
“HOW IS ARTIFICIAL INTELLIGENCE IMPACTING THE BEAUTY
INDUSTRY ON MAKING DATA-DRIVEN DECISIONS?”

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Quoting one of Pink Floyd's lyrics:

“Together we stand, divided we fall.”

Resumo

A Inteligência Artificial (IA) está a ser vez cada mais usada como uma ferramenta estratégica para tomar decisões baseadas em dados, e funciona como um complemento para a tomada de decisão humana. Isso leva a processos mais eficazes e impulsiona a inovação, permitindo uma forte coordenação entre todos os agentes envolvidos – tais como gestores, consumidores e fornecedores. A transformação digital, que tem a IA na sua essência, está a revolucionar as operações das empresas, provocando mudanças significativas nos processos de criação de valor e nos modelos de negócios adotados, com a crescente prevalência de plataformas digitais usando mecanismos e tecnologias como IA e Machine Learning (ML). A indústria da beleza não é exceção a essa tendência, e o potencial de aplicação da IA nesse setor é enorme, pois há uma quantidade significativa de dados a serem produzidos em plataformas online e em redes sociais. Além disso, há inúmeras necessidades do consumidor de cosméticos a serem respondidas. Desta forma, há uma forte necessidade de personalização eficaz e estratégias de marketing direcionadas a esses consumidores.

Apesar do tópico ser relevante e das oportunidades destacadas acima, há uma escassez de investigação teórica e empírica neste campo, o que faz a questão de investigação: *Como é que a IA está a impactar a indústria da beleza na tomada de decisões baseadas em dados?* – pertinente.

Devido à falta de estudos académicos sobre este tópico, esta dissertação é de índole exploratória, incluindo duas partes principais: (i) revisão de literatura com base numa *framework* desenvolvida originalmente e (ii) um estudo empírico qualitativo com base numa análise de múltiplos casos de estudo. Os dados foram recolhidos por meio de entrevistas semiestruturadas a gestores de topo de duas empresas líderes do setor da beleza- L'Oréal e Perfect Corp.-, complementados por dados provenientes de fontes secundárias.

Esta dissertação teve como resultados: a interconexão entre as últimas tendências tecnológicas, a forte colaboração entre todos os agentes e uma gestão eficaz de Big Data são essenciais para sustentar uma estratégia de IA para tomar decisões relevantes neste setor.

Palavras-Chave: Inteligência Artificial; Indústria da Beleza; Plataformas digitais; Indústria 4.0; Tecnologia; Online; Comportamento do consumidor; Interconexão; Inovação; Inovação Aberta; Inovação do usuário; Tomada de decisão

Abstract

Artificial Intelligence (AI) is increasingly being used as a strategic tool to make data-driven decisions, working as a complement to human decision-making. This leads to more effective processes and drives innovation in a better way, enabling a strong coordination between all the agents involved - such as managers, consumers, and partners. Digital transformation, which has AI at its core, has been disrupting companies' operations by provoking significant changes on the value creation processes and business models firms adopt, with the increasing prevalence of digital platforms using mechanisms and technologies like AI and Machine Learning (ML). The beauty industry is no exception to this trend, and the potential for applying AI in such sector is enormous as it is a sector where there is a significant amount of data being produced across online platforms and social media channels. Furthermore, there are infinite needs of the cosmetics consumer to be fulfilled, hence there is a strong need for effective personalization and targeted marketing strategies.

Despite the relevance of the topic and the considerable opportunities highlighted above, there is a scarcity of theoretical and empirical research on the field, which makes the present research question - *How is AI impacting the beauty industry on making data-driven decisions?* - pertinent and worth investigating.

Due to the lack of academic studies on this topic, this dissertation has an exploratory nature, including two main parts: (i) a literature review based on an originally developed framework and (ii) a qualitative empirical study based on a multiple case study analysis. The data was collected through in-depth semi-structured interviews to top managers of two leading companies in the beauty sector - L'Oréal and Perfect Corp-, complemented by data from secondary sources.

This dissertation had the following results: the interconnection between the latest technological trends, strong collaboration between all the agents and an effective Big Data management are critical to sustain an AI strategy to make relevant decisions in this sector.

Keywords: Artificial Intelligence; Beauty Industry; Big Data; Consumer Behavior; Decision-Making; Digital Platforms; Industry 4.0; Innovation; Interconnectivity; Online; Open Innovation; Technology; User Innovation

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1. Introduction

Digital transformation is rapidly driving disruption across, and impacting on, every sector: by 2022, over 60% of global GDP will be digitized and an estimated 70% of new value created in the economy over the next 10 years will be based on digital platforms (Schwab, 2018). Hence, one of the main challenges that companies face nowadays is integrating and exploiting new digital technologies (Hess, Matt, Benlian, & Wiesbock, 2016).

This digital transformation is related to what may be considered a change in techno-economic paradigm (Freeman & Perez, 1988) commonly called Industry 4.0 or Fourth Industrial Revolution - where manufacturing processes are undergoing changes towards a more digital environment. Consequently, firms have been trying to embrace digital transformation on their processes and products along the value chain, affecting not only how they operate but also their business model (Klein, 2020).

Artificial Intelligence (AI) is a key strategic tool to foster the digital capabilities of a company powered by Big Data (Duan, Edwards, & Dwivedi, 2019). AI harnesses the power of Big Data by introducing new mechanisms such as opinion mining and recommendation systems which allow the companies to be more efficient and productive (Chui et al., 2018). These mechanisms are enabled in a context where innovation is increasingly open (Chesbrough, 2003) and democratized (von Hippel, 2005, 2016), allowing external knowledge (of partners, users and other stakeholders) to be part of the value creation process. The literature has also recognized the phenomenon of “user innovation”, in which consumers or other types of users at large may be a relevant source of innovation, with producers or suppliers learning from them (Grabher, Ibert, & Flohr, 2008).

The beauty industry was one of the first commercial sectors to embrace digital platforms and maximize the power of large-scale data capturing and analytics to respond to customer demand (Menear, 2019). The value of the beauty industry is stated at more than 500 billion dollars and it's expected to reach more than 800 billion dollars by 2025 (Danziger, 2019).

This market has been changing their business model (previously characterized by a brick-and-mortar strategy) towards a more digital one with a massive online presence (Biron, 2019).

Beauty firms are shifting from advertising their products in order to create maximum awareness (product-centric approach) to a more customer-centric approach by adapting to the individuality and creating tailored products for each one of their consumers, putting these consumers at the core of their product creation process. These firms are leveraging technological development on their strategies in order to stay competitive in the market by offering personalized products and services (Bruculieri, 2018), and AI can clearly offer revolutionary possibilities in this domain.

Due to the technological advancements on AI technologies, and beauty being characterized as a personalized and engaging market generating a massive amount of data, AI appears as a solution to deal with this complex environment, leading the beauty companies to apply data-driven decisions on their strategies in order to stay competitive.

These firms are now empowered with digital technologies and capturing information from all the agents (consumers, partners, service providers) by storing data of many types, from almost any source. Yet, this process of data capturing, and storage only adds value when it has a useful purpose (Power, 2014). By fostering data-driven processes, businesses are more likely to improve their Return on Investment (ROI) and improving consumer loyalty. Therefore, firms using these AI- and data-driven technologies are 23 times more likely to convert and 6 times more to retain the customers (Advance2000, 2018).

Companies like Sephora, L'Oréal, PROVEN, among others, have already recognized such potential and are applying AI in different ways. For instance, AI has been reinventing the way beauty brands operate through processes, providing much more efficient services, understanding consumer behavior, predict and plan demand, maximize supply chain channels' potential (Avvocato, 2019).

Even if this is a phenomenon of foremost importance, there are few theoretical and empirical articles explaining *“how a firm can realize value from Big Data using AI”* (Günther, Mehrizi, Huysman, & Feldberg, 2017, p. 192). Moreover, regarding the Beauty Industry, there is a scarcity of quantitative and qualitative research on the field (only 26 articles found on the Web of Science with “beauty” and “AI” topics’ - compared to 2042 articles for “health”, for example). To the best of our knowledge, there is no academic research on how beauty firms

are being impacted by AI to make data-driven decisions. This is the motivation to answer the research question: *“How AI is impacting the beauty industry on making data-driven decisions?”*.

Regarding the structure of the dissertation, it will firstly consist of a thorough literature review, starting by analyzing articles and publications with “data-driven decision making” and “AI” as keywords - and, if possible, with “beauty” or “cosmetics” - on leading bibliographical databases such as Web Of Science, Scopus, EBSCO, etc. The use of specific keywords will help to narrow down to the relevant literature, in order to identify the main themes pertinent to the focus of this dissertation and to review the most important research.

To organize the theoretical background underlying this dissertation, I developed an original framework to explain three key concepts and articulate the interrelations between them: (i) Enabling Technology, (ii) Collaboration and (iii) Big Data – reviewing in those sections the relevant literature, and explaining after these three sections how AI is related to these crucial concepts.

The second main part of the dissertation includes an empirical research based on a qualitative methodology given on the one hand the scarce literature and data on this area – which motivates the exploratory nature of this study-, and on the other hand since it gives a more comprehensive and an in-depth investigation of a complex issue (Creswell & Creswell, 2017). The qualitative research will include, firstly, an assessment with experts from the field to refine the empirical methodology and map the questions orienting the semi-structured interview. And then, based on the interviews and complementary data gathered, a multiple case studies-based empirical study will be developed, with a discussion of the respective findings. It is expected that the results of this dissertation will shed light and contribute to the almost non-existing academic literature on this area.

2. Literature Review

The literature review will focus on the key topics mentioned below. It will be based on a systematic search and analysis of articles and studies found on relevant databases such as Web of Science, Scopus, Google Scholar, Research Gate, among others. Besides the academic databases mentioned above, this dissertation will devote special attention to the latest business reports focused on the integration of the focal new technologies published by top consulting firms such as Deloitte and McKinsey. Furthermore, due to the novelty of these topics, portals focused on the beauty industry were also consulted.

The literature review is divided into three main parts. Firstly, it consists of the presentation and analysis of an originally developed framework. Secondly, explains in detail the key concepts highlighted on the framework such as Digital Transformation, Collaboration, Big Data, Open and User Innovation, and AI. Due to the complexity and interactions of each concept, the framework will also highlight how the topics are interrelated and interdependent, according to the literature available.

Lastly, the beauty industry is analyzed using the latest literature on the topic and drawing on examples from brands that are competing on the area under analysis. In the same section, there will be an overview of how the industry is being revolutionized by AI, in what regards business models.

2.1. An original framework: proposal and analysis

This dissertation aims at addressing the research question *“How is AI impacting the beauty industry on making data-driven decisions?”*. Since it involves the interaction between complex concepts, a theoretical framework that serves as the foundation to understand the literature available was purposefully developed. Such original framework supports the rationale of the dissertation and helps answering the proposed research question (Osanloo & Grant, 2016). Furthermore, the use of a framework helps to structure the concepts highlighted and bring clarity to the investigation (Hennink, Hutter, & Bailey, 2020).

The framework developed comprises the interplay of three different key areas: Technology, Collaboration, and Big Data - and the way they lead to Digital Transformation and the application of AI technologies by companies. These concepts are interrelated, and a careful account of their bilateral interactions helps explaining the complex phenomenon under analysis.

After the graphic presentation of the above-mentioned framework, three sections follow, each addressing one of the three key areas of the framework. Section 2.2.1. develops the technology aspects that enable the adoption of AI mechanisms. Section 2.2.2. explains how user and producer are working together across the value chain to innovate and create new products and services. Section 2.2.3. explores how Big Data is being generated from these synergies to fuel the ever-more digitalized ecosystem we live in today. After, section 2.2.4 explores how these three major aspects result in, and are intrinsic to, digital transformation - and are the foundation for the emergence of AI as a key tool in making data-driven decisions.

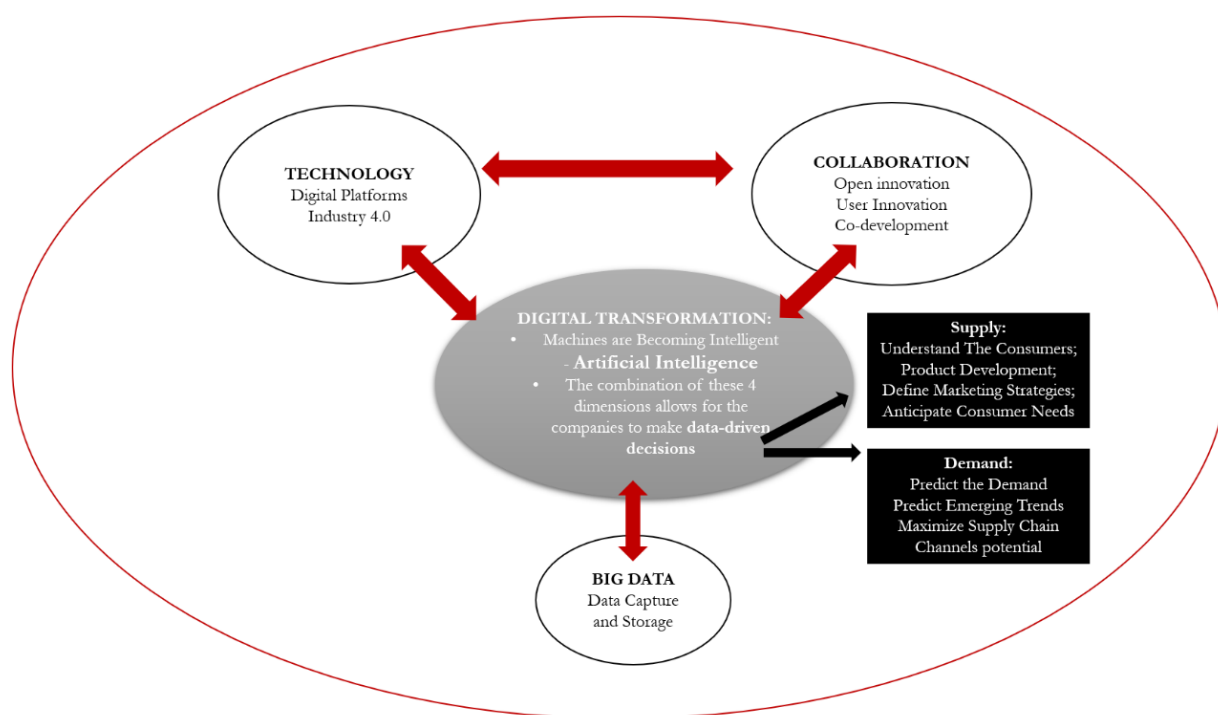


Figure 1: Framework developed to address the current research question

Source: Own elaboration.

2.2 Conceptual background: framework explanation

2.2.1. Technology as an enabler to Digital Transformation

This section explains how digital transformation is enabled by technology, exploring concepts such as Industry 4.0 and digital platforms. Then, it analyzes how AI emerged from this transformation and how it is creating value in the firms.

Digital transformation has been defined as *“a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies”* (Vial, 2019, p. 3). The integration of these technologies will impact all parts of the companies' structure such as processes, sales channels and supply chains but it will most likely bring productivity, more sales and new ways of engage with consumers (Matt, Hess, & Benlian, 2015).

The current phenomenon of digitalization of industry – called commonly Industry 4.0 - is intimately linked to this transformation – implying that manufacturing processes will be more digitalized - involving the integration of cyber-physical systems (Tay, Lee, Hamid, & Ahmad, 2018). The term Industry 4.0, identified with the *Fourth Industrial Revolution*, originated in 2011 in Germany, at the Hannover Messe, the leading trade fair for industrial technologies. Industry 4.0 was launched as a strategy to differentiate German and European Union industries from their competitors, thus increasing the competitiveness of the former in international markets (Pascall, 2017). It refers to a *“further developmental stage in the organization and management of the entire value chain process involved in manufacturing industry”* (Deloitte, 2015, p. 3) and with the growth of the impact of this transformation, companies face an opportunity to adopt technology at scale and disseminate across the entire ecosystem (Schwab, 2018). Industry 4.0 allows for the development of new organizational capabilities (Nosalska, Piątek, Mazurek, & Rządca, 2019) enabling the implementation of digital platforms in the value creation process (Kagermann, Helbig, Hellinger, & Wahlster, 2013) by developing innovative products which involves the interconnection of different types of agents (Tay et al., 2018).

Connected with digital transformation and Industry 4.0 is the concept of digital platforms. It is estimated that 70% of new value creation in the economy over the next 10 years will be based on digital platforms (Schwab, 2018). Digital platforms represent *“a digital technology-*

based system infrastructure, business model, and intermediary acting as a market place that interlinks multiple actors, both internal and external to the company, like customers and suppliers?” (Schmidt, Veile, Müller, & Voigt, 2019, p. 6) Digital platforms have high scalability and low transaction costs achieving network effects (Gawer & Cusumano, 2014) when the number of users increases, the product of the service or product value increases as well.

The rise of an economy based on digital platforms (or “the platform economy”) poses a significant challenge for organizations (Chan, Voortman, & Rogers, 2019). Digital platforms compel the interaction between agents and play a key role on this environment since they reduce costs and economic friction (Evans & Schmalensee, 2008). Furthermore, business models are dependent on how the competition is playing to stay competitive. Tirole and Rochet (2003) analyze how this platform competition on two-sided markets works, stating that markets with network externalities “cross-subsidize” different types of users that are part of the transactions on the platforms. This means that the total profit depends on the total price charged to the parties involved on the transaction and on its decomposition (Rochet & Tirole, 2003).

This transformation is reshaping business models, leading to the integration of digital platforms across the entire value chain with the main goal of staying competitive in the industry, improving performance. Companies are embracing a digital transformation strategy, where integration of all the agents such as consumers, suppliers, competitors is the key driver of this era (Hess et al., 2016).

Technologies such as Internet of Things (IoT), AI, additive manufacturing, cloud computing, robotic process automation, ML, Virtual Reality, Augmented Reality, 3D Printing, virtual agents, are part of the creation of these valuable networks in order to have a dynamic, real-time and self-organized company (Tay et al., 2018). Companies have been integrating these technologies in their business strategies, conducting not only to a significant increase in investment and adoption, but also to making sure that the technical foundation is in place in order to be effective (Chui et al., 2018).

Among those technologies highlighted above, one (and a crucial one) of them is AI. AI is a leading component and driver of the digital transformation across industries, disrupting the

retailing landscape (Grewal & Roggeveen, 2017). AI is not new: John McCarthy invented the term in 1956 and referred that AI consisted of *“making intelligent machines”* (McCarthy, 2019). With a given objective, AI uses software to perceive the environment, interpreted by an algorithm in order to predict, recommend and make decisions (OECD, 2019).

With the advent of AI, new definitions of the term have arisen for better understanding of its purpose. Modern definitions see AI as sub-field of computer science, shifting from a traditional approach of machines imitating human intelligence to being human-like (Bughin, Seong, Manyika, Chui, & Joshi, 2018). IBM describes AI as a *“shorthand to describe any machines that mimic our cognitive functions such as “learning” and “problem solving””* (IBM, n.d).

AI is playing an increasingly important role in the economy. By 2030, the additional output enabled by its application is expected to reach 13 trillion dollars, and companies are expected to double their cash-flow (Zhao, 2018). This is a result of the progress on key areas that are disrupting both economies and companies such as improvement in computer power and capacity, generating of data and the significant progress in algorithms (Chui et al., 2018).

For the adoption of these mechanisms to be effective, the technical infrastructure needs to act as the foundation alongside with the collaboration of skilled labor and experience. Furthermore, since the choice of adopting AI is likely to impact the outcomes, the adoption strategy needs to be carefully thought to improve the absorption across the firm (Bughin et al., 2018)

2.2.2. Collaboration and value exchange between different stakeholders

Another aspect that is crucial to the emergence of digital transformation is collaboration and how it impacts the daily operations of firms. It is of foremost importance to understand how the interconnectivity between all the agents change the business models and firms' performance.

Collaboration (and connectivity) is a defining feature at the core of Industry 4.0. Industry 4.0 allows products, machines, components, individuals and systems to create a smart network (Kamble, Gunasekaran, & Sharma, 2018). The customers' role and the growth of social networks is allowing for more inclusion through the introduction of new forms of

personalization. Consequently, there is a shift from a mass production to a customized products strategy (Nosalska et al., 2019). This means that the value creation process is not only relying on technology, but also on a strong collaboration between stakeholders - partners, customers, and suppliers (Tay et al., 2018) transitioning from a centralized production to a more flexible and self-controlled production model (Nosalska et al., 2019).

Innovation is a process that is deployed across different types of agents across society and the economy: public or private firms, the State, universities, and nonprofit institutions (Lundvall, 1992). That has evolved through the years. At first, innovation started in-house with research, moved to industrial application and then, if successful, would lead to the product placement in the market. This traditional approach to innovation is essentially based on control and ownership as the factor to stay competitive and create value (Chesbrough & Appleyard, 2007).

Due to the increasing interconnectivity of agents, internet, globalization and competitiveness, companies needed to fill the high demand of the market in a different way. Firms moved from a “closed” science-driven innovation to an “open” learning driven innovation where all the actors are involved on a continuous way (Marques, 2014). The open innovation model was developed by Chesbrough (2003) and is defined as: *“Distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization’s business model”* (Chesbrough & Bogers, 2014, p. 3). The balance between traditional and open innovation aims to increase the value creation across firms, and the introduction of, and collaboration between, outside innovators is of the foremost importance to companies who lead through innovation (Chesbrough & Appleyard, 2007).

Increased digitalization influences a vast array of business activities by enabling new forms of cooperation (Rachinger, Rauter, Müller, Vorraber, & Schirgi, 2019). These new forms of cooperation allow for a significant interchange of knowledge: valuable ideas can come from inside or outside the company and can go to the market from inside or outside the company as well, and consequently, industrial innovation is becoming more open (Chesbrough, 2003). Thus, an open innovation strategy requires a change along the business model considering new sources of value capturing and value creation (Chesbrough & Appleyard, 2007).

With the combination of external and internal knowledge, agents can take part in the innovation process, including users, adding value to the firm (Marques, 2014). Extensive theoretical and empirical research has now led to an understanding that users are also a major source of innovation development (von Hippel, 1986; von Hippel & Riggs, 1997). This means that now producers tend to learn from users on how they should create their products through co-development, transforming the product into a variable (Grabher et al., 2008).

Due to open innovation, and to user innovation, innovation is becoming democratized, meaning that users of products and services— both firms and individual consumers—are increasingly able to innovate for themselves, resulting in the creation of individually and commercially important new products and services (von Hippel, 2005). von Hippel argues that users are reinventing the products to serve their own needs and companies are taking advantage by discovering, adapting, and capitalizing on these innovations (von Hippel & Mangelsdorf, 2011). These innovative users are often called as “lead users”, a term coined by von Hippel. Lead users are “*users whose present strong needs will become general in a marketplace months or years in the future*” (von Hippel, 1986, p. 791). These type of users can bring relevant inputs both on design and concept to the companies, so they can be part of the process of spotting future opportunities, understand the needs of new products and services and consequently, companies can benefit from this information to develop their strategies (von Hippel & Riggs, 1997).

Latest developments on data capture and consumer behavior enabled a new way of spotting lead users amongst the web ecosystems. Tracking all the user-generated content and their reviews can be time consuming and costly, which leads to new ways of spotting consumers outputs. Data mining appears as solution to detect trends and opinions that might be relevant to the community. Through the analysis of their preferences, their online behavior, organizations can integrate consumer’s needs and adapt to their needs leading to successful products that came directly from their ideas (Kaulartz & von Hippel, 2019).

Combining machines, systems and different type of individuals, digital platforms are expected to drive innovation and collaboration between these agents by easing the communication and coordination (Esposito De Falco, Renzi, Orlando, & Cucari, 2017).

2.2.3 Big Data and value generation

Lastly, all the activities that are performed across the firms are daily fueled by data and, also, by the very creation of data. It is a challenge to organize and maximize the value that data brings, in order to make business decisions. This chapter explains how the dimensions of Big Data and the interactions between the all agents involved impact the knowledge creation across the value chain.

Digital transformation has one key factor that enables technological development: data capturing and storage (Junge, Verhoeven, Reipert, & Mansfeld, 2019). According to International Data Corporation (Rydning, 2018) it is estimated that the production of data will go up to 175 zettabytes by 2025 (*“A single zettabyte contains one sextillion bytes, or one billion terabytes. That means it would take one billion one terabyte hard drives to store one zettabyte of data”*- (Christensson, 2012, p. 1)) by 2025, 10 times higher than 2016, achieving an opportunity to extract value now more than ever before. The world is producing data with more speed, disrupting enterprises by introducing innovative technologies being more productive and increasing consumer surplus (Manyika, 2011).

Since the amount of data increased on the last years alongside with the complexity that evolved on the process of data capturing and storing, some academics such as Charles Tilly and John R. Mashey introduced a new term called Big Data (Diebold, 2012). According to Provost and Fawcett (2013), it's defined as *“data sets that are too large for traditional data-processing systems and that therefore require new technologies”* (Provost & Fawcett, 2013, p. 54). Consequently, firms rely on a strong technical architecture to support data capturing and storage, enhancing once again the importance of technological strategies on the process of digital transformation.

Businesses are using data in order to generate value through data manipulation technologies, such as retrospective, predictive and prescriptive analysis (Power, 2014). Through these processes, firms can harness the power that Big Data can bring, by using it to the development of innovative insights, products, and services (Davenport, Barth, & Bean, 2012). All the inflows are stored on data warehouses that can empower the decision-maker agents with a strong foundation of fact. But, this type of warehouses doesn't concern an important aspect on making decisions: tacit knowledge. Knowledge warehouses are

warehouses that rely not only on data but also on the tacit and explicit knowledge from the employees that can enhance decision-making. These warehouses can have AI at its core, and it will help the decision-makers to detect new patterns, understand the relations between them and provide explanations. Thus, knowledge warehouses can improve the decision-makers processes by using AI mechanisms and amplify the rationale behind each decision (Nemati, Steiger, Iyer, & Herschel, 2002).

Big Data is considered critical for companies to be competitive in the market (Grewal & Roggeveen, 2017) since the development of new technologies and the changes on shopping behavior are affecting how the firms operate every day. However, having a competitive advantage based on data is temporary, so companies need to have a certain level of flexibility to adapt to market changes (Baierle, Sellitto, Frozza, Schaefer, & Habekost, 2019).

AI automates cognitive and physical tasks through the capturing and storage of data (Saratchandran, 2019). This mechanism is bidirectional since it can answer and question the consumer by responding to queries and making suggestions, targeting more effectively the users (Grewal & Roggeveen, 2017). Due to the oscillation of the markets, there are emerging platforms that according to the authors above “*forces*” that will disrupt the retailing industry and one of them is AI, the focus of this dissertation (Grewal & Roggeveen, 2017).

2.2.4 AI and its relation with the three major concepts highlighted: technology, collaboration, and Big Data

Sections 2.2.1, 2.2.2, 2.2.3 aimed to explain the dimensions of the framework and serve as the conceptual base to introduce the topic of this dissertation. One can conclude that technology enables digital transformation, the capture and storage of Big Data and the increasing participation of all the agents through collaboration. AI is a mechanism that combines and relies on these three dimensions but there is still very scarce academic research explaining how AI can unleash the power of Big Data and its impact on making decisions (Duan et al., 2019).

Using information, AI will manipulate and store the data, easing its access, making it available for any purpose at any time, serving as a basis for decision-making (Baierle et al., 2019). Decision-making has the main goal of changing the current state to a more desirable one and

it deals with uncertainty and preferences when humans are involved in it (Pomerol, 1997). Using AI will, indeed, reduce labor needs on manipulating the data (Saratchandran, 2019) but it will not eliminate human involvement at all. Decision-makers should be able to question the output and explain the reasoning behind the assumptions and their variables (Curry & Moutinho, 1994).

With the increase of computer power and data storage, AI will augment human intelligence, enabling the process of decision-making (Saratchandran, 2019). Moreover, academic research shows that humans and algorithms should complement each other by enhancing their unique competencies and capabilities (Bader & Kaiser, 2019), showing once again, the relevance of the collaboration dimension.

The adoption of AI on decision-making implies that organizational structures need to be changed. Firstly, firms need to judge their capabilities and how they can find an opportunity to adopt AI on their business models. The analysis of the implementation of AI on the processes across the value chain will help firms on their assessment and how they can incorporate AI to make decisions (Paschen, Pitt, & Kietzmann, 2020). Recent studies from Shrestha, Ben-Menahem, and Von Krogh (2019), for example, show that there are different structures of decision-making processes on integrating AI. Consequently, companies need to choose which is the best option for their business model so they can exploit the human capabilities and algorithm decision-making in order to enable better decisions (Shrestha et al., 2019).

There are many strategies that can unleash and improve the performance of the companies using AI on making decisions. It is expected that, by 2025, AI will have a 40 billion dollars impact on marketing (Reavie, 2018). Real-time data gathering will help firms to predict consumer behavior and better target what they want, helping firms to decide which is the best marketing strategy for each type of consumer. One strategy mentioned above was using AI to provide recommendation tools to help the marketing and the customer service team(s) to tailor the content displayed according to consumer preferences and feedbacks (Baierle et al., 2019; Saratchandran, 2019; Shin et al., 2019).

AI, will help, as well, to anticipate trends and forecast what shoppers want, and this will serve as the basis for the product development team so they can better adapt to specific needs. Moreover, it will also improve the process of demand forecasting through the use of customer relationship programs (Campbell, Sands, Ferraro, Tsao, & Mavrommatis, 2020) that are key to understand the consumers.

Firms are now implementing the strategies stated above to improve their decision-making and engage the consumer across all the touchpoints on the buyer journey, making them more interested and curious about the products (Shin et al., 2019).

Given all that was explained in this section, it is clear that AI implies the three dimensions mentioned above (technology, collaboration and Big Data), and that it represents a powerful tool to improve decision-making and firm performance.

2.3. Beauty industry analysis and the impact of AI

Historically, the beauty industry had its first appearance on the Roman Society. Fragrance was the first category to appear on the market since oils and perfumes were used to cure the Black Death. Furthermore, Louis XIV, French king, stimulated the luxury within its society which helped to boost the production. Consequently, France was the first region to be considered the capital of fashion and luxury, especially Paris. By the end of the XIX century, the beauty market turned itself into a capitalist industry. It was characterized by a range of prices, which changed due to the customer relationship established with each consumer on the department stores. The beauty business model back then had the goal to expand to more types of people, going to an international expansion, and go further on the type of products offered, such as powders, creams. As any other business, beauty was strongly dependent of the society and its political implications. World wars had relevant impact on the production and growth of the market. Nevertheless, some companies managed to survive and found an opportunity to advertise soap since “war” was associated with “dirt”. An example is Procter & Gamble, who enjoyed its first-mover advantage and capitalized on this product through advertisement and differentiated packaging (Jones, 2010).

The value of the beauty industry is estimated at 532 billion dollars and it is expected to reach more than 800 billion dollars by 2025, growing 5%-7% annually (Danziger, 2019). The constant change of lifestyle of the consumers, the increased of brands created, and the development of new ingredients contribute to the growth of this market. The cosmetics market comprises skincare, make-up, haircare, oral care, fragrances, toiletries, deodorants and generally, are mixtures of chemicals that enhance the appearance or smell of the human body (Rajput, 2016) being skincare the leading category as the most profitable (Shahbandeh, 2020).

The beauty industry is characterized as profitable, innovative, and fast-paced (Haddara, Hsieh, Fagerström, Eriksson, & Sigurðsson, 2020). The key to succeed in this market is to quickly create new products, satisfying to the needs and preferences of each consumer through the development of brand-new products, their replacement or their upgrade (Kumar, Massie, & Dumonceaux, 2006). Speed and flexibility act as the key factors to be effective on this market, alongside a constant consumer listening. Answering to customer's new preferences as early as possible and involve them in product development are critical to the beauty companies' success (Haddara et al., 2020). A quarter of all the beauty products are new or improved each year (Haddara et al., 2020). Furthermore, for the make-up category, the product lifecycle tends to be short due to the color variations that it has. On the other hand, soaps, facial products have a higher product life cycle. The industry needs to satisfy each consumer need fast in order to stay competitive (Kumar et al., 2006).

Compared to the previous century, the beauty industry has integrated innovation and digital transformation, improving its online presence changing their previous brick-and-mortar business model. Yet, 80.7% of global beauty sales are made in store, the research and discovery start online (Coresightresearch, 2019).

Beauty companies are leveraging their online presence with the purpose of raising awareness and, generate revenue in order to scale faster (Kestenbaum, 2019). With the global e-commerce phenomenon, brands have been also been launched exclusively online like Victoria Beckham Beauty (Barr, 2019). This means that the beauty market is following an omnichannel path which combines the benefits of offline and online experiences through websites, retailers, and stores.

Due to the growing size of the market (Rajput, 2016) and the fact that it is characterized by personalized services, there is a massive amount of data created every day and a strong need for recommendation systems (Shin et al., 2019). This amount of data that is being created is an opportunity to the beauty companies, as they have the ability to understand better the consumers, hear them, and engage with them, involving thus the consumers on product creation (Haddara et al., 2020). There are infinite needs of the consumer to be fulfilled, hence there is a strong need for effective personalization and targeted marketing strategies.

Technologies like AI have been infiltrating the industry over the past few years and are expected to grow in the upcoming coming years, with revenues increasing from around 9.5 billion U.S. dollars in 2018 to an expected 118.6 billion by 2025 (Liu, 2020) and its impact is likely to be most substantial in marketing as well as supply chain management (Chui et al., 2018). These technologies are mainly used by major corporations, government, agencies but the ones that better benefit from AI are services that are daily fueled by data like the beauty market (Shin et al., 2019). Most of the companies in beauty are already implementing AI on their strategies to stay competitive in the market. For example, Sephora had a revenue growth of 11% on the first quarter, after they launched the Sephora Virtual Artist, tool that allows customers to “try on” the products they want (Troyer, 2019) among other examples that will be studied throughout the empirical research.

The global investment for AI including Fashion, Luxury, and Cosmetics – is expected to grow to \$7.3 billion by 2022. These mechanisms on the beauty market are changing the way brands operate by providing 10x more efficient services (Avvocato, 2019).

3. Empirical Application

3.1. Empirical Methodology

This section aims to explain the methodology underlying the empirical part of this research.

3.1.1 Qualitative Research

Empirical academic research can be performed using qualitative or quantitative methodologies, or both. Quantitative research aims to quantify or measure a problem, using statistical or other type of purposefully gathered data. On the other hand, qualitative research has the purpose of understanding “why” and “how” within a context of a certain phenomenon (Hennink et al., 2020), and is often used when there are no data available, typically in tackling recent phenomena.

On this topic, there is no database available to draw upon, or any quantitative study to build a solid statistical foundation to enable a quantitative study. Adding to that, AI in the beauty industry is a novel and recent strategy and some companies are already testing these advanced technologies. However, there is not a general application to all the companies, which makes it harder to find patterns and quantify the research question.

According to Yin (2015), there are certain key factors that differentiate qualitative research such as to understanding a person’s role, representing their opinions on a given context and add value to contemporary situations through explanatory methodologies, through the use of different data sources (Yin, 2015). Given all these aspects, qualitative research appears as the best strategy to answer this research question.

3.1.2 Multiple Case Study Methodology

The methodology used in this empirical part of the dissertation, of a qualitative nature as justified above, will rely on case studies from the beauty industry. Paraphrasing Starman (2013), “*interpretative paradigm, phenomenological approach, and constructivism as a paradigmatic basis of qualitative research are closely linked to the definition and characteristics of case studies*” (Starman, 2013, p. 30). The analysis of case studies appears as the best strategy to answer research questions where its main goal is understanding “how” and “why”, allowing the researcher to enter an

undiscovered research area (Starman, 2013) and investigate the data on a certain situation (Zainal, 2007). The case study methodology has been widely used by academics, in particular in fields such as management (Starman, 2013).

To define a case study, is important to understand if the inquiry examines a *“contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”* (Yin, 1981, p. 97). Since this research aims to understand and explain how AI is impacting the beauty industry, or in other words, explain the knowledge utilization process, then the case study approach is the most adequate.

This methodology brings advantages such as the exploration of ideas, what happened, explain and deep dive on complex and unique situations. Furthermore, there is a freedom to collect a range of different sources of data, being essential to explore in-depth the case (Essays, 2018).

Due to all these conditions and the explanations above, the analysis of case studies was deemed the appropriate methodology to report on this emerging phenomenon.

After deciding that the empirical part of this dissertation should be based on the analysis of case studies, it was also decided that a multiple case study methodology should be implemented, in order to make the analysis richer and more representative of a diversity of strategies happening in the beauty industry – thus allowing for better addressing the research question. As Yin (2009) defended, using different case studies gives a more synergistic and comprehensive view of the issue being studied. Moreover, given that the industry under analysis is quite diverse, with multiple brands actively competing in the market, and implementing different strategies as will be developed subsequently. Even though the cases might be different, each case study should be analyzed in-depth and its compilation should be intended to be the foundation for further replication and confirmation (Yin, 1981). Adding to that, is important to find different companies, not only on their sector, but also on their business strategies so it may be possible to anticipate all of the scenarios and serve all of the points of view (Greene & David, 1984).

The construction of these case studies was based on the analysis of primary and secondary sources, explained in the section below.

3.1.3 Data collection methodology

The data collection methodology was based on the analysis of primary and secondary qualitative data.

In terms of primary sources, it was decided to gather data through interviews. The research interview is considered one of the most relevant strategies to conduct a qualitative data collection and it can provide a rich amount of data (Qu & Dumay, 2011).

This research will have the input from interviews to experts on the beauty area that are dealing with AI on their business strategies. Their functions are based on business development, data science, or any role that is intrinsically related to AI. The interviewees were contacted through LinkedIn and work e-mails. It was not an easy process as high level executives were targeted (s they are in charge of AI-related decisions), and the current context of the Covid-19 pandemic made the study much more difficult and challenging – implying that certain executives were very hard to contact and confirm. Still, the main companies of interest were interviewed.

The information from the interviews helped to define the scope of analysis and to map position the key case studies on the area under research. It was decided to use semi-structured interviews, as this type of interview involves systematic questioning (Qu & Dumay, 2011) - for example including questions that have a “likert scale” which will help the interviewer to map the importance of the areas under analysis. Plus, this type of interview includes open questions so the interviewee can complement the information obtained in questions with structured answer options. This type of approach is relevant since it allows the expert to share in greater qualitative detail their experiences which can be fundamental to develop the analysis and the scope of cases to be studied (Muylaert, Sarubbi Jr, Gallo, Neto, & Reis, 2014). This type of interviews appears to be the best strategy for this dissertation because it allows the interviewees to freely develop their ideas and their experience on the environment of the case study, enabling answers from their personal understanding of how AI is impacting the beauty industry (Qu & Dumay, 2011).

The data collection underlying this dissertation relies also on complementary secondary sources, in order to enrich the content and add value to the construction of case studies. With this objective, an in-depth analysis of publicly available content such as companies' websites, electronic articles, press releases, among other relevant sources, was conducted.

3.1.4 The survey instrument and its structure

The questionnaire purposefully designed for this dissertation is divided into three main parts: general information about the company, general questions at a corporate level, and specific questions for each case study. The complete and detailed version of the survey instrument can be found in Annex 1 to this dissertation. This part is a summary of the survey instrument underpinning the interviews.

- **General information about the company**

This part aims to obtain relevant information about the company such as: global headquarters, size of the company (regarding size of the employees and turnover from the last year), strategic business units, international spread, among others. This input will help to understand important aspects about the company and to draw some conclusions regarding its organization. Also, it will help to compare the different companies on how they are internally structured and key strategic geographical areas.

- **General questions at a corporate level**

This part is divided into four main sections related to, and being coherent with, the framework developed for the purpose of this dissertation mentioned on the literature review. They involve questions that evaluate technology as an enabler of digital transformation, collaboration, Big Data and AI. Given the interrelations between these areas, and the object of the present study and its reference to key literature reviewed, it was decided to organize this part of the questionnaire as follows:

- (a) **Innovation Process:** The questions will address how the innovation process flows in the mentioned company. These questions will ask if the innovation is done in-house or if it is outsourced, and it will help to understand if the company uses 'open innovation' on their strategies. Also, the questions on this section will address 'user

innovation' by asking if the company captures users' input, how they perform it and how they spot 'lead users'. The answers related to this part will explain how consumers are sources of information for the internal development of the company's strategy, and how they capture the data.

- (b) **Use of digital technologies:** On this section, the interviewee will tell which are the technologies being used by the company. The interviewee will evaluate its rate of use, its relative importance to achieve strategic goals, and which are the key performance indicators. This approach will help to understand how developed the company is in terms of advanced technologies and to what extent they are being used.
- (c) **Application of AI:** The questions will approach how AI is deployed across the company, the changes on the organizational structure and if it is a priority to integrate more AI projects in the future. The answers will help to understand how the company is handling with the integration of AI on their strategy, how employees are working and its impact on the company structure.
- (a) **Decision-making:** This section aims to understand how the decision-making flows in the company and how AI is impacting it.
- **Specific questions about the selection of a specific AI-related mechanism by the interviewed company**

This part of the questionnaire will help to understand some key aspects related to a chosen AI-related mechanism, in order to dive in detail in that particular case. The questions will address how the company found the opportunity to launch the mechanism/product, its process of implementation and how was the collaboration among all the agents involved. It will also address if was worthwhile to launch the project comparing to others that do not require AI, and on which measures. Furthermore, this dissertation tries to assess how and to what extent decision-making is/has been impacted by AI, and how the company will approach this area in the future.

3.2 Analysis of Multiple Case Studies

This section analyzes the case studies selected to answer this dissertation's research question. The cases were chosen to cover the diversity of the beauty industry.

On the business to business (B2B) side, we will analyze Perfect Corp, a company that provides beauty-tech solutions to the brands wanting to implement a digital strategy that includes AI mechanisms. The apps of the firm have already been downloaded 700 million times having a 60 million monthly active users (Shu, 2019). Among other achievements, Perfect Corp. won the Edison Award, created by Thomas Edison, which honors the leading innovations on a certain industry - on the Innovative Services Category this year (Awards, 2020). Their advancements in AI, AR and ML on the retail landscape were recognized alongside the progress of their main platform, YouCam, explained in detail in section 3.2.1.. The Senior Vice President and Chief Strategy Officer, Louis Chen, shared his insights on how the firm is dealing with AI on their strategy and their relationship with their clients – i.e. the brands that want to use these advanced technologies on their operational strategy.

On the business to consumer side (B2C), L'Oréal, one of the industry's leaders (Balon, 2019), was chosen. L'Oréal competes in the market with over 20 brands (L'Oréal, n.d-j). The case focuses on how L'Oréal is implementing AI strategies on their business, with the input of Jorge Sucena, Marketing Director of L'Oréal Portugal. L'Oréal has been shaping technological advances in the beauty industry, which led them to acquire for the first time a non-beauty brand, considered as the “*creators of AR tech for the beauty industry*” (Simsek, 2018). This integration allowed them to continue their digital acceleration strategy, giving them competitive advantage for being on the frontline of new advanced beauty-tech related technologies.

Adding to L'Oréal, on the B2C side, this dissertation will analyze PROVEN, considered as the “Tesla of skincare” (DeAcetis, 2020), a company that has the largest skincare database and with the input from the consumer, matches their data, creating an unique and customized products using AI and ML mechanisms. The researcher tried to contact several managers of the company through LinkedIn and e-mail, but with no response to enquiry. This case study, deemed very important for the purposes of this dissertation, will be based on secondary sources such as website information, press releases, published interviews, among others.

3.2.1 Perfect Corp.

- **Background on the company**

Perfect Corp is a technological company founded in 2014 by Alice Chang (Crunchbase, n.d-a). Perfect Corp. is owned by CyberLink, a digital media software developer (Shu, 2019). It employs 230 workers across the globe and does not disclose turnover numbers (Chen, 2020). The firm operates on the beauty industry and provides technologies mainly focused on AR and AI that aim to disrupt the consumer beauty journey (PerfectCorp., n.d-a). Their global headquarters and R&D centers are in Taipei and they have global teams spread around the world. Perfect Corp is present on 11 countries with global sales and support offices, but the most important ones are in New York, Tokyo, Shanghai, Paris, and Taipei (Chen, 2020).

- **Technology as an enabler to Digital Transformation**

Perfect Corp. offers consumer-centric solutions in order to better understand and adapt to every consumer needs on an omnichannel approach with the use of advanced technology. The technologies developed by the company have changed the way brands and retailers interact with beauty consumers, both in store and digitally, through the integration of cutting-edge precision analysis and recommendation tools creating interactive journeys to every type of consumers (PerfectCorp., n.d-b).

The creation of those technologies requires the usage of internal mechanisms and digital tools. Louis Chen, when asked, stated that User Social Networks, Virtual Reality, AR, Cloud Computing and ML are the most used and the important ones to achieve strategic goals. The manager also added the importance of processing large amounts of data, and that capability is also of extremely use and achieve their strategic goals. In terms of measurement of these tools, or, in other words, Key Performance Indicators (KPIs), Louis Chen focused his answer on the importance of the accuracy and the speed of the platforms/services. These two KPIs are the key factors that give the end-consumer a better experience, and successfully use the applications (Chen, 2020).

However, the interviewee mentioned that it is important to analyze these KPIs and integrate them on an overall value proposition. The value accrued from the technologies stated above is based on solving the problems of the consumer. The brands that apply these technologies

on their strategy look at the improvement of sales, average basket size, conversion rate, return rate, among others in order to assess the performance of digital tools (Chen, 2020).

Concluding, Perfect Corp. analyzes the technological value on two different ways. They aim to deliver the most accurate and fastest resource to their consumers, in this case, the brands that want to integrate their beauty-tech solutions. Adding to that, they also rely on e-commerce KPIs from the brands so they can understand if there is a window of opportunity to improve their performance as well (Chen, 2020).

- **Collaboration and value exchange between different stakeholders**

Perfect Corp is at the intersection between consumers, content creator's beauty brands and retailers that are interacting together by introducing cutting-edge products such as: virtual try-ons, skincare diagnosis, in-store consultation, between others (PerfectCorp., n.d-a). The company has strategic partnerships with major retailers such as Alibaba where they can improve new virtual try-outs to Chinese consumers with the use of YouCam, their main platform (Perfect Corp., 2019a).

Perfect Corp offers its services to beauty companies and retailers, but consumers are also part of their target market. YouCam Makeup, YouCam Perfect, YouCam Video, YouCamNails, YouCamFun are apps that engage directly with the users through selfies retouch, try-on of different products, applying accessories, among others, without involving the brand, original concept of Perfect Corp. (Corp., n.d-b). However, on Youcam Shop, users can select from a range of products which are the ones they want to try before buy and purchase them directly in-app (Corp., n.d-d).

The devices that support these apps have been evolving over the past years too. Louis Chen mentioned the importance of the release of new features on smartphones. A great example is the integration of advanced cameras. For the Perfect Corp. leader their innovation is driven by the advancement of those technologies itself. At the company, the department in charge of the innovation, analyze the technology and find an application for it, counting with the inputs from other teams such as marketing. They prototype and then test with the brands if it's usable in the beauty market or not (Chen, 2020).

On the other hand, innovation comes from the brands. For example, they produce a new serum and want to create a technology to go together with the product. They approach Perfect Corp. and discuss between themselves the best solution and, sometimes, they combine different APIs with the input from the brand as well (Chen, 2020).

Even though their innovation is exclusively in-house, counting with a team of 150 developers, the company relies on brands' feedback that are also translated from end-consumers feedback, to improve their platforms or create brand new solutions derived from the demand side. There is a strong collaboration, between the brands and Perfect Corp., to achieve results (Chen, 2020).

- **Big Data and value generation**

The interaction between the users and the platforms provided by Perfect Corp. generate heavy amounts of data. According to Louis Chen, the firm daily processes almost 1 terabyte of data, internally managed by a Big Data CRM (Chen, 2020).

Louis Chen said that one of key challenge is to get user consent to collect the data and for how long, since they don't need the data forever. Heavy encryption, protection, anonymity are essential to collect the data generated, reinforcing that they're interested in a bulk of data and not on individual requests (Chen, 2020). Perfect Corp. holds a Big Data CRM from multiple touchpoints, such as mobile devices, from essentially end consumers like millennials and gen-z users. This data is analyzed and used to understand consumer behavior, trends, among others. Brands can also, use this past data to leverage their marketing campaigns, for instance (Chen, 2020)

- **AI and its relation with the three major concepts highlighted: technology, collaboration, and Big Data**

The technological solutions from Perfect Corp. are AI driven. Their core product, YouCam, uses deep-learning algorithms alongside AR technologies to provide an immersive experience to the consumer (Corp., n.d-a, n.d-c). According to Louis Chen, the YouCam AI solution is their hero product, where users can test virtually their make-up before buying it, both on desktop and on mobile. More than 200 brands are already using this solution to provide advice. According to a statement released by the company on July 19th, where they launched

the app for web, this technology *“boost consumer confidence, increase user engagements, click-through-rate, and sales conversions for ecommerce, and furthermore decrease returns”* (Corp., 2019b). This tech solution is integrated on brands’ e-commerce website, giving them the flexibility to setup, manage and track its results (Corp., 2019b).

One of those brands is Johnson & Johnson. They announced this year the first-ever AR virtual contact-lens (Corp., 2020). This platform is available at TaoBao (e-commerce giant in China, owned by Alibaba) and WeChat Mini Programs (sub-features that can be e-commerce related within WeChat ecosystem – Chinese messaging app). This is an example that Perfect Corp. is exploiting products beyond the traditional cosmetics categories’ and entering new segments using AR and AI technologies. This brings great advantages like a reinforcement of brand loyalty and a more complete consumer journey (Corp., 2020).

On the interview, Louis Chen stated that AI is extremely important being the only way to be transformative not only with the consumers, but also internally. The leader affirmed that the integration of AI brought operational changes. One of them is the relationship between the machines and the humans. At Perfect Corp, they have the philosophy that these mechanisms won’t replace humans, but rather augment their intelligence, by processing heavy amounts of information, identify patterns, specific user needs, among others, with the main goal of making better decisions (Chen, 2020).

- **YouCam - platform selected for a deeper analysis**

As briefly explained above, their hero product is YouCam, a digital platform where users can virtually try-on different products, see on the moment how they would look like, and edit their photos. This idea was driven by the evolution of the smartphone, where they launched an app that enhances selfies. There were many users downloading the app and the team found an opportunity to apply these mechanisms on the beauty industry. According to them, consumers want to easily try-out products, new shades in order to enhance their natural beauty and YouCam was a solution to act as a real-time magic mirror (Chen, 2020). On an era where there was no evident exploration of these technologies, YouCam was launched in 2014 expanding their services beyond selfies enhancement to e-commerce and retail, pioneering the way on beauty-tech (Industry Global News24, 2019). Brands and retailers

such as Estée Lauder and Target have already integrated YouCam on their business strategy (Shu, 2019).

The launch of YouCam opened a door of AI possibilities and opportunities to Perfect Corp.. Louis Chen affirmed that projects integrating AI mechanisms compared to projects that don't require AI are more effective in terms of performance, sales, among other indicators such as Best Consumer review. In terms of value measurement, Louis Chen stated that the future potential of the technology, or, in other words, how much growth it can bring in the long-term is the key indicator of the success of the platform. (Chen, 2020).

- **A synthesis of the case study**

Perfect Corp. is a technological company focused on the beauty industry that has been disrupting the market on the past years. They are constantly testing and launching new features with key strategic partners with innovative services, covering the demands of the market. Their focus on serving their clients' needs, both brands and end-consumers, and the constant technological development are the key factors to succeed on a fast-paced industry like beauty.

The input from Louis Chen allowed to conclude that keeping up with the latest digital trends, especially, software updates, the strong reliance on consumer feedback, and the collaboration amongst project managers and all the agents involved, are extremely important for the process of innovation and consequently, for decision-making.

The mechanism selected for deeper analysis, YouCam, was one of the first examples of AI applied to the beauty market, where consumers were able to envision themselves trying-on make-up virtually, without going to the store. It was a success and now, this platform is available for brands to integrate on their business strategies, scaling its digital presence.

Concluding, for Perfect Corp., AI is essential to open new doors of possibilities, regarding their business and on the beauty industry itself. In terms of effective performance and other indicators, Louis Chen states that projects that integrate AI are worthier than projects that do not involve AI. The leader considers that integrating AI in their decision-making process is a critical topic and it is part of their core strategy.

3.2.2 L'Oréal

- **Background on the company**

L'Oréal is considered as a “*giant*” on the beauty industry (Boone, Kurtz, & Berston, 2019). Founded by Eugène Schueller in 1909, L'Oréal operates on manufacturing and selling cosmetics. Headquartered in Clichy, France, the company acts across the world, being one of the leaders on the industry (Forbes, 2020).

L'Oréal has five strategic business units: Professional Products Division, Consumer Products Division, L'Oréal Luxury Division, Active Cosmetics Division and Travel Retail Division. The Professional Products comprise the following brands: L'Oréal Professionnel Paris, Redken, Kérastase, Matrix and Pureology. This division creates haircare products and handle the relationship with hairdressers around the world. With more than 250 training studios and 1,5 million partner hairdressers, this segment has already transformed more than 36000 salons through their training programs, enhancing the importance of the close collaboration between the haircare professionals, the brands that operate with them, and the consumers (L'Oréal, n.d-k). The Consumer Products division offers a wide range of products using a mass market retail strategy, making them accessible to all types of consumers. This segment comprises L'Oréal Paris, Garnier, Maybelline, NYX, Dark and Lovely, Niely, among others. These brands covers different categories such as haircare, make up, skin care and are essentially sold on supermarkets, drugstores, and through online e-commerce platforms (L'Oréal, n.d-c). The L'Oréal Luxe segment aims to offer luxury products providing unique experiences. This division has 26 brands such as Lancôme, Giorgio Armani Beauty, Ralph Lauren, among others, where 17 of them are global brands (L'Oréal, n.d-i). The fourth division is Active Cosmetics and it is strictly related to dermocosmetic skincare products. This segment works closely with professionals on the health area being distributed across pharmacies, drugstores, among others (L'Oréal, n.d-a). Lastly, and considered the “6th continent”, Travel Retail Division is focused on selling the products mentioned above to travelers that cross airports from all around the world. This division aims to exploit the curiosity and the needs of the global consumers, that want to try the newest releases alongside innovative ways to buy (L'Oréal, n.d-h).

The divisions mentioned above contribute to a global turnover of 30 billion euros, being present in all continents, on more than 130 countries. However, their biggest areas regarding turnover are China, United States of America, Brazil, France, Italy, Germany, Spain and United Kingdom. In terms of innovation, their R&D centers are mainly focused in Paris with research hubs in North America, South America and Asia (Sucena, 2020).

- **Technology as an enabler to Digital Transformation**

The consumer behavior has been changing for the past years since expectations have been evolving and information flows fast. To meet the consumer demand, the time to market needs to be shorter, constantly adapting to new trends. At L'Oréal, technological changes were made so they could stay agile in a fast market, introducing industrial development on the different stages of each process regarding technology, product, logistics and manufacturing. The adaptation to Industry 4.0 era had the main goal of introducing new digitized strategies that allowed the company to decrease the time to market. One example was on the production facilities, where L'Oréal integrated intelligent mechanisms that collaborate with the employees simplifying the processes overall (L'Oréal, n.d-f).

Jorge Sucena, Marketing Director of L'Oréal, reinforced that, at L'Oréal, there was an awakening on the past decade regarding consumer behavior. The company had to adapt to this new reality, introducing a digital transformation strategy that have been accelerating on the past 5 years, focusing on 3 main areas: e-commerce, relationship with the consumer, and the way the company invests media (Sucena, 2020).

In order to meet consumer expectations, there are digital technologies that enable the relationship with them, alongside the creation of products and services. Jorge Sucena affirmed that in terms of the usage and importance to achieve strategic goals, user social networks are essential for all the brands, where they focus part of their investment on them. Also, ecommerce is essential since it has been accelerating on the past years, and due to the pandemic they grew on this channel too (Sucena, 2020).

The L'Oréal leader explained that hardware applied to the consumer is also part of this transformation, such as 3D Printing that will be relevant both internally, industrial level, and in-stores in the long-term. Jorge Sucena also reinforced that there is an opportunity to skin

analysis portable devices in order to be able to have information about personal usage (meteorological statistics, the places the consumers visit, times of the year) and cross it with their own data in order to assess the performance (Sucena, 2020).

When asked about the most important KPIs, in terms of understanding the values of the digital technologies mentioned above, Jorge Sucena says it is the volume of first-party data of the consumer. The leader explained that it is a way of understanding better the consumers and with the diagnosis provided by the services L'Oréal has, how it impacts e-commerce KPIs such as conversion rate (Sucena, 2020).

- **Collaboration and value exchange between different stakeholders**

As mentioned on the literature, the collaboration between different key stakeholders is essential to be digitally transformative. This means involving the company, consumers, and suppliers on their operations and extract the most value out of it to apply on the innovation processes.

Jorge Sucena focused his answers about the innovation processes on the product perspective, stating that theirs is developed in-house. However, they rely on some suppliers regarding molecules and sustainable packaging. With the acquisition of ModiFace (explained on the section below about AI), L'Oréal was able to integrate their know-how, having the ability to improve some technological processes and develop beauty-tech solutions (Sucena, 2020).

There are two product-centered innovation processes at L'Oréal. Firstly, the advanced investigation deals with technological platforms to identify future molecules and, new future technological platforms. Secondly, the applied investigation occurs on a reversed perspective: the internal teams analyze the market needs, and then brief the applied investigation teams accordingly. Then, they can create new formulas or adapt to existing ones (Sucena, 2020).

The manager reinforced that data is a factor that is important across the innovation processes: primary data, beauty needs, personal preferences are essential to brief the investigation teams' on product development (Sucena, 2020). This means that the usage of these digital platforms and the interactions among consumers, allows to find opportunities on the beauty market, or in other words, consumers are indirectly innovating.

Furthermore, once a year, L'Oréal sponsors the 'NEXT Challenge' where brands teams' are challenged to create a new marketing campaign for a product, where creativity is more evaluated than sales turnout. The winners receive a cash award and professional training across the world. The challenge within the teams allows them to interact and exploit their creative potential, recommending ideas that can be potential of value to the company, giving the opportunity to internal employees who're not directly related to innovation matters to pitch their ideas (Ariel, 2018).

Even though L'Oréal's product innovation is done in-house, they have a program entitled "Open Innovation program", dedicated to establishing connections with beauty-tech start-ups. The company benefits from ground-breaking innovations and the start-ups learn with their expertise to accelerate and scale their business. The program has strategic partnerships with relevant entities such as Station F, the world's biggest startup campus. The Beauty Tech Atelier is established within their facilities, where the start-ups work and enjoy the synergies with other tech start-ups. The Founders Factory supports the program as well, where they help start-ups to accelerate their businesses. Lastly, they count on one investment partner, Partech Ventures (L'Oréal, n.d-g).

The Open Innovation program develops two types of initiatives. Beauty Products and Devices Start-ups focuses on growth and learning, where is possible to create cohorts within their entrepreneurial ecosystem, such as access to Station F and mentoring. Secondly, the program promotes the acceleration of digital services and tech startups, giving them the opportunity to integrate their projects globally at L'Oréal (L'Oréal, n.d-g).

- **Big Data and value generation**

These technological interactions between consumers and brands create data interchanged across digital platforms. Consumers are willing to share personal details if used to create value for themselves whether in personalized suggestions or better brand experiences. L'Oréal captures, uses and stores data in order to improve their processes and meet better the consumers' expectations with more precision, sharing it internally to relevant teams, specially the one in charge of Research & Innovation (Schiffer, 2020).

The increased daily amount of data created is a window of opportunity to L'Oréal since it gives more information about consumers' preferences, their shopping behavior, relationship with partners, among others. However, this exchange brings ethical challenges that the company overcomes since there is a constant need of transparency and protection when asking for data (L'Oréal, n.d-d) giving them freedom to opt out when they want to (Schiffer, 2020). L'Oréal believes that these factors are essential to build relationships with consumers, employees, and partners (L'Oréal, n.d-d).

Currently, L'Oréal collects 1,3 billion of different data touch points from consumers (Joseph, 2020), processing 50 million pieces of data per day (Manufacturer, 2019). In order to tackle the amount of data created every day and store 100 years of product development research, L'Oréal joined forces with Talend, cloud data integration company, to build a data lake in a private IaaS (Internet as a Service) environment on Microsoft Azure (infrastructure that uses cloud computing). This data lake is a repository that integrates all types of data sources, combining all databases, and raw data such as images or even robotics metrics (Combs, 2019). The Research & Innovation team, in partnership with Talend, allows the connection of all types of data sources from IoT, marketing, finance on a real-time basis, counting with intelligent algorithms that integrates directly the data flows using API's (Menear, 2019).

This data strategy gave L'Oréal a centralization of all data sources which also allow to create algorithms to facilitate the employees involved on these processes such as Data Scientists and Analysts, helping them on making decisions using high-quality decisions (Menear, 2019). L'Oréal created an environment that harnesses the power of Big Data, using advanced analysis, making them more agile to create innovative products and respond better to consumer demand.

- **AI and its relation with the three major concepts highlighted: technology, collaboration, and Big Data**

L'Oréal is reinventing beauty using advanced technology to innovate. The company believes that science and technology are enablers of efficiency, inclusivity, and effectiveness. Through research and innovation, L'Oréal has two main ambitions: commitment to a more sustainable world by integrating green strategies using the experience of biologists, biotechnologists on

their processes and products and offering more personalized products to respond to the consumers' needs using advanced technologies such as AI (L'Oréal, n.d-b).

The company has been integrating this tech-oriented strategy for the past decade. Since 2012, L'Oréal created the Technology Incubator within the Research and Innovation department, an internal start-up aiming to combine the beauty expertise with advanced technological solutions to keep up with the increased demand of personalized experiences and products (Culliney, 2020). The company was one of the first to enter the beauty-tech market (Redrup, 2019), where they spot a huge opportunity on customization: 52% of young women from 13 and 36 year old would like to have their own beauty products, personalized by themselves (Schiffer, 2020). The Technology Incubator has a team of physicists, engineers, data scientists, among other specialists and are spread across the world at offices in New York, New Jersey, California, France and Japan (Incubator, n.d).

In 2014, they launched the “Makeup Genius” where it used AR to engage with consumers on trying shades of make up using their mobile devices. Once the consumers find the perfect shade, the app gives options to buy the product on that moment. On these interactions, L'Oréal can collect multiple data points such as skin tones (Sheep, 2018), tastes, and based on that assortment, the app recommend products that match the consumers' needs (Markets, 2018). From then, the firm have been launching new technologies, at least once a year (Redrup, 2019). Jorge reinforced that virtual try-ons of make-up strengthen the relationship with the consumer, increasing their conversion. The usage of these solutions, besides engaging with the consumer gives powerful information to the company, since the teams are given valuable info and can find opportunities in the consumers' results (Sucena, 2020).

In 2018, the company acquired a tech company for the first time, ModiFace, leader in AR and AI exclusively focused on the beauty field. This acquisition aims to integrate advanced technology in the L'Oréal strategy, using the expertise of engineers and scientists, providing enhanced experiences to the customers such as virtual try-ons, voice services, and new devices (for example, “Perso”, launched in 2020). The full integration of ModiFace within L'Oréal business strategy allowed them to gain an advantage over its competitors due to in-house synergies (Biron, 2018) and the ownership of diverse patents (Carman, 2018). Modiface have been actively within L'Oréal ecosystem such as retail and advertising partners.

This integration allows to, whenever they have the opportunity, target better the consumer and instantly show the results when using the services (L'Oréal, n.d-e). Jorge Sucena enhanced on his interview the importance of L'Oréal's digital acceleration strategy with the integration of ModiFace. The innovation processes of the company are now improved with their know-how and information that they can extract from their diagnosis tools (Sucena, 2020).

In order to keep up with the speed of the consumer demand and create products that are valuable to them, tech innovation is the solution to answer to this challenge (Culliney, 2020) and L'Oréal Tech Incubator is in charge of designing new approaches to the consumer giving them control on how they personalize their own products (Joseph, 2020).

The market is fast-paced and growing, is full of beauty-tech solutions from brands like Estée Lauder Companies, Shiseido, among others. L'Oréal spotted a continuous bet on AI related solutions and increased investments on digital technologies on other beauty companies and made a bold move in order to stay relevant in the market (Schiffer, 2020).

Jorge Sucena stated that, in general, the use of AI depends of the job roles and of the regions (if it's headquarters, regional offices, among others), considering that it is essential to continue to integrate AI as a data analysis tool and service provider to the consumer in the future, alongside a strong relationship with Big Data.

- **Perso – device selected for a deeper analysis**

In January 2020, L'Oréal launched Perso, a physical device that allows the consumer to create their own products on demand. The equipment has an AI mechanism which gets smarter over time with the increase of the storage of user data and their personal preferences (L'Oréal, n.d-l). This device will provide even more data than the usual product interactions, once it will record all of the products formulas created by the consumer (Joseph, 2020).

The use of Perso requires the download of an app that will allow the consumer to take a photo and it will automatically analyze their skin characteristics, such as fine lines, wrinkles, among others. Adding to this, this app partnered with BreezoMeter, a firm that gives information about the air conditions, UV rays, weather, humidity using geo-location data.

Finally, the consumer can select some personal skincare concerns that they want to tackle, and the device creates the product accordingly (L'Oréal, n.d-l). This strategic move differentiated L'Oréal from other beauty companies that use customization as their strategy. For example, PROVEN creates custom products through their online platforms (more information about their strategy on the section 3.2.3) and delivers them according to their personal tastes and environmental factors. However, it takes time to create the product, ship and deliver it, proposition that L'Oréal wants to change with Perso: instant creation of the product, in under two minutes (Schiffer, 2020).

The launch of Perso is set for 2021 and it is expected to be a skincare leader on the official debut from the L'Oréal brand portfolio (L'Oréal, n.d-l). Jorge Sucena affirmed that since the device is not in the market yet, it is hard to draw some conclusions regarding its performance, sales, consumer reviews, or other valuable business KPIs. It is hard as well in terms of project management to assess the team performance, time management, among others. However, the leader believes this is the future of cosmetics (Sucena, 2020).

- **A synthesis of the case study**

L'Oréal, as mentioned above, is a giant amongst all its competitors in terms of technological and product innovation. Covering different segments of consumers on their 5 strategic divisions, the company acts worldwide targeting efficiently their geographical operations.

The acquisition of ModiFace was a milestone since L'Oréal fully integrate technological innovation processes on the company in order to be on the beauty-tech frontline. They were able to integrate edgy technological expertise and transforming them in valuable products, services, and platforms, aiming to meet consumer expectations. Their innovation is exclusively in-house; however, they have some programs that allow external experts to share their ideas and exploit new talents.

L'Oréal recognizes the importance of Big Data management for the development of new products and services too and did a strategic partnership with Talend in order to harness its power and deliver valuable insights across their value chain.

Perso was a major step for L'Oréal since it enabled them to be on the frontline, once again, of hardware beauty-devices, anticipating future technologies and exploring the power of beauty on demand. The device is not yet on the market, so there are no proven results of their performance. However, for L'Oréal is the future of cosmetics.

Concluding, L'Oréal and AI technologies are aligned to give the best consumer experience and on internal processes. According to Jorge Sucena, there is a window of opportunity to grow on AI mechanisms to support decision-making in the future.

3.2.3 PROVEN

- **Background on the company**

Proven is a cosmetics company that develops customized products for each consumer. Considered as the “The Tesla Of Skincare” (DeAcetis, 2020), the company was founded in 2016 and launched in 2019 by Ming Zhao and Amy Yuan, headquartered in San Francisco, United States (Crunchbase, n.d-b). The founders faced personal skincare issues and the solution to their problems were hard to find. Starting as a personal mission, the founders, with a background in business strategy and science developed “The Skin Genome Project” (PROVEN, n.d). This project, winner of MIT’s 2018 AI Award, is the largest skincare database that includes ingredients clinically tested, excluding bad chemicals. Due to the huge amount of data generated, the founders found an opportunity to analyze them and find patterns between the ingredients and the type of skin of the consumer (Taylor, 2018).

- **Technology as an enabler to Digital Transformation**

At the core of the company was the need to find an effective solution to tackle the difficulty of treating the diversity of skincare. PROVEN is a tech-first company and always had been as it had a strong technological background from the very beginning. The company relies on AI mechanisms, such as ML, to operate (Taylor, 2018). This means that the adaptation for a more digitized environment was a natural process since they already implemented a digital transformation approach at its roots.

- **Collaboration and value exchange between different stakeholders**

The online research for this research was exhaustive but there is no official source stating how PROVEN conducts their process of innovation. However, there are some conclusions we can draw from news, articles, and other sources such as their website.

PROVEN, as mentioned above, has its business roots on AI, ML and Big Data. The co-founder, Amy Yuan, created from scratch the largest skincare database comprising data points from different sources and the technological requirements behind the business. One can conclude that the process of implementing the innovation was in-house using Amy's expertise and digital tools, such as ML algorithms to deep dive into the data and find relevant patterns that solve the skincare problems of the consumer. This means that the founders did not use an open innovation strategy to put the business in practice.

However, when entering PROVEN's website, the consumer needs to fill out a quiz, where it asks for personal preferences, skin conditions and their situation. This means that they are inputting the data and feeding the database. When feeding the database, the ML algorithms get smarter over time and improve the recommendations with the supervision of the dermatologists of the team. One can conclude that the user is contributing to the process of innovation indirectly, not being actively involved on it.

- **Big Data and value generation**

PROVEN started its business with a strong foundation on a Big Data strategy, created by Amy Yuan, CTO and co-founder. She created the largest skincare database, "The Skin Genome Project". It comprises over 8 million reviews, the effectiveness of more than 20 000 ingredients, and meteorological data where the consumer lives, among other relevant data sources such as information of 100 000 products and academic publications (M. Zhao, n.d).

- **AI and its relation with the three major concepts highlighted: technology, collaboration, and Big Data**

PROVEN, as referred to above, has an AI technology combined with an efficient ML capability. In addition, the company partnered with a skincare expert, considering the analysis of the data on the "Skin Genome Project" for the consumers to create unique solutions. The website has a quiz entitled "PROVEN's Skin Assessment", where the consumers select their

concerns, the level of sensitiveness, hours of sleep, the location, among others (Taylor, 2018). These interactions between the consumer and the website allow the ML algorithms to go through their database and determine which are the ingredients that are addressing the individual skincare concerns of each consumer creating a unique formula for the consumer. The consumers are then faced with a regimen highly personalized to their skincare issues and they can maximize their time when searching for products, giving them the control, and reducing the uncertainty.

- **A synthesis of the case study**

PROVEN is a company that creates customized products using the largest skincare database, the skin type of the consumer and personal preferences, proposing a 3-product regimen to the consumer. By answering a questionnaire, the company is able to effectively personalize the beauty routine of the consumers. This brings great advantages once consumers do not spend their time trying out the perfect formula for them.

The company has at its core a strong ML and Big Data structure that enables them to provide the best solutions alongside the expertise of dermatologists who contribute to create and analyze proposed patterns. One can conclude that their innovation process is closed. Nevertheless, the consumer is indirectly being part through the share of data and personal preferences, improving the ML algorithm.

3.3. Conclusion

This dissertation aimed to answer the research question *“How is AI impacting the beauty industry on making data-decisions?”*. By analyzing the topics in depth through a thorough literature review, and analyzing in as much detail as possible three different and complementary case studies, this research contributes to the scarce literature available by providing new insights about the impact of AI on beauty companies. Furthermore, an original conceptual framework was created to map and clarify the relationship between Collaboration, Big Data and Technology to explain the digital transformation of the sector and the emergence of AI.

The beauty industry has been evolving throughout the past decade essentially due to the integration of new technologies and the change on consumer shopping behavior. Beauty companies have been integrating digital transformation on their business models to create the best shopping experience, so they can meet consumers’ expectations and fulfill their needs. Furthermore, this digital transformation has also the main goal of changing internally the processes, generating more efficiency and creating more value along the value chain.

AI has been entering this industry, providing new ways of engaging with the consumer, bringing efficiency and tailored solutions to the beauty client. Both online and offline, the companies have been integrating advanced technologies to stay competitive in the market and find opportunities to improve their shopping experiences, expecting results not only in sales but also in processes efficiency.

The world is facing a pandemic during the past months and it has impacted all the sectors. The beauty market is no exception and the reality the beauty consumer was used to have now changed. Due to health concerns, the consumer cannot try the products offline. Despite being a world crisis, is now an opportunity for beauty brands to increase their investment on digital solutions to fill in this gap. All the related AI mechanisms can offer clear advantages on this domain, exploring new ecommerce solutions and online engaging experiences.

The Coronavirus pandemic also affected the way this research was conducted as it made difficult to contact managers and to obtain their answers to the questionnaire underpinning this research. Even with this considerable and unexpected difficulty, this dissertation bases

its conclusions on three extremely relevant and different case studies of companies impacted by AI: Perfect Corp., L'Oréal and PROVEN.

This extensive research made possible to draw some conclusions intrinsically related to the original proposed framework:

- **Technology is indeed an enabler to digital transformation** – The beauty companies are directly affected by how the technological software and hardware evolves and need to stay on top of all the trends in order to stay relevant and be competitive in the market. Especially for firms that provide beauty-tech solutions such as Perfect Corp., their business is impacted by all the latest tech features - given that they need to be particularly agile, implying always improving their KPIs on precision and speed.
- **Collaboration is essential to interchange and increase value** – The innovation process towards digital transformation demands the interconnectivity of all agents involved. On one side, the participation of the users is being increasingly more important since they are now more informed, and their expectations are higher. The brands need to communicate and be transparent asking actively for feedback, example of L'Oréal and PROVEN. On the other side, beauty brands and beauty-tech companies need to fully exploit the value of their usage to create custom products that meet those expectations and deliver engaging experiences to them.
- **Big Data management is essential and a critical factor to the technologies' success** – Data capture and storage is nowadays critical to all companies on the beauty industry. The management of the consumers' data using advanced technologies enables the companies to understand consumer behavior, their preferences, affecting their demand and supply. Some companies rely on strategic partnerships to deal with this data like L'Oréal to fully explore their expertise and efficiently manage their data. PROVEN is another proven example of the power of harnessing Big Data on providing personalized products without needing the direct intervention of other parties, maximizing the time of the consumers. However, there

are still some concerns on the consumer side to share their data, challenge that these companies have been trying to achieve.

- **AI is the biggest window of opportunity to the beauty industry** – The three key concepts highlighted above serve as the foundation to explain the importance of solutions like AI to fully exploit the digital transformation beauty companies face today. Some of them are already applying AI but, right now, is the time to scale and drive innovation on the sector, amidst this pandemic. Offline virtual experiences provided by beauty tech suppliers (YouCam from Perfect Corp.), devices that produce beauty products on demand (Perso from L'Oréal) and creation of personalized products (PROVEN) are examples that the industry is part of the digital transformation.

Concluding, AI offers multiple advantages and there is still an opportunity to grow. Companies are relying on these mechanisms to make decisions based on data, to give the best experience to the consumer, introducing new ways of engaging virtually. The decision-making process overall depends on the type of the companies. Beauty-tech suppliers like Perfect Corp., are extremely influenced by AI to take corporate decisions. However, beauty companies like L'Oréal are influenced but expected to be even more in the future. This means that AI is not fully explored and used on the beauty product side, contrarily to technological companies.

Despite these contributions to the scarce available literature, there are limitations of this research. It is an emergent topic which is constantly changing due to market oscillations regarding consumer needs and technological evolvement, making all the analyses tentative and at best speculative. Moreover, as there are no statistical and qualitative databases that would enable a better analysis of the proposed research question, we were circumscribed to the information given by few interviews and secondary sources. For that reason, we are conscious that the results of this research, albeit making a tangible contribution, should not be taken as fully generalizable for the whole of the beauty industry.

This research points to promising additional research avenues. Further questions for research could be, for instance: the beauty on demand devices (such as Perso) will be cost-effective to the consumer? Will beauty companies base their decision-making only on AI outputs?

Will the beauty stores disappear due to the pandemic? Will the consumers continue to share their data?

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Annex 1

Questionnaire

Interviewer: Catarina João Vieira

Interviewee: _____

These answers are confidential, and they will only be used for the statistical analysis of this dissertation. If you feel uncomfortable with some questions, please let us know.

PART I: General information about the company

• Name of the company:

• Global Headquarters:

• Foundation year

• Description of activity/ sector/ subsector

• Size of the company:

Number of employees worldwide	Turnover (last available year) or average 3 last available years
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• Strategic Business Units

• International spread in terms of turnover (both in countries and regions)

• Number of factories worldwide, location and which is the most important?

- Location of the R&D Centers

- Other type of affiliates (regional headquarters, offices locations?)

PART II: General Questions at a corporate level

(A) Innovation process

1. Can you please characterize the innovation process in your company?

2. Innovation is developed in your in-house centers?

- 1 – Not at all (all out sourced);
- 2 – Mostly out sourced;
- 3 – About the same in-house/outsourced;
- 4 – Mostly in house;
- 5 – Exclusively in-house innovation

3. If it is all outsourced, mostly outsourced or about the same (option number 1, 2 or 3), which are the entities that are contributing to the innovation processes? (You can choose more than one and please rate the relative importance)

Entities	Yes/No	Importance (1- Not Important, 2- Slightly Important, 3- Moderately Important, 4-Very Important, 5-Extremely Important)
Start-ups		
Private companies		
Universities		
Consumers / Users		
Others		

4. How do you capture user' input? You can choose more than one and please rate its relative importance.

Capture of user data	Yes/No	Importance (1- Not Important, 2- Slightly Important, 3- Moderately Important, 4-Very Important, 5-Extremely Important)
Through data capture and storage		
Through customer support		
Through interactions on physical points of sale		
Through interviews or focus groups		
Through questionnaires		
Others		

5. Can you please elaborate on how you capture and store data, if one of your answers was *“Through Data Capture and Storage”*?

6. Through these interactions, who do you think that are **lead users** (*“users who feel today strong needs that will spread into the rest of the market months or years later: they get significant benefit from products that propose solutions corresponding to these needs that are unsatisfied by the market”* (von Hippel, 1986) (You can choose more than one)

- Celebrities
- Influencers
- Identification through online communities (forums, website reviews, user social networks, etc)
- Identification through reviews on the website
- Others

7. If you identify them through online communities, how do you get to them?

(B) Use of digital technologies

8. What are the digital technologies that your company is using nowadays and their relative importance to achieve strategic goals? (You can choose more than one)

Usage of Digital Technologies	Yes/No	Usage (1 – Not at all, 2 – To a little extent, 3 – To a moderate extent, 4 – To a large extent, 5 – To a very large extent)	Importance to achieve strategic goals (1- Not Important, 2- Slightly Important, 3- Moderately Important , 4-Very Important, 5- Extremely Important)
User Social Networks			
Ecommerce			
CRM – Customer Relationship Management			
AI			
Virtual Reality			
AR			
ERP – Enterprise Resource Planning			
Cloud computing			
ML			
Robotic Process Automation			
Others			

9. How do you measure the value accrued through the usage of digital technologies? Do you have any Key Performance Indicator (KPI) that measure its performance?

10. Is AI an important part of your business?

- 1- Not Important
- 2- Slightly Important
- 3- Moderately Important
- 4- Very Important
- 5- Extremely Important

11. Did the integration of AI change organizational structures?

- 1 – Not at all
- 2 – To a little extent
- 3 – To a moderate extent
- 4 – To a large extent
- 5 – To a very large extent

12. Do you think it is a priority to your business to integrate AI mechanisms in the future?

- 1 - Not a priority
- 2 – Low priority
- 3 – Moderate priority
- 4 - High priority
- 5 – Essential/Critical

13. Can you share with me your thoughts on the relationship between humans and AI?

How does it work on your company?

(D) Decision-making

14. Can you please explain how the decision-making flows in your company?

15. To what extent is decision-making (overall) dependent of AI?

- 1 – Not at all
- 2 – To a little extent
- 3 – To a moderate extent
- 4 – To a large extent
- 5 – To a very large extent

Part III: Specific questions for each specified AI mechanism

16. How did you find the opportunity to launch this project/product? (Example: through research, data analysis, brainstorming sessions, competitive pressure)

17. Can you explain a bit more how the process of implementation was conducted for this project/product? How was the team structure?

18. How was the coordination and collaboration between all the agents involved?

19. Was it worthwhile to implement this project in terms of value, compared to other projects that do not require AI?

Value	Worthwhile (1- Not Worthwhile , 2- Slightly Worthwhile, 3- Moderately Worthwhile, 4-Very Worthwhile, 5- Extremely Worthwhile)
Team management	
Time management	
Effective Performance	
Performance Indicators (Sales, Best Consumer Review, Financial aspects, Others)	
Others	

20. How did you measure it? (sales, reviews, revenue, new costumers, etc)

21. What type of operational changes did AI bring? (Supply/Demand)

22. Is it likely that you replicate the same type of application of AI in the future?

- 1 – Not at all
- 2 – Quite unlikely
- 3 – Neither likely nor unlikely
- 4 – Quite likely
- 5 – Extremely likely

23. What would you change?

24. How did AI impact your decision-making? In which terms? How did you measure it?

25. How will you approach decision-making in the future with the integration of AI?

26. Finally, at what extent do you think AI influences decision-making?

- 1 – Not at all influential
- 2 – Slightly influential
- 3 – Somewhat influential
- 4 – Very influential
- 5 – Extremely influential