customer experience, and platforms. Content concerns information and products that can generate new sources of revenue and buzz if they are continuously improved and updated. Customer experience refers to the quality of the interaction between a company and its customers. A superior customer experience can encourage cross-selling and increase revenue per customer.

Last, platform describes how the content is delivered internally via digitized activities, infrastructure, and data, and externally via services. When a company develops digital platforms that can be shared and reused across the organization, it can scale economies and improve margins (Weill & Woerner, 2018).

Weill and Woerner (2018) argue that a company will eventually need to excel at all three competitive capabilities to remain competitive in today's digital economy. If a company successfully combines these factors, it can stand out from its competitors and become the preferred destination for consumers. Nevertheless, it is difficult to build all these capabilities simultaneously. Hence, it is optimally done incrementally, over time, as well as ensuring alignment between consumer preferences and the content, customer experience, and platform the business provides (Weill & Woerner, 2018).

3.2.4 Synthesized Business Model for Digital Contraceptives

When comparing the above business models and their adaptations, clear synergies are present. Furthermore, as mentioned above, all are valuable in the clarification and investigation of the digital contraceptive business model. Hence, the below model is my own synthesis of the business model frameworks by Osterwalder and Pigneur (2010), Trimi and Berbegal-Mirabent (2012), Hulme (2011), Weill and Woerner (2018), and Piester and Rosager (2017).

The middle part was already presented earlier as the combined adaptation from Osterwalder and Pigneur (2010), Trimi & Berbegal-Mirabent (2012), and Hulme (2011). To this, elements from Piester and Rosager's 2017 Sinua MedTech model are added to address 'legislation' and 'documentation', as well as referring to the 'customer' as 'user'.

Weill and Woerner's 2018 Digital Business Model framework and Digital Competitive Advantage model have been incorporated into the two parts 'growth strategy' and 'competitive strategy' respectively, presented by Hulme (2011). According to Weill and Woerner (2018), the Digital Business Model framework can be used to assess which business models produce the highest levels of growth, efficiency, profitability and customer satisfaction. Hence, fitting well into the 10th block on the BMC as defined by Hulme (2011) – growth strategy. Weill and Woerner's (2018) Digital Competitive Advantage model fits well into what Hulme (2011) defines as 'competitive strategy', as it is used to assess where a company's competitive advantages lie – from one or more of three sources: content, customer experience, and platform. Further, it can be used to identify on which capabilities it must improve to remain competitive in the digital economy.

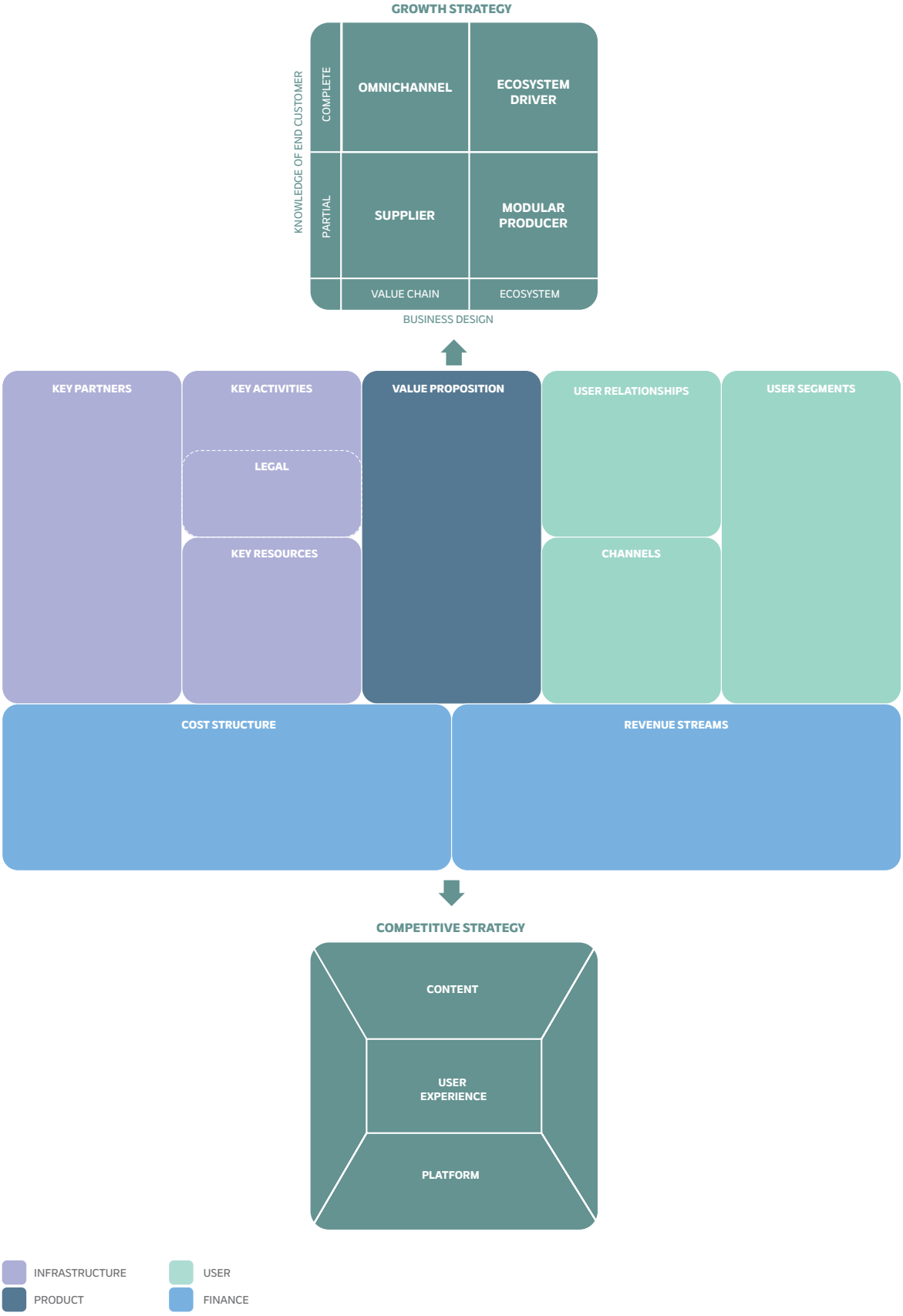


Figure 6: Synthesized Business Model (SBMC) to fit digital contraceptives. Source: Own adaptation of Osterwalder & Pigneur (2010), Trimi & Berbegal-Mirabent (2012), Hulme (2011), Weill & Woerner (2018), and Piester & Rosager (2017)

3.3 Disruptive Innovation

3.3.1 Disruptive Innovation Theory and its Origins

The term “disruptive innovation” was first coined by Harvard Business School professor Clayton Christensen in his 1997 book, The Innovator’s Dilemma, defining disruptive innovation as:

> *“a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors” (Christensen, 1997).*

The idea was already born in 1942 in the theory of creative destruction introduced by Joseph Schumpeter (1942). He believed that under capitalism, competition is not fundamentally about prices or quality, but instead about developing new technologies and business models that transform industries. Schumpeter defined creative destruction as the “process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one” (Schumpeter, 1942, p. 82). Christensen adapted Schumpeter’s idea for the modern world and classified innovations as sustaining or disruptive. In contrast to sustaining innovation, which improves existing products and technologies, disruptive innovation challenges established firms, products, and business models (Christensen, 1997). Building further on this theory, Christensen co-authored the books: “The Innovator’s Solution” (2003) and “Seeing What’s Next” (2004), along with numerous journal articles. Since his publications, the theory of disruptive innovation has received considerable attention both in academia and business, being praised by many as ‘groundbreaking’ (Tellis, 2006; Danneels, 2004; Schmidt & Druehl, 2008).

Christensen (1997) argued in his original research that disruptive innovations capture the low end of the market, historically overlooked by incumbents. Disruptors are able to gain a foothold in the market by delivering better functionality, and frequently at a lower price. The incumbents, often chasing a high profit margin in more demanding segments tend to not respond strongly to the new entrants. Eventually, the entrants move upmarket and deliver what the incumbent’s mainstream customers need, while maintaining their early advantages (Christensen, 1997; Christensen et al., 2015). Furthermore, for an innovation to be disruptive, Christensen (2015) sets forth two criteria: first, that it initially performs worse than the incumbents’ technology on the dimensions that set the industry’s leading metrics, and secondly, that the technology must improve rapidly on the metrics most valued in the industry. Disruption has occurred once the mainstream market adopts the new technology in volume (Christensen, 1997; Christensen et al., 2015).

As part of their revised research, Christensen & Raynor (2003) recognized another approach to disruptive innovation; in addition to low-end disruption, they coined the term new-market disruption. This is where disrupters create a market where none existed before and turn non-consumers into consumers (Christensen & Raynor, 2003). This idea, that a disruptive innovation could at least initially create a new market was supported by Schmidt & Druehl (2008) among others. According to their theory, disruptive innovations would take off in new market segments and only encroach on incumbent segments at a later stage. Markides (2006) supports this in his claim that the power of disruption is limited to a minor, but significant, share of the market, why the old and disruptive technology tends to coexist in the medium- or long-term. Accordingly, Christensen and Raynor (2015) present the example of how more than 50 years have passed since the opening of the first discount department store, and yet mainstream retail companies still operate their traditional department store formats. If a complete substitution occurs, it may take decades, as the incremental profit from staying with the old model one more year often trumps proposals to write off the assets at once (Christensen & Raynor, 2015). Accordingly, disruptive technologies do not necessarily displace established products, even as Christensen initially conceived of them. Instead, they may create new market niches, that can work to enlarge and broaden markets and provide new functionality (Utterback & Acee, 2005; Rakic, 2020).

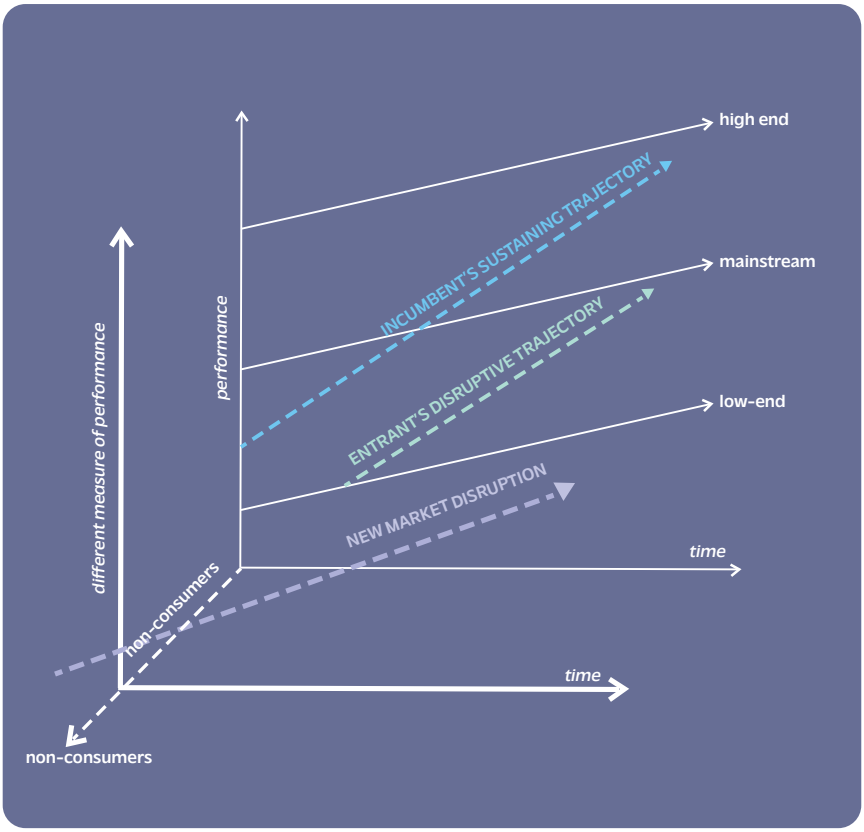


Figure 7: Low-end disruption and new-market disruption. Source: Own adaptation 7 Christensen (1997) & Christensen & Raynor (2003)

In the academic world, this definition of disruptive innovation has long been the widely accepted definition, where Christensen's work has carried significant weight. Having given birth to the term, Christensen's definition has been established as "law" by many scholars. Nevertheless, Christensen's industry analyses have been continuously challenged by journalists and academics, who have questioned their accuracy (Wadhwa, 2015; Moazed & Johnson, 2016; Lepore, 2015). Critics argue that his work is somewhat outdated and that his proposition of disruptive innovation may teach companies to look for threats in the wrong places. Christensen's original research is based primarily on more linear companies, defined to a higher degree by a more linear supply chain where value and information flows primarily in one direction. Hence, when suddenly platform businesses such as Uber and Apple enter the scene, his original ideas may be challenged.

According to Danneels (2002) and Rakic (2020), Christensen's definition of disruptive innovation faces an identification problem; how can we determine a disruptive technology a priori, before it shows its merits? Technologies such as artificial intelligence and robotics are rapidly advancing and converging. Thus, arguably allowing industries to encroach on and disrupt one another in a different way and at a faster pace than before (Wadhwa, 2015). Rakic (2020) emphasizes the importance of leveraging digital technology to reach and engage with non-consumers. Today, the term disruptive innovation is more commonly applied to companies like Uber, Apple, Tesla, and others, which began life as upmarket companies with high-quality products and services, instead of low-cost startups as per Christensen's definition. A broadening use of the term disruption coincides with accelerating disruption rates as product development cycles and customer acquisition times shrink (Moazed & Johnson, 2016; Lepore, 2015).

Nevertheless, this broadening use of the term is arguably also a trap in and of itself. Disruption has become a buzzword, which is now too frequently used loosely to invoke the concept of innovation in support of whatever one's mission is. Both in business and academia disruptive innovation is now commonly used to describe any situation in which industry incumbents are shaken by a newcomer (Christensen & Raynor, 2015). The problem with this is that strategic approaches may be misapplied to succeed as an innovator or defend against one since different types of innovations require different strategies. Hence, it is therefore important to find a balance between over- or misuse and Christensen's perhaps too strict and somewhat outdated laws on disruptive innovation.

To summarize, disruptive innovation can originate in either low-end or new market footholds. Low-end market disruptors initially perform worse, but then relentlessly move up market, eventually displacing incumbents, whereas new-market disruptors create a market where none existed before, turning non-consumers into consumers. Thus, creating a new market segment and broadening the market. In line with this, it does not necessarily have to displace all industry incumbents or capture the entire market but can instead coexist with incumbents.

4. Primary Data Results

The following section presents the results derived from the primary data. First, the codes derived from the semi-structured interviews, and secondly data visualizations conducted from the customer survey results.

4.1 Interview Coding

As mentioned, NVivo was used to facilitate the qualitative data analysis of the interviews. The following Table 3 shows the number of files and references each code was present in.

RQ	CODE	DESCRIPTION	FILES	REFERENCES
RQ 1	Changing consumer mindset	The changing mindset of consumers regarding hormonal contraceptives and the move towards digital solutions.	4	8
RQ 1	One size doesn't fit all	Digital contraceptives will not be for everyone due to individual circumstances and needs applicable to different women.	4	9
RQ 1	Value of digital contraceptives	The value proposition and benefits of digital contraceptives compared to other offerings.	4	8
RQ 1	Sexual Education & Empowerment	The feminist movement behind digital contraceptives, and why they simultaneously help to empower and educate women.	4	11
RQ 2	Lack of reimbursement & insurance	How the financing of digital contraceptives differentiates from other medtech, due to lack of reimbursement options.	3	8
RQ 2	Lack of female health research	The historical lack of research into women's health – especially reproductive health.	3	8
RQ 2	Cultural barriers	Cultural barriers that possibly hinder the growth of digital contraceptives.	5	13
RQ 2	Disruptive potential	Reflections on the disruptive potential of digital contraceptives	6	8
RQ 2	Personal stories	Personal stories of founders and employees for joining the femtech movement – an industry driven by passion over profits.	3	11
RQ 3	Pharmaceutical's reaction	The general historical lack of involvement and innovation in contraceptives solutions by the pharmaceutical industry.	4	7
RQ 3	Pharmaceutical collaboration potential	Potential collaboration opportunities between pharmaceuticals and femtech.	4	6

Table 3: Codes, descriptions, files and references extracted from NVivo.

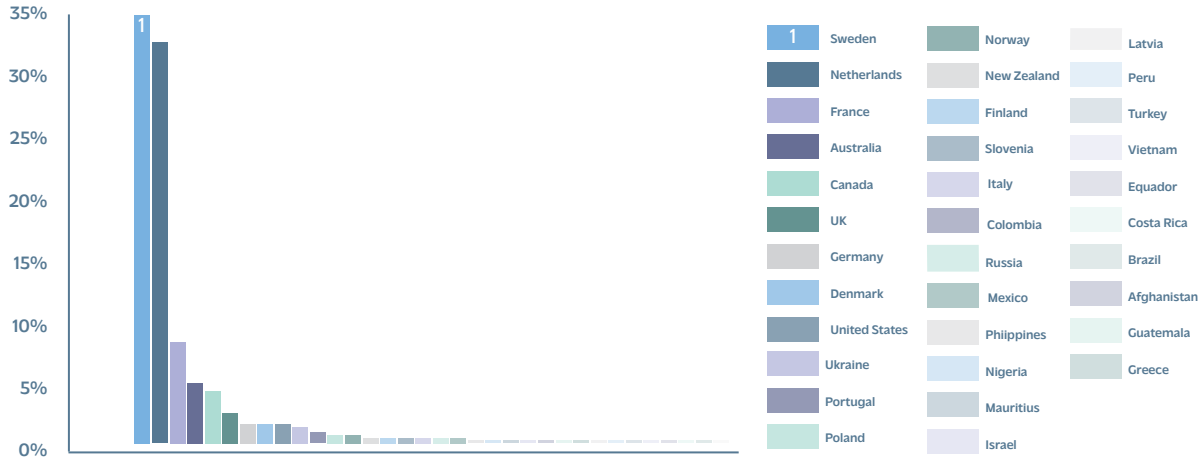
4.2 Survey Results (Survey)

The consumer behavior in terms of contraceptive use and digital apps for cycle tracking was assessed through a quantitative web questionnaire created with Qualtrics Research CORE. The following illustrates the combined results from the ***460 respondents*** in the four surveys in Danish, German, English, and Swedish (Appendix 5):

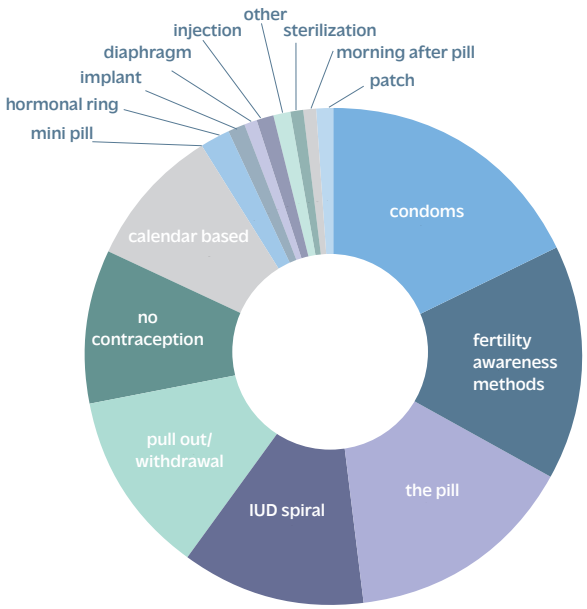
1. How old are you?

- Age mean: 29.4

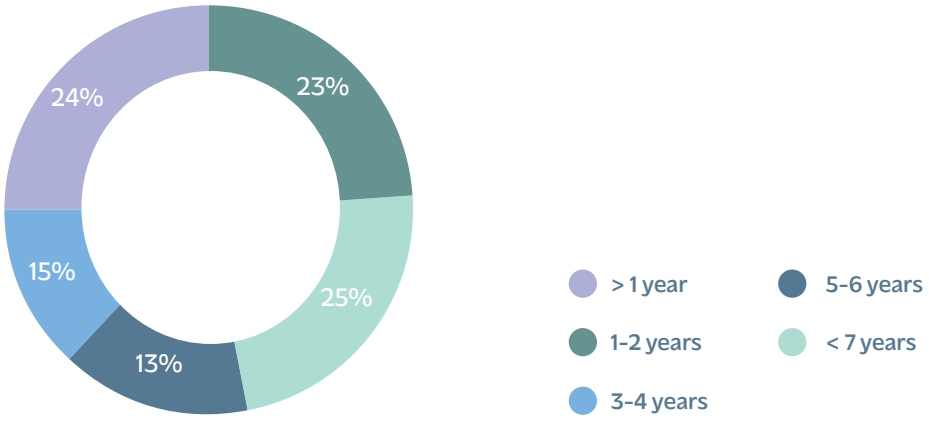
2. What is your nationality?



3. What kind of contraception do you use?



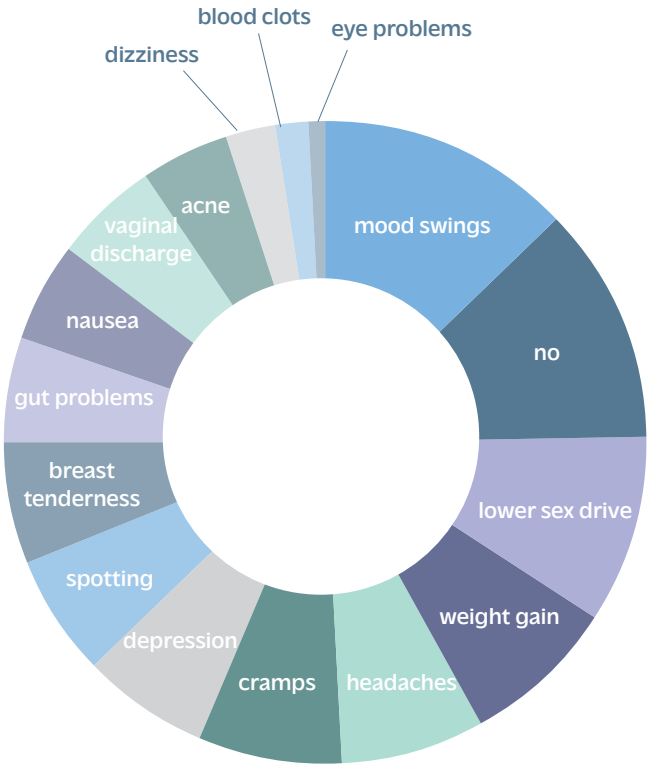
4. How long have you used this contraception method?



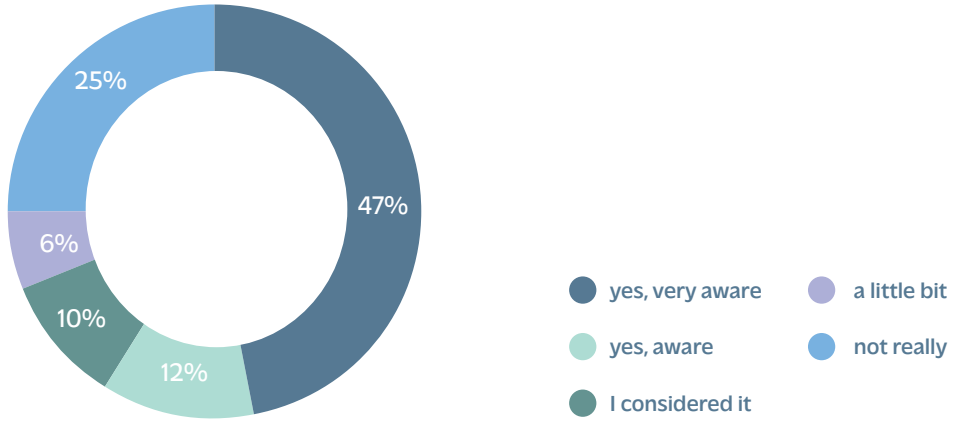
5. How satisfied are you with your current contraception method?

- Satisfaction mean: 79%

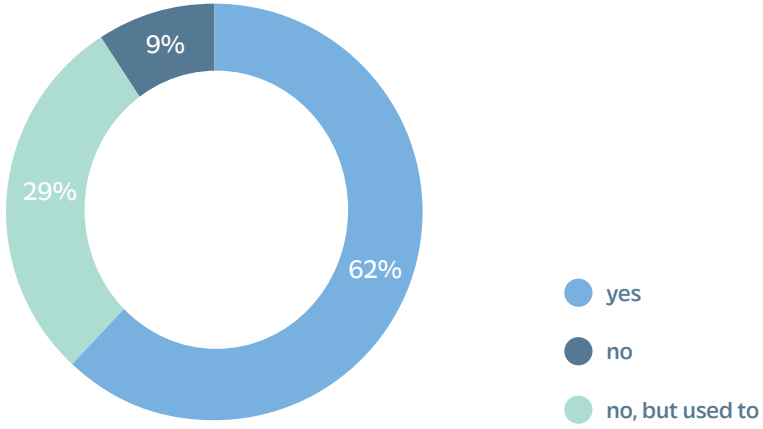
6. Have you ever experienced any of the following side effects with your current or previous contraceptives?



7. Did you consider the level of hormones when choosing your method of contraception?

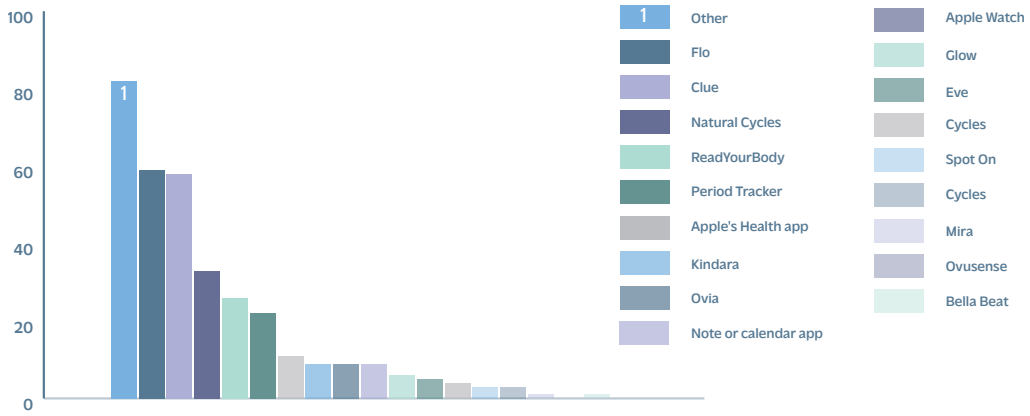


8. Do you use any mobile apps to track your menstrual cycle or fertility window?



- 71% use or have used an app for tracking their cycle and/or fertility window

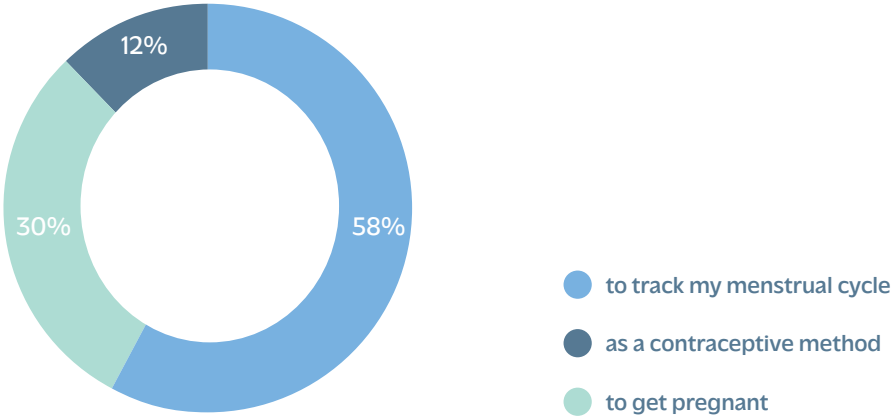
9. Which app do (or did) you use?



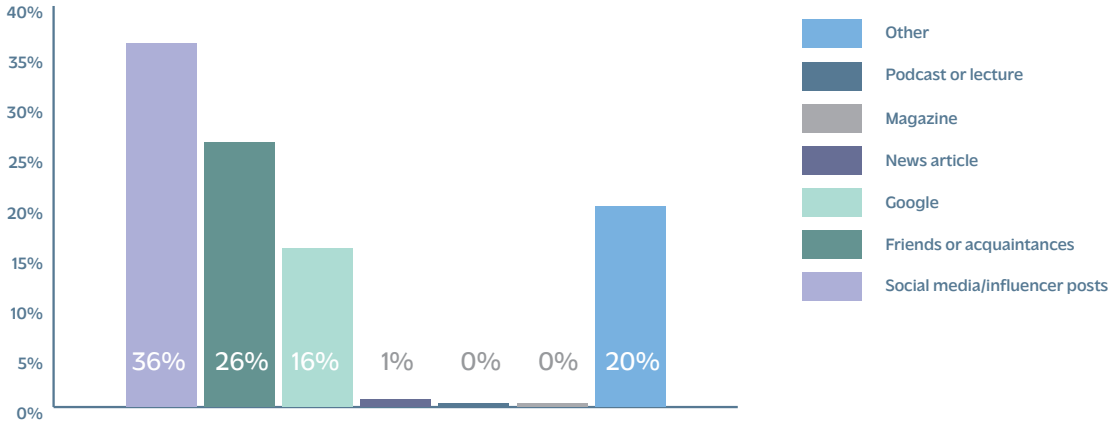
10. How satisfied are you with this app?

- Satisfaction mean: 83%

11. What do you use this app for?



12. Where did you first hear about this app?



13. How important to you is it whether such an app has been approved by the FDA and/or the EU?

- Importance mean: 49%

These data are referred back to as (Survey) throughout this thesis.

5. Analysis & Discussion

This chapter will provide an extensive analysis and discussion of the research question "What is the disruptive potential of digital contraceptives?" and its subquestions using the theoretical foundation from chapter 2 and the findings from the interviews, the survey and secondary data. First, through the application of Porter's Five Forces analysis and the Blue Ocean theory to thoroughly analyze the digital contraceptive market. Next, the chapter will apply and discuss Figure 6, the synthesized business model framework for digital contraceptives. Finally, this chapter will evaluate the disruptive potential of digital contraceptives by drawing on both the existing literature and the data results.

5.1. Competitive Analysis of the Femtech Market

In the following section, an analysis of Porter's Five Forces will be conducted on the digital contraceptive market. The aim of this analysis is to identify the sources of competitive advantage that determine the distribution of economic value among industry players. Each of the five forces will be analyzed in detail.

5.1.1 Intensity of Rivalry

The first factor to consider is the intensity of rivalry. To gain an in-depth understanding of the competitive pressures present, it is first relevant to provide an overview of the femtech market and its different categories – herein where digital contraceptives fit in. The femtech market can be divided into nine overall categories: menstruation care, pregnancy care, pelvic/sexual health, fertility solutions, fertility tracking, menopausal health, cancer care, nursing care, and general health care (CB Insights A, 2022; Appendix 4). Digital contraceptives are a part of the fertility tracking market segment and will hence be used as the focus point for this market analysis. The overall femtech industry was valued at $51B in 2021, is characterized by double digit CAGR and is expected to reach $100B in 2030. This growth is particularly concentrated in the segments of fertility solutions, maternal health and menstrual health products (CB Insights A, 2022; McKinsey A, 2022).

Nevertheless, due to the femtech industry's young age, the competitive pressure can still be considered relatively low. According to a report by McKinsey (A, 2022), there are still considerable white space opportunities to stake out, hence decreasing the competitive pressure. Adding to this, Brittany Barreto, founder of FemTech Focus, argues that:

> *"this industry is "(…) predominantly made up of females that are driven by passion over profits", and "when you have an industry built on people like that, it's a very collaborative industry" (Interview 2).*

Barreto further adds that there are a lot of partnerships and a lot of collaboration in the femtech industry, much more than what is observed in other industries (Interview 2). This is likely due to the shared sense of purpose and mutual support within this historically underserved market, creating a unique sisterhood and a sense of community that fosters collaboration among companies and individuals.

Barreto further supports the McKinsey (A, 2022) report, stating that the places we see the most crowding are in menstruation, maternal health and fertility (Interview 2). This is where digital contraceptives fit in – among "all the apps (...) [where] there's more traction, there's more funding, there's more startups" (Interview 2). This is a young segment nonetheless, where Natural Cycles, Clue, Flo, Glow, Ava, and Bellabeat take up the most market space as well as funding (CB Insights A, 2022). Here especially two players are prominent, having recently received Food & Drug Administration (FDA) approval as contraceptive methods – Natural Cycles in 2018 and Clue in 2021. Yet, also Flo, while not holding an FDA approval, is leading in the category with its user base of more than 200M globally and total funding of more than $70M (Lomas, 2021; Statista, 2022; CB Insights B, 2022). The position of these three companies is also supported by the survey conducted for this thesis, which shows Flo, Clue and Natural Cycles as the top three apps that the respondents use (Survey).

Ava, Glow, and Bellabeat follow behind these three major players, also with significant funding and market share, whereafter the rest of the market players are currently somewhat insignificant (CB Insights B, 2022). Apart from these pure digital contraceptive apps, there is another large and potentially threatening player in the field, namely Apple Watch, which launched its Cycle Tracking function in late 2019. While it is currently only operating at a basic level, tracking the menstrual cycle, it could soon become a substantial threat to other companies in this space.

While this may at first sight seem like a category characterized by competitive pressures, these companies have all managed to differentiate themselves to some extent from one another, and there are arguably still untapped opportunities. Where Natural Cycles and Clue are both FDA approved digital contraceptives with connected thermometers and wearables, Flo focuses to a larger extent on wellbeing and health around the cycle supported by various digital content. Ava and Bellabeat are digital bracelets worn around the clock. Finally, both Glow and Ava are focused to a larger extent on fertility tracking for pregnancy but still have the option of using it for contraception (McKinsey A, 2022; CB Insights A, 2022; Jewell & Benton, 2022; Natural Cycles A, 2022; Clue, 2022; Glow, 2022; BellaBeat, 2022; Flo, 2022).

Furthermore, femtech also presents interesting new partnership opportunities for more traditional sector players. Recently, for example, a partnership between L'Oréal and Clue was revealed, which will work to deepen the knowledge of the relationship between women's cycles and their skin health (McKinsey A, 2022). Further underpinning the differentiation between market players. Finally, these companies have different pricing models, with some offering free services, while others have subscription-based models or sell their wearable technologies as part of a yearly subscription.

Summing up, the level of competitive rivalry is currently relatively low. First, there is a relatively high degree of differentiation between the companies' offerings, and they are not competing on price, but instead on product features, brand image and other improvements, which can justify higher prices. Furthermore, there are currently few companies that offer the same products and the industry is characterized by high growth, decreasing the rivalry further (Porter, 2008). Nevertheless, the competitive pressures could soon increase significantly if market players such as Apple enhance their efforts in this space.

5.1.2 Threat of New Entrants

Threat of new entrants depends on the presence or absence of seven sources of entry barriers:

(1) Supply-side economies of scale are arguably relatively high, since the larger the user base on their apps, the lower cost per unit the companies enjoy as their fixed costs can be spread over more units (Porter, 2008).

(2) Demand-side benefits of scale are considered medium. While there are no direct network effects, one can argue that the more users on these relatively new apps, the higher the level of trust towards them. This can also be seen in the companies' marketing campaigns which are often focused on social media and influencer reviews, which seemingly creates a pull effect and a higher level of trust towards these apps.

(3) Customer switching costs are quite high between these companies due to the amount of unique cycle data stored in the apps. The AI used in these apps gets increasingly precise the longer the user is connected to it or enters her data (CB Insights A, 2022). Hence one's personal cycle data is built up over a long period of time, which will be lost if switching to a new app. Furthermore, several of these companies have connected technologies such as special thermometers, digital rings, or bracelets, which will also have to be bought new.

(4) At first sight capital requirements seem relatively low since the main product is the app. Nevertheless, some companies have had to invest more in R&D, product development and legal processes. These include for example Ava and Bellabeat with their unique wearable technology as well as Natural Cycles and Clue's FDA approval processes with extensive clinical trials to obtain these approvals. Furthermore, due to the industry's young age, these companies have had to invest large amounts of capital into their marketing programs. Not only to inform and educate consumers about these new technologies but also why people should trust and use these instead of the traditional, long-trusted hormonal contraceptives from big pharmaceutical companies (source). Hence, capital requirements are medium.

(5) Incumbency advantages independent of size are low, as there are seemingly no critical cost or quality advantages which are not available to potential rivals. One could argue that brand image could be one such barrier, as some of these companies have managed to establish themselves quite solidly in the marketplace, such as Clue and Flo. Yet, due to these companies' young age, none of them really have a critical advantage in this regard. Furthermore, while Natural Cycles and Clue have the advantage of being FDA-approved, these are also very recent approvals (2018 and 2021) and do not keep other companies from seeking similar approvals.

(6) Access to distribution channels is overall relatively equal in this industry since these are digital products and can be downloaded directly in AppStore. Nevertheless, the companies with FDA and EU approval have an advantage since they are allowed to market themselves as contraceptives rather than just fertility tracker apps. Hence, giving them a distribution advantage. Thus, access to distribution channels is medium.

(7) Government policy can hinder or aid new entry directly. In this case, there is again the matter of FDA and EU approval, that can promote a product in a different way and add more trust to the product. Looking at the survey conducted, the mean score of the importance of FDA/EU approval is 60% (Survey). Hence, EU or FDA approval does carry some weight in the mind of consumers and can act as a barrier to entry.

Summing up, the threat of new entrants is medium due to the presence of several entry barriers. However, there are still many untapped opportunities in the young industry (McKinsey A, 2022). Despite relatively high switching costs, there are still many potential consumers who have not yet adopted any of the apps, and different offerings differentiate themselves from each other, allowing a consumer to use different apps in her lifetime (United Nations, 2019). Overall, the threat of new entrants is medium-low.

5.1.3 Threat of Substitutes

Graph number 3 in the above results section shows the distribution of contraceptive mehtods among the surveyed sample. Natural methods like the fertility awareness/calendar-based method (which digital contraceptives build on), the pull-out method, and no contraception have gained popularity, but there are still clear substitutes present for digital contraceptives. These include the pill, mini pill, IUD, injection, implant, patch, diaphragm, hormonal ring, sterilization, “pull-out” or withdrawal method, the morning after pill, and the traditional paper calendar, as indicated by the survey.

These substitutes are strong, and many of them have been standard methods for many generations. In Europe and North America, the pill, male condom, IUD, injection, implant, patch, diaphragm, hormonal ring, sterilization, “pull-out” or withdrawal method, the morning-after pill, and the traditional paper calendar, as indicated by the survey. These substitutes are strong, and many of them have been standard methods for many generations. In Europe and North America, the pill, male condom, and IUD were the most popular contraceptive methods in 2019 (17.8%, 14.6%, and 7.8% respectively) (United Nations, 2019). These findings are consistent with our survey results, where the same methods ranked within the top four (Survey).

Yet, digital contraceptives arguably distance themselves from their substitutes through product performance and marketing. Hormonal contraceptives have been linked to severe side effects such as depression, mood swings, weight gain, headaches, decreased libido, and fertility concerns, as reported by Le Guen et al. (2021). In fact, 68% of respondents in my survey reported at least one side effect from their current or previous contraceptive method, with mood swings, lower sex drive, and weight gain being the most severe (Survey). While this is still an understudied area, the oral contraceptive pill was developed in the 1960s and has seen little to no innovation since then (Le Guen et al., 2021). Additionally, a large Danish study found a significant relationship between hormonal contraceptives and an increased risk of depression (Skovlund et al., 2016). Digital contraceptives offer a product that can alleviate these adverse side effects and concerns and bring the consumer back to her natural body state without drugs or implants impacting her hormones. On top of this, digital contraceptives offer features such as cycle tracking and educational content that can alleviate adverse side effects and bring the consumer back to her natural body state. As expressed by Natural Cycles user Laurie Kirby:

> *“The thing I like the most is that I know what my body’s doing.” (Interview 6).*

Unlike traditional contraceptive methods, digital contraceptives often rely on extensive social media marketing and influencer content to educate and build trust with consumers. This is necessary to a higher degree since these apps are not yet presented in the doctor's office to women seeking a contraceptive method (Interview 1; Interview 2). In fact, 36% of the surveyed individuals heard about the app they use through social media, while 26% learned about it through friends or acquaintances, emphasizing the significance of marketing and storytelling (Survey).

Although digital contraceptives are becoming increasingly popular alternatives, there are still potential adverse effects that may cause consumers to switch back to traditional methods. Natural Cycles and Clue have been clinically tested to be 92-93% effective at preventing pregnancy under 'typical use' and 97-98% effective under 'perfect use' (Natural Cycles A, 2022; Lomas, 2022).

However, in 2019, Natural Cycles faced a PR crisis after a number of Swedish users became pregnant unintentionally, which may have led some users to switch back to more established contraceptive methods (Deprez, 2019). While some may see traditional methods as more dependable, it is worth noting that the unwanted pregnancies were within the expected range of perfect and typical use statistics, as with any other contraceptive method (Interview 5). Hence, substitute products may indeed have an edge for some time, while these new options gain a more solid and trustable foothold in the market.

Further, according to Carrie Walter, CEO of Clue (Interview 1):

> *"(…) there should be a menu of options, and women should be able to choose."*

She argues that rather than competing with the traditional methods of contraception, digital contraceptives should be an alternative for those women who are personally dissatisfied with the traditional options available. It is about providing women with a choice and the information to make that choice. As Walter put it, digital contraceptives are simply the "digital self-serve option" (Interview 1). The interview coding data also reflects this sentiment that "one size doesn't fit all," emphasizing the need for different options that cater to individual women's needs (Table 3).

Summing up, the threat of substitutes is relatively low because those who choose to switch to digital contraceptives have generally done so because of their dissatisfaction with traditional methods and the added benefits that these apps provide. They accept the possible consequences of this method, making it a personal choice that aligns with their needs and preferences.

5.1.4 Bargaining Power of Suppliers

Bargaining power of suppliers refers to the leverage suppliers have over industry firms (Porter, 2008). Suppliers' bargaining power in the digital contraceptive industry depends on their ability to provide essential products or services for the app or the wearable technology.

App developers have relatively low bargaining power as they are competing in a large open market and against the possibility of firms developing apps in-house, reducing the need for external app development services (Ling, 2021). However, Apple and Google, which supply the App Store and Google Play for distribution, have high bargaining power because there is no substitute for distribution, and they charge a significant margin of 30% for each transaction made in the apps distributed on their platforms (Ling, 2021). Considering, that most of the digital contraceptive apps charge subscriptions to their users, this is a substantial margin.

Wearable technology or thermometers are generally supplied by other firms, often through partnership or acquisition agreements. For instance, Natural Cycles has partnered with Ōura, a smart ring innovator firm, to pair with their app, while Clue has acquired assets from a small company to facilitate their digital contraceptive tool (Natural Cycles B, 2022; Interview 1). This decreases the bargaining power of these suppliers. Overall, the bargaining power of suppliers for digital contraceptives is medium (Porter, 2008).

5.1.5 Bargaining Power of Buyers

Similarly to supplier power, buyer bargaining power determines how much leverage buyers have over vendors (Porter, 2008). Buyers in this regard are the users of digital contraceptives since it is a direct to consumers product with no intermediaries. According to Porter, high buyer bargaining power occurs when there are few large buyers, standardized offerings, low switching costs, and the ability to integrate backwards into the industry (Porter, 2008). However, the potential buyers in this industry count all women before menopause, hence not few. Further, the offerings are somewhat differentiated and buyers have high switching costs due to the unique cycle data storage and the connected technology cost. Finally, buyers are unable to integrate backwards.

Thus, the bargaining power of buyers is low at the current industry stage. Nevertheless, this landscape may change in the future, if health insurance companies enter this market space, acting as buyers with higher bargaining power than the current consumers (Interview 1).

5.1.5 Porter's Five Forces Sub-Conclusion

In summary, the Porter's Five Forces analysis indicates that the digital contraceptive industry is characterized by low competitive rivalry due to differentiation and few similar products, and a medium threat of new entrants due to several entry barriers but also untapped opportunities. The threat of substitutes is low, and supplier bargaining power is medium, while buyer bargaining power is currently low but may increase if health insurance companies enter the market. Overall, this suggests substantial growth potential in the digital contraceptive industry, but it also emphasizes the need for market players to remain vigilant and adaptable to changing market conditions and buyer behaviors.

5.2 The Blue Ocean of Digital Contraceptives

The Blue Ocean framework identifies two market spaces: the red ocean, which is the known market space with cutthroat competition, and the blue ocean, which is the untainted and untapped market space (Kim & Mauborgne, 2005). For digital contraceptives, the traditional contraceptive drug market can be seen as the red ocean, following a conventional approach to competition within the existing industry order. The key players competing in the red ocean are Veru Inc., Pfizer Inc., Bayer AG, Teva Pharmaceutical Industries Limited, Abbvie Inc., Cooper Companies Inc., Ansell LTD., Mayer Laboratories, Merck & Co Inc., and Church and Dwight Co. Inc (Amol & Onkar, 2022).

One of the greatest medical advances of the twentieth century was the introduction of the oral contraceptive pill in 1960. Together with subsequent forms of hormonal- and nonhormonal contraception, the pill gave women control over their fertility and paved the way for social advancements that enabled women to work and plan their families (Callahan et al., 2020). Contraception has made critical advances over the past six decades, yet the current method mix is not suited to women's needs across their reproductive lifespans. The global contraceptive market is characterized by a growing population that is seeking new options, which, in theory, should be a drug company's dream. Yet, pharmaceutical companies practice active avoidance (Interview 1).

The lack of interest by big pharma comes as scientific and technological advancements in biology and medicine offer more opportunities than ever to create new and innovative drugs. Yet, the large pharmaceutical companies abandoned both their hormonal and nonhormonal contraceptive drug discovery R&D programs in the early 2000s (Callahan et al., 2020). Reasons for this include the existence of various low-cost, effective products, the high bar for developing commercially successful products compared to those already out there, liability concerns due to the nature of contraceptives being used on healthy individuals, and finally the large R&D expenditures needed. Both Barreto and Walter argue that the contraceptive market is no longer profitable for pharmaceuticals due to patents running out and a history of investment cases gone bad (Interview 1; Interview 2). Furthermore, the contraceptive market, although estimated at $28.3 billion, is too fragmented to ensure big profits (Callahan et al., 2020; Amol & Onkar, 2022). This presents a clear red ocean, whereas the market space gets crowded, prospects for profits and growth are reduced (Kim & Mauborgne, 2005).

The need for innovation in contraceptive offerings has led to the creation of a blue ocean in the digital contraceptive market. This was achieved by companies such as Natural Cycles, Clue, and Flo, who followed the value innovation strategy to create a new, uncontested market space (Kim & Mauborgne, 2005). As Walter argues: "I don't think we are actually that much of a competition to these pharma companies" (Interview 1).

To achieve value innovation, companies need to align innovation with utility, price, and cost positions (Kim & Mauborgne, 2005). When evaluating digital contraceptives, these factors are well-aligned, providing enhanced utility for many users as a natural, non-hormonal alternative with none of the side effects of traditional contraceptives. According to Askervall:

> *"I don't think we are actually that much of a competition to these pharma companies" (Interview 1).*

To achieve value innovation, companies need to align innovation with utility, price, and cost positions (Kim & Mauborgne, 2005). When evaluating digital contraceptives, these factors are well-aligned, providing enhanced utility for many users as a natural, non-hormonal alternative with none of the side effects of traditional contraceptives. According to Askervall:

> *"It's been life changing, to not use hormonal contraception and, and traditional birth control methods" (Interview 3).*

Further, they add additional utility on top in the form of personalized, educational and wellness content directed at the woman at each stage of her cycle, and can be used to track various things such as PMS, stress, acne, body changes, sex drive and more. This is expressed by Natural Cycles user Kirby:

> *"I think it's just like, really nice […] that I can recognize when I'm ovulating and things like that […] I know what my body's doing." (Interview 6).*

Looking at price and cost positions, many of these apps offer free services, or relatively cheap subscription-based payment when the app is accompanied by wearable technology and other premium functions, ranging from $39 to $99 per year including wearable technologies (Natural Cycles A, 2022; Clue, 2022; Glow, 2022; BellaBeat, 2022; Flo, 2022).

This compared to traditional birth control, which is generally more expensive depending on the country, subsidies and one's health insurance. In the US getting an IUD out of pocket generally ranges from $500 to $1,300, whereas the price for each pack of oral birth control ranges between $20 and $50, adding up to an annual cost of $240 to $600 (Hudson, 2022).

Moreover, value innovation challenges a commonly accepted dogma of competition-based strategy, namely the value-cost trade-off. According to conventional thinking, companies can either deliver greater value at a higher cost or deliver reasonable value at a lower cost. In this context, strategy is a choice between low cost and differentiation, while blue ocean creators pursue both simultaneously (Kim & Mauborgne, 2005). Looking at the digital contraceptive offerings, these do indeed pursue both simultaneously for the above-mentioned reasons. Adding value both in terms of relieving consumers of their pains with traditional contraceptives as well as the additional value in terms of personalization and content, while also being an often cheaper alternative to some of the most widely used traditional options.

In conclusion, digital contraceptives have created a blue ocean, challenging the traditional competition-based approach of traditional contraceptives in the red ocean. The digital pioneers have used the value innovation strategy to create new, uncontested market space by offering enhanced utility, personalized content, and lower costs.

5.3 Synthesized Business Model Canvas Applied to Digital Contraceptives

The femtech business model is an understudied area, despite the existence of general business model templates and some research into the medtech business model. To briefly establish the overall dynamics, femtech companies, including those offering digital contraceptives, follow a Direct-to-Consumer (D2C) business model. According to Frost & Sullivan (2020), D2C business models are among the 8 strategic imperatives that are likely to disrupt the healthcare industry due to its customer-centric solutions and technological advancements. The following section will apply Figure 6 (SBMC) to get a closer look at the underlying dynamics of the business model of digital contraceptives.

The following analysis utilizes the SBMC (Figure 6), which consists of three components: first, the Business Model Canvas by Osterwalder et al. (2010), organized into four main areas as per Trimi and Berbegal-Mirabent's vision (2012) and with elements of Piester and Rosager's (2017) medtech model; second, its placement in the DBM framework; and finally, an exploration of its digital competitive advantage, both based on Weill and Woerner's (2018) approach.

5.3.1 Product

The product refers to the value proposition of digital contraceptives. Compared to traditional contraceptives, digital contraceptives present a natural birth control method with zero hormones or any of the regular side effects often reported in traditional contraceptives (Survey). As Jepsen puts it: “The value proposition is to allow the woman to access a high quality contraceptive solution, but without interfering with her hormonal cycles” (Interview 5).

Users like Kirby appreciate the knowledge and empowerment they gain from tracking their cycles as well as avoiding serious side-effects: “The thing I like the most is that I know what my body’s doing (...) So it’s nice to feel supported (...) And it doesn’t make me depressed.” (Interview 6).
With typical use, digital contraceptives are 92-93% effective and 97-98% effective with perfect use, which is similar to the effectiveness of oral contraceptives and IUDs (Natural Cycles A, 2022; Lomas, 2022). However, using these methods requires increased responsibility and lifestyle factors such as wearing a wearable device to bed or measuring temperature upon waking up (Interview 2; 5). Furthermore, if the user is hungover or sick, the basal temperature may be different, and thus cannot be regarded in the calculations (Interview 2; 5). Yet, for many users, the lack of hormones in digital contraceptives outweighs the slightly higher risk of pregnancy and the increased involvement. It is also worth noting that traditional contraceptives also come with a risk of failure. For instance, Kirby, a user of digital contraceptives, shares that her mother became pregnant while using the pill. Kirby feels more in control and at ease using Natural Cycles, as she has full knowledge and control compared to when she had the implant and had to rely solely on it (Interview 6). Baretto supports this, arguing that digital contraceptives empower women to know their own bodies and give a tool to easily track them, and in the process avoid being hormoned (Interview 2).

In addition to this, digital contraceptive apps offer various features and benefits, such as cycle tracking, educational content, wellness content, and personal check-ins, all conveniently accessible on the smartphone. In today’s fast-paced world, having these resources at your fingertips helps to empower women to take control of their health with ease and convenience alongside their daily activities.

5.3.2 User

This part concerns the user segments, user relationships, and channels to reach these users.

5.3.2.1 User Segment

Digital contraceptive apps are intended for sexually active women who are seeking contraceptive options. The user segment for these apps includes women between the ages of approximately 17-55, which is the average age range when women are both menstruating and sexually active, making them potential customers for digital contraceptives (NHS, 2019; Zava, 2018). While these apps are used for fertility tracking worldwide, they are currently only legally approved for contraceptive use in Europe, the U.S., Australia, and Singapore (Natural Cycles, 2022; Lomas, 2021). These are arguably also the regions in which there exists the biggest interest and prevalence of digital contraceptives.

Within these demographics, the user segment is diverse and includes both women who seek non-invasive, hormone-free contraceptive options and those who want to better understand their bodies. For some, traditional hormonal contraceptives may have caused unwanted side effects, leading them to explore alternative options. Others may prefer a more natural approach to contraception or have specific fertility goals in mind. While others again simply want to get back in sync with their bodies and track the various phases of their cycle and what they mean for their mood, wellbeing, symptoms etc. Adding to this, many digital contraceptives users are tech-savvy and enjoy using technology for various aspects of their lives.

Adding to this, Jepsen, Walter, Ilia and Barretto all agree that women's lifestyles also affect whether they fit into the appropriate user segment or not (Interviews 1; 2; 4; 5). If the user is hungover, has varying sleep schedules or similar, the basal temperature may be different, and thus cannot be regarded in the calculations. And as Jepsen argues:

> *"There are segments of people that would not be optimal users of this product, because they would not respect the indications given by the product, right? And then you end up with these unwanted pregnancies" (Interview 5).*

Choosing the right contraceptive method can be highly subjective, and what works well for one person may not work for another due to differences in lifestyle, health factors, and personal preferences. Women are often forced to make compromises between efficacy, invasiveness, and side effects when choosing a method (Forbes, 2021). For example, a woman experiencing unfortunate side effects from hormones may opt for digital contraceptives, accepting the fact that the efficacy is somewhat lower (Forbes, 2021).

On the other hand, there are women like Baretto, who suffer from cysts on her ovaries and has to stay on birth control for medical reasons:

> *"Women like me, who suffer from other things like endometriosis or acne or mental health illness, really requires us to be on those hormones" (Interview 2).*

Finally, the interest for digital contraception has somewhat faded in certain U.S. states as a response to the recent overturn of Roe vs. Wade, incriminating abortions (Interview 1; Interview 2; Survey). This is due to the lower effectiveness rate of digital contraceptives compared to hormonal ones as well as the fear of data leakages to law enforcement agencies (Interview 2; Interview 1).

In summary, the target user segment for digital contraceptives includes sexually active women between the ages of 17-55 who live in Europe, certain U.S. states, Australia, and Singapore, and who lead a lifestyle appropriate for the use of these apps. These women are seeking a natural and non-invasive contraceptive option and are willing to accept the lower efficacy rate of digital contraceptives compared to hormonal options.

5.3.2.2 User Relationships

User relationships are generally strong for these products. Compared to other digital health startups, which are predominantly enterprise-focused, following a B2B or a B2B2C business model, digital contraceptive companies are predominantly D2C, and thus more consumer-centric.

One of the main differentiators of digital contraceptives compared to traditional contraceptives is their ability to offer a more personalized experience to users, who can track their temperature, symptoms, and cycle progress every day. This enhanced understanding of users allows the apps to provide customized feedback and messaging, empowering users to make informed decisions about their own bodies. According to the survey conducted for this thesis, digital contraceptive app users report an average satisfaction rate of 83% (Survey).

Additionally, these companies foster strong user relationships through various channels, such as personalized app features and social media communities. For instance, Natural Cycles has an official Facebook group with over 8,300 users, and similar user-created groups collectively reach 8,400 users (Facebook, 2022). As Askervall notes:

> *"(…) [the users] tend to find their own communities. And they really do want to share in the app, in social media communities etc." (Interview 3).*

5.3.2.3 Channels

The channels for digital contraceptive companies include their main platform – the app, the company websites with informative content and app download links, social media to market the product and raise awareness (also including direct purchase links), influencers with discount codes and direct purchase links, as well as the physical postage of the wearable or accompanying technology.

Social media is the main channel for these companies in reaching their users (CB Insights A, 2022; Interview 1; Interview 3). According to the survey, 36% of users first heard about the app that they use through social media or influencer posts (Survey). Askervall argues, that: "the biggest benefit [of social media] is that you can really get to know your audience and get to know your user (...) it's really platforms where you can teach and educate" (Interview 3).

Influencer marketing is particularly beneficial in this sense since they can tell their own story about going from hormonal contraceptives to now using Natural Cycles, for example (Interview 3). Nevertheless, this has also been shamed in the media, where critics (of varying levels of scientific accuracy) argue that influencers should stop encouraging people to get off hormonal birth control (Sloat, 2022). Despite this, Barretto notes that: "[it is] not surprising (...) that especially digital contraception would market themselves on social media. This idea of like, potentially just quickly downloading it." (Interview 2). She emphasizes the convenience of having influencers share on social media, referring to the direct download and purchase links that influencers commonly use.

However, social media as a channel has its limitations due to the wide censoring in the area of sexual health, particularly for women, and the rules and regulations for marketing an FDA-approved medical product (Interview 2; Interview 3). Askervall suggests that there are new censoring restrictions almost every week (Interview 3). This is a substantial barrier for femtech companies, as they cannot market their products effectively and face the risk of having their accounts closed or even experiencing difficulty with banks that refuse to process payments related to sexual health (Interview 2). Barreto argues that this is an issue of gender inequality in advertising:

> *"You for example can't say sexual wellness on social, but you can say erectile dysfunction. You can say ejaculate, but you can't say vulva." (Interview 2)*

5.3.3 Infrastructure

Infrastructure relates to the key resources, key activities, and key partners.

5.3.2.1 Key Resources

Key resources are the assets required to offer and deliver the previously described elements of the business model (Osterwalder et al., 2010). In the case of digital contraceptives, key resources include a well-functioning, AI-powered app and algorithm, wearable or accompanying technology, and engaging and informative content to aid users in achieving the highest efficiency of usage. As earlier established, the wearable technology is generally sourced from external partners, whereas the app design, algorithm, and content are generally produced in-house (Interview 1; Interview 4). Most companies in the industry have a strong in-house medical team and also employ external medical experts (Interview 1; Interview 3; Interview 4).

Furthermore, lack of investment has been a key issue for startups in the femtech industry, particularly since they are spearheading this revolution, educating consumers, seeking FDA approvals as pioneers in their field, and engaging in extensive R&D (Interview 1; Interview 3). Despite increasing interest, the femtech industry remains underfunded when considered in the overall medtech industry; having received $1.9 billion in funding in 2021, accounting for merely 5% of the global medtech funding that year (The Economist, 2021; Deloitte, 2022). According to Kuznetsov, lack of funding really is a key barrier to growth, and it is *"(…) the ability to demonstrate that you're really needed. And to prove to the venture capital, that we are still sustainable."* (Interview 4). Even startups with good margins are forced to cease operations due to a lack of funding (Interview 4).

5.3.2.2 Key Activities

The key activities to make the business model work include app management and maintenance, service provisioning, promotion, customer service, as well as R&D and legislative processes. The two latter refer to the two key activities specifically highlighted in the SBMC (Figure 6): documentation and legislation, respectively.

Due to the historically severe lack of investments in women's health research and development *"Most of [femtech] startups are spending their first two years just doing R&D"* (Interview 2; CB Insights A; Das, 2019). Therefore, R&D is a crucial activity for many startups in the category, and it can be very costly and serve as a barrier to growth in the early years.

Legal: To be officially able to market oneself as a digital contraceptive option, it requires FDA approval, CE marking, or corresponding approvals depending on the region. This is a time-consuming and costly process that involves both legislation and documentation. In particular, the regulatory compliance process requires extensive documentation to prove the safety and efficacy of the product and to obtain approval from regulatory bodies. The companies who have been the first to achieve this in the category (Natural Cycles and Clue) have had to invest extensive resources, spearheading this transformation from tech company to medical device (Interview 1; Interview 3). As Askervall from Natural Cycles states (Interview 3):

> *"It's been a lot about testing and learning and really just trying to figure it out. We've been in the media several times, both good and bad, but we learn from everything."*

Furthermore, documentation is not only necessary for legal compliance but also to gain market approval and acceptance, particularly in a new and developing category with high stakes. Consumers need to trust that the product they are using is reliable and effective, and documentation can help establish this trust by providing evidence of the product's safety and performance (Piester & Rosager, 2017).

5.3.2.3 Key Partnerships

For digital contraceptive companies, partnerships are quite common and can be crucial to optimize their business model or acquire new resources (Osterwalder et al., 2010). One of the factors making this industry quite unique, according to Barreto, is that it is generally characterized by a high degree of collaboration and partnerships: *"Everyone partners together"* (Interview 2).

Some examples of partnerships include Natural Cycles' recent partnership with Ōura, – a smart ring innovator firm, which can be paired with the Natural Cycles app to allow for an even more seamless experience with increased accuracy of measurement (Natural Cycles B, 2022). Clue's recent partnership with L'Oréal aims to pioneer scientific innovation and deepen knowledge of the relationship between skin health and the menstrual cycle, thereby adding additional value to consumers (L'Oréal, 2021).

Furthermore, due to the general lack of research into female health, Flo, Natural Cycles, and Clue all collaborate with various acclaimed medical experts, research institutions, universities, and corporate research groups to produce evidence-based medical information, optimize their technology and increase awareness on the subject matter (Flo B, 2022; Natural Cycles C, 2022; Clue B, 2022).

Looking into the future, there may be potential collaboration opportunities between digital contraceptive companies and larger pharmaceuticals currently in the space of traditional contraceptives. Kuznetsov and Jepsen noted in interviews (4; 5) that pharmaceutical companies have begun to recognize the potential of collaborating with digital contraceptive companies. For example, purchasing cycle data from these apps allows them to better target their female audience and conduct research. Yet, according to both Walter and Baretto, pharmaceuticals are hesitant to dedicate much resources to women's health (Interview 1; Interview 2). Rather than partnering, they typically wait until femtech startups have done all the work and proven the technology by reaching FDA approval, and then approach them with an acqusition proposal (Interview 2). Despite this, partnerships remain a valuable strategy for digital contraceptive companies to optimize their business model and acquire new resources.

5.3.4 Finance

Finance refers to revenue streams and cost structure.

5.3.4.1 Revenue Streams

The main revenue stream for digital contraceptives is monthly or yearly subscriptions ranging from $39 to $99 per year including thermometer or wearable technologies (Natural Cycles A, 2022; Clue, 2022; Glow, 2022; BellaBeat, 2022; Flo, 2022). One of the key areas where the femtech business model differentiates itself from the medtech business model is the question of reimbursement (Interview 1; Interview 2). As Walter states (Interview 1):

> *"Many of the specifically female reproductive health conditions are not reimbursable, menopause related stuff is not reimbursable. Fertility related stuff is not reimbursable"*

In the US, this is largely due to missing billing codes, as Baretto states (Interview 2) :

> *"[Due to] lack of innovation in women's health, no one made the codes for tests that didn't exist yet."*

The process of getting a new code made it very difficult, capital-intensive and generally requires several years. This is a long-standing issue in the contraceptive field, but it does have some benefits. According to Walter, a product is always going to reflect who pays for it. Serving the insurance systems generally means cutting down the time and costs of the HCP interaction, whereas having an add-based model usually means a worse customer experience and can be ill-placed in such an intimate space of the woman's cycle data (Interview 1; John et al., 2018). Hence, if the end user pays, it is going to look to a higher degree like something she wants.

A way to overcome the lack of billing codes and reimbursement is to pursue a B2B model. In today's labor market, companies are increasingly offering female-specific benefits to attract and retain female talent (Interview 2; David, 2022; Kurter, 2019). This presents an opportunity for femtech companies to partner with these employers. In fact, digital contraceptive firms have already secured major deals with companies like Amazon for thousands of subscriptions (Interview 2). This way, they eliminate the need for direct payment from end consumers, as well as the need for billing codes and insurance company reimbursement schemes.

5.3.4.2 Cost Structure

Looking at the cost structure of these companies, they are generally more value-driven at this stage of the industry.

The cost structure of femtech companies is generally more value-driven at this stage of the industry, as many of the founders and team members are motivated by passion over profits. As one interviewee, Barreto put it:

> *"(…) they are driven by passion over profits […] these die-hard women, who are giving up six-figure salaries to dedicate their life savings to these products to improve women's health" (Interview 2).*

Personal stories of experiencing unmet needs in women's health motivated several of the interviewees to join femtech companies: Walter going through a tough second pregnancy and feeling unaccommodated by the medical system, Barreto discovering for herself the lack of innovation in medical devices for female-specific conditions as well as her history of cysts on her ovaries, Askervall joining to be able to make a difference for women and because digital contraceptives were lifechanging for her (Interview 1, Interview 2; Interview 3). This is also highlighted in the coding data, where personal stories were referenced 11 times throughout the interviews (Table 3).

Nevertheless, it is also an industry currently in rapid growth with significant opportunities for entrepreneurs, hence, there is needless to say also a profit aspect to consider. Kuznetsov for instance joined the femtech industry due to its growth potential (Interview 4).

In summary, digital contraceptive companies' cost structures are driven by both passion and profit, with personal experiences motivating many founders and team members, while the growth potential of the industry and economies of scale enable them to achieve sustainable margins.

5.3.5 DBM Position

The next part of Figure 6 concerns digital contraceptive companies' position in the DBM framework. The DBM framework, as defined by Weill and Woerner (2018), provides a roadmap for achieving success in the digital economy. To determine the position of digital contraceptive companies within this framework, two factors must be considered: first, whether they are part of a controlled value chain or a complex digital ecosystem, and second the depth of knowledge of users they possess (Weill & Woerner, 2018).

As mentioned earlier, digital contraceptive companies have a high level of user understanding due to the personal, intimate and interactive nature of their products (Interview 1; Interview 3). Further, most digital contraceptive apps create multiproduct user experiences to address different life events (cycle tracking, birth control, pregnancy planning and pregnancy tracking) (Weill & Woerner, 2018). Hence, they have complete knowledge of their users and own the user experience. Secondly, these businesses are currently characterized by an integrated value chain, as they have direct relationships with the end-users and control the entire process of creating and delivering the product or service (Weill & Woerner, 2018). Summing up, digital contraceptives have complete knowledge of their customers and operate in an integrated value chain and can therefore be placed in the omnichannel quadrant (Weill & Woerner, 2018).

While the value chain model provides a strong foundation for these companies, Weill and Woerner (2018) suggest that the most successful digital companies operate within ecosystems, which offer higher profit margins, revenue growth, and customer experiences. Hence, companies in this space may wish to move closer to ecosystem driver, which also may be possible for the future imagined by Jepsen, where: *"(…) the devices that women wear will offer a whole range of health benefits and contraception will be one of them"* (Interview 5).

Nevertheless, moving toward an ecosystem model may be challenging for these companies given the need for intimacy and privacy that these products require. Walter notes that maintaining a focus on customer needs and functionality is crucial to the success of these technologies (Interview 1).

5.3.6 Digital Competitive Advantage

This section discusses the sources of digital competitive advantage for digital contraceptives, specifically evaluating content, customer experience, and platforms as per Weill and Woerner (2018). The following subsections explore each source of competitive advantage in detail.

5.3.6.1 Content

First, a company needs quality content that addresses customers' needs and is continuously improved (Weill & Woerner, 2018).

In the case of digital contraceptives, the content can be categorized into four main products: cycle tracking, birth control, pregnancy planning, and pregnancy tracking. These are generally some of the options, that are presented upon downloading the apps, which will guide the following user experience. For the purposes of this thesis, the focus will be on the birth control option.

The product utilizes a calendar-based method of birth control, enhanced for the digital age with improved accuracy and user experience (Interview 1). In contraceptive mode, the app provides a binary output (red or green) indicating whether there is a significant chance of pregnancy at the current time and weather protection is advised. The algorithm relies on daily temperature readings of the basal body temperature, along with various indications such as pain, feelings, sexual intercourse, fertility tests, and events that can affect the basal temperature (Appendix 1; Appendix 2).

Push notifications accompany the basic functions of the app to remind the user of her obligations, while informative content on the current phase is available in a comprehensive in-app learning section or blog (Appendix 2; Appendix 3). Additionally, the learning or insights section of each app offers informative content on a range of topics, including menstrual cycles, reproductive health, sex and pleasure, different phases of the cycle, common worries, mental health, protection, pregnancy, and more (Appendix 3). This section is regularly updated to provide users with a better understanding of their bodies and to increase insight into topics that can otherwise be considered taboo. Companies also use social media, particularly Instagram and Facebook, to provide similar content to both new and existing customers, which helps keep their followers engaged (Instagram A, 2022; Instagram B, 2022).

Adding to this, the user-generated content in online communities on Facebook is strong, creating a "safe space" where women share their intimate experiences and thoughts (Facebook, 2022). Thus, providing additional valuable user-generated content.

Most of these apps offer free services or relatively low-cost subscription-based payments, ranging from $39 to $99 per year, including wearable technologies (Natural Cycles A, 2022; Clue, 2022; Glow, 2022; BellaBeat, 2022; Flo, 2022). By using advanced algorithms and AI, these apps are able to gather information on the user and gradually build a better

understanding of their body and cycle, resulting in a highly customized and personalized experience. This not only improves the accuracy of the calculations but also enhances the overall reliability of the contraceptive method. Nevertheless, with the overturn of Roe vs Wade in 2022, fears grew among women regarding data privacy on cycle tracking apps, as data collected by these apps could be used against them in criminal cases in states where abortion is illegal. Criminal defence attorney Sara Spector confirmed that period trackers on a user's device could be subpoenaed in such cases (Garamvolgyi, 2022). However, each company has its own data storage and privacy policies, and interviewees from Natural Cycles, Clue, and Flo emphasized their commitment to data privacy compliance and care, arguing that it is central to their brands and reputations (Interview 1; 2; 4).

5.3.6.2 User Experience

The competitive advantage for digital contraceptives lies primarily in the user experience and access to data presented in a user-friendly and engaging way. A superior user experience is essential for encouraging cross-selling and increasing revenue per customer (Weill & Woerner, 2018).

Digital contraceptive apps provide multiproduct user experiences, including cycle tracking, birth control, pregnancy planning, and tracking. As mentioned in section 4.3.2.2, these companies have strong relationships with their users. Compared to traditional contraceptive options, digital contraceptives demonstrate an improved understanding of women's bodies, empowering and educating them. The apps are personalized, and user preferences are reflected in the design of the app, further enhancing the quality of the interactions between the companies and their customers (Interview 1; 3). Kirby, a user of Natural Cycles, reports that the app has helped her connect with her body on a deeper level, and she hopes others can benefit from it too:

> *"I just think that the more people realize that they can be in tune with their body, the bigger this is going to become. And I really hope it does. Because I think that women need to feel empowered." (Interview 6)*

Nevertheless, when looking at V1 of some of these apps, where the user must use a thermometer first thing each morning when waking up, and manually plot it into the app, this makes for a quite cumbersome customer experience. Nevertheless, as Jepsen argues:

> *"[The V1] is a stepping stone to what we could call wearable contraception" (Interview 5).*

As technology has advanced, wearable devices like rings, bracelets, and watches can now track the basal body temperature and a range of other health data automatically, greatly improving the user experience for the digital age. Thus increasing satisfaction and accuracy of the user experience.

Moreover, it is worth noting that some companies are more successful at attracting and retaining their users. These are the companies that understand and meet their users' needs. They are companies often led by like-minded young women who use the products themselves. According to Walter, some of Clue's competitors are led by men with very commercial goals in mind, who do not themselves have *"skin in the game"* (Interview 1). They may not understand their customers to the same extent and may not offer optimal user experiences.

Yet, overall most digital contraceptive companies excel at offering personalized, user-friendly apps that foster intimate relationships and superior user experiences.

5.3.6.3 Platforms

Finally, platforms describe how the content is delivered internally via digitized activities, infrastructure, and data, and externally via services to the customers. When a company develops digital platforms that can be shared and reused across the organization, it can scale economies and improve margins (Weill & Woerner, 2018). Digital contraceptive apps have different aspects to their platforms.

First, there are internal activities such as the infrastructure, algorithm and data storage which are key to having a well-functioning app. These apps were born as mobile apps, with most of the technology developed in-house, resulting in an overall smooth internal infrastructure (Interview 1; Interview 4). The overall cycle tracking features are currently quite simple: *"Right now it is much simpler because we are all on pretty much basic level"* (Interview 4).

However, the introduction of wearable technologies has increased the complexity. Future advances in algorithms and wearable technologies are expected to enable more complex and personalized tasks for each user, extending beyond contraceptive and reproductive health to a range of other health-related tasks (Interview 4; Interview 5). Hence, the complexity of the internal infrastructure and algorithm is growing, increasing the pressure on digital contraceptive companies to keep up with the competition. Adding to this, the increased concerns about data storage in light of Roe vs Wade have added additional complexity, forcing companies in this space to increase their emphasis on user data storage, data security and communication.

The digital contraceptive apps follow the omnichannel business model and thus engage externally directly with end-customers – through their apps, social media, as well as online communities organized both by the companies themselves and by their users. The integration of wearable technology into these apps has significantly improved the services they offer, delivering content more smoothly and accurately, and improving the overall user experience. These additions work to enhance rather than fragment the platforms and the user experience.

Finally, the use of social media and online communities, particularly Facebook groups, serves as both a marketing platform and a platform for users to share their intimate experiences and thoughts while providing support to one another (Facebook, 2022).

5.3.6.4 Competitive Advantage Sum-Up

From analyzing the above three sources, digital contraceptive apps have competitive advantages over traditional contraceptive methods particularly in terms of their user experience and platforms. With the advent of wearable technology, the integrated and multilayered platform of these apps creates a seamless and personalized user experience. Unlike hormonal contraceptives, these companies deliver superior user experiences, providing highly personalized overviews and building intimate relationships with their users.

Nevertheless, these technologies are still in their early stages and have a long way to go before they can fully compete. According to Kuznetsov and Jepsen, there is great potential for the future of these apps to offer more valuable content that extends beyond reproductive health and encompasses all aspects of female health (Interview 4; 5). This includes physical and mental health that can be tracked from a single bracelet or ring, making them competitive in all three capabilities: content, user experience, and platforms.

5.3.7 Business Model Sub-Conclusion

Figure 8 below summarizes the SBMC discussed in the preceding sections. This diagram illustrates how the various components of the business model are interconnected and dependent on one another for the success of the overall business model. The SBMC incorporates the traditional BMC by Osterwalder and Pigneur (2021), which has been adapted to startups by Trimi & Berbegal-Mirabent (2012) and Hulme (2011). It is further strengthened with medtech building blocks from Piester & Rosager's (2017) work and adapted to the digital world by incorporating Weill & Woerner's (2018) frameworks into growth- and competitive strategy.

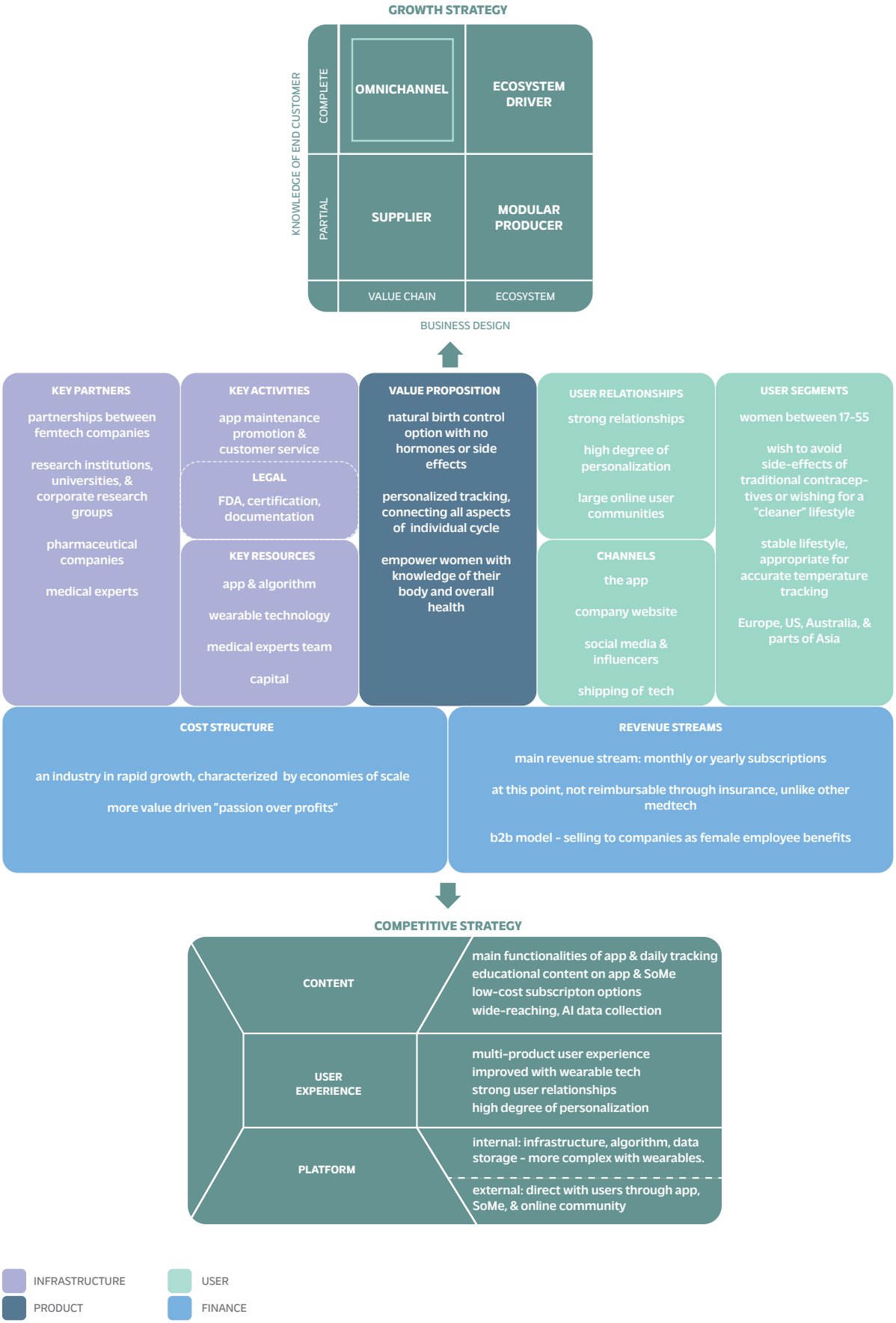


Figure 8: SBMC to fit digital contraceptives – filled out. Source: Own adaptation of Osterwalder & Pigneur (2021), Trimi & Berbegal-Mirabent (2012), Hulme (2011), Weill & Woerner (2018), and Piester & Rosager (2017).

5.4 Disruptive Potential of Digital Contraceptives

5.4.1 Disruptive Innovation Theory Applied to Digital Contraceptives

Having gained an in-depth understanding of the digital contraceptive market and its business model, it is now relevant to investigate the overall RQ of this thesis, namely whether it can be classified as a disruptive innovation or merely a sustaining one.

According to Frost & Sullivan (2018): *"Femtech has the power to disrupt women's health market."* However, as discussed earlier, disruptive innovation is a term with many meanings and definitions. Today, the term has become a buzzword, which is arguably somewhat misused to describe any situation in which an industry is shaken up, causing previously successful incumbents to struggle (Christensen et al., 2015). Nevertheless, the most agreed-upon definition has been set forth by Christensen, who describes two types of disruptive innovations, respectively originating in either the low-end or new market footholds. Low-end market disruptors initially perform worse, but then relentlessly move up market, eventually displacing incumbents. On the other hand, new-market disruptors create a market where none existed before, turning non-consumers into consumers (Christensen, 1997; Christensen & Raynor, 2003). Thus, they create a new market segment and broaden the market, rather than necessarily displacing industry incumbents. The following section will apply these ideas of Christensen (1997; 2015), supported and debated by the works of Markides (2006), Utterback & Acee (2005), and Rakic (2020), to digital contraceptives to investigate their disruptive character.

First, digital contraceptives are examined against the two footholds: low-end or new-market. It is difficult to claim, that digital contraceptives found a low-end opportunity. Low-end footholds arise when incumbents try to provide their most profitable and demanding customers with ever-improving products, paying less attention to less-demanding customers (Christensen & Raynor, 2015). That would have meant, that pharmaceuticals had overshot the needs of a material number of customers (low-end and mainstream) by making contraceptives better and better and responding primarily to the high-end of the market (Christensen & Raynor, 2015). Yet, quite the opposite is true. The reality is a historical lack of innovation in contraceptive solutions, with no real high or low end. The large pharmaceutical companies abandoned both their hormonal and nonhormonal contraceptive drug discovery R&D programs in the early 2000s (Callahan et al., 2020). Instead, digital contraceptives may be tapping into new-market footholds, as these companies are primarily targeting non-consumers at this point. Worldwide, around 171 million women between ages 15-49 (1 out of 11) are currently not using contraception despite the fact that they wish to avoid pregnancy (United Nations, 2019).

These are women who report issues such as strong side effects, lack of access, medical concerns, and difficulty of use (Callahan et al., 2020).

This is further supported by CB Insights (A, 2022), who argue,

”The rise of femtech offers needed solutions for women who have had to accept healthcare that wasn’t designed for their physiology.”

In line with this, a recent Forbes article by Marija Butkovic (2021) argued:

> *“Today, it is clear that traditional contraceptive options are being challenged. Increasing awareness of side-effects, combined with the fact that we are more than ever aware of what we put into our bodies and how this impacts our health, and finally a frustration about the lack of innovation in contraception, has resulted in a strong demand for a wider range of products that will allow women to better choose their preferred options depending on considerations like personal habits, lifestyle, and individual physiology.”*

This has also been found true in the survey of women’s contraceptive behavior, where 68% report that they have suffered severe side effects from hormonal contraceptive methods including depression, mood changes, weight gain, headaches, decrease in libido and even fertility concerns (Survey). Adding to this, 69% of respondents consider the hormonal level when choosing their contraceptive method (Survey). Furthermore, digital contraceptive apps offer low-cost subscriptions ranging from $39 to $99 per year, compared to traditional contraceptive options that can easily cost $240 to $600 annually (Hudson, 2022). Therefore, digital contraceptives arguably create a new market niche by providing new functionality and catering to unmet needs (Utterback & Acee, 2005; Rakic, 2020).

Moreover, for an innovation to be disruptive, Christensen (2015) sets forth two criteria: (1) the innovation must initially perform worse than incumbents’ technology on the dimensions that set the industry’s leading metrics, and (2) rapidly improve on the metrics most valued in the industry (Christensen, 1997; Christensen et al., 2015). Disruption has occurred once the mainstream market adopts the new technology in volume (Christensen, 1997; Christensen et al., 2015).

The first approved digital contraceptive app, Natural Cycles, launched initially with a thermometer and a simpler app, making it a cumbersome and manual process that was a somewhat disturbing part of one’s morning routine (Interview 5). The manual process resulted in a higher degree of inaccurateness, potentially increasing the chances of unwanted pregnancy.

Therefore, digital contraceptives initially performed worse than the incumbents on the dimensions of convenience and safety. However, in only a few years, digital contraceptives evolved into more user-friendly, effective wearable technologies, offering a seamless and convenient user experience.

They also offer additional functionality that none of the traditional methods offer, such as tracking various symptoms and providing educational content to better understand the effects that the menstrual cycle has on their body (CB Insights A, 2022). According to Jepsen, these upgraded versions are just

”the bridgehead to something better, automatic, downstream” (Interview 5).

This sentiment is supported by a McKinsey report (A, 2022) which suggests that femtech has barely scratched the surface of what it can accomplish, as it is still in its early stages of development. Jepsen also believes that digital contraceptives have the potential to “take more market share than some people might think”, as wearable technology and mobile applications have already proved able in enabling us to monitor our health habits and make more informed decisions about our health (Interview 5).

As technology continues to improve, consumers are becoming increasingly empowered (McKinsey B, 2022). In fact, a Deloitte study predicts that medtech and related health applications will play a critical role in driving value-based care in the future, with a focus on personalized and participatory care (May, 2021). For these reasons, it seems that digital contraceptives meet Christensen’s (1997; 2015) second criteria of rapidly improving on the dimensions that the industry values. Moreover, Karina Varizvova, co-founder of FemTech Lab, argues:

> *“As with any sector that gets used to operating in a certain way, disruption often comes from products that go directly to consumers and create amazing consumer experiences. It disrupts the entire chain that way.” (Ellis-Tait, 2021).*

One way that digital contraceptives set themselves apart from traditional contraceptives is by following a D2C business model that creates superior user experiences characterized by enhanced customer understanding, personalization, and intimate customer relationships. These companies have an advantage in having access to vast amounts of customer data, giving them insights into their ideal buyers and how to deliver superior customer experiences.

Katia Lang, the other co-founder of FemTech Lab, sees the traditional fertility and contraception sector as overpriced and inefficient and as

“a product market that has been ripe for disruption for a while” (Ellis-Tait, 2021).

Digital contraceptivecompanies are able to offer more competitive pricing due to their D2C business model, which uses digital and mobile channels to sell directly to customers without any middlemen. This presents an inexpensive and easy-to-access solution, reducing costs for women and offering a contraceptive solution for underserved areas around the world (Scott & Mars, 2015). Additionally, Rakic (2020) highlights the importance of leveraging digital technology to reach and engage with non-consumers. He argues that digital platforms can provide disruptors with a low-cost way to access and learn from potential customers, test and iterate new solutions rapidly, and quickly identify and address unmet needs among non-consumers to build a loyal customer base. Therefore, a significant part of the disruption in the contraceptive industry can be attributed to the innovative business model of these companies.

5.4.2 Timeframe

Based on the abovementioned dimensions, it seems that digital contraceptives do have the potential to disrupt the contraceptive market through a new-market foothold. Yet, it is relevant to examine the timeframe and extent of such a potential disruption. Digital contraceptives user Kirby states (Interview 6):

> *“I would say probably in like, the next 10 years, my generation, for sure, will have made the switch [to digital contraceptives]”, demonstrating her belief in their disruptive potential (Interview 6).*

Similarly, Askervall, Barreto, and Kuznetsov agree on the disruptive potential of this technology, while Walter and Jepsen express more scepticism (Interview 1; 2; 3; 4; 5). Jepsen argues (5):

> *“I don’t think it will ever be the only solution […] there will be IUDs and other solutions for various reasons. And there will also be women where this is not a very good solution”*

Likewise, Walter believes that the disruption is not so much in the behavioral change, but rather in educating consumers and presenting a ”menu of options”, where women are able to choose and have good information to make an informed decision (Interview 1).

The question arises as to whether digital contraceptives can truly be considered a disruptive innovation if they do not directly substitute traditional contraceptive products, but rather present an additional option on the ”menu.”

However, according to Schmidt and Druehl (2008) and Markides (2006), the power of disruption is limited to a minor, but significant share of the market. Therefore, disruptive innovations often coexist with old technologies in the market. Christensen and Raynor (2015) also argue that complete substitution is not a given and may take decades, as incremental profit often trumps the proposal to write off assets at once. Jepsen suggests that:

"(...) for quite a while, it will be an extra thing on the menu. I would say that this market changes slowly, for many reasons." (Interview 5)

In line with this, the history of traditional contraceptives shows that the introduction of new options, such as the pill, IUDs, and implants, were also years underway and characterized by hesitancy of political and cultural discourse and did not lead to substitution but rather coexistence with existing options (Harrison & Rosenfield, 1996). Accordingly, digital contraceptives do not have to displace hormonal contraceptives but can create a new market niche that expands and broadens the contraceptive market, providing new functionality (Utterback & Acee, 2005; Rakic, 2020). This gives consumers more options, educates them, and empowers them to make informed decisions about their contraceptive choices. It is particularly relevant for the large segment of women worldwide who do not currently use contraceptives but do not wish to get pregnant. Digital contraceptives can play a significant role in making contraceptive solutions more accessible and affordable to women worldwide.

5.4.3 Barriers to Overcome Before Moving Into the Mainstream Market

Nevertheless, before this niche can hope to move toward the mainstream market, there are various barriers that it will need to overcome.

One of these barriers is the investment issue. Despite increasing interest, the femtech industry remains underfunded when considered in the overall medtech industry; having received $1.9 billion in funding in 2021, accounting for merely 5% of the global medtech funding that year (The Economist, 2021; Deloitte, 2022). A study by Frost and Sullivan (2018) found that a key barrier to its investment potential is that it is labelled as a niche market, and hence often overlooked as just another product or service in the women's health portfolio. Adding to this, due to the sector's immaturity, *"there aren't many amazing success stories [which makes it] quite hard to get old-school investors interested"* says Lang (Ellis-Tait, 2021). Nevertheless, venture capital funding for femtech has tripled over the past five years, and according to expert opinion, the potential of this industry is immense (The Economist, 2021; Deloitte, 2022).

A second barrier is that fertility-related products are generally not reimbursable, which is largely due to difficulty in getting billing codes and thus insurance companies on board. This means that the users must pay out of pocket, which could deter some from using these products (Interview 1). However, there is some hope for the future. Jepsen suggests that insurance coverage for femtech products may increase in the future: ”I think in the future, there will be more markets where Natural Cycles is also covered” (Interview 5). This could make them more accessible and affordable for users, potentially increasing the uptake of these products.

It is worth noting that some femtech companies have already started exploring alternative business models that could bypass the need for insurance coverage. For instance, some femtech companies have entered into major B2B deals for thousands of subscriptions with companies like Amazon, where the end consumer is relieved of direct payment (Interview 2). This could be a way for femtech companies to overcome the reimbursement issue.

A third barrier is the general cultural/religious barrier which is especially evident in the space of contraception. The interview code “cultural barriers” appeared in 13 interview references (Table 3). Jepsen, in particular, noted that (Interview 5):

> *“[It is] a culture conservative market […] In health care, people are careful to begin with. But I think when you touch this contraceptive stuff […] people are more risk-averse.”*

This cultural conservatism is not limited to customers alone but is also prevalent in the pharmaceutical industry. Although the industry is recognizing the potential of these products and that they are going to be part of the market, Jepsen notes that:

> *”it took 10 years for the pill to be accepted, and it was hugely controversial in the beginning, and this company [Natural Cycles], it was controversial as well” (Interview 5).*

Furthermore, given that this is a relatively new field, many doctors may not have adequate training and experience with digital contraceptives and may feel uncomfortable recommending them to their patients. This lack of familiarity with the technology may also lead to hesitation among potential users who may prefer to stick to more traditional methods. To increase the adoption of digital contraceptives, it will be essential to provide education and training to both healthcare professionals and potential users. Additionally, companies should prioritize building strong relationships with healthcare providers to gain their trust and increase their confidence in recommending these alternatives to existing options.

Finally, the recent overturn of Roe vs. Wade in 2022, which incriminates abortions in several US states, has contributed to the fear and scepticism of many users towards digital contraceptives. This is partly due to their lower effectiveness rate compared to hormonal contraceptives, as well as the risk of data leaks to law enforcement agencies. (Interview 1; Interview 2; Survey). Hence, data privacy and protection must become key issues for these companies to ensure the safe use of their apps going forward.

5.4.4 Industry Incumbents

If digital contraceptives indeed prove disruptive to the contraceptive market, it is worth examining the extent to which they challenge industry incumbents. Digital contraceptive companies are targeting segments overlooked by industry incumbents, and are gaining a foothold because they offer more suitable functionality – a contraceptive method without the common side-effects associated with traditional contraceptives (Christensen & Raynor, 2015). Industry incumbents – large pharmaceuticals such as Pfizer Inc., Bayer AG, Merck & Co Inc., etc. – have shown a historically severe lack of innovation in their contraceptives products, and have failed to address the numerous serious side effects that customers have complained about for years (Amol & Onkar, 2022; Callahan et al., 2020). Therefore, it is debatable to what extent they will respond as digital contraceptives gradually move into the mainstream market.

Walter suggests that these products are no longer profitable for pharmaceutical companies as "*(…) pharma doesn't actually make a lot of money on them anymore. And that's because a lot of these patents are running out"* (Interview 1). She argues that this is why most R&D money goes into areas such as oncology or rare diseases rather than women's health (Interview 1). Baretto adds that pharma's unwillingness to dedicate a lot of money into women's health is due to *"(…) many examples of pharma dedicating money to women's health and blowing up in their face."* (Interview 2).

For example, Johnson & Johnson's Vaginal Mesh case spanning from 2008 to 2023 with over 100,000 litigation cases constituted one of the largest mass tort litigations in US history, and Bayer's Essure case from 2002 to 2017 resulted in over 39,000 affected individuals filing lawsuits (Cuniff, 2023; Bieber, 2022).

Despite this, pharmaceuticals are slowly realizing the potential of digital contraceptives (Interview 4; Interview 5). For example, Mats Berggren, coordinator of digital health activities at Merck (2016), states that:

"Natural Cycles is an example of how digital medicine is poised to transform biomedical research and clinical practice. As a global science and technology company we are interested in how this group of clinically validated and rigorously tested technologies will impact society, healthcare and benefit patients. "

Yet, Barreto states, that instead of dedicating significant resources to R&D and similar processes, firms like Merck usually wait until a promising femtech startup has proven their technology through FDA approval before they approach with an acquisition proposal (Interview 2).

Nevertheless, we are still only at "the dawn of the FemTech revolution" according to McKinsey (A, 2022). They suggest that the vast opportunities femtech presents are becoming increasingly evident. In line with this, Butcovic (2021) argues that:

"It is clear that a new non-hormonal contraceptive technology that provides efficacy comparable to the pill without the hormone-related side effects could disrupt the market and create a paradigm shift in contraception."

Hence, much can happen before pharmaceutical companies act or react more seriously to this rapidly growing segment. Thus, allowing digital contraceptives further space to gradually move into the mainstream market, and disrupt the contraceptive market in the process.

5.4.5 Conclusion of Disruptive Potential

In conclusion, applying Christensen's (1997; 2015) concept of disruptive innovation to the case of digital contraceptives reveals that they can be considered a disruptive innovation in a new-market foothold.

Digital contraceptives have created a new market niche, turning non-consumers into consumers by offering new functionality and providing an important addition to the menu of contraceptive methods. They address the needs of the millions of women who are currently not using contraception or who are seeking an option that better suits their wants, needs, and lifestyles.

Further, they meet Christensen's criteria for disruptive innovation by initially performing worse than incumbents on convenience and safety, but rapidly improving on these metrics to offer enhanced utility and additional functionality. As femtech is still in its early stages of development, digital contraceptives have the potential to take a significant market share and transform the contraceptive industry. Thereby, challenging established incumbents in the long run.

In addition, this is likely to prompt a behavioral change in which women become more educated and empowered to assert greater control over their reproductive health. This may lead to a shift in the way doctors and other healthcare providers approach conversations about contraception, moving away from a one-size-fits-all approach towards a more personalized approach that takes into account individual lifestyle and preferences. Ultimately, this can provide women with greater freedom and agency in their reproductive choices.

6. Concluding Remarks

In conclusion, this thesis has explored the disruptive potential of digital contraceptives through an analysis of the changing consumer mindset towards contraception, the business model of digital contraceptives, and the competitive landscape, with a particular focus on how pharmaceutical companies shall adapt to these changing consumer demands and the rise of femtech.

The first sub RQ explored how the female consumer mindset is changing in regard to contraceptives and the potential for digital contraceptives. This research has shown that female consumers are increasingly seeking personalized and convenient options for contraception, while also demanding methods that do not have significant side effects. The rise of femtech and the increasing availability of digital contraceptive options offer women the potential to take control of their reproductive health with greater ease and autonomy.

The second sub RQ investigated whether the business model of digital contraceptives facilitates disruption. The SBMC combined frameworks from various sources, including Osterwalder and Pigneur, Trimi and Berbegal-Mirabent, Hulme, Weill and Woerner, and Piester and Rosager, to create a digital contraceptive business model. To summarize, this model is centred on providing personalized user experiences through a well-designed app and algorithm, seamless integration with wearable technology, and strategic collaborations within and across industries. Digital contraceptive companies have a competitive advantage over traditional methods by offering superior user experiences through highly personalized platforms and valuable content that extends beyond reproductive health. With the ability to build intimate relationships with their users, digital contraceptive companies are well-positioned to transform the contraceptive industry and empower women to take greater control over their reproductive health. This interdependent business model underscores the importance of a holistic and integrated approach to disrupt the contraceptive industry and meet the evolving needs of consumers.

Applying Christensen's concept of disruptive innovation has revealed that digital contraceptives can be considered a disruptive innovation in a new-market foothold. They address the needs of millions of women who are currently not using contraception or who are seeking an option that better suits their wants, needs, and lifestyles. Digital contraceptives initially performed worse than incumbents on convenience and safety, but rapidly improved to offer enhanced utility and additional functionality.

As femtech is still in its early stages of development, digital contraceptives have the potential to take a significant market share and challenge established incumbents in the long run. This is likely to prompt a behavioral change and empowering women to have greater freedom and agency in their reproductive choices.

Digital contraceptives have created a blue ocean by challenging the traditional competition-based approach of traditional contraceptives in the red ocean. By offering enhanced utility, personalized content, and affordability, the pioneers in this industry have used a value innovation strategy to create a new, uncontested market space. The industry has significant growth potential, but market players must remain adaptable to changing market conditions and buyer behaviors, as highlighted by the Porter's Five Forces analysis.

In light of these findings, it is clear that the rise of digital contraceptives and changing consumer demands necessitate a shift in the way pharmaceutical companies approach the development and marketing of contraceptive products. It is important that companies adapt to these changing market conditions and embrace digital innovation to remain competitive. As such, digital contraceptives have the potential to transform the contraceptive industry and provide women with greater control over their reproductive health.

7. Limitations

The present research is of exploratory nature and aims at providing an analysis of digital contraceptives' disruptive potential. Nonetheless, certain limitations apply to this study.
First, limited access to femtech data, particularly digital contraceptives, due to its early stage, necessitated the use of publicly available archival data such as online newspaper articles and websites. Although some sources are affiliated with the femtech industry and may contain biases, extensive research and multiple sources were used to ensure data quality. Femtech data was also analyzed in conjunction with medtech data due to the greater availability of data in those sectors.

A second limitation is the number of interviews that were conducted as well as the sample size of the survey. Although a longitudinal study and a larger sample could have added more insights and increased credibility to this thesis, this is beyond the scope of this paper. Also, the 6 semi-structured interviews and 460 survey respondents are considered statistically significant (Cresswell, 2007; Saunders et al., 2021).

Third, this study provides a snapshot of the digital contraceptive market, its business model and disruptive potential. Therefore, the author's sensemaking and that of the interviewees and respondents may differ at a later point in time.

A fourth limitation is the study's pragmatic research philosophy, which means reality is shaped by both objective and subjective meanings. The author acknowledges personal experiences and perspectives, as well as those of the interviewees and respondents, may have influenced the analysis and interpretation of the data. To address this limitation, the author followed an integral and reflexive practice (Saunders et al., 2021). Further, the author deemed this research philosophy appropriate given the novel nature of digital contraceptives and the goal to gain new insights into their disruptive potential.

Finally, a limitation exists in the sampling of the survey since it was distributed through various Facebook groups. However, this method may have led to a biased sample, as the characteristics and opinions of the respondents in these groups may differ from the general population.

8. Practical Implications and Theoretical Contribution

This section presents the practical implications and theoretical contributions of the study. The presented implications aim to provide suggestions to entrepreneurs, network owners, capital providers, and other organizations in the femtech industry, as well as those in other medtech and regular tech startups.

The main practical implication of this study is the SBMC for digital contraceptives presented in section 3.2.4 and applied in section 4.3. This framework combines the business model frameworks of Osterwalder and Pigneur (2010), Trimi and Berbegal-Mirabent (2012), Hulme (2011), Weill and Woerner (2018), and Piester and Rosager (2017) to accommodate a more in-depth analysis of digital contraceptives. It is adaptable for any digitally focused company and particularly relevant for startups in the femtech space.

Compared to the traditional Business Model Canvas by Osterwalder and Pigneur (2010), this SBMC adds important dimensions necessary for navigating the rapidly changing digital economy. It shows which value proposition to focus on, where a company is positioned in relation to its competitors and how to identify one's competitive advantage. Moreover, it emphasizes the importance of understanding a company's competitive position in its ecosystem and highlights the need for strategic thinking in a rapidly changing market. By taking into account these dynamic factors, the SBMC provides a more nuanced understanding of a company's positioning in the digital economy and can aid them in devising strategies to become ecosystem drivers in their space.

Hence, the synthesized business model framework provides entrepreneurs and investors with a tool to navigate the complexities of the digital economy and stay ahead of the competition. The practical implications and theoretical contributions of this study demonstrate the importance of adapting traditional business models to new and emerging industries such as femtech. By providing a more nuanced understanding of the unique challenges and opportunities in the digital contraceptive industry, this study can help entrepreneurs and investors to better understand their competitive positioning and take proactive steps to stay ahead of competition in the rapidly changing digital economy.

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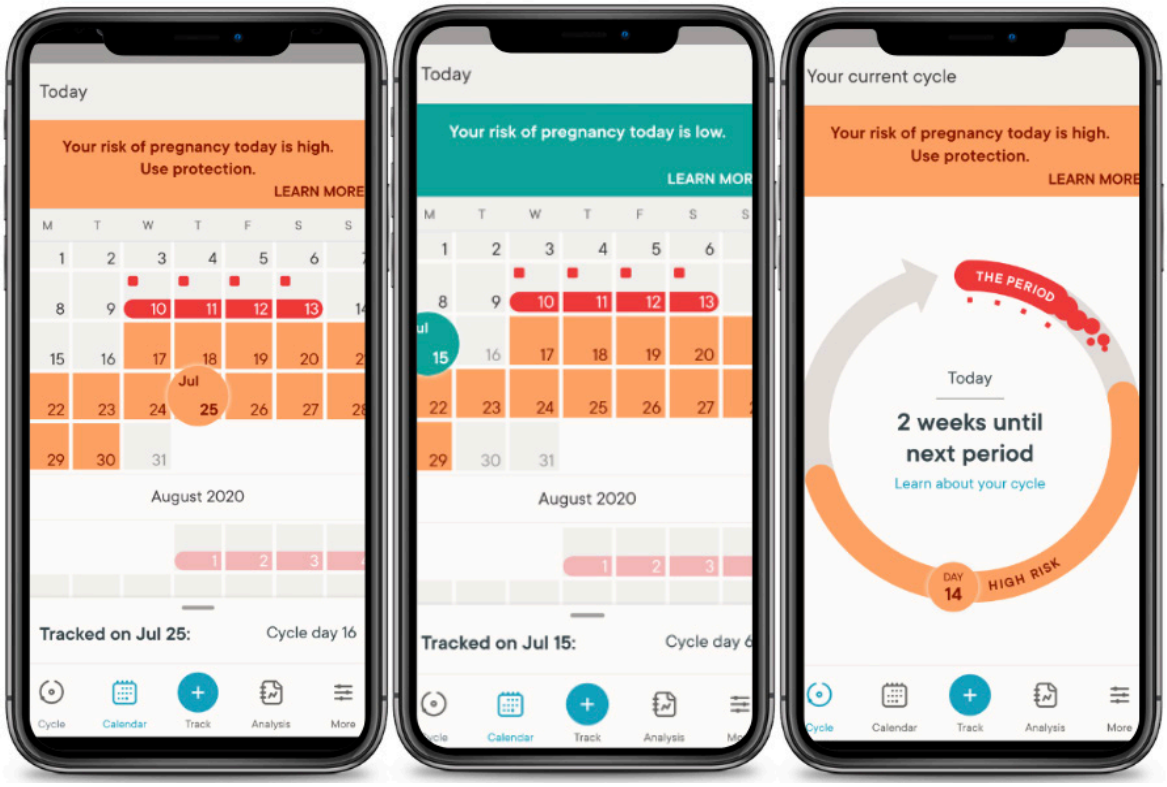
10. Appendix

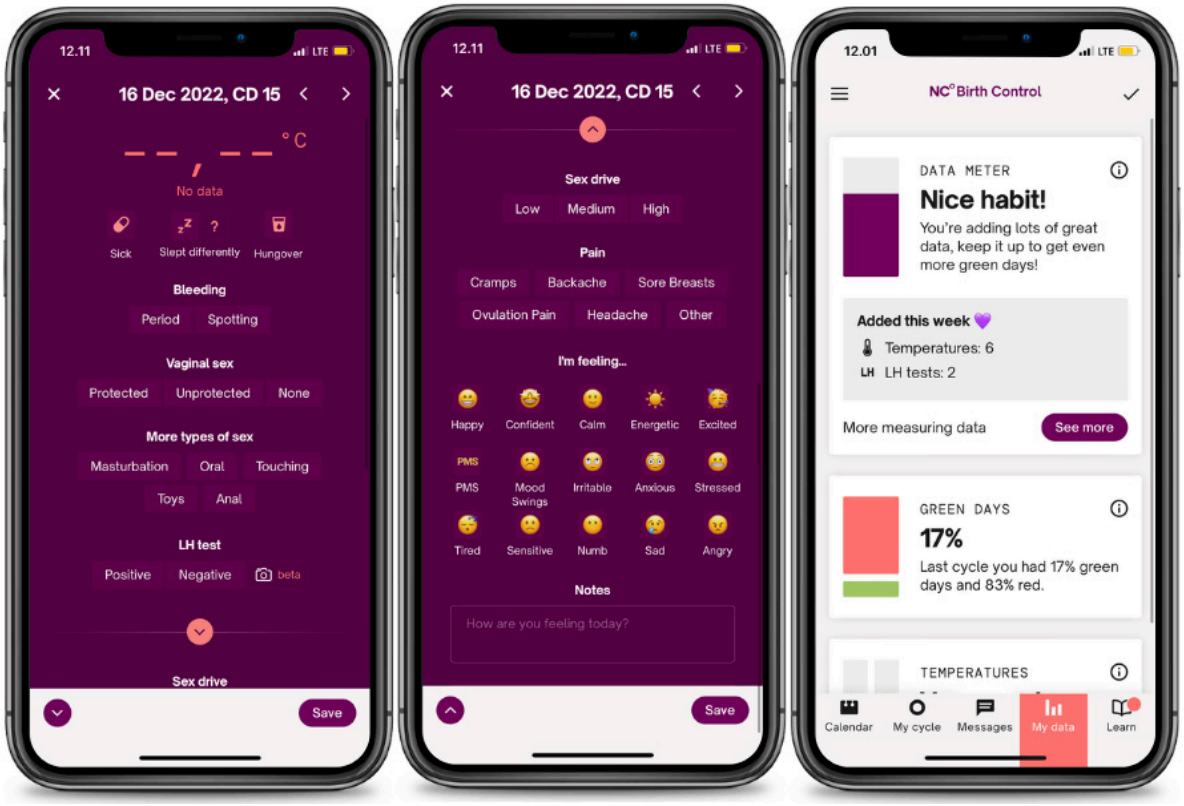
Appendix 1

Natural Cycles screens of digital contraceptive function. Source: Natural Cycles C, 2022.



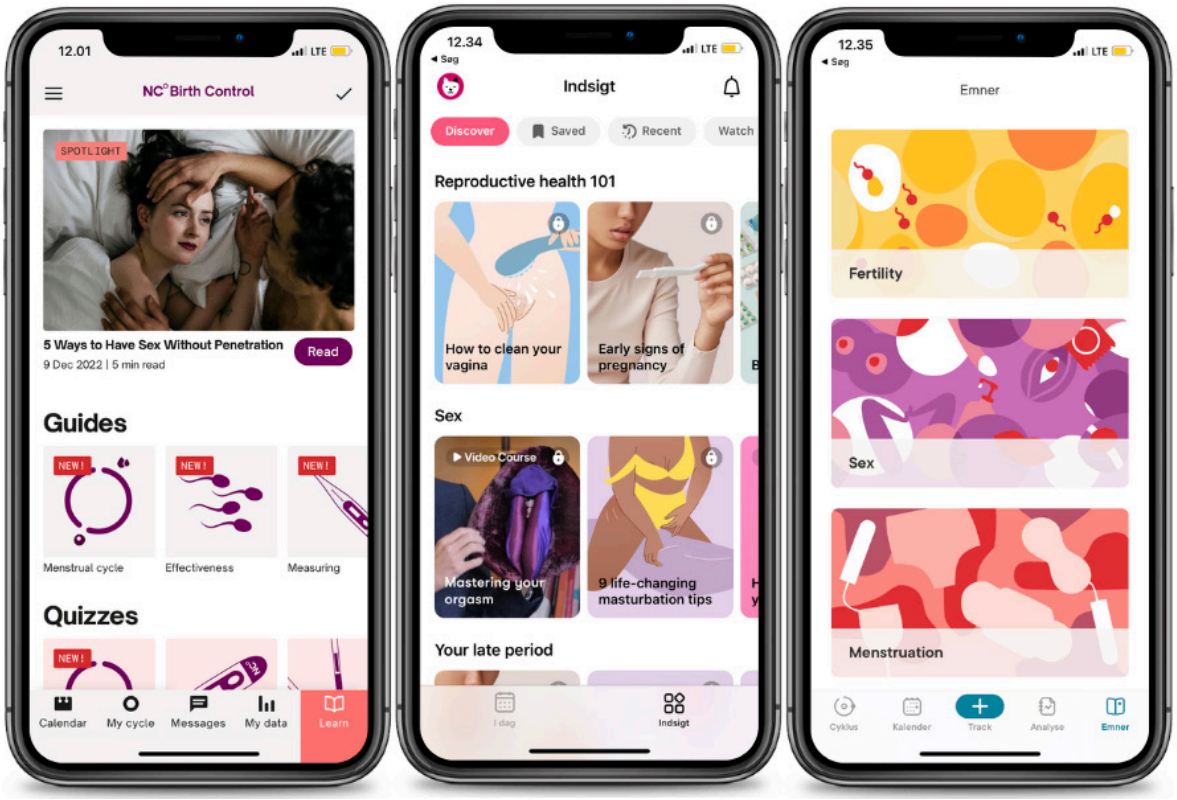
Clue screens of digital contraceptive function. Source: Lomas, 202

Appendix 2



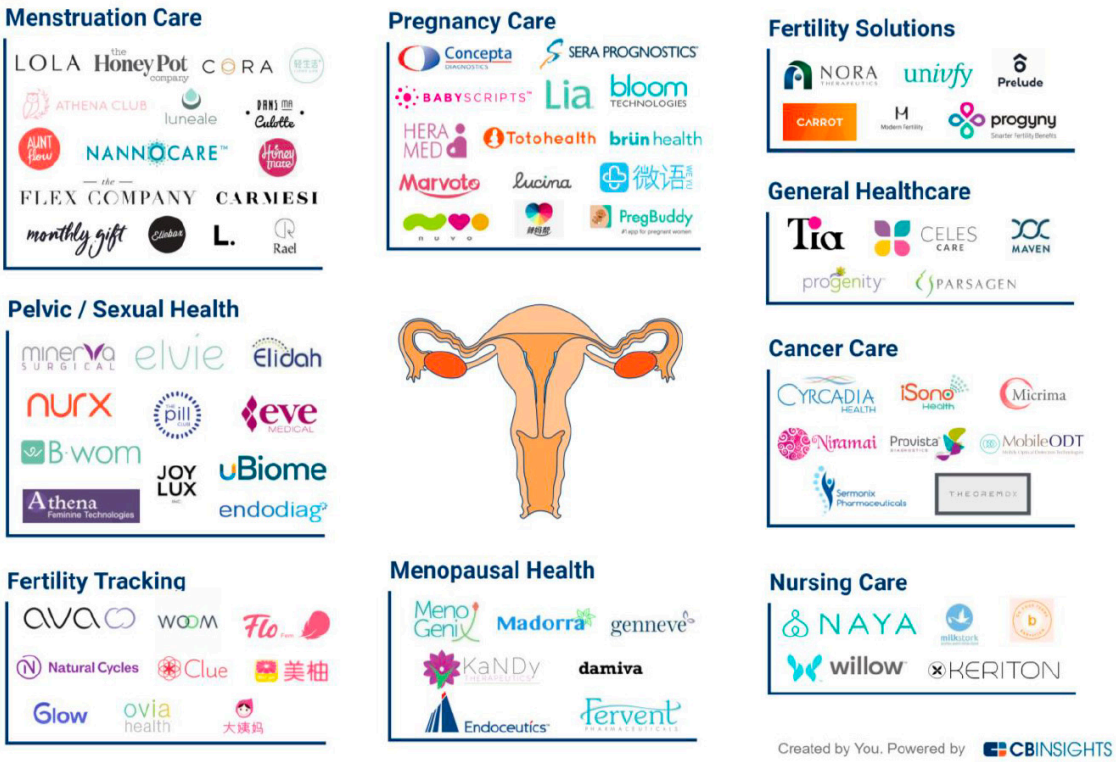
Natural Cycles screen of symptoms tracking. Source: Natural Cycles C, 2022.

Appendix 3



Learn section of Natural Cycles Learn section of Flo Learn section of Clue

Appendix 4



Overview of femtech companies and the market segments. Source: CB Insights A, 2022, p. 11

Appendix 5

	Project name	Status	Responses	Type
☆	Verhütungsmittel	Active	30	Survey
☆	Prævention	Active	131	Survey
☆	Preventivmedel	Active	4	Survey
☆	Contraceptive use	Active	295	Survey

Surveys and response rates in Danish, English, German and Swedish. Screenshot from Qualtrics.com

Appendix 6

RESEARCH PHILOSOPHY	RESEARCH QUESTION	THEORY	DATA	INTERVIEW QUESTION
Pragmatic Research Philosophy	***What is the disruptive potential of digital contraceptives?***	*Introductory / warm up questions*		Can you start by presenting yourself, your background, and current position? What attracted you to femtech initially?
	How is the consumer mindset changing in regard to contraceptives and the potential for digital contraceptives?	Porter's Five Forces (2008) Blue Ocean strategy – Kim & Mauborgne (2005) Disruptive Innovation theory (Christensen, 1997; 2015)	Quantitative data: Industry reports and articles & Questionnaire Qualitative data: Interviews with industry experts and femtech companies	How do you believe that the female consumer mindset is changing in regard to contraceptives and the potential for digital solutions?
				What do you believe to currently be femtech's biggest threats or barriers to growth?
				Who are your biggest competitors and where do you see [Company] positioned in its competitive landscape?
	Does the femtech business model facilitate disruption?	Business Model building blocks: Osterwalder (2010), Trimi & Berbegal-Mirabent's (2012), Hulme (2011) MedTech business model – Piester & Rosager (2017) Digital Business Model & Competitive Advantage - Weill & Woerner (2018) Synthesis of all frameworks	Quantitative data: Industry reports and articles & Questionnaire Qualitative data: Interviews with industry experts and femtech companies	How would you describe your business model/the femtech business model in short? And perhaps how does it differentiate from regular medtech?
				What do you believe is [Company] main value proposition?
				Where do you believe your competitive advantages lie?
				It seems many femtech companies reach their customers through social media. What are your main sales channels, and how do these support your product distribution?
	How shall pharmaceutical companies react to these changing consumer demands and the rise of femtech?	Disruptive innovation theory (Christensen, 1997; 2015)	Quantitative data: Industry reports and articles & Questionnaire Qualitative data: Interviews with industry experts and femtech companies	Do you believe digital contraceptives to be disruptive?
				How do you picture your growth journey for the next 5 years?
				How do you expect the pharmaceutical industry to respond to these changing consumer demands and the rise of femtech?
				Do you see collaboration potential for the future with larger pharmaceuticals?

Interview Guide