UNDERSTANDING CELL CULTURE CUSTOMERS: ONLINE, INFORMATION-SEEKING, AND BUYING BEHAVIOUR OF CELL CULTURE RESEARCHERS

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ABSTRACT

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Abstract

The overall online behaviour and online buying behaviour of business and consumer customers has been studied before. However, some customer groups fail to fall under either of these categories. For example, universities belong under institutional and government buyers; thus, their online and buying behaviour may differ from individual consumers and profit-seeking businesses.

This study focused on academic and institutional customers who are researchers in the niche market of cell culture. Cell culture as a field has existed since the 1900s, but an entrenched market leader has dominated the cell culture medium and matrix market for the past decades. The development of technology has enabled the evolvement of cell culture research, opening opportunities for new products to enter the markets. This study aimed to investigate cell culture researchers' online information-seeking and buying behaviour to provide a better understanding of the customers in this niche market for more advanced marketing opportunities.

To set the foundation for the study, the key concepts reviewed in the theoretical framework were organizational buying behaviour, marketing and sales funnel concepts, digital marketing, and science marketing.

The research followed subjective ontological and intepretivist epistemological research paradigms. The research data was collected with a qualitative semi-structured interview approach. In total, eight academic and institutional cell culture researchers were interviewed. Data was analysed with a thematic approach.

Several themes were identified from the results. Firstly, the role of the internet and its online platforms and channels could be divided into direct communication, sharing information, entertainment, and information seeking and receiving. Secondly, the information cell culture researchers sought could be categorised into development, industry updates, products and finance opportunities. Thirdly, the buying process varied depending on whether researchers were making repeated or new purchases. However, researchers were reluctant to buy new cell culture reagents due to already existing established products and processes. The scientific community was also seen to strongly influence the purchasing of new reagents.

Keywords
cell culture researcher, buying behaviour, online behaviour, customer behaviour

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Tiivistelmä

Yritys- ja yksityisasiakkaiden kokonaisvaltainen online-käyttäytyminen ja online-ostokäyttäytyminen ovat yleisesti tutkittuja alueita. On kuitenkin olemassa myös asiakasryhmiä, jotka eivät kuulu kumpaakaan näistä asiakasryhmistä. Esimerkiksi yliopistot kuuluvat instituutio- ja valtioasiakasryhmään, jonka vuoksi heidän online- ja ostokäyttäytymisensä saattaa poiketa yksityisasiakkaiden ja voittoa tavoittelevien yritysten käyttäytymisestä.

Tässä tutkimuksessa keskityttiin akateemisiin ja institutionaalisiin asiakkaisiin soluviljely *niche*-markkina-alueella. Soluviljelyala on ollut toiminnassa 1900-luvulta asti, mutta eräs vakiintunut toimija on dominoinut soluviljelykasvatusliuos- ja kasvualustamarkkinaa viime vuosikymmenet. Teknologian kehitys on mahdollistanut myös soluviljelytutkimuksien kehittymisen, jonka ansioista kyseiselle markkinalle on auennut mahdollisuuksia uusille tuotteille. Tämä tutkimus pyrki selvittämään soluviljelytutkijoiden online-tiedonhaku- ja -ostokäyttäytymistä. Tutkimuksen avulla voidaan tarjota parempaa asiakasymmärrystä kyseisellä markkinalla, joka mahdollistaa kehittyneempien markkinointitoimeenpanojen muodostamisen ja käyttöönoton.

Tutkimuksen pohjana teoreettisessa viitekehyksessä on käsitelty seuraavia avainkäsitteitä: organisaationaalinen ostokäyttäytyminen, markkinointi- ja myyntisuppilot, digitaalinen markkinointi ja tiedemarkkinointi.

Tutkimuksessa noudatettiin subjektiivista ontologista ja interpretivististä epistemologista tutkimusparadigmiaa. Tutkimusdata kerättiin kvalitatiivisina puolistrukturoituina haastatteluina ja yhteensä kahdeksan akateemista ja institutionaalista soluviljelytutkijaa haastateltiin. Tutkimusdatan analysointiin käytettiin temaattista lähestymistapaa.

Tuloksista oli tunnistettavissa useita teemoja. Internetin ja onlinealustojen ja -kanavien rooli voitiin jakaa suorakommunikaatioon, tiedon jakamiseen, viihteeseen sekä tiedonhakuun ja vastaanottamiseen. Tieto, jota soluviljelytutkijat hakivat, voitiin kategorisoida kehittymistarpeisiin, toimialan ajankohtaisuuksiin, tuotteisiin ja rahoitusmahdollisuuksiin. Ostoprosessi vaihteli riippuen siitä, olivatko tutkijat ostamassa samoja tuotteita uudelleen vai kokonaan uusia tuotteita. Tutkijoissa oli kuitenkin havaittavissa vastahakoisuutta uusien soluviljelyreagenssien ostoa kohtaan. Vastahakoisuuden syynä olivat markkinoiden muut toimijat ja prosessit, jotka olivat jo ennestään vakiintuneita. Myös tiedeyhteisöllä oli vahva vaikutus uusien reagenssien ostamiseen.

Asiasanat
soluviljelytutkijat, ostokäyttäytyminen, online käyttäytyminen, asiakaskäyttäytyminen

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1 INTRODUCTION

1.1 Introduction to the topic

Cell culture markets which are part of the life science industry, have grown rapidly and are forecasted to continue their growth. According to MarketsandMarkets (2020), the cell culture market worth in 2020 was US 19.0 billion and is estimated as US 33.1 billion in 2025.

Cell culture research requires multiple components, one of the key components being the cell culture reagent used as the base for the cell culture experiment. This part of the cell culture reagent market is currently being dominated by an entrenched market leader that has operated in the field for decades (Aisenbrey and Murphy, 2020). As the markets are dominated by such an established player, it is challenging for new companies and products to enter them. However, the development of science and technology has enabled new methods for cell culture, which have opened new opportunities.

Though there has been academic research on developing and commercialising new life science products, there has not been enough research focusing on understanding customer behaviour in the cell culture markets. As the internet is full of freely available information to customers and evaluating different product alternatives is relatively easy, companies must ensure they understand their customers' information-seeking behaviour well (Kotler and Keller, 2016). Garza Ramos et al. (2022) recognize the cell culture market as having two customer segments: pharma and research. This research focuses on providing knowledge on the research customer segment by investigating academic and research institution researchers.

From a marketing perspective, the biotechnology industry has heavily relied on traditional marketing communication and science marketing, including journal articles, scientific conferences, references and citations, and informative websites and brochures (Eriksson and Rajamäki, 2010). Though these are important, more information is needed on the digital and online aspects of life science, biotechnology, and cell culture marketing, especially since many B2B companies have been seen to take a digital leap which was further expedited by the Covid-19 pandemic (Arslan et al., 2021). This could also be the case with cell culture markets. Therefore, it poses an opportunity for new companies to build an online presence and bring more brand awareness and consideration for their products through digital channels. However, there is a lack of research and knowledge on how cell culture researchers and scientists use online tools and channels in their careers, leaving a gap in knowledge on where and how companies should be present in the digital world. This research aims to fill in this gap.

1.2 Cell culture market and life science industry

This master's thesis focuses on the niche market of cell culture reagents. However, a broader look into the overall cell culture market and the life science industry is required to get a deeper understanding of the niche market. This thesis' overall industry scope and focus are illustrated in FIGURE 1.

FIGURE 1 The industry and market scope of the thesis

National Academies Press (2004, as cited in Howard, 2016, p. 23) describes **life science** as follows: "*Life science refers to the study of living organisms including, microbes, human beings, animals, fungi, and plants.*". The term life science is closely tied to the term biology. Ashraf and Sarfraz (2016) state that "*biology literally means 'the study of life'*". Life sciences seek to break the concepts of life and biology into small parts and understand them from the smallest particle all the way to the whole ecosystem (Ashraf and Sarfraz, 2016). In addition to biology, life sciences can be seen to include some of the interdisciplinary branches of biology, such as neuroscience (Tanner, 2006) and biotechnology (Tibell and Rundgren, 2010).

The interdisciplinarity of life sciences can also be seen in modern-day microbiology, which enables research areas such as cell culture (Mendez-Vilas, 2006). **Cell culture** is a research method that allows researchers to examine and study cells in laboratory settings outside the body (Abbott, 2003). The cell culture research method can be used, for example, when researching cancer cells or developing new drugs (Kapałczyńska et al., 2018).

Overall, cell culture is not a new invention: the first cell culture research was already performed in the 1900s (Kapałczyńska et al., 2018). However, new methods for cell culture have been created since. In the beginning, cell culture was performed in 2D – meaning that the cells were growing in a monolayer in two dimensions (Kapałczyńska et al., 2018). The majority of cell culture research is, in fact, still performed in 2D (Kapałczyńska et al., 2018). However, Kapałczyńska et al. (2018) state that 2D cultures do not mimic the natural habitat of the cells, which can negatively alter the research results and reliability. Later, in the 1970s, the 3D cell culture method was developed to conquer some of the disadvantages of 2D cell culture (Kapałczyńska et al., 2018). The development of the 3D cell culture method is one example of the new technologies that have opened market gaps for new products in the cell culture reagent markets.

Regardless of the cell culture method, successful **cell culture research** requires various **components** to maintain propitious habitats for the cells to stay viable and metabolically active (Yoon, 2022). The components used vary based on the method, cells, and products used, but they can be reagents such as growth factors and culture media and matrices, instruments, such as tubes and dishes, and devices such as freezers (Yoon, 2022) and high-throughput machines (Hung et al., 2005). It can be assumed that the buying behaviour varies between the product types, as the resource investment requirements and product lifetime expectancy vary widely. Thus this research focuses merely on one of the product types: cell culture reagents, and even more specifically, cell culture media and matrices, which provide cells with an environment where they can live and grow (Yoon, 2022).

As an industry, life science is known to be more Business-to-Business (B2B) than Business-to-Consumer (B2C) focused (Frei, 2004). Frei (2004) describes that the customer relationship in the life science industry typically starts quite early – as early as the product development stage. Furthermore, being involved in the product development stage essentially adds value to the customer, rather than, for example, the cheapest price (Frei, 2004).

Though the cell culture market is growing, the potential customer number is still narrow. Garza Ramos et al. (2022) recognize two customer segments in cell culture markets: research and pharma. Research customers are more willing to try emerging technologies in their study than pharma customers (Garza Ramos et al., 2022). Hence, this research will concentrate on the research customer segment.

1.3 Research questions and objectives

In the previous chapter, the industry scope was discussed. This chapter focuses on defining the research questions and objectives. A research project starts from a research idea which is further developed into a clear research problem (Hair Jr. et al., 2015). The research problem of this study is: it is challenging for new products to enter the markets and obtain a digital presence in the cell culture matrix and medium markets due to entrenched market leaders dominating the field.

Once the research problem is identified, compact research questions that help determine the underlying issues should be created, and eventually, these questions should be transformed into research objectives (Hair Jr. et al., 2015). This study identifies the underlying issue beneath the research problem: the need to understand customers' online behaviour better. The study investigates these through the following three research questions (RQ).

> RQ1: What are the roles of the internet and its online platforms and channels in the career of researchers in cell culture?

The objective of the first research question is to understand what role researchers consider the internet and its online platforms and channels to have in their careers and the science community in general.

RQ2: How do researchers look for information on cell culture?

The second research question aims to gain knowledge on how researchers actively search and look for information on cell culture and how they receive information without the need to seek it. The research question also investigates what type of information the researchers are looking for about cell culture in general and specifically on cell culture reagents alone.

RQ3: How do researchers buy cell culture reagents?

The objective of the third research question is to get an overall understanding of what the buying process of cell culture reagents is like for researchers. The aim is not to investigate every single detail; however, as no previous academic research could be found about the buying process of cell culture reagents in general, it is essential to find the main factors affecting the purchase decision-making and buying.

The study can provide theoretical implications for understanding academic and institutional researchers in cell culture as a customer segment through these research questions. In addition, managerial implications can be suggested for companies to build a more substantial online presence in the applicable online platforms and channels.

1.4 Justification of the study

The existing research on marketing in the life science industry is limited, let alone academic research on cell culture markets and customer segments' buying behaviour is non-existent. Thus, this study offers a novel perspective on the fields of marketing and life sciences.

According to Eriksson and Rajamäki (2010), research on biotechnology marketing has been mainly conducted by quantitative methods from external viewpoints, without taking into consideration the distinctive features of the biotechnology industry. They also suggest that qualitative research methods enable a broader understanding of the diversity of biotechnology marketing (Eriksson and Rajamäki, 2010). This thesis follows their recommendation by taking a qualitative approach by interviewing researchers, thus providing new insight into life science, biotechnology, and cell culture marketing from the perspective of research customers.

Eriksson and Rajamäki (2010) introduce a concept of *science marketing*, which is further investigated in the literature review section. This thesis builds on the previous literature by providing information on researchers' career-related online behaviour, adding a topical perspective to science marketing. Providing new information on the online behaviour of researchers has become even more topical due to the expedited usage of digital marketing in B2B due to the Covid-19 pandemic (Arslan et al., 2021).

Besides brining a novel academic perspective to the fields of marketing and life science, the thesis aims to provide practical solutions for biotechnology companies aiming to enter the cell culture media and matrix markets.

1.5 Structure of the study

The study consists of five main chapters: introduction, theoretical framework, research methodology, results, and analysis and discussion. The study also includes references and an interview framework in the appendices.

The first chapter, introduction, introduces the general topic of the thesis and then continues to further describe the industry scope by providing information on the life science industry and cell culture markets. The study's research questions, objectives, and justification are also discussed in the introduction section.

The second chapter, theoretical framework, provides a literature review on the relevant topics discussed in academic papers and commonly known marketing theory textbooks. The literature review covers the following topics: organizational buying behaviour, marketing and sales funnel concepts and models, digital marketing, and science marketing.

The third chapter, research methodology, discusses the research philosophy of the thesis. The methodology examines the research paradigm, data collection method, research subject sampling, and data analysis approaches.

The fourth chapter presents the research results acquired through interviews. The results first discuss the research subjects and their background. Then the results are discussed corresponding to the research questions: first, investigating the role of the internet and its online platforms and channels; second, examining how researchers gain information; and third, presenting the top-level findings of the buying behaviour of cell culture researchers.

The fifth chapter focuses on analysing and discussing the results of the research. Common themes are identified, findings are compared to the previous literature, and practical activities for companies to take are recommended. Furthermore, the study's reliability, validity and limitations are evaluated, and areas for further research are suggested.

2 THEORETICAL FRAMEWORK

2.1 Organizational buying behaviour

Two of the perhaps most well-known customer relationship models are business-to-business (B2B) and business-to-consumer (B2C) models. Academic and research institution researchers fail to fall under either of the categories perfectly. However, as buyers, they can be considered to belong under the term organizational buyer, which shares similar attributes to B2B buyers (Kotler and Keller, 2016). Thus, this section covers the distinctive features of different organizational buyers, including B2B as well as institutional and government buyer groups. In addition, the chapter covers cell culture buyer types and distinctive features of online buying.

2.1.1 B2B buying process

In B2B markets, businesses sell their products or services to other businesses for production, further reselling, renting, or supplying purposes (Kotler and Keller, 2016). Business customers have distinctive features that differ from B2C customer relationships. Kotler and Keller (2016, p. 213–214) recognize the following distinctive features: *fewer and larger buyers, close supplier-customer-relationships, professional purchasing, multiple buying influences, multiple sales calls, derived demand, inelastic demand, fluctuating demand, geographically concentrated buyers, and direct purchasing.* Grewal et al. (2015) highlight four typical B2B buying behaviour features 1. B2B purchases tend to be made for proper need rather than buying for impulse wants, 2. multiple people participate in purchase decision-making, 3. purchase decision-making can be time-consuming and require various negotiations, and 4. B2B buyers are more interested in the whole product package and support rather than only the product itself.

As mentioned, due to the complex nature of B2B buying processes, purchase decision-making usually involves more than one participant (Grewal et al., 2015; Kotler and Keller, 2016). Kotler and Keller (2016) suggest that as many as seven different buyer parties can be involved in the purchase decision-making: initiators, users, influencers, deciders, approvers, buyers, and gatekeepers.

Various frameworks have been developed to better understand the industrial and organizational buying process. One of the older and prevalent frameworks that has been used as the basis for even today's refined frameworks consists of eight buy phases: "*anticipation or recognition of a problem (need), determination of the characteristics and quantity of the needed item, description of same, search for and qualification of potential sources, acquisition and analyses of proposals, evaluation of proposals and selection of suppliers, selection of an order routine, and performance feedback and evaluation*" (Robinson et al. 1967, as cited in Silk, 1968, p. 86). Webster and Wind (1972, p. 16) have condensed the previous buy phases to five stages:

"*identification of need, establishment of specifications, identification of alternatives, evaluation of alternatives, and selection of suppliers*". Grewal et al. (2015, p. 200) further summarized the old framework into three stages: *information gathering, evaluation and negotiation, and buying and usage*.

The frameworks by Robinson et al. (1967) and Webster and Wind (1972) start with the buyer identifying a need. However, Marvasti et al. (2021) recognize in their internet-search-based B2B buying process framework that potential customers are not always looking to buy anything, placing them in a no-funnel stage in their framework. Although, Marvasti et al. (2021) also adopt the idea from Grewal et al. (2015), where the B2B buying process starts with a business problem, but if no problem is identified, the buyer is in the no-funnel stage.

As can be imagined, not all purchase situations look the same. One of the significant determinants of what the purchase situation looks like is whether the buyer is buying a completely new product, has bought the exact same product before, or wants to slightly modify the purchase from a previous order (Robinson et al., 1967 as cited in Kotler and Keller, 2016).

The development of technology has influenced the B2B purchase decision-making process. More and more of the necessary information is sought online, and buyers are advancing further in the buying process through online channels by themselves without the assistance of a salesperson (Marketing Leadership Council, 2012, as cited in Grewal et al., 2015).

2.1.2 Institutional and government buyers

Organizations that do not tend to seek profit, such as schools and hospitals, can be considered institutional and government buyers (Kotler and Keller, 2016). Though institutional and government buyers share many similarities with profit-seeking business customers, one of the main differences is the budget (Kotler and Keller, 2016). Institutional and government buyers often have a minimal budget compared to B2B buyers (Kotler and Keller, 2016).

2.1.3 Cell culture buyers

Buyer segments in the field of cell culture are limitedly researched. In a study by Garza Ramos et al. (2022), two customer segments were found in the cell culture field: research customers and pharma customers. Garza Ramos et al. (2022) found two key differences between research and pharma customers: 1. research customers tend to have a smaller budget than pharma customers, and 2. research customers tend to be more willing to try new methods and innovations than pharma customers. In both customer segments, the number of potential customers was found to be very limited (Garza Ramos et al., 2022).

2.1.4 Online buying process

Digitalization and the increased usage of online tools has been seen to influence the buying behaviour of customers (Marketing Leadership Council, 2012, as cited in Grewal et al., 2015). Since this thesis focuses on the online behaviour of academic and institutional researchers, it is essential to have a brief overview of how online channels can impact the buying behaviour. When both offline and online channels are considered in the buying process Chaffey and Smith (2013, p. 182–183) have conceptualized high-involvement product purchases into six steps: *problem recognition, information search, evaluation, decision, action (sale), and post-sale*. The buying journey starts with the customer recognizing a problem that needs to be solved (Chaffey and Smith, 2013). This is followed by the customer looking for information to solve the problem (Chaffey and Smith, 2013). Once the customer has found various sources of information, the customer starts to evaluate what solution best fits their needs and makes a buying decision based on the information provided (Chaffey and Smith, 2013). Once the customer has made a decision, they buy the product, after which they advance to the post-sale stage, where they, for example, receive support material for the product or service purchased (Chaffey and Smith, 2013).

As can be noticed, these buying stages do not differ much from the previously discussed B2B buying stages. Chaffey and Smith (2013), however, highlight that online behaviour has impacted the evolution of the purchase process through, for example, recommendations and user-generated content, supplier search, search marketing, and increased importance of brand as a symbol of trust.

2.1.5 Conclusion of organizational buying behaviour

In conclusion, in B2B purchase decision making it is typical that the buying journey starts with a buyer identifying a need or a problem (Chaffey and Smith, 2013; Grewal et al., 2015; Marvasti et al., 2021; Robinson et al., 1967, as cited in Silk, 1968; Webster and Wind, 1972), although, potential customers may hear about offers even when no problem or need is recognized (Marvasti et al., 2021). Once a need or a problem is recognized, it is followed by information search and evaluation, purchase, (Chaffey and Smith, 2013; Grewal et al., 2015; Robinson et al., 1967, as cited in Silk, 1968; Webster and Wind, 1972) and post-purchase stages (Chaffey and Smith, 2013; Robinson et al., 1967, as cited in Silk, 1968).

Having fewer but larger buyers, close supplier-customer-relationship, complex and time consuming buying journey with multiple negotiations, inelastic and fluctuating demand, direct purchasing, geographically concentrated buyers, and need-based buying are some of the distinctive features for B2B buyers (Grewal et al., 2015; Kotler and Keller, 2016). Although academic and institutional customers cannot be entirely equated with B2B buyers, according to Kottler and Keller (2016) they share many similar attributes with B2B buyers, with the main difference being lower budgets than B2B buyers. Garza Ramos et al. (2022) similarly recognized academic and research institution cell culture customers

having lower budgets than pharma customers. In addition, research customers were recognized to be more open to new methods and innovations than pharma customers (Garza Ramos et al., 2022).

As the previous literature on institutional and government buyers, as well as cell culture buyers is limited, B2B customers were also examined. Further investigation on academic and institutional cell culture customers is examined in later chapters through the third research question.

2.2 Marketing and sales funnel concepts and models

The previous chapter covered organisational buyers' distinctive features and different buying process frameworks. This chapter investigates these from the marketing and sales operations perspective by exploring existing funnel concepts developed to combine the buying stages with brand interaction, thereby uniformly conceptualizing these. Concepts that are introduced in this chapter are AIDA-model, customer engagement cycle model, RACE framework, and lead funnel.

2.2.1 AIDA-model

One of the perhaps most well-known marketing funnel models, AIDA, was introduced in 1989 (Hassan et al., 2015). AIDA, as seen in FIGURE 2, is an acronym that represents the following marketing funnel stages: Attention, Interest, Desire, and Action (Hassan et al., 2015; Wenger, 2021). In other words, the AIDA marketing funnel breaks the customers' psychological advancement in purchase decision-making into four stages, which helps to improve strategic planning and evaluate the effectiveness of marketing and advertising actions (Hassan et al., 2015). AIDA represents how companies need first to ensure the potential customers are aware of their brand and product; second, they need to pique customers' interest in the offering; third, they need to ensure customers desire the product so that at the end they take action by acquiring the product or service (Hassan et al., 2015). Different marketing and advertising measures can be taken at each funnel stage to improve the probability of potential and existing customers advancing to the next funnel stage (Hassan et al., 2015).

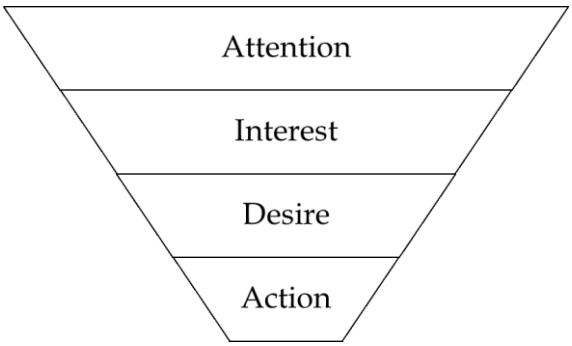

FIGURE 2 The four stages of the AIDA-model based on Hassan et al. (2015, p. 265)

2.2.2 Customer engagement cycle model

Another model explores customer engagement more specifically. Sashi (2012) acknowledges that the internet and Web 2.0 have impacted the way brands interact and build relationships with their customers. Engaging and building relationships with customers is increasingly important, which can also be seen in the nature of customer relationships (Sashi, 2012). Besides transactional customer relationships, three types of relationships can be found: delighted customers, loyal customers, and fans (Sashi, 2012). Sashi (2012) suggests that the customer engagement cycle model that consists of seven stages, as seen in FIGURE 3*: connection, interaction, satisfaction, retention, commitment, advocacy, and engagement*, can help companies build beneficial and meaningful long-term relationships with customers.

In the first stage, *connection*, it can be either the company or the customer who initiates a connection (Sashi, 2012). Building connections can be helpful, especially in B2B, where it is essential to hear and know the customers' needs, as these can help companies provide new solutions and products (Sashi, 2012). Once a connection has been built, the customer may *interact* with both the company and other customers (Sashi, 2012). The Internet has enabled fast access to provide and seek information (Sashi, 2012). Interacting and listening to customers' synergy helps companies better understand their customers' needs and create value through cooperation (Sashi, 2012).

Unlike often introduced, Sashi (2012) believes that customer *satisfaction* is not the end goal of a relationship with a customer but rather a necessity for continuous customer engagement that can be achieved through positive and fulfilling interactions. Customer satisfaction or highly positive emotions can lead to customer *retention,* which can lead to commitment, roughly divided into calculated and affective commitment (Sashi, 2012). More rational, calculative commitment suggests loyalty in a relationship, and more emotional affective commitment suggests trust and delight in the relationship (Sashi, 2012). Customers can be delighted and loyal by showing both calculative and affective commitment (Sashi, 2012). Customers who are delighted through an emotional relationship with the company tend to advocate more than customers who have not built an

emotional relationship (Sashi, 2012). This can be seen to suggest that emotional bonds between customer and company can positively affect, for example, word-of-mouth communication (Sashi, 2012). Advocacy, however, is not one-sided; both the customer and company advocate for each other, meaning that the company may advocate for the customer through, for example, being honest about competing offerings even if that instance is only beneficial for the customer and not for the company, as this can lead to trust and loyalty, which can then lead to customers advocating for the company (Sashi, 2012).

Customer relationships where both delight and loyalty are present can advance to the last stage: engagement (Sashi, 2012). Engaged customers are fans who bring value to the company through a stable relationship with active interaction, communication of needs, and advocacy, which leads to new connections and keeps the cycle going on (Sashi, 2012).

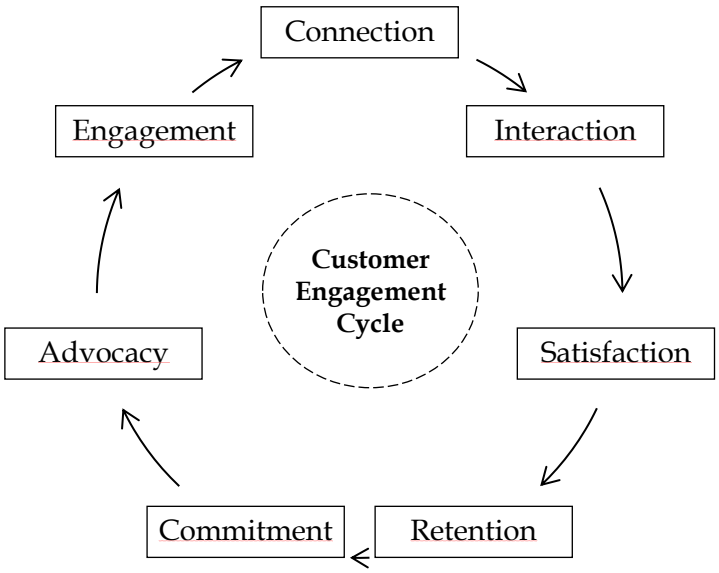

FIGURE 3 Customer engagement cycle stages (Sashi, 2012, p. 261)

2.2.3 RACE framework

RACE (FIGURE 4), an acronym for the framework's four stages: Reach, Act, Convert, and Engage, is a practical framework focusing on digital marketing (Chaffey and Ellis-Chadwick, 2019). In the first stage, the aim is to reach customers by building awareness (Chaffey and Ellis-Chadwick, 2019). The objective of the second stage, act, is to engage with the customers and get them to interact with the company by, for example, visiting the website (Chaffey and Ellis-Chadwick, 2019). The aim of the third stage, convert, is to generate sales or leads (Chaffey and Ellis-Chadwick, 2019). Lastly, the objective of the fourth stage, engage, is to build stronger relationships with the customers to enforce customer retention and repurchases (Chaffey and Ellis-Chadwick, 2019).

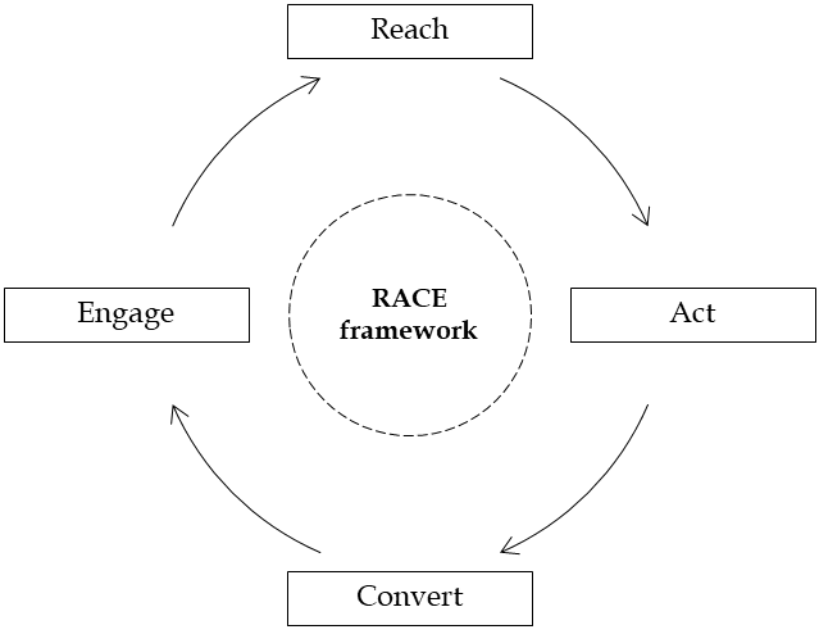

FIGURE 4 RACE framework (Chaffey and Ellis-Chadwick, 2019, p. 29)

2.2.4 Lead funnel

Lead funnel addresses the importance of marketing and sales functions' cooperation in B2B lead generation, nurturing, and qualification (Wenger, 2021), as shown in FIGURE 5. The lead funnel aims to create a trackable and measurable continuous flow between each stage of the lead funnel using the AIDA model as the base but expanding the model by introducing the different team functions and including lead stages that support the complexity of B2B customer relationships stages all the way from potential customer to sale (Wenger, 2021).

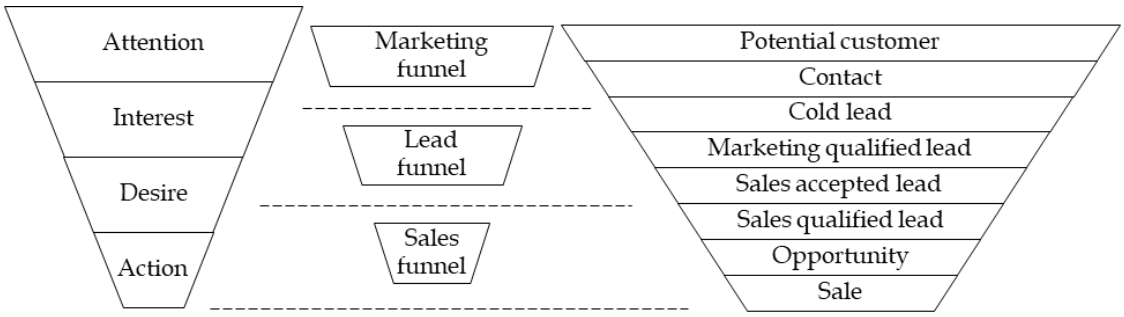

FIGURE 5 Lead funnel (Wenger, 2021, p. 258)

2.2.5 Conclusion of introduced funnel concepts and models

The different funnel concepts and models (TABLE 1) approach marketing, lead generation, sales, and customer relationship from slightly different perspectives.

The AIDA funnel focuses more on the customer's first-time purchase but fails to follow through with the stages after a purchase. In contrast, the customer engagement cycle considers the whole customer flow from the first interaction to a loyal and meaningful relationship but is strictly focused on building long-term relationships. Lead funnel considers the complexity of B2B customer relationships and combines the efforts of marketing, lead, and sales teams into one funnel concept. Lastly, the RACE model introduces a digital marketing-focused framework that aims to provide a more practical concept for companies' marketing efforts.

TABLE 1 Conclusion of introduced funnel concepts and models, based on Chaffey and Ellis-Chadwick (2019, p. 29), Hassan et al. (2015, p. 265), Sashi (2012, p. 261) and Wenger (2021, p. 258).

AIDA	**Customer engagement cycle**	**RACE**	**Lead funnel**
Attention	Connection	Reach	Potential customer
Interest	Interaction	Act	Contact
Desire	Satisfaction	Convert	Cold lead
Action	Retention	Engage	Marketing qualified lead
	Commitment		Sales accepted lead
	Advocacy		Sales qualified lead
	Engagement		Opportunity
			Sale

Though the perspectives of the introduced funnels and models differ, the core of the early stages of the required marketing and customer relationship efforts portray the same: the need for companies to build brand awareness and interact with potential customers. The next chapter investigates digital marketing and covers, for example, what tools and tactics can be used for building awareness and interacting with customers on the internet.

2.3 Digital marketing

The internet has dramatically transformed both the behaviour of customers and the practices of businesses (Dwivedi et al., 2021). The internet offers customers new ways to seek information, buy products, and communicate with other customers and businesses, whilst for businesses, the internet provides new ways to build brand awareness and sell their products (Dwivedi et al., 2021).

Digital marketing is a term often used to describe marketing operations through the use of technology, the internet, data, and digital media (Chaffey and Ellis-Chadwick, 2019). As a term, digital marketing is loose and does not have any set definition. Other terms to describe similar activities are *online marketing*, *internet marketing* (Järvinen et al., 2012), and *e-marketing* (Trainor et al., 2011). This

thesis will consider digital marketing as a broad concept defined by Pandey et al. (2020, p. 1192), "*the use of internet technologies or activities, which includes internet marketing, digital channels, e-commerce, social media marketing and mobile marketing to achieve the company's objective*".

2.3.1 Benefits of digital media and marketing

Digital media and marketing offer companies and customers lots of benefits. Digital media provides new communication methods that allow more interactivity between companies and customers, customers and customers, and communication among other stakeholders (Chaffey and Ellis-Chadwick, 2019). Before digital media, marketing tended to be *push* communication, meaning that the communication came from the company to the customers (Chaffey and Ellis-Chadwick, 2019). However, digital media has enabled *pull* communication, meaning customers can now easily communicate with companies and other stakeholders (Chaffey and Ellis-Chadwick, 2019).

Technology and digital media have also enabled broader data collection, which, then again, has enabled the usage of data for more personalized marketing, advertising, and communication (Chaffey and Ellis-Chadwick, 2019). Targeting individuals who show interest in the company's offerings enables advertising with lower costs and higher investment returns (Chaffey and Ellis-Chadwick, 2019).

Another benefit of technology and digital media is that they enable integrations between different channels, allowing better multichannel marketing where the marketing and communication efforts in different channels support each other and provide additional value to the company and its customers (Chaffey and Ellis-Chadwick, 2019). And not to forget that digital media enables a broader reach regardless of the location of the company and the customer (Chaffey and Ellis-Chadwick, 2019).

2.3.2 Digital marketing tools and tactics

Digital marketing enables the utilization of various tools and tactics. Some examples of digital marketing tools and tactics are websites, social media, search and banner advertisements, and email marketing (Chaffey and Smith, 2013; Stokes, 2018). A broader list of different tools and tactics can be found below:

- Forums
- Blogs
- Ebooks
- Social media
- Display and banner advertising
- Search advertising (Pay-per-click)
- Sponsorship (websites, online events, etc.)
- E-newsletters and other emails

- Call-to-actions (emails, websites, social media, etc.)
- Customer Relationship Management software
- Affiliate and partner marketing
- Virtual exhibitions, events, and worlds
- Webinars
- Feeds and RSS
- SEO
- Video marketing
- Website and ad personalization

(Chaffey and Ellis-Chadwick, 2019, p. 28; Chaffey and Smith, 2013, p. 559–560; Opreana and Vinerean, 2015, p. 30; Stokes, 2018, p. 16–17)

Although a website is only one of the digital marketing tools, it can be considered one of the most prominent tools for companies. As seen in TABLE 2, Chaffey and Smith (2013) have further defined and listed different types of valuable and versatile information and content that companies can provide on their website to support the different buying stages of the customers.

TABLE 2 Supporting website content and information based on the buying stage (Chaffey and Smith, 2013, p. 184)

Buying process stage	**Site content**
Awareness	Search engines Portals Featured products On-site banner ads Opt-in email
Findability	Keyword search Product code Faceted browse
Evaluation	Online product guides Product selector configurations Detailed information Product picture Price, availability, delivery information Consumer reviews and ratings
Decision	Security guarantee Service promise Discounts Store locator Call to action Consumer reviews and ratings
Purchase	Gift options Delivery options Postcode add Minimize steps
Support	Email notifications FAQs

	Order history Knowledge base Diagnostics tools
Rewards	E-newsletters Competitions Reminder service Loyalty schemes Personalized recommendations

2.3.3 Digital marketing in B2B

In the early stages of digitalization, research was focused more on understanding the effects of digitalization in marketing and customer relationships in B2C markets (Hofacker et al., 2020). After the 1990s, research started to consider the impact of digitalization on B2B marketing and relationships (Hofacker et al., 2020). Hofacker et al. (2020) identify seven areas that digital marketing will likely impact in B2B markets: coopetition, value co-creation, B2B branding, servitization, innovation networks, relationship dynamics, and power and trust.

Opreana and Vinerean (2015) state that in today's digital world, customers engage with companies differently than before. Thus, instead of traditional marketing that pushes the message out, companies should focus on digital inbound marketing that encourages customers to interact with the brand (Opreana and Vinerean, 2015). The aim of digital inbound marketing can be described as creating interesting content that attracts potential customers to take action and engage with the content and the company (Vieira et al., 2019). Vieira et al. (2019) consider digital inbound marketing a good practice for generating leads in emerging markets.

Besides digital inbound marketing, various other digital marketing strategies and tactics are used in the B2B sector, such as content marketing (Holliman and Rowley, 2014), social media marketing (Rose et al., 2021), and customer relationship management systems (Saura et al., 2021). Pandey et al. (2020) highlight how digital media has transformed B2B customer behaviour through, for example, broader access to information that was not freely available before digitalization and improved customer relationship management systems. Although the implementation of digital marketing practices has lately grown in B2B markets, many B2B companies are still unable to harness all the potential digital marketing provides (Pandey et al., 2020).

2.4 Science marketing

The number of research specifically focused on marketing and communications in the life science industry is very limited. Eriksson and Rajamäki (2010) researched marketing from the perspective of five biotechnology companies' scientist-managers. As a result, they found that biotechnology companies perform

what they call science marketing besides generic marketing activities, such as B2B communication, advertising, and brand building (Eriksson and Rajamäki, 2010). Science marketing can be seen as building a reputable and expert status among the science community through marketing activities that are distinctive for science fields, such as publishing in academic journals, participating in exhibitions and conferences, getting cited, and gaining references (Eriksson and Rajamäki, 2010).

Rose et al. (2021) researched the role of social media communication on the vendor-customer relationship between a scientific technology company and its customers in the life science industry. Their study aimed to research how the shared beliefs of social media, vendor-to-customer communication in social media, and customer-to-customer communication on social media affect trust and loyalty in the vendor (Rose et al., 2021). The study's findings indicate that the social media communication of companies influences customers and that social media communication in the science field can directly and positively affect customers' trust in the vendor (Rose et al., 2021). Mainly social media communication from a vendor to the customers was seen to influence trust in the vendor (Rose et al., 2021).

Although research in the marketing practices in science fields is limited, the studies indicate that science marketing consists of unique characteristics. The studies also indicate that digital marketing tactics can influence customers in the science fields and are thus applicable regardless of the uniqueness of the field.

3 RESEARCH METHODOLOGY

3.1 Research philosophy

There is no predetermined exact right way to design and conduct research, but all decisions made should be possible to justify reliably (D O'Gorman and MacIntosh, 2014). This chapter introduces the chosen research paradigm, data collection method, research subjects and sampling, and data analysis approach.

3.1.1 Research paradigm

D O'Gorman and MacIntosh (2014) suggest that the starting point of designing research is selecting the ontology for the research. Ontology stands for the concept of reality and can be either objective or subjective (D O'Gorman and MacIntosh, 2014). Objective ontology assumes that certain realities are commonly shared realities and are almost like set in stone – things and ideas that are shared facts regardless of from whose perspective they are perceived, whereas subjective ontology considers reality from each individual's perception, meaning that reality is not set in stone but is instead personal to each individual – individuals can see and understand matters in unique ways and each individual can have their own reality of the addressed matter (D O'Gorman and MacIntosh, 2014). This study takes a majorly subjective ontological perspective, allowing each individual to perceive ideas and things in their way through their own habits and beliefs.

According to D O'Gorman and MacIntosh (2014), epistemology is the second aspect of the research paradigm. Where ontology stands for the concept of reality, epistemology stands for the perception of knowledge (D O'Gorman and MacIntosh, 2014). Stating the epistemological perception allows more trustworthy claims, as it allows the researcher to share with the reader how research results are assumed. Two of the extremities in epistemological positions are the positivist paradigm, which is more aligned with objective ontology and quantitative research methods, and the interpretivist paradigm, which is more aligned with subjective ontology and qualitative research methods (D O'Gorman and MacIntosh, 2014). Positivism is more focused on fundamental laws and straight facts through measuring large data sets, whereas interpretivism is more focused on understanding certain phenomena (D O'Gorman and MacIntosh, 2014). As this study aims to examine the individual behaviour of the research subjects and understand the underlying factors influencing their behaviour, an interpretivist epistemological approach is selected for the research. This approach enables providing understanding on the research subjects' behaviour.

3.1.2 Data collection method

Research data collection methods are often divided into two: quantitative and qualitative (John Adams et al., 2014). Quantitative research focuses on analyzing masses of numeric data and providing statistically relevant results (Hair Jr. et al., 2015). In contrast, qualitative research uses fewer research subjects and aims to provide information on, for example, hidden motivations (Hair Jr. et al., 2015). Subjective ontological and interpretivist epistemological approaches align with qualitative research methods (D O'Gorman and MacIntosh, 2014), and thus qualitative approach is adapted in this study.

Qualitative data can be collected through various methods, such as case studies, ethnographies, focus groups, interviews, and observations (Eriksson and Kovalainen, 2022; Hair Jr. et al., 2015). This study views interviews as the most suitable data collection method for this research since the aim is to gain both broad and more specific knowledge from the research subjects' perspective, and interviews enable this (Arsel, 2017). Generally, interview structure can vary from structured interviews, where the questions are strictly pre-determined and asked in the same order, to unstructured interviews, where communication between the interviewer and interviewee is open but based on a pre-determined topic (Hair Jr. et al., 2015). In addition to unstructured and structured interviews, a researcher can opt to use a semi-structured interview, where the interviewer follows a question structure but is free to adjust and add more questions based on the interview flow and received answers (Hair Jr. et al., 2015). This study takes the semi-structured interview approach, which enables flexibility without compromising the comparability of the results. Interview as the research method also aligns with the research gap identified by Eriksson and Rajamäki (2010), where most prior biotechnology marketing research has taken a quantitative approach relying on features taken from other industries, and therefore lacking the overall understanding of the uniqueness of the science-based industry.

The interview structure was carefully developed and tested to combat the previously mentioned lack of understanding of the uniqueness of the science industries. John Adams et al. (2014) also highlight the importance of practising and testing interviewing to ensure the interview questions' effectiveness, improve interviewing skills, and confirm a fitting interview schedule. The preliminary interview questions were first run through personnel of a biotechnology company to ensure correct terminology and to make sure that all relevant factors were considered. After this, three pilot interviews were conducted with persons who fit into the research subject profile. Feedback on the questions and the overall interview was collected, and the interview structure and questions were modified based on the input. The finalized research interview framework can be found in APPENDIX 1.

3.1.3 Research subjects and sampling

Garza Ramos et al. (2022) identified two customer groups, pharma and research, in their cell culture focused study. This thesis chooses to focus on the research customer segment due to, firstly, the customer segment being more open to emerging technologies (Garza Ramos et al., 2022) and, secondly, due to the assumption that the research segment is more open to sharing information than pharma segment, where subjects would likely have stricter non-disclosure agreements.

Research customers can work either in research institutions or academia (Garza Ramos et al., 2022). As both can be considered to belong in the research segment, which highly differentiates from pharma, both academia and research institutions are in the scope of this thesis.

The research customer segment is limited, so no proper sampling is executed when finding research subjects. The only qualifying factors for research samples are 1. working in academia or a research institute and 2. working or having recently worked with either 2D or 3D cell culture. No other requirements, such as country, position, or working experience, are set for research subjects. Not assessing other qualifying factors allows for rich research data since it can be assumed that people can, for example, affect the buying process and decision regardless of position.

Four methods for gaining research subjects were attempted:

1. Recommendations by pilot interviewees and research interviewees
2. Announcement via thesis researcher's LinkedIn and Twitter posts
3. Looking through recent cell culture related publications via Google Scholar and emailing the authors
4. Contacting personal connections of employees of a biotechnology company

The third and fourth methods were the most successful. Over 80 people, who had recently published an article indexed in Google Scholar, were emailed, and 4 of them were eventually interviewed. Three interviewees were gained through personal connections with the employees of a biotechnology company. Furthermore, one interviewee was gained by them contacting the thesis researcher via email after seeing a social media post announcing the research topic and a callout for interviewees.

Eight interviews were conducted between the 20th of April and the 27th of May 2022. The interviews were voice recorded and each interview lasted between 29 and 70 minutes, totalling 5 hours and 52 minutes of interview material (TABLE 3). The interviewees worked in Europe and North America: two worked in Finland, two worked in the US, one in Canada, one in the UK, one in Sweden, and one in Denmark. Their years of experience and roles varied. All but one interviewee were working with cell culture at the time of the interviews. At the time of the interviews, one of the interviewees worked as a biobank director at a university, working mainly with the biopreservation of cells. Thus, the interviewee

answered partly with the perspective of when they were a PhD student working with cell culture around five years ago. A complete list of interviewees' roles, experience in their current position, and countries can be seen in TABLE 3.

TABLE 3 List of interview subjects' roles, experience, and interview lengths, in no particular order, to ensure the anonymity of interviewees.

Interviewee	Role	Research facility	Years in current position	Interview length [hh:mm:ss]
I1	Research fellow	Research institution	2-3 years	01:09:55
I2	Post-doctoral employee	University	Unknown	00:51:20
I3	Associate professor	University	20+ years	00:43:18
I4	Doctoral researcher /PhD student	University	3-4 years	00:44:47
I5	Associate professor	University	10+ years	00:43:56
I6	Doctoral researcher /PhD student	University	Unknown	00:30:44
I7	Doctoral researcher /PhD student	University	1-2 years	00:38:45
I8	Biobank Director	University	1-2 years	00:29:18
				Total: 05:52:03

3.1.4 Data analysis approaches

There are many approaches, such as grounded theory, thematic analysis, template analysis, discourse analysis, and hermeneutics, for analyzing qualitative data collected via interviews (D O'Gorman and MacIntosh, 2014). The grounded theory approach focuses on building a new theory that is not built on previous research and findings. In contrast, template analysis builds codes constructed prior to data collection, and discourse analysis and hermeneutics attempt to analyze what is said and how it is said (D O'Gorman and MacIntosh, 2014).

Thematic analysis is chosen as the data analysis approach for this thesis. To support the decision to follow the thematic data analysis approach, three reasons are found: firstly, the aim is to understand what is said rather than understanding how things are said; secondly, due to researching a novel research topic, there is no comprehensive enough prior theory that codes could be built for before data collection, and thirdly, thematic analysis is the right approach when the aim is to provide new viewpoints to an unexplored research area rather than building a precise new theory.

As the base for the thematic analysis, the voice recorded interviews were first manually transcribed. The transcribed interviews were carefully read through multiple times and the data was categorized through qualitative coding process for outlining the results and identifying themes for analysis and discussion.

4 RESULTS

4.1 Background

This chapter broadly examines the interviewees' research and work-related background information. Although all the interviewed research subjects work or have worked with cell culture, the years of experience, positions, locations, research areas, cell types, and methods differ. The list of interviewees can be found in the previous chapter's TABLE 3.

All research subjects mentioned working or having worked on the bench, meaning they have participated in and conducted the cell culture experiments in the laboratory. However, depending on the position, the main focus and duties vary. Few of the research subjects mentioned being in charge of their research project, whereas few others mentioned their primary responsibilities being teaching or administrative tasks, such as applying for grants and buying necessary products to perform cell culture experiments. One of the respondents explained that their primary responsibilities are overseeing clinical trials and providing samples to other teams, but during their PhD studies, they worked with cell cultures with different primary cell lines. Other duties interviewees listed were designing experiments, building a laboratory, analysing data, writing research papers or reports, supervising and guiding students, and maintaining the research group's website and online matters.

The research subjects work in various research areas, such as virology, neurobiology, organ-on-chip, 3D bioprinting, and bio-preservation of cells. The research subjects also work with different human, mammalian, and invertebrate tissues, organoids, extracellular vesicles, cell lines, and cell types. Some of the cell types mentioned during the interviews were primary neurons and cell lines, intestine and liver cells, standard and simpler cell lines, stem cells, and cancer cells.

Six interviewees mentioned working in both 2D and 3D, whereas two mentioned working in 2D only. I1 explained that 2D systems are sometimes more fitting due to being less complex and time-consuming, causing less noise and enabling more accessible access to see the results when researching virus infections. Although, I1 also recognized that 3D systems are more physiologically relevant. I6 mentioned 3D systems enabling more functional data. I5 was unsure whether some systems they worked with were categorized under 2D or 3D as they were working with inserts. I3, who worked with both 2D and 3D cultures, mentioned that the decision of which one to work with is made based on what needs to be modelled.

Seven of the interviewees recognized having a go-to matrix or medium they tend always to use. I4 explained that using the same media simplifies processes, and I5 emphasized even being willing to pay more to keep using the same

medium. I8 declared always using the same media throughout the research project to ensure consistency and to avoid having to repeat the experiments with new media that could influence the validity of results. However, I2 mentioned that different cells require different media. Furthermore, I7 stated using the medium that the manufacturer of the cell lines they are buying from recommends using. A couple of the interviewees said having considered testing other matrices or media, one further explaining the reason being production shortages of the matrix or medium they usually use.

4.2 Role of internet and its online platforms and channels

This chapter introduces the research data from the perspective of the first research question: "*What are the roles of the internet and its online platforms and channels in the career of researchers in cell culture?*". Overall, all research subjects consider the role of the internet and its online platforms and channels as being essential and having a massive role in their career. The scale of their role, however, varied between research subjects. Some interviewees considered the role of the internet to focus mainly on easy access to information through different search engines and indexes or communicating with colleagues. In contrast, some interviewees described the role of the internet and online channels and platforms as having a broader role with more use cases in their careers as researchers. These use cases are further discussed in this chapter.

4.2.1 Online tools, channels, and platforms in the research field

The interviewees described utilizing multiple online tools, channels, and platforms as part of their careers. The ways of using these channels and platforms varied from looking for information on products and protocols to science-related entertainment. As seen in TABLE 4, the used online tools could be roughly divided into four categories: 1. Search engines, indexes, and databases, 2. social media, forums, and feeds, 3. websites, and 4. other communication tools and platforms.

TABLE 4 Online tools, channels, and platforms the interviewees mentioned using related to their careers.

Search engines, indexes, and databases	**Social media, communities and networks, and feeds**	**Websites**	**Other communication tools and platforms**
Google	Twitter	Journal and magazine sites	Email
Google Scholar	ResearchGate	Lab's websites	Microsoft Teams
PubMed	LinkedIn	Companies' websites	Zoom
Web of Science	Reddit		Slack
Scopus	Google news feed		Webinars, conferences, and seminars
Universities' databases	YouTube		Membership-based online societies

Search engines, indexes, and databases

Most interviewees highlighted the importance of finding and reading articles, publications, manuscripts, and peer-reviewed papers, all essentially referring to the same type of content via the internet. The interviewees searched for these papers directly from Google or from databases and indexes for science papers, of which the interviewees used mostly PubMed. However, Google Scholar, Web of Science, Scopus, and universities' databases were also mentioned. Some interviewees felt that Google sometimes gives too many search results that do not directly relate to what they are looking for. Thus, more science-focused databases, such as PubMed, were found to be great for finding more relevant information. However, few interviewees felt that Google is the quickest and easiest way to find what they are looking for.

In addition to using Google and other search engines, indexes, and databases to find scientific papers, interviewees explained using Google to find reagents, commercial cell lines, and other necessary products for their experiments and laboratories. I3 described that they might use search terms such as "Matrigel replacement", "scaffold material", and "hydrogels" to look for reagents to buy. I5 described that if they cannot find something they are looking for from Google but have previously read about it from a scientific paper, they might directly contact the paper's author for more information.

Overall, the role of search engines, indexes, and databases was seen to have an enormous role since reading primarily scientific papers has a considerable role in their career, and all the scientific papers can nowadays be found online. I5 even described that previously the method for finding scientific papers was through libraries, but according to them, no one goes to physical libraries anymore. All the information is looked for online.

Social media, forums, and feeds

The role of social media, forums, and feeds divided opinions. Six mentioned using social media for career purposes, while two mentioned not using social media in work matters. However, I3, who stated not using social media for work matters yet still revealed using LinkedIn to communicate with other colleagues.

Twitter was the most often mentioned social media channel, with four declaring using Twitter, two recognizing their colleagues use it, and two mentioning that if they were to use social media for work purposes, they would use Twitter. I4 suggested that Twitter has an academic side filled with valuable resources, tips, and recent publications. I5 said that Twitter helps them keep up with the advancements in technology and public health, of which the importance grew due to the pandemic. Three interviewees mentioned using LinkedIn. Moreover, three mentioned using ResearchGate. The discussed platforms and channels were mentioned as being used for communication and networking with colleagues, keeping up with the latest information, finding posts about freshly published papers, and promoting their publications. I2 highlighted using ResearchGate for troubleshooting and I4 stated looking for others' experiences with specific reagents through reading posts on ResearchGate. In addition to Twitter, LinkedIn, and ResearchGate, few mentioned watching videos from YouTube, one disclosed using Reddit for science-related entertainment, and one stated finding science news from their Google News feed.

In addition to the previously mentioned social media channels, Facebook, TikTok, and Instagram were also brought up a couple of times during the interviews. However, these were only mentioned as channels the interviewees do not use for work purposes. I4 acknowledged that Facebook has research communities, although, according to the interviewee, they have become less popular in recent years and are no longer that active.

In addition to the interviewees' personal profiles on these platforms and channels, two mentioned their lab or research group also having social media profiles which they use to promote and share published papers and work, to thank for grants, to communicate and network with colleagues, and to promote their lab or group to increase the interest of those students who are looking for research groups to join. One interviewee also stated that different journals have their own social media profiles where they post about newly published articles. Some journals even ask researchers for pictures for social media posts when submitting an article.

In general, social media was seen as something that could be beneficial but using social media for career-related purposes was not seen as mandatory. One of the interviewees explained that researchers are responsible for their own publicity and PR; therefore, it is up to the researchers to get their publications spread to the world. Moreover, two interviewees raised concerns about how time-consuming social media is. One further described that the benefits of social media are limited, and thus the benefits compared to the time it requires may not be worth it.

Websites

The websites interviewees mentioned using can be divided into journal and magazine websites, companies' websites, and their labs' websites. Whereas the role of the websites could be divided roughly into two: looking for information and sharing information.

The interviewees use journal and magazine websites to find interesting scientific articles and protocols to see how other scientists are doing things to learn new techniques and best practices of working. Additionally, I3 mentioned reading "research gossip" from magazine websites. The interviewees listed some of their favourite journals and magazines they could remember by heart: Cancers, eLife, frontiers, MDPI, nature and its sub-journals, and Science. In addition to reading journal sites and articles, a couple of the interviewees stated reviewing journal articles.

Few of the interviewees declared using companies' websites as a source to look for information. One of them disclosed exploring websites of big companies, and another stated remembering specific companies having good websites with valuable tools and protocol libraries. Furthermore, two interviewees mentioned that their lab or research group has a website they maintain.

Other communication tools and platforms

When asked about what online channels and platforms interviewees use, email, Microsoft Teams, Slack, Zoom, webinar, conference and seminar platforms, and membership-based online societies were also mentioned. Email was mainly used for receiving newsletters and other promotional materials and for direct communication with companies, colleagues, and others. Microsoft Teams, Slack, and Zoom were also used for direct communication with different stakeholders.

Seven interviewees expressed having participated in cell culture or other life science webinars. However, interviewees were quite particular about what webinars they participated in. I2 specified that they participate in webinars if the subject aligns with their interests. I3 mentioned having participated in only one webinar as they prefer videos over webinars. I4 explained that because the topics and speakers have become repetitive, they have gotten tired of participating in webinars. The interviewee felt that webinars are not interactive and personal enough. I7 stated participating in webinars if the topics relate to their research question or if the webinars help them get started with a new method they are about to use. I5 disclosed being more likely to forward webinars to their students than participate in them themselves. I1 declared not having time for webinars if they last for more than half a day and not being interested in participating in webinars if they are unsure whether they can use the gained information immediately in their research.

When asked about emails and newsletters, all but one of the interviewees answered receiving newsletters from companies, societies, or other organizations, but their opinions varied. Two interviewees shared more positive toned experiences, one more neutral toned experience, and four more negative toned experiences with receiving newsletters. With a positive tone, I4 shared liking receiving newsletters as they help them stay up to date with information and updates on findings. I5 disclosed having felt more pessimistic about newsletters previously, but as they have become busier and, therefore, have less time to seek information, newsletters have become a vital part of staying updated. Especially newsletters that include technical notes and information were seen as good. Some more negative-toned thoughts on newsletters were also shared. I3 and I4 felt that newsletters might become "spammy". I3 further explained that the number of newsletters received increases after participating in conferences. I1 confessed to deleting newsletters immediately and I5 disclosed deleting them quickly if they were not relevant. I2 felt they were being "lured and trapped" to subscribing to newsletters by filling in forms to access the content they wanted to view. I6 described emails as "annoying" if they are not targeted to their needs.

4.3 Gaining information

In this chapter, the data is introduced, focusing on the second research question: *"How do researchers look for information on cell culture?"*. Though the perspective of the research question is merely on active information seeking, passively receiving information is included in the research scope, as researchers can gain information by looking for it and receiving it without the active intention of finding information. Unlike the first research question, this research question includes both offline and online touchpoints.

4.3.1 Gaining information online

The overall role of the internet and its online platforms and channels were previously discussed in detail, covering the different ways researchers use online tools. This chapter focuses on how researchers gain information through the internet, online channels, and platforms.

When the interviewed researchers actively seek for information on cell culture, the leading online sources for information seeking were Google and PubMed. Six interviewees expressed using Google's regular search engine to seek information. Three of them mentioned using it to specifically seek scientific papers, three to look for products to buy, and two to search for something specific they are looking for. Besides using Google to seek scientific papers, other indexes were also mentioned. Four interviewees mentioned seeking scientific papers from PubMed, three from Google Scholar, two from Web of Science, one from

Scopus, and one from their university's database. One of the interviewees also specifically mentioned not liking PubMed.

One of the main content types the interviewed researchers look for is science literature and papers related primarily to the research project they are working on. I2 shared that reading peer-reviewed papers and other scientific literature is the best way to stay up to date with the latest techniques and methods, as well as the used products and catalogue numbers. I7 described journal articles as an excellent way to know what others have done.

I4 explained searching for information on the ups and downs of different reagents and their suitability with the cells they are working with. The interviewee further described mainly looking for protocols based on a product they hope will also work with their cells. I5 mentioned looking for information on cell lines, cell culture conditions, and previous examples of experiments. I6 explained looking for information on the best protocols necessary to the cells they are working with and how to improve what they are doing. I7 explained that scientific papers are an excellent way to see what others have done and what reagents others have used, and if the results in the paper seem to be good, they may opt to use the reagent the authors of the paper have used. I8 explained that if they switched to a new cell line, they would look for manuscripts to see what others have done and what reagents others have used. This information could then be used to decide what reagents they will use in their research project. However, I1 found a few shortcomings in the literature. There is very little previous literature on their research topic as they work in pioneering areas. Furthermore, according to the interviewee, literature tends only to show positive results and does not reflect the whole reality.

Two interviewees also mentioned looking for "troubleshooting" information if they had difficulties with their research project. An online tool one of the interviewees disclosed using for troubleshooting was ResearchGate.

When wanting to learn new techniques and methods, three of the interviewees described using YouTube to find instructions and other videos. Seven interviewees mentioned having participated in webinars to gain information, and two explained using some companies' websites to look for information, such as technical protocols from their protocol libraries.

Researchers rely heavily on direct communication with colleagues and companies when seeking information. Email, Microsoft Teams, Zoom, and Slack were mentioned as online tools that enable direct communication.

In addition to actively seeking information, researchers receive information passively through different online channels and platforms. The interviewees mentioned gaining information through social media channels, Google news feed, newsletters, and internal communication channels. Twitter, ResearchGate, LinkedIn, Reddit, and YouTube were mentioned as social media channels and forums being used.

4.3.2 Gaining information offline

Although none of the interview questions directly asked about gaining information via offline channels, few interviewees highlighted receiving information through in-person communication with colleagues and company representatives. I4 described preferring "the old format", where researchers could go to companies' physical booths during conferences and exhibitions and directly discuss and ask questions from the company representatives. I2 and I6 informed that many conferences were online during the Covid-19 pandemic, but I6 explained that they have again started moving back to in-person. I7 mentioned that asking questions from colleagues in their lab building is also an excellent method for looking for information. I8 revealed preferring in-person conversations over, for example, online conversations via Zoom. The interviewee also mentioned preferring in-person tradeshows where companies visit their university to show their products, answer all questions and give trial-size samples of products.

4.3.3 Circumstantial factors in gaining information

Regardless of whether the information was gained online or offline, some thoughts and concerns with seeking information were brought up. These factors were regarding the timing of information, communicating directly with colleagues and companies, and difficulties in finding information on companies and products.

Timing of information: On-demand vs passive information

One of the factors that arose from the interviewees was that the interviewees wanted to be able to access information on demand. Few interviewees described how information is the most valuable if the gained information can be immediately put to use. I1 expressed that it is essential to find information on specific needs right then and there when a need or problem occurs.

Direct communication: word-of-mouth and support

Interviewees explained that one of the primary ways of hearing new information about cell culture techniques, reagents, and other cell culture topics happens through direct discussion with colleagues or company representatives. According to the interviewees, such discussions could happen in person in the laboratories and other premises, in internal communication channels, via email, and during seminars and conferences. Word-of-mouth through offline and online channels was seen as necessary by all interviewees.

Seven interviewees mentioned participating in online or offline seminars and conferences, six mentioned communicating directly with internal or external colleagues, and six mentioned directly communicating with companies. I1 mentioned that company representatives know better what others have done and are

therefore able to provide more details. I1 added that they highly value support and guidance from companies, further explaining that building a personal relationship with the suppliers, company representatives, or technicians provides confidence.

Difficulties in finding information on companies and products

Two interviewees brought up concerns with finding information on companies and their products. I3 felt that although the offerings of small and medium-sized companies are likely extremely interesting, these companies and their offerings are rather difficult to find and come across. The interviewee shared that big companies have such enormous market positions that they overshadow smaller companies. To combat this issue, the interviewee suggested that small and medium-sized companies could improve cooperation and build together a shared marketplace for new products, which could gain more visibility and traffic with a shared contribution to the promotion of the marketplace. Furthermore, I5 said that in ideal situations, websites should be easily found via Google. Contrarily, I6 shared that they rarely come across new companies, as they can already remember all the more prominent and important companies by heart. However, the interviewee believes they initially found these companies through a Google search.

4.3.4 Product information

When asked about the information they would need and want to know about cell culture reagents when looking to buy new reagents, the information type could easily be divided into three groups: evidence, practical information, and instructions (TABLE 5).

First, most interviewees wanted to see evidence and indications that the reagent would actually work. Such evidence could be different visuals, photos, images, and figures; data to describe how the reagents perform; and evidence on how others have used the reagent and what they have thought about it – which could be given in the format of publications and peer-reviewed articles, references, or reviews.

Second, interviewees wanted to have different types of practical information on the reagent and its availability. Many interviewees mentioned wanting to know as much information as possible about the reagents' composition. However, they also mentioned understanding that companies might not be willing to share the exact compositions due to patent issues. Another important practical information was being able to easily view the price information of the reagent to evaluate whether the price was within the project budget. I3 mentioned that price is something companies often hide, but knowing the price is essential, especially for universities who may go straight to evaluate an alternative reagent if no price is found. Related to the budget, I4 also mentioned wanting to know how much of the product they would need for their experiment to calculate the overall price easier and evaluate the product's suitability with the budget. Other

information mentioned was the delivery time, storing information, shelf-life, and required health and safety documentation.

Third, the interviewees wanted instructions on how the reagent should be used. One of the concerns was knowing how the reagent would interact with other reagents: if there are other reagents that should or are recommended to be used with the reagent or if there are reagents that should not be used as they cross-react with the reagent. Knowing these and any other information on suitability was found important. In addition, many interviewees stated preferring if the reagent comes with either written or video protocols which they could easily follow when performing their experiment to avoid the need to ask further questions. However, I7 found it ideal to also have information on technical support they could be in touch with in case of any problems with the reagent or experiment. An overall common conclusion was that they would like as much information as possible – the more information, the better.

TABLE 5 Needed and ideal information to have about cell culture reagents

Evidence	**Practical**	**Instructions**
Visuals (Photos, images and figures)	Composition	List of other required or recommended components
Data proving competitive advantages	Price	List of other cross-reacting reagents
References	Estimated quantity to be used	Protocols
Reviews	Delivery time	Videos
Publications and articles	Shelf-life	Suitability for the experiment
	Health and safety documents	Technical Support contact information
	Storing information	

4.3.5 The credibility of information sources

To further understand the information-seeking process, the aim is to understand if there are any differences in the perceived credibility of information depending on who the source of information is. Overall, the views on the credibility of information sources varied. The majority felt more trusting when the source of information is other researchers, colleagues, or peer-reviewed papers. However, few felt that there is no significant difference with who the source of information is, as long as the person is a professional in the field of cell culture. I1 shared that they tend to trust big companies more than academia, as the interviewee felt that big companies have more on the line.

4.4 Buying behaviour

This chapter aims to examine and analyse the interview answers concentrating on the third research question: *"How do researchers buy cell culture reagents?"*. The first part addresses the buying process on the surface level from the perspective of the interviewees, without going too deep into each individual stage and required actions from all people who participate in the buying process, as the aim is to mainly understand how the research subjects are involved in the buying process. The second part of this chapter aims to then investigate attitudes towards testing reagents they have not used before, attempting to give an idea of the willingness and ease of potentially switching to an alternative reagent that is new in the market.

4.4.1 Buying process

When asked about the buying process, most interviewees described two different scenarios: buying reagents they have bought before and buying an entirely new reagent. Buying reagents that the lab has used before was seen as an easier process. Most interviewees reported that their institution or university has a buying system which they use to buy most reagents. If a reagent has been used and bought before, the reagents can easily be found in the system, which lessens the steps needed to be taken when buying a product. However, if the reagent has not been bought before, extra steps will have to be taken, as it requires filling forms with extra details. One of the interviewees mentioned that all new companies must go through pre-processing to evaluate whether the company is stable and credible.

Many interviewees said their university or institution has contracts with bigger suppliers, and many research groups share an inventory of common reagents among their universities. One interviewee shared that buying in larger quantities enables negotiating a better deal with the suppliers. Another interviewee reported that the country *(Denmark)* they operate in also has legislation which can affect the buying process.

Regardless of the role and position of the interviewee, all interviewees could either buy products themselves or initiate buying products.

4.4.2 Attitude towards new reagents

When interviewees were asked about attitudes towards testing entirely new reagents, most interviewees showed reluctance. Some of the negative toned words and expressions the interviewees used to describe the process of testing new reagents were: "stressful", "tricky", "painful", and "necessary evil". Though reluctance was common, none of the interviewees were entirely opposed, and more positive-toned thoughts were shared, such as that testing new reagents could enable ground-breaking research. Overall, three themes could be identified from

the research data related to testing new reagents: *established products and processes*, *existing problems and potential benefits*, and *consumption of resources*, which are now looked further into.

Established products and processes

Many of the interviewees mentioned that they tend always to use the same matrices and media. Five interviewees mentioned using matrices or media from established, well-known and trusted companies in cell culture. I1 openly expressed using mainly what are seen as the standard reagents in the field and being more biased towards bigger companies, as the research subject believes that if everyone in the field is using those reagents, the company and its products must be trustworthy. However, the research subject mentioned still buying some reagents from smaller companies. I2 mentioned that if they are using a reagent from an established company and if the reagent works and has worked perfectly for years, they will not likely change to another reagent. I2 also mentioned relying on brands they have used before. I4 mentioned having used the same media for a long period, and since the media has worked, they keep consistently using the same media.

I5 described cell culture researchers as superstitious and mentioned that cell culture researchers want to use the same manufacturer and lot of fetal bovine serum (FBS, which is a cell culture reagent) for as long as possible. I5 also mentioned that media could contain unknown components, and thus it reinforces the need to ensure consistency through using the same manufacturer and lot, as not fully knowing all the components and then changing something can lead to different results without knowing the underlying reason for the fluctuating results.

Most research subjects mentioned using protocols for their cell culture assays, meaning that their research group follows step-by-step guides with the exact products and quantities to use. Three interviewees said they prefer not to change anything if the existing system or protocol works. One of them further described that they try to avoid any variability throughout the project.

Existing problems and potential benefits

Although the interviewees seemed reluctant to test new reagents, two primary reasons for testing new reagents arose. All interviewees mentioned they would be willing to test a new reagent if there were any significant problems with using one or more of the reagents they were currently using, and five interviewees mentioned they would be interested in testing new products if they would add great benefit. Two of the research subjects explained that testing just for the sake of testing provides very little meaning. Moreover, one research subject explained that instead of saying they are interested in testing new reagents, they would rather say they are interested in doing something that requires the usage of new reagents.

Some of the problems (TABLE 6) interviewees mentioned were more general type, whereas some of the problems were more specific to their current or past research projects. One, however, disclosed that problems with the current reagents and protocols do not happen often. One of the problems was supply and availability issues with the reagents they were using. According to two research subjects, the supply issues were caused by the Covid-19 pandemic. I5 explained having waited for over a year without receiving a product they had ordered. I3 shared that long waiting times to get some of the reagents is an issue, especially considering how short, for example, PhD studies last. The difficulties in refilling the stocks and receiving the typically used reagents influenced a few research subjects to consider and look for alternatives to some of the reagents they were having supply issues with. Other problems among the research subjects were too high prices for the research project budget, old systems being understudied, issues with the consistency of reagents, issues with pre-differentiation, and issues with too high organoid or cell death rates.

As mentioned earlier, five interviewees mentioned they would be willing to test a new reagent if it offered valuable enough benefits (TABLE 6). Most of these interviewees stated that the benefits would have to be valuable enough, or there would need to be various benefits. Otherwise, they would be reluctant to test the new reagents.

I2 explained that the problems they face with different reagents and the benefits the new reagents could provide depend on the person's role and duties. The interviewee mentioned that the person in charge of the financials of a project, regardless of whether it is the principal investigator or someone else, is more likely to point out cost-related issues and benefits. In contrast, those who mainly work in the laboratory are more likely to pinpoint issues related to practical matters, such as the complexity of current processes or the potential simplicity of new processes using a new product could provide as a benefit.

TABLE 6 Summary of possible problems with reagents the research subjects are currently using or have used in the past and potential benefits testing a new reagent could offer

Problems with current reagent	**Potential benefits of new reagent**
Too high price	Lower price
Understudied system	Simplifies the process
Supply issues, problems in getting stock	Speeds up the process
Consistency issues	More visually appealing microscopy
Issues with pre-differentiation	Media contains everything necessary
Organoid or cell death	

Resource consumption

Although testing new reagents was seen as an option if problems occurred with an old product or the new reagent would offer great benefits, most interviewees explained that testing new reagents consumes lots of resources, mainly time and money.

According to a few research subjects, testing new reagents always requires optimising existing protocols and processes. To enhance the efficiency of the research projects, minimizing the amount of optimization stages was found important. In some situations, the need to re-optimize everything was seen as worth it. In contrast, I5 mentioned being willing even to pay more to avoid the need to optimize everything again. In general, the interviewees would not change the media used constantly, only if necessary or beneficial for the research project.

Two of the research subjects mentioned that the goal of academic researchers is to publish peer-reviewed papers, as the funding and grant money are awarded based on the number of published publications. One of them stated that testing new reagents will not lead to publications, which can become an issue with funding.

As testing can get expensive if there is any uncertainty of whether the reagent will work in their research project's culture composition, a few interviewees mentioned sometimes receiving free samples or discounted prices to ease the monetary burden. In return for the samples or discounted prices, companies usually get feedback on the product, which they can use in further development.

In conclusion, researchers utilize various online tools, channels, and platforms in their work. For example, being able to stay in touch with colleagues and searching for information on-demand were essential aspects. When looking for information on cell culture reagents, researchers highlighted that they need to see evidence of the product working, have access to practical information on the product, and gain instructions on best practices. Furthermore, once the researchers had advanced to the purchase-making stage, the buying process differed depending on whether the purchase was a repeated purchase or an entirely new reagent. Furthermore, researchers showed reluctance to test new reagents. In the next chapter, the results will be further discussed and analysed.

5 ANALYSIS AND DISCUSSION

5.1 Conclusions

As indicated before, this thesis provides a new perspective to theory by looking into customer behaviour in the niche market of cell culture. The thesis investigates how research customers use the internet and online platforms in their careers, how they look for information, and how they buy products. This chapter focuses on contributing to theory by analysing the results discussed in the previous chapter.

5.1.1 Role of the internet and its online platforms and channels in the career of researchers in the field of cell culture

When analysing the results of the first research question, *"What are the roles of the internet and its online platforms and channels in the career of researchers in cell culture?"*, the results suggest that researchers in the field of cell culture find the internet and its online platforms and channels vital for their careers. Four themes are recognized: 1. direct communication, 2. information sharing, 3. entertainment, and 4. seeking and receiving information (FIGURE 6).

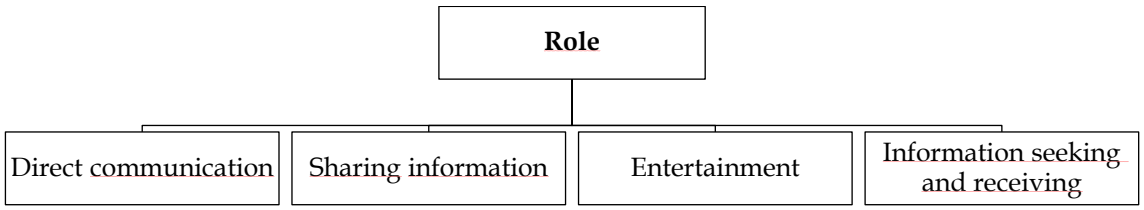

FIGURE 6 Role of the internet and its online platforms and channels in the career of researchers in the field of cell culture

Direct communication

The results indicate that cell culture researchers value personal and direct communication with colleagues, companies, and other stakeholders. The Internet enables easy and fast methods to stay in touch with internal and external colleagues, companies, and other stakeholders worldwide. Communicating directly via online channels and platforms allows co-operating with scientists from many universities and labs regardless of the location of the university or the lab. This enables broader sharing of information and discussion of experiences.

The science community among researchers seems strong. Researchers use social media channels (Twitter and LinkedIn), communities and networks (Re-

searchGate), Email, Microsoft Teams, Zoom, and Slack to stay in touch with internal and external colleagues, companies, and other stakeholders. As researchers tend to trust and respect other scientists' experiences and directly discuss cell culture techniques, protocols, and experiences with different reagents, word-of-mouth communication plays a significant part in everyday life of cell culture researchers. Besides valuing the experience of other scientists, researchers appear to value good technical support from companies, and personal relationships with company representatives and technicians are seen as valuable and confidence-strengthening.

Information sharing

Researchers share information via private and direct communication with different stakeholders and use online tools to share information more publicly. Like Eriksson and Rajamäki (2010) introduced that publishing in academic journals is typical for the science fields, the findings of this thesis support their statement. One of the significant ways of widely sharing information is by writing and publishing peer-reviewed papers. In fact, the funds of university research groups can be based on the number of published articles. All articles are published and shared online and can usually be found via PubMed or other science article databases. Thus, publishing information online in these databases plays a significant part in the career of cell culture researchers. Besides publishing peer-reviewed papers, researchers also review other scientists' papers.

Researchers use various online channels and platforms to share their publications and other information. Twitter was said to have a robust academic side where scientists share resources, tips, and publications. Furthermore, ResearchGate was said to be a platform where scientists, for example, publicly share experiences with different reagents and ask troubleshooting questions about problems they have faced with their cell cultures.

Information is also shared through labs' and research groups' social media and websites. These contain information on published papers, grants, and general information on the activities of research groups to attract new students. Journals also have their own social media profiles where researchers contribute by attaching pictures related to submitted publications which the journals can use for social media posts.

It can be concluded that researchers share information widely, especially intending to reach other scientists. Researchers also tend to be in charge of promoting their own publications. Thus, it can be assumed that the more a researcher promotes their publication via different online channels and platforms, the more audience the paper reaches and the more readers it receives. However, as the promotion of papers is up to the researchers themselves, how wide of an audience a paper gets could depend on how important each researcher finds sharing information via online channels and platforms. Some researchers seemed to care more about getting their work out to the world, while others seemed more focused on just publishing the paper. It was also brought up that the researchers

are often busy and do not have much time to be active on different online channels and platforms. Thus, the responsibility of promoting their work drifts to free time, which each researcher then gets to decide how big of a priority it is to get the papers shared and read.

Entertainment

Researchers use the internet and online channels and platforms for science-related entertainment, too, although using these for entertainment purposes was only mentioned by a few of the interviewees. Besides seeing LinkedIn and online science magazines as sources that provide opportunities for learning new things and communicating with different stakeholders, these were seen as sources of entertainment. Reddit also was seen as a platform that provides science-related entertainment. This finding suggests that although, on many occasions, researchers were looking for information that could be useful for their research projects, researchers also enjoy more light-weighted content that still reflects science.

Seeking and receiving information

One of the most critical roles of the internet and its online platforms and channels based on the interviews is being able to look for information. Seeking and receiving information partly overlaps with direct communication and entertainment, as direct communication is also a way to look for information, and entertaining content can be considered informational content. However, seeking and receiving information has been separated as its section in this thesis due to playing such a crucial part in online behaviour and being a broader concept with sub-areas further discussed in the next chapter.

5.1.2 Researchers' information-seeking behaviour in the field of cell culture

Continuing from the previous chapter, but focusing on the second research question, *"How do researchers look for information on cell culture?"*, the results indicate that researchers think that all information can nowadays be found online. However, in addition to seeking and receiving information online, offline channels support gaining information. Four themes could be defined when evaluating how researchers look for information on cell culture: development, industry updates, products, and finance opportunities (FIGURE 7).

In general, information was seen as useful and valuable, especially if the information could be accessed on-demand at the moment of the need for such information. Although online channels play a big part in gaining information, both online and offline word-of-mouth information play a significant role in the science community. Researchers value personal connection and support from other colleagues and companies. This study backs the statement by Eriksson and Rajamäki (2010) that exhibitions and conferences are typical to science fields and

science marketing. The interviewees found in-person conferences, seminars, and other events generally important.

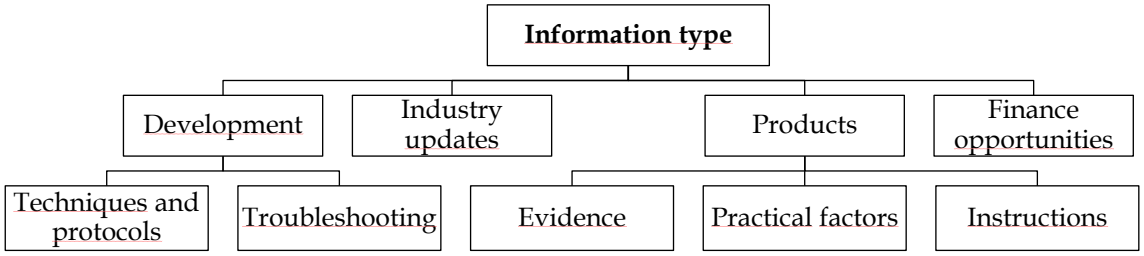

FIGURE 7 Summary of the information types the cell culture researchers look for

Development

Researchers aim to develop their skills and techniques, as well as the research methods and protocols used in their research projects. Looking for information on techniques and protocols is essential in information seeking, especially if the researchers need to optimize their current protocols or start using different cell types and lines. In addition, when faced with a problem in their research project, researchers seek information for troubleshooting the problems to find solutions. When gaining information on aspects to develop, the focus seemed to be more on active information seeking rather than passively receiving information.

Researchers use a wide range of offline and online channels to gain information on how to develop techniques and protocols or troubleshoot problems. For the development of techniques and protocols, one of the significant ways to find information was said to be through what could be classified as general search engines, such as Google. In addition, more science-focused search engines, indexes, and databases are widely used among cell culture researchers. From such search engines, indexes, and databases, PubMed is majorly used, but Google Scholar, Web of Science, Scopus, and universities' own databases are also used. Science articles and protocols were seen as a good way to see how others are doing things, from which the researcher could learn techniques and methods.

However, gaining information on how to develop skills, protocols, and techniques is not limited to only science literature. The results imply that social media, online communities, and networks are also used to learn new techniques and troubleshoot problems. Especially the usefulness of Twitter, ResearchGate, and YouTube was highlighted. Twitter was explained to have an academic side where other researchers share valuable resources, tips, and recent publications. Furthermore, ResearchGate was seen as especially practical for troubleshooting and YouTube for watching instructional videos. Besides these, researchers share knowledge by directly communicating with colleagues, companies, and other stakeholders both online and offline.

Industry updates

Methods for gaining information on the latest news and industry updates in the field of cell culture were similar to gaining development-related information. However, besides looking for industry updates and news, researchers emphasized receiving these without the need to always look for the information.

Like development information, researchers gain industry updates by reading science articles, searching them through search engines, indexes, and databases, and through direct discussions with colleagues, companies, and other stakeholders offline and online. From social media, communities and networks, and feeds, Twitter, ResearchGate, LinkedIn, and Google news feed were mentioned.

Many researchers felt they received industry updates through newsletters, although they were not always read. With newsletters, researchers were more appreciative if the newsletters were targeted to the researcher's specific needs and provided more informational and useful material, such as technical notes, rather than just companies' promotional material. Newsletters were also often seen as "spammy", especially if the researcher did not intend to sign up for the newsletter but ended up on newsletter lists after conferences or downloading materials. Researchers also mentioned participating in webinars, although they were pretty selective with what webinars they participated in, primarily due to limited time and topics needing to be related to ongoing or upcoming research projects or other interests.

Product information

When researchers look for new cell culture reagents to buy, they need evidence that affirms the reagent works, practical information about the purchasing and usage of the reagent, and instructions on how to use the reagent to ensure it is used and will work correctly. The results shown in TABLE 5 closely resemble Chaffey and Smith (2013)'s list of website content and information categorized based on the customer's buying stage, as seen in TABLE 2. Though their list is comprehensive, this research indicates that cell culture researchers require additional and field-specific information about the products when making purchase decisions, as listed in TABLE 7 in accordance to each buying process stage.

When evaluating cell culture reagents, in addition to the product picture, price, availability, delivery information and consumer reviews and ratings, the researchers need figures and images demonstrating how well the product performs, and they value reading references, publications and articles. Researchers also need to know more about the reagent composition, estimated quantity to be used, and data proving the competitive advantages.

In order to come to a purchase decision, researchers need to assess whether the reagent would likely work in their research project. Therefore, researchers need as much information as possible on the suitability of the reagent

for their experiment. As some research projects are novel and no similar previous research has been done, having easy access to technical support is essential in the decision-making process. Furthermore, cell culture research appears to be a pretty regulated field, and thus reagents need to come with health and safety documents.

The results indicate that researchers value comprehensive support. Thus, support material with videos, protocols, personal contact details for technical support, and a list of other required or recommended components and cross-reacting reagents were seen as good support material.

TABLE 7 Ideal product information of cell culture reagents incorporated into website content listing in accordance to each buying process stage by Chaffey and Smith (2013, p. 184). Findings from the research have been added to the table and are formatted in italics.

Buying process stage	Site content
Awareness	Search engines
	Portals
	Opt-in email
	Scientific publications and articles
Findability	Keyword search
	Product code
Evaluation	Detailed information
	Visuals (Product picture, *figures and images*)
	Price, availability, delivery information, *shelf-life, storing information*
	Consumer reviews, ratings and *references*
	Scientific publications and articles
	Composition of the product
	Estimated quantity to be used
	Data proving competitive advantages
Decision	Consumer reviews, ratings and *references*
	Scientific publications and articles
	Suitability for the experiment
	Technical support contact information
	Product health and safety documents
Purchase	Minimize steps
Support	Email notifications
	FAQs
	Knowledge base
	Diagnostics tools
	Protocol, instruction, and support videos
	Assay protocols
	List of other required or recommended components
	List of other cross-reacting reagents
	Technical support contact information
Rewards	E-newsletters
	Personalized recommendations

Finance opportunities

The results indicate that one of the ways researchers get funding for their projects is through receiving grants based on the number of published publications. Sometimes researchers hear about available grants and finance opportunities through newsletters. These newsletters include other information as well. However, one interviewee indicated that hearing about possible grants was their primary reason for being subscribed to a specific newsletter.

5.1.3 Researchers' buying behaviour of cell culture reagents

This chapter discusses and analyses the results of the third research question: *"How do researchers buy cell culture reagents?"*. The chapter is divided into two themes: buying process and researchers as cell culture reagent customers.

Buying process

The results of this research suggest that academic and research institution research customers share many similarities with B2B customers and buying processes. These similarities, as first introduced applying to the B2B buying process by Grewal et al. (2015), are:

1. The buying process tends to start from a proper need rather than making impulse purchases
2. Many parties are involved in the buying process
3. Instead of only being interested in buying a product, cell culture researchers want to ensure the product comes with proper support.

However, unlike B2B customers, researchers showed no indication of buying processes being too time-consuming due to requiring various negotiations.

As introduced by Robinson et al. (1967), as cited in Kotler and Keller (2016), the steps of a buying decision are determined based on how many purchases have been made before. In this study, the researchers explained two different purchase scenarios: 1. a repeat purchase and 2. buying an utterly new reagent not bought before (FIGURE 8). Buying cell culture reagents the research group had bought before was seen as a more straightforward process than buying entirely new ones. In the simplified process, if making a repeat purchase, the only step researchers were required to make was to make an order through the university's or research institution's buying system. However, if researchers wanted to buy something that could not be found in the buying systems, a few additional steps needed to be taken, such as filling in information about the company in the systems. Sometimes, the company also needed to go through a pre-processing system before a purchase could be made. However, the results indicated that taking these few additional steps were not often seen as tremendous obstacles.

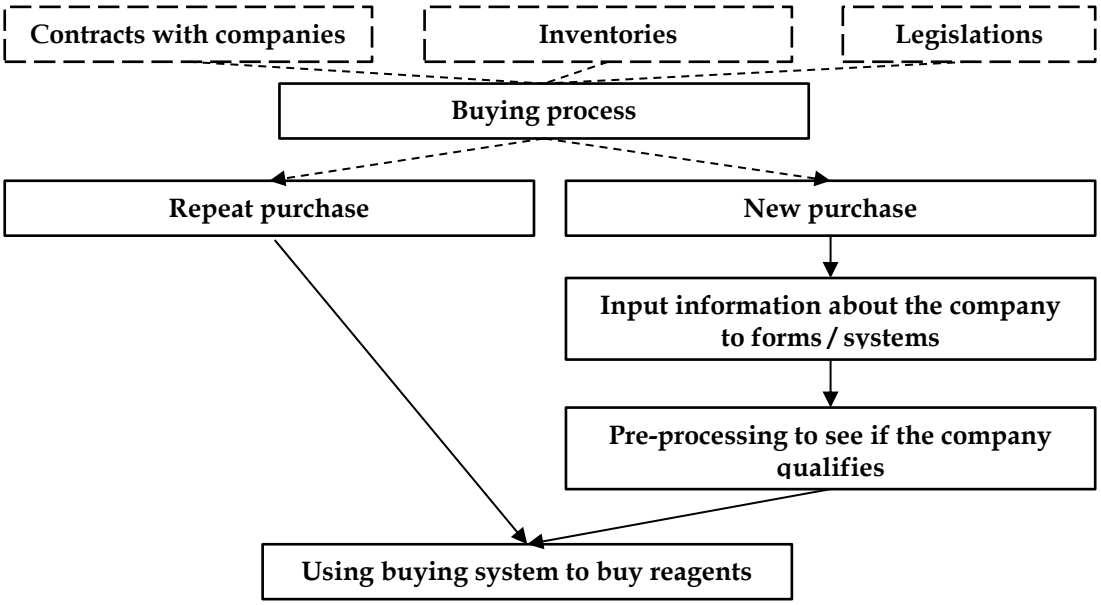

FIGURE 8 Conclusions of the simplified buying process of cell culture reagents from the perspective of cell culture researchers

Universities were shown to have shared storage of commonly used reagents for research groups. Having shared storage enables buying larger quantities of reagents, which could lower prices. Some universities have signed contracts with companies for discounted prices when buying larger quantities. However, if a reagent is research group specific, research groups buy these reagents for their group in smaller quantities.

Another influencing factor in the buying process can be legislation. Different countries have different regulations for universities' buying processes. If such legislation exists, universities must comply with them.

Researchers as cell culture reagent customers

Though the study by Garza Ramos et al. (2022) suggests that research customers are more willing to try new innovations and methods in cell culture research than pharma customers, the results of this thesis indicate that even academic and institution research customers are reluctant to test new reagents. Two major themes behind the reluctance are identified: established products and processes and the strong science community (FIGURE 9).

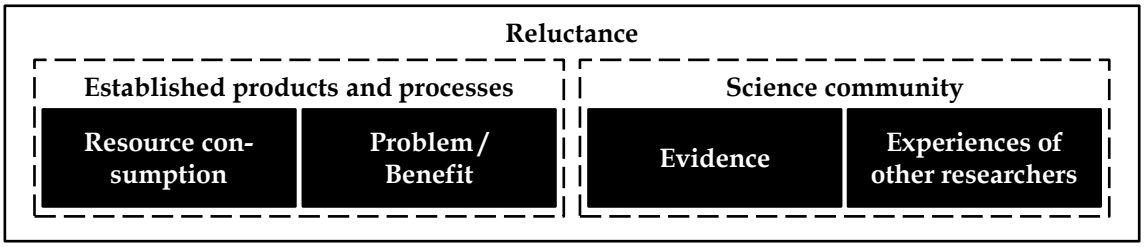

FIGURE 9 Conclusion of factors producing reluctance in cell culture researchers' reagent buying process

The results imply that the cell culture reagent markets have well-established products, and research groups have existing protocols and processes for their research projects. These create reluctance in the researchers for switching to use new reagents. Switching to new reagents is seen to consume lots of resources, as using new reagents requires protocol optimization, which is time-consuming and requires labour. Furthermore, testing new reagents may not result in a publication, thus affecting the financial status by not necessarily being able to receive grant money.

Since switching to new reagents requires lots of resources, the new reagent needs to either solve a problem or add great benefit for researchers to consider using a new reagent. Such problems and benefits could be, for example, price, availability, or process related. The complete list of problems with current reagents and the potential benefits of new reagents were discussed in the results section in TABLE 6.

The results suggest that the science community is well-connected, and researchers communicate a lot about experiences with different reagents within the science community. The results imply that researchers trust other researchers heavily. Furthermore, the results indicate that researchers want to be able to read, hear or view evidence and experiences of other researchers before buying new reagents. Reading numerous science articles and discussing with colleagues when considering new reagents are standard practices. It can be assumed that the better reviews a reagent has gained, the more willing a researcher is to switch to testing a new reagent. Based on the results, researchers seem hesitant to test new reagents unless they have read articles that prove the reagent's functionality and suitability or have heard about good and successful experiences from colleagues.

5.2 Digital marketing insights

Based on the research results and thematic analysis, several themes were found that can improve companies marketing results in the science fields, especially in

the cell culture market. These key areas are ensuring findability, selecting suitable segments to target, implementing need-based marketing communication, being present on applicable social media, communities, and networks, providing interesting and helpful content, and cooperating with universities and researchers.

5.2.1 Ensuring findability

As discussed in the previous chapters, researchers tend to rely heavily on search engines and databases when looking for information on cell culture topics. Thus, companies should ensure they can be easily found using search engines and indexes.

The results suggest that researchers use Google to look for information on cell culture. Thus, to improve their visibility and ranking on Google's search results page, companies could invest in keyword research and organic search engine optimization (SEO) of their website content. Companies should do further research on what keywords researchers use to look for cell culture information and ensure their webpage can be found with these keywords, if applicable to the business. In addition, paid Google advertising can be used to promote websites on Google's search results page.

In addition to using Google, the research results suggest that researchers use science literature databases (TABLE 4) to look for information. Hence, companies could look for ways to ensure their brands are mentioned in the scientific papers that use their products.

5.2.2 Suitable targeting and segmentation

The results suggest that once a research group has started using a specific reagent, they are not easily willing to switch reagents unless significant problems occur or if a new reagent offers great benefits (TABLE 6). Thus, cell culture reagent companies could opt for targeting researchers who are facing problems with the reagent in use or target research groups in the early stages of starting a research project and do not yet have any established protocols and reagents they use for the project.

5.2.3 Need-based marketing communications

As discussed before, the results suggest that for a researcher to be willing to switch to an alternative reagent, there need to be either problems with the used reagents or the new reagent needs to offer significant benefits. Hence, the focus on marketing communications could also be on need-based communication. This study discovered several problems researchers face with the reagents currently in use and what kind of benefits would pique the interest of researchers (TABLE 6). However, more research is needed to recognize more reagent-type-specific

problems and possible benefits. As the study suggests that researchers value personal connections with company representatives, offline exhibitions and conferences could be used to better discuss with researchers to understand the problems and potential benefits. Once these are found, they can be used in organic marketing and paid advertising.

5.2.4 Being present on applicable social media, communities, and networks

As discovered in the research by Rose et al. (2021), social media communication from vendors to customers builds trust in the relationship. The results of this thesis found that cell culture researchers use social media channels and forums, primarily Twitter, LinkedIn, and ResearchGate. Hence, companies could build an online presence in these social media channels and forums. In addition to ensuring the companies are present and actively engaged in these social media and forums, companies can cooperate with scientists to bring visibility to the company and its products.

5.2.5 Interesting and helpful content

The results highlight that researchers value educational and helpful content. Researchers prefer if the content, such as newsletters, offers valuable information, such as the latest publications and protocols. The content was seen as most valuable if it somehow related to their ongoing or upcoming research project or aligned with their interests. Researchers were not as keen on receiving promotional materials. In addition to educational, valuable and personalised content, science-related entertainment was brought up during some interviews.

When looking for information about reagents, researchers prefer to have access to as much information as possible. Companies can help researchers advance to the next buying stage by providing information that researchers could find helpful at each buying stage. Complete lists of such content can be found in the TABLE 5 and TABLE 7.

5.2.6 Cooperation with universities and researchers

As discussed in the results chapter, 1. some researchers trust information more if the information is shared by other researchers, colleagues, or peer-reviewed papers, and 2. buying centres partake in the buying process in many universities.

Since cell culture researchers trust other researchers and colleagues, companies could collaborate with university researchers. Companies could aim to encourage researchers to share their experiences and opinions of their products through the channels they use, such as Twitter, LinkedIn, or ResearchGate.

The study also found that many universities or research institutions have a buying centre or contracts with companies to buy reagents at lower prices. To make the buying process easier for the researchers, companies could aim to get their information and products in the buying centres' systems to lessen the steps

required to buy the company's products. Another possibility could be negotiating contracts with universities where the universities buy the reagents in larger quantities at discounted prices.

5.3 Evaluation of the study

The reliability, validity, generalizability, and limitations of the study are discussed in this chapter.

First, as is typical for qualitative studies, the number of research subjects is limited. Thus, the findings and implications of the study should not be generalized, as they are subjective to the individual interviewees. Finding research subjects for the study was challenging due to the complexity of the research topic.

Second, as one of the interviewees was acquired through social media as a tool for finding research subjects, it may indicate that this interviewee is generally more active in at least one of the social media channels, Twitter or LinkedIn. However, there is no certainty of this. It was also ensured that research subjects were not only found through social media but also through other means, as explained in the research methodology chapter.

Third, only a little research has been done on marketing-related topics in the fields of science, biotechnology, and cell culture, and no peer-reviewed papers could be found about the customer behaviour of academic researchers. Thus, the number of field-specific background literature is limited. Therefore, the scope of the literature review section was broadened to include B2B-related literature, as according to Kotler and Keller (2016), B2B buyers closely resemble institutional and government buyers. The limitation of the background literature was, however, acknowledged in the overall thesis process. Actions, such as cooperation with a biotechnology company and pilot interviews, were taken to ensure the validity and reliability of the science-related information in the industry introduction and interview question forming.

Fourth, as the thesis researcher does not have a strong background in cell culture, the pilot interviews and cooperation with the biotechnology company also ensured better usage of cell culture-related terms, such as "reagent". However, it was brought to the thesis researcher's attention that many science terms do not have set definitions. Thus, although during the interviews, the terms were defined and explained by the interviewer to the interviewees, the interpretation of the questions may differ interview-to-interview.

Fifth, due to the limited number of people in this niche industry, actions were taken to ensure the anonymity of the interviewees. For example, the countries of operation were listed separately in the text and are not directly linked with the individual interviewees in the interviewee table.

Sixth, due to the chosen data collection method and format, it was sometimes challenging to specify whether the interviewees were speaking about of-

fline or online channels, such as seminars, conferences, and direct communication. Thus, if the thesis researcher was unsure whether the interviewee was talking about an offline or online channel, this was not specified in the results and analysis section to ensure the results were not distorted. The validity and reliability of the results and analysis were improved through all these measures.

5.4 Suggestions for further research

This research provided a broad overview of cell culture researchers' online, information-seeking, and buying behaviour with a qualitative data collection and analysis standpoint. Although Eriksson and Rajamäki (2010) suggested that the field of biotechnology has been more researched with quantitative methods, the online behaviour and digital marketing aspects could still benefit from further research with quantitative methods. This study provides a wide range of online tools, channels, and platforms and suggests different ways researchers use these. However, the research subject number is limited due to the chosen qualitative research method. Thus, the results cannot be fully generalized to represent the whole cell culture research community. A quantitative research method could be used to investigate the most used online channels and platforms among researchers in the field of cell culture. As this research had research subjects from only North America and Europe, another interesting aspect could be to expand the scope to cover other continents to see if the online tools differ.

Alternatively, further research could focus on the other cell culture customer segment. Garza Ramos et al. (2022) stated that cell culture has two customer segments: research and pharma. As this study only focused on research customers, a similar study could be done on the pharma segment.

Since this study was conducted after the Covid-19 pandemic had started and was still ongoing, it can be assumed that the pandemic influenced the behaviour of scientists. Interviewees referred to the pandemic influencing the behaviour of the science community by forcing more rapid digital transformation, with fewer in-person conferences, events, and meetings and an increased number of online activities such as webinars. This provides an opportunity to study the online behaviour of cell culture researchers post-pandemic to see if the digital leap driven by the pandemic is permanent.

Though this study provided a broad overview of the overall buying behaviour and its underlying influencing factors, the study focused on the early funnel stages: awareness and interaction. Therefore, further research could be conducted by expanding the scope to the next buying purchase and funnel stages to broaden the understanding of how cell culture researchers buy cell culture reagents once information has been sought.

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APPENDIX 1 Interview question framework

Background information

- What do you do for a living? *What organization? Role? Duties? How long have you been in the current position?*
- What would you say your normal workday looks like?
- What cell culture research project are you currently *(or have recently been)* working on?
- What do you use for culturing? *What reagents? Cell lines? etc.*
- Do you work in 2D or 3D?

General

- How do you stay up to date with the latest information and news on the cell culture industry?
- How do you look for information on cell culture? *What information? Where?*
- How do you like to receive information on cell culture? *What information? In what format? Through what channels and platforms?*

Now, I'll ask some questions that deal with cell culture reagents, including liquid phases, scaffolds, media, other additives, etc.

Buying reagents

- How do you buy reagents? *Describe the buying process from start to end. Your role in buying? Who's involved?*
- When do you buy new reagents? *Before each project? Already existing inventory?*
- Do you prefer to buy straight from the manufacturer or buy from a distributor?
- How do you decide which matrix or media to go with?

New product

- What do you think of testing new reagents? *Do you test new reagents? Why? Why not? When? What makes you interested in testing new reagents?*
- How do you hear about new reagents?
- When you are looking for new reagents, what information do you need?
- Do you have any specific go-to matrix or media you always use? *Do you test different matrices or media? Why? Why not?*
- What are the most important factors when buying cell culture matrices or media?

Now for a moment we can, as in, forget the previous questions, and the next questions will be about how you use the internet, online platforms, and such as a researcher.

Online behaviour

- What would you say is the role of internet and its online platforms and channels in your career as a researcher? *Do you find using online platforms and channels relevant in your work? What are the most important channels for a cell culture researcher to use?*
- How do you use online platforms and channels in your work as a researcher? *What online platforms and channels do you use? What information do you get from them? Why do you (not) use them?*
    - Do you use social media channels?
    - Do you read industry outlets, like scientific journals, forums, or any other industry websites online?
    - Are you subscribed to life science or cell culture newsletters?
    - Do you participate in cell culture online webinars and online events? Which ones?
- Which online platforms do you prefer for gaining information and knowledge on cell culture?
- Do you think online presence is important as a researcher? *Why? Why not?*
- Does it matter who has made and shared the information?

Now we are almost at the end of the interview. Just a final or few final questions left.

Conclusion

- What would an ideal situation be like when buying a new cell culture reagent? *What information would you get? How? What format? How and where would you buy it?*