



FACULTY OF ECONOMICS AND BUSINESS

Final Year Dissertation

THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN THE FASHION INDUSTRY

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ABSTRACT

The fashion industry, traditionally known for its conventional practices, has recently experienced significant transformations through the integration of cutting-edge technologies. Among these, Generative Artificial Intelligence (Generative AI) has emerged as a powerful tool with the potential to revolutionize various aspects of the fashion industry. This dissertation examines potential applications of Generative AI in fields such as marketing, supply chain and logistics; while also exploring the potential implications, both positive and negative, of employing this technology.

In this context, we anticipate that numerous fashion brands will be eager to adopt these applications and explore the benefits offered by Generative AI. To facilitate this process, we propose a framework that companies can utilize as a guide for the successful implementation of this technology within their operations.

KEYWORDS:

Fashion, Artificial Intelligence, Generative Artificial Intelligence, Applications, Implications, Framework

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1. INTRODUCTION

“It’s going to be interesting to see how society deals with artificial intelligence, but it will definitely be cool.”

—Colin Angle

Artificial intelligence (AI) is changing and reshaping the way to do business in many industries, and the correct adaptation and usage of this technology will be a key factor of success for the players of the affected industries. Among these industries, the fashion industry has always been considered a very traditional industry, but recently it has also experienced disruptions through the adoption of AI in different subfields and applications. This research project aims to further explore one type of AI recently applied in this industry: Generative Artificial Intelligence (Generative AI).

After our research, we noticed that previous studies shown limited results concerning the utilization of Generative AI in the fashion industry. This can be attributed to the ongoing need for further exploration in this field. Currently, there are only a few real-world applications being employed, and most proposed applications are still undergoing testing by industry players.

Building upon the limited previous research, other industry reports and industry developments, the dissertation aims to provide two different outputs. Firstly, it seeks to conduct a comprehensive analysis of the current state of Generative AI in the fashion industry, by delving into its applications (for design, logistics, marketing, and customer experience), implications, and challenges, we seek to understand how it can revolutionize traditional fashion practices. Through this analysis, we aim to gain insights into how Generative AI is being implemented and utilized in the industry. Secondly, building upon the findings of the analysis, and with the help of a business case study that will allow the reader to further understand the functioning of the technology, we aim to investigate the integration of Generative AI in the business domain and provide a framework for its effective application within traditional fashion industry firms.

We have structured our paper into several sections. In Section 2, we provide a comprehensive literature review encompassing both Fashion and Artificial Intelligence, setting the foundation for our research. Then, in Section 3, we narrow our focus to Generative Artificial Intelligence, the primary subject of our investigation, in this section we provide a technical explanation of Generative AI and discuss about the potential applications and implications. Moving forward, Section 4 explains the methodology we adopted to accomplish our objectives. In this part, we detail the approach we employed to achieve our goals. In Section 5, we will commence by examining the practical implementation of Generative AI through a comprehensive business case study. Subsequently, we will delve into the development of a robust framework to guide future Generative AI deployments. Lastly, in Section 6, we draw our conclusions based on the research conducted and summarize the key insights derived from our study.

2. LITERATURE REVIEW

2.1 FASHION & THE FASHION INDUSTRY

Fashion extends beyond fulfilling basic needs and takes on the role of establishing individual differentiation, showcasing personal taste, and signifying group affiliation, sometimes even to exclusive circles (Beltramo et al., 2020). It is not primarily material: the term does not exclusively encompass specific clothing items, textiles, or accessories. Moreover, fashion is also not solely focused on aesthetics. Rather, its uniqueness lies in the ever-changing nature of its aesthetic expression (Petrov, 2019).

There are several subcategories of fashion existing nowadays, but two of the most prominent subcategories are fast fashion and luxury fashion, each with its own distinct reasons for their prominence. Fast fashion dominates the market in terms of size, catering to a larger consumer base than luxury fashion. On the other hand, luxury fashion targets affluent consumers who possess a strong willingness to pay, resulting in higher profit margins within the market (Shen et al., 2017).

Fast fashion is characterized by its ability to swiftly translate trendy designs into readily accessible articles that can be purchased by the masses (Sull & Turconi, 2008) and aims to reduce the processes involved in the buying cycle and lead times for getting new fashion products into stores, in order to satisfy consumer demand at its peak (Barnes & Lea-Greenwood, 2006). On the other hand, luxury fashion products are renowned for their strong association with being expensive, high quality, and unique. It serve as a perfect means of self-expression and self-image enhancement (Giovannini, 2015), and the consumption of luxury fashion products is believed to be influenced by consumers' public self-consciousness level (Wong, 1997).

One peculiar characteristic is that as fashion spreads, its distinctiveness also diminishes, signaling the end of a trend and creation of new fashionable goods to satisfy the need for distinction among human beings, thus perpetuating a never-ending cycle of profitability for the players of this industry (Simmel, 2020).

The fashion industry is one of the biggest industries in the world, achieving a global revenue of \$1.7 trillion dollars in 2021 (Fashion United, 2022). This market size shrunk in 2020 due to the Covid-19, but the industry recovered significantly during 2021 and much of 2022. Currently many industry leaders are pessimistic about future growth due to a range of challenges, being the inflation one major concern. The market is expected to have a flat or even negative growth, with only the luxury fashion segment to have a solid growth of 5-10% in 2023 (Amed et al., 2022).

Shifting markets, supply chain disruptions, changes in consumer behavior and preferences, and increased importance of sustainability are the reasons for the companies of this sector to adapt

their operations, marketing strategies, and distribution channels to remain competitive (Amed et al., 2022). Moreover, another rising reason for adaptation in this industry is technology. AI, metaverse, nonfungible tokens (NFTs), digital IDs, augmented or virtual reality and other new cutting-edge disrupted this industry that was normally categorized as traditional.

Academically, fashion is a subject that is extensively studied from various perspectives and disciplines, including sociology, technology, art, history, anthropology, psychology, and business. It is considered by many scholars as an important aspect of culture, that will normally reflect the broader social, economic, and political context in which is produced and consumed. Many authors with business focus have already studied this topic and its industry, providing valuable insights across diverse domains such as production, distribution, consumption, sustainability, technology, and regulatory aspects of fashion goods. These allowed us to develop a further comprehension of the topics discussed in the fashion industry.

One prominent area of research focuses on the consumption patterns of fashionable goods, this works are more focused in behavioral economics and the study of the shifting consumer preferences (Giovannini, 2015); (Han, 2017). Sustainability emerges as another crucial theme addressed by many scholars, recognizing the imperative need for a circular economy and effective recycling of outdated fashion items (Colasante & D'Adamo, 2021); (Denisova, 2021). Other authors also proposed regulatory approaches to tackle sustainability challenges within the fashion industry (Niu, 2017); (Mizrachi & Tal, 2022). In table 1, you can find a detailed description of each of the previously mentioned works.

Table 1. Summary of the cited works.

| | Academic Research on Fashion | |
|----------------------|--|---|
| | Authors and title | Description |
| Behavioral Economics | Giovannini, S., Xu, Y. & Thomas, J. 2015, "Luxury fashion consumption and Generation Y consumers", Journal of Fashion Marketing and Management, vol. 19, no. 1, pp. 22-40. | This paper investigates how Generation Y consumers engage with luxury fashion products. The study sheds light on the preferences and behaviors of this influential consumer group, providing valuable insights for marketers in the luxury fashion industry. |
| | Han, J. et al. (2017) Staging luxury experiences for understanding sustainable fashion consumption: A balance theory application. Journal of business research. | This study illustrates how marketers can encourage contemporary consumers to become strongly oriented toward sustainable fashion product consumption (SFPC) by examining the attitude-behavior gap and using Heider's balance theory and luxury brand experiences to understand the psychological factors influencing consumer behaviors. |

| | | |
|----------------|--|---|
| Sustainability | Colasante, A. & D'Adamo, I. (2021) The circular economy and bioeconomy in the fashion sector: Emergence of a 'sustainability bias'. Journal of cleaner production. | This paper examines consumer attitudes towards the fashion circular economy, finding that while consumers showed willingness to purchase bio-based clothes, they were reluctant to buy used clothes, highlighting the need for increased consumer awareness and businesses combining ethical and circular bioeconomy practices for sustainable fashion. |
| | Denisova, A. (2021) Fashion Media and Sustainability: Encouraging Ethical Consumption via Journalism and Influencers. Vol. 7. | This book highlights the influence of fashion media in promoting unsustainable consumption behaviors and proposes practical steps, such as regulating vocabulary and affiliated links, discussing the psychology of buying, and promoting restyling advice. |
| Regulation | Niu, B. et al. (2017) Punishing or subsidizing? Regulation analysis of sustainable fashion procurement strategies. Transportation research. Part E, Logistics and transportation review. | This paper examines the impact of government regulations, specifically punishing and subsidizing, on the management of sustainable fashion procurement in a typical fashion supply chain. |
| | Peleg Mizrachi, M. & Tal, A. (2022) Sustainable Fashion—Rationale and Policies. Encyclopedia (Basel, Switzerland). | This paper provides an overview of the sustainable fashion industry, highlighting new policies worldwide aimed at improving sustainability and addressing issues of employee exploitation. |

Source: Own Elaboration

Although these are the most discussed topics, in this project we will focus on AI-related topics, which we will explain in the following section.

2.2 ARTIFICIAL INTELLIGENCE IN THE FASHION INDUSTRY

Artificial Intelligence (AI) is now ubiquitous across various industries, and it allows computers to learn from experience, adapt to new inputs, and perform human-like tasks. This technology still has undiscovered potential and will enable new emerging technologies in the next few years (Dilmegani, 2017). AI is a rapidly developing multidisciplinary research area that aims to solve increasingly complex problems. In nowadays highly integrated world, AI promises to become a robust and powerful means for obtaining solutions to previously unsolvable problems (Fernandez & Travieso-Gonzalez, 2022).

The fashion industry has embraced AI technology in various ways. Some examples include designing clothes through intelligent forecasting, providing personalized sales assistance to consumers, optimizing manufacturing processes, and enhancing the overall fashion sales experience to clients. For example, AI-powered e-commerce apps allow customers to take a photo or screenshot of a fashion product they like and search for matching items in that category. Major

companies such as Microsoft, Apple, and Google are also contributing to the improvement of the fashion shopping experience through voice assistance devices and conversational interfaces like Alexa, Cortana, Google Home, Siri, and Baidu, providing customers with 24/7 engagement and assistance (Cognilytica, 2019).

To gain a comprehensive and structured understanding of the diverse applications of AI in the fashion industry, a valuable resource is the work by (Gu et al., 2020) titled "Fashion Analysis and Understanding with Artificial Intelligence." Gu's research provides an insightful classification and overview of some AI applications in fashion, ranging from low-level fashion recognition to high-level fashion applications. At the low level, AI enables the identification of fashion garments at a pixel level through tasks like clothing/human parsing and landmark detection. Moving to the middle level, AI facilitates the extraction of semantics from fashion data, allowing for clothing attribute prediction and fashion style prediction. At the highest level, AI powers fashion retrieval, recommendation, compatibility assessment, image synthesis, and data mining, propelling the industry towards AI-enhanced solutions. These applications revolutionize fashion by improving garment recognition, supporting personalized recommendations, enabling virtual prototyping, and extracting valuable insights from large-scale datasets, among other advancements. Hence, these advances can be a game-changer for fashion industry in a near future, and it is worth exploring it.

2.3 GENERATIVE ARTIFICIAL INTELLIGENCE IN THE FASHION INDUSTRY

As an introductory overview, Generative AI refers to a class of machine learning algorithms specifically designed to produce novel and original content based on given input data. It finds application in various domains, such as text generation, image synthesis, music composition, code creation, and even website generation. Some advanced models enable AI systems to undertake creative tasks that were traditionally considered exclusive to human capability. Leveraging the power of generative modeling, these advanced machine learning models can generate highly realistic images, videos, and voice outputs with remarkable accuracy and fidelity. (Musiol, n.d.)

The fashion industry has yet to fully explore the potential of Generative AI, even as it quickly adopts other cutting-edge technologies such as the metaverse, nonfungible tokens (NFTs), digital IDs, and augmented or virtual reality. Generative AI is currently used as a tool to diversify and personalize fashion designs, generate models that will increase the representation of all body types, creating automated digital experience in online shopping, and, in the retail industry (where both aesthetics and consumer pleasure are important factors in product design and speed and

novelty are crucial), offering an efficient way to generate new product designs at a low cost (Dilmegani, 2022).

There were several academic works related to AI and fashion, but not too much academic work of Generative AI in the fashion industry with a business perspective: most of the work is more related to science and technology. Focusing, for example, on more in the technical understanding of the different AI models used in the industry (Gu et al., 2020), or the provision of an input dataset (Rostamzadeh et al., 2021). From the other hand, there is also work related to the creation of frameworks for the application of different types of AI in the fashion (Banerjee et al., 2021).

Despite this lack of academical resources, there are a lot of resources in company reports, website articles and other non-academic works, such as fashion industry reports from industry companies, for example the Mckinsey and Business of Fashion (BoF) articles and reports, and specialized websites focused on the Generative AI created by professionals of the field, such as the AI industry analyst Cem Dilmegani website.

This section presents a comprehensive examination of prior research and applications of Generative AI in the fashion industry and a more introductory explanation of it. In the subsequent section, we will delve deeper into the technical aspects of this technology, offering a more detailed analysis.

3. GENERATIVE ARTIFICIAL INTELLIGENCE

In this section, we offer a deeper technical exploration of generative artificial intelligence, while also examining its applications and implications within the fashion industry, as previously mentioned in the introduction.

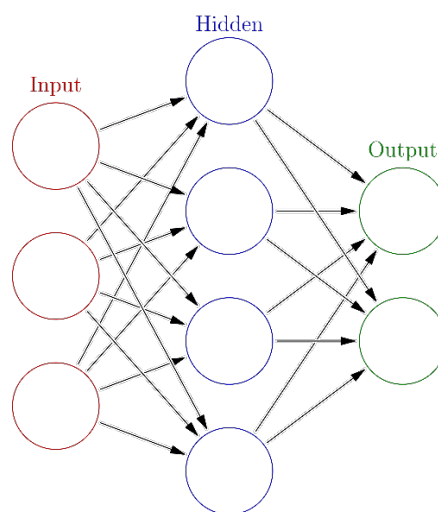
Generative modeling is a branch of machine learning that involves training a model to produce new data that is like a given dataset. To do it, we need a consistent dataset with many examples of the entity we are trying to generate and train the algorithm so that it can generate new content based on it. This technology can be used to create different types of data such as text, images, voices and even 3D objects as mentioned in previous sections.

To better understand the concepts, we proceed to explain the differences between Generative AI and classic AI, the applications, and the implications of the usage of this technology in the following subsections.

3.1 DIFFERENCE BETWEEN GENERATIVE AND CLASSIC AI

Generative AI can be defined as the field of science that focuses on the automated construction of intelligence. This contrasts with contemporary AI, which studies the understanding and construction of intelligence by humans. Both approaches follow the Input-Process-Output paradigm while operating (Van der Zant et al., 2013), which involves the utilization of Artificial Neural Networks (ANNs). ANNs attempt to simulate the functioning of biological neural networks, particularly the human brain. These networks consist of interconnected nodes (neurons) that process and transmit information through weighted connections (Schönbach et al., 2018).

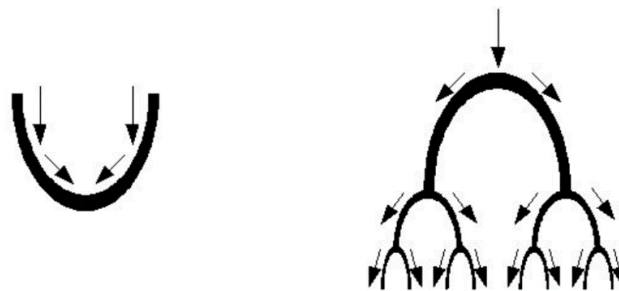
Figure 1 . A simple representation of Artificial Neural Network compost by 3 types of nodes: Input, Hidden Layers (Process), and Output.



Source: (Wikipedia, 2019)

The difference between the Classic AI approach with Generative AI lies in the openness of each model. The classical automatization model was created to proceed with specific tasks, making it a close-ended system. In this approach, the system lacks the capability to generate new properties or adapt to new problems without human intervention. Whenever a new problem arises, human interaction is required to introduce new solutions and address the issue. This limits the ability of the system to explore and adapt autonomously.

Figure 2. *Traditional AI vs. Generative AI.*



Source: (Van der Zant et al., 2013)

Meanwhile, Generative AI has an open system (Van der Zant et al., 2013), which means it can autonomously modify its nodes and generate intelligent outputs without relying on explicit programming or human intervention (AltexSoft, 2022). Generative AI models are capable of learning underlying patterns and distributions from data and generating novel outputs based on that knowledge (Balaji et al., 2019). Figure 2 illustrates the distinction between Classical AI and Generative AI. In Classical AI (left figure), the focus is on optimization towards a predictable end-state. In contrast, Generative AI (right figure) is influenced by its internal dynamics and interactions with the environment: The system learns and adapts continuously as it executes tasks, allowing it to improve over time and to arrive at a wider range of responses.

There are several models of Generative AI in which GAN and VAE are the most known and used ones in business. On the table below, there are some technical papers related to each type of Generative AI and AI.

Table 2. *Past academic research related to Generative network.*

| Technical Academic Research | |
|--|---|
| Zupan, J., 1994. Introduction to Artificial Neural Network (ANN) Methods: What They Are and How to Use Them. | A brief introduction to Artificial Neural Network |

| | |
|---|---|
| <p>Bond-Taylor, S., Leach, A., Long, Y. Willcocks, C.G., 2022. Deep Generative Modelling: A Comparative Review of VAEs, GANs, Normalizing Flows, Energy- Based and Autoregressive Models.</p> | <p>This article compares the trade-offs, advancements, and implementations succinctly and comprehensively of different generative models.</p> |
| <p>Gm, H., Gourisaria, M.K., Pandey, M., Rautaray, S.S., 2020. A comprehensive survey and analysis of generative models in machine learning.</p> | |

Source: Own elaboration

3.2 APPLICATIONS OF GENERATIVE AI IN THE FASHION INDUSTRY

The necessity for efficient operations, changing customer tastes, and rising trends all contribute to the fashion industry's ongoing evolution (Amed et al., 2022). In this subsection we are going to explain some of the potential applications of Generative AI in fields including product design, supply chain management, customer support, and marketing.

Product design: The creation of high-fidelity designs from sketches, garment images, and contour images (Cui et al., 2018) is made possible by Generative AI, which helps designers better visualize and iterate their creations with minimal effort (Luce, 2018).

Figure 3. Examples of how Generative AI generates garment images from the garment design elements like fashion sketches and fabric patterns.



Source: (Luce, 2018)

Additionally, like Tommy Hilfiger did in 2018, designers can mix their creativity with limitless amounts of data (for example, prior product lines, patterns, inspirational photos, and fashion trends) that this technology can provide to generate designs (Arthur, 2018).

Moreover, mass customization of items for specific customers is possible with Generative AI. For instance, Adidas introduced in 2017 an initiative where customers could visit a pop-up store and use Generative AI algorithms that generated custom merino wool sweater based on their specifications. The patterns were then sent to computer-controlled knitting machines, which produced the personalized sweaters on the spot (Adidas Knit for you, n.d.).

Supply Chain and Logistics: Fashion companies can benefit from the application of Generative AI in the supply chain and logistics operations. A successful supply chain relies on effective logistics management and efficient transportation. For example, by considering traffic conditions, weather predictions, vehicle capacity, and customer requests, Generative AI can improve route planning, delivery scheduling, and resource allocation. Organizations can design transportation routes that optimize its results by using less fuel, speeding up deliveries, and increasing customer satisfaction. Additionally, this technology may dynamically modify strategies in real-time to account for unanticipated events or interruptions, increasing the supply chain's overall resilience (Kaur, 2023).

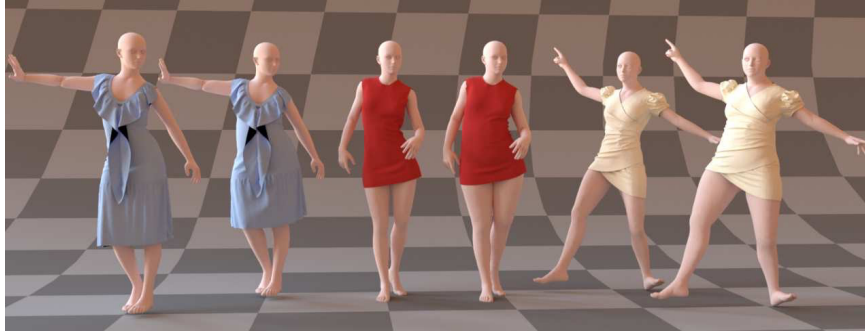
Many fast fashion retailers report piles of unsold stock that can be worth billions of dollars. Businesses may utilize a variety of historical data with AI-driven demand forecasting to estimate future demand, and even specific versions can be created for recurring occasions like Black Friday or other busy shopping days. This way, companies will be able to minimize the risk of having too much inventory while still having the items that customers desire by forecasting the amount of stock they should have on hand and the probability of returns (Nikolaiev, 2019).

Choosing trustworthy suppliers and building solid connections are essential for the effective running of a supply chain. By examining many types of data, including supplier performance, quality history, price, and geography, Generative AI can help in supplier selection. Organizations may increase the robustness of their supply chains by using Generative AI to find acceptable suppliers based on established criteria. Additionally, the utilization of this technology may improve supplier relationship management. It offers insights into risks, chances for improvement, and negotiating tactics by examining previous contacts, contractual provisions, and performance data. As a result, businesses are better equipped to deal with supplier issues and promote good partnerships, which improves the performance of the supply chain (Kaur, 2023).

Marketing and Consumer Experience: The fashion industry can see a marketing revolution because of Generative AI, which uses massive volumes of unstructured data to recognize and forecast patterns. On the one hand, Generative AI can predict the possibility of customer turnover by analyzing historical data and learning about consumers' past behavior. With the aid of these analytics, marketers can gather insights that will direct the future strategies and actions of their company (Dilmegani, 2022).

On the other hand, customers could digitally "try on" clothing by using virtual representations of fashion objects that can be placed onto photographs of individuals using this technology. Customers may visualize how certain outfits might appear on them by customizing these virtual models to depict a variety of body kinds, colors, and sizes (Shi et al., 2021).

Figure 4. Representation of how the garment can transfer from a standard body to mannequins with distinctive body shapes, preserving the original garment design.



Source: (Shi et al., 2021)

Moreover, companies can engage their customers by using Generative AI for the personalization of online consumer experiences and offers by utilizing unique consumer profiles, customizing web pages and product descriptions to each customer's interests and demands (Dilmegani, 2022). Fashion firms may also engage with their customers by using Generative AI algorithms to enhance targeted marketing tactics by evaluating consumer sentiment, in-store activity, and omnichannel data. By automating consumer segmentation at scale, Generative AI enables marketers to customize their activities depending on certain client categories. Additionally, it uses unstructured data from customer profiles and community insights to produce customized marketing content (Harreis et al., 2023).

Furthermore, Generative AI would improve the already used artificial agents, such as chatbots or virtual assistants, since they are built to interpret natural language used by humans and can come up with relevant responses to inputs that are not exactly pre-defined (Luce, 2018).

3.3 IMPLICATIONS OF GENERATIVE AI IN THE FASHION INDUSTRY

While Generative AI presents a multitude of innovative applications that significantly benefit the fashion industry, it is also accompanied by a set of profound implications that must be carefully considered. In this part, we weight some of these different aspects surrounding Generative AI.

3.3.1 POSITIVE IMPLICATIONS

The application of Generative AI is expected to contribute to improvements in various areas within the fashion business, including sustainability and enhanced customer experience, among others.

Sustainability: The fashion industry has faced criticism for its environmental impact, mainly due to overproduction, making it highly wasteful (Laura, 2023). Generative AI can help establish sustainable practices by optimizing inventory, allowing fashion retailers to determine the best geographical locations for new product releases. It also contributes to addressing the industry's pollution problem by providing insights into sustainable materials, processes, and practices. Through data analysis, Generative AI can identify and suggest sustainable materials and production methods, including recycling, biodegradability, and energy efficiency. Embracing sustainability not only reduces waste and emissions but also appeals to environmentally conscious consumers (Generative AI for Fashion and Retail, n.d.).

Improved Customer Experience: Generative AI can personalize the shopping experience, making product recommendations based on past purchases and preferences and offering stylist suggestions. This increased personalization relies on significant personal data collection, raising concerns about data privacy and security (Harreis et al., 2023). Adidas' initiative in 2017 exemplifies this, wherein customers could generate custom merino wool sweaters based on their specifications through Generative AI algorithms (Adidas Knit for you, n.d.).

Creativity Augmentation: Generative AI can enhance human creativity by providing inspiration for new designs. An example of this is the partnership between Zalando and Google, which leverages Generative AI to create designs influenced by customer preferences (Barrera, 2023). By considering customer preferences for colors, textures, and other style elements, the Generative AI can come up with designs that are tailored to the tastes of individual customers. This technology enables a level of personalization that would be incredibly time-consuming, if not impossible, for a human designer to achieve manually.

Efficiency: Generative AI offers efficiency to the fashion retail industry by automating repetitive and time-consuming tasks. It can tag products, categorize images, and manage inventory, allowing employees to focus on customer service and product development. This technology optimizes the

supply chain by predicting demand, maintaining inventory flow, and minimizing the risk of overstocking or understocking.

Moreover, Generative AI streamlines the design process, reducing time to market and design costs. Through real-time data analysis of sales trends and stock levels, it can automatically replenish low-stock items or reduce inventory of slow-moving products. This enhances searchability and improves the overall customer experience (Generative AI for Fashion and Retail, n.d.).

3.3.2 NEGATIVE IMPLICATIONS

The rise of Generative AI in the fashion industry, while carrying many advantages, also comes with risks, such as brand reputational risk, job loss, among all the others, which we explain next.

Brand Reputational risk: One concern is the potential bias and fairness problems in generative-AI systems, which can present reputational risks for brands that rely on the technology. Biased datasets, which cannot accurately present the population due to some errors in the data, can produce advertising campaigns with inappropriate or offensive images that may damage the reputation of the brand if shared globally (Harreis et al., 2023). For instance, if the data used by Generative AI to produce custom marketing content misinterprets consumer sentiment, it could lead to a poorly received marketing campaign.

Job loss: The advent of Generative AI has heralded significant shifts in employment within the fashion industry, with notable consequences in job displacement. A salient example of this can be seen in the rise of AI-generated clothing models, such as those employed by Levi's. These AI models have the potential to revolutionize the industry by promoting inclusivity, offering the ability to visualize clothing on a diverse array of body shapes, ages, sizes, and skin tones. However, this technological advancement also carries with it a threat to job security for human models (Weatherbed, 2023).

This unsettling scenario has already begun to unfold, evidenced by the recent actions of Levi's “: the company has been progressively reducing its human workforce over the past few years, with major layoffs occurring in 2022 and 2020” (Weatherbed, 2023).

Despite the assertion of Levi's that these AI-generated models are intended to "complement" rather than replace human models, the correlation between the introduction of this technology and the substantial reduction of human roles within the company raises substantial concern.

Figure 5. Example of Levi's AI Models.



Source: (Bain, 2023)

Detriment of creativity: One of the risks is the potential overshadowing of human creativity and craftsmanship. The power of Generative AI lies in its capacity to process massive amounts of data and generate designs based on existing trends, styles, and customer preferences. This efficiency, however, can also be its downfall. There is a risk that AI-generated designs may resemble existing ones too closely, potentially leading to copyright infringement disputes. AI operates on patterns, and its "creations" are fundamentally rooted in already existing data. Thus, it might reproduce aspects of designs that are legally protected, causing complex legal disputes.

Additionally, as Generative AI becomes a more prevalent tool in the fashion industry, there is a growing concern about the potential homogenization of styles and trends (YEC, 2023). With AI drawing from the same or similar datasets to generate designs, the distinctiveness of fashion, which often arises from individual creativity and cultural nuances, might gradually fade. This can lead to a less diverse fashion landscape, where styles and trends seem increasingly similar, diminishing the value of fashion as a form of personal expression and cultural identity (Stephens, 2023).

The case of Tommy Hilfiger illustrates how Generative AI might eclipse the unique creativity of the designer. Despite the benefit of offering limitless data for generating designs, the role of AI might diminish the value and originality of the creative input of the designer (Arthur, 2018).

In essence, while Generative AI can be an effective tool for increasing efficiency and predicting trends, it is crucial to strike a balance where it supports human creativity rather than suppresses it. The future of fashion should ideally involve a harmonious symbiosis between AI and human design, ensuring that technology enhances rather than hinders the creative process.

Legal risk: The ongoing uncertainty surrounding the legal framework governing its usage. Designers can come under fire for producing derivative or knock-off designs, and determining ownership of intellectual property and creative rights in AI-generated works is currently decided on a case-by-case basis. An instance illustrating the potential legal entanglements for fashion brands with the emergence of new technologies, albeit not involving Generative AI, was the widely publicized conflict between Hermès and artist Mason Rothschild over MetaBirkin NFTs. A judge determined these NFTs violated Hermès's trademark (Harreis et al., 2023).

3.3.3 CHALLENGES

In this final subsection we explore all the potential future challenges that the companies will face if they want to implement Generative AI in their activities.

Data Scarcity and Privacy: The historical lack of data in the fashion sector poses a challenge for generated AI implementation. Furthermore, personalization using generated AI relies on extensive personal data collection, leading to concerns about data privacy and security (Harreis et al., 2023).

Authenticity of Creativity: Generated AI, while excellent at problem-solving, might not match human-level creativity. Its approach to creativity is limited to existing instances and data, which might be considered as a limitation (Stephens, 2023).

Lack of Comprehensive Data: The data often available falls short of capturing the comprehensive customer preferences and experiences, posing a challenge to the effectiveness of Generative AI in producing customer-centric designs and experiences (Dilmegani, 2022).

3.3.4 CONCLUSIONS OF IMPLICATIONS

To conclude section 3.3, Generative AI promises to revolutionize the fashion industry, offering benefits such as personalized designs, sustainability, and improved customer experiences. However, it also brings a host of challenges and implications that must not be overlooked. These include potential job losses, copyright infringement risks, threats to brand reputation, customer trust, and unresolved legal complexities. Despite these concerns, the potential of AI for innovation and efficiency in the fashion industry remains promising. Nonetheless, the careful and responsible management of these technologies is essential to ensure that we preserve the human element of creativity, diversity, and authenticity in fashion. In summary, the harmonious integration of human ingenuity and AI represents the future of a vibrant, diverse, and sustainable fashion industry.

4. METHODOLOGY

The objective of this project is to develop a robust framework that facilitates the seamless integration of Generative AI into diverse business activities within a fashion company. Our methodological approach consists of three primary stages: information collection, information processing, and generating the final output.

In the initial phase, our focus was on conducting extensive research and gathering relevant information pertaining to the fashion industry and Generative AI. We collected both business and technical data from reputable sources such as McKinsey & Company, Bain, and the BoF website. Additionally, we utilized tools like UPF Finder (an academic searching engine owned by the University Pompeu Fabra) and Google Scholar to discover additional valuable articles. The objective was to deepen our understanding of the fashion industry and its application of AI so that we can establish a preliminary foundation and mindset for our project.

Once we accumulated a substantial amount of information, our next step involved extracting key insights from the reviewed papers and categorizing them into four sections: historical context (literature review), technical information (Generative AI algorithms), application of the technology, and implications. This step aimed to organize our information database effectively, gain a clearer understanding, and identify any knowledge gaps.

During the information processing step, we revisited the entire dataset and focused on summarizing the information into bullet points. This allowed us to unify ideas, enhance comprehension, and complement the collected information with our understanding of the project, as reflected in the implications section.

Finally, the culmination of this academic research is the development of a comprehensive framework for integrating Generative AI into various business activities within the fashion industry. Throughout the section, we incorporated a brief case study to use it as an illustrative example when explaining the different stages of our framework.

The developed framework aims to provide fashion companies a guideline to optimize their operations and harness the power of Generative AI technology. By leveraging this framework, businesses can enhance their decision-making processes, streamline operations, and create innovative solutions within the fashion industry. It offers practical insights and actionable steps for fashion companies to effectively integrate Generative AI into their business activities, leading to improved efficiency, creativity, and competitiveness in the market.

5. RESULTS

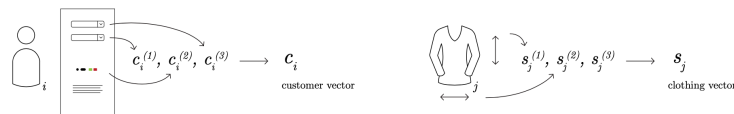
The main objective of section 5 is to be able to develop a framework that companies can apply when they want to integrate Generative AI into their activities. As mentioned above, the potential of Generative AI has not yet been fully exploited, which is why we have considered it optimal to analyze one of the few applications that exist today through a business case study in order to increase our knowledge and thus, together with all the knowledge we have gained thanks to the research we have carried out in section 2 and 3, to be able to develop a framework.

5.1 BUSINESS CASE STUDY

Considering all the information provided in previous sections, Generative AI is one significant application that has the potential to alter the way fashion is made, consumed, and personalized. This section looks at the business case of Stitch Fix, a pioneering online personal styling service that is currently engaged in experimental utilization of DALL-E 2 to assist their employees in creating personalized recommendations, a task that they were developing before (H. Davenport & Mittal, 2022).

Stitch Fix is a forward-thinking online apparel shop that has grown in popularity due to its unique approach to individualized styling. The company, founded in 2011 by Katrina Lake (Stitch Fix, n.d.), has revolutionized the traditional fashion sector by curating individualized apparel and accessory recommendations for its consumers combining data science, artificial intelligence, and human knowledge. Customers fill out a thorough style profile, and Stitch Fix uses this information to harness AI algorithms to evaluate enormous volumes of fashion-related data and produce tailored apparel recommendations.

Figure 6. Data collection from clients and clothing.











Source: (Colson et al., n.d.)

Through the utilization of AI algorithms, Stitch Fix demonstrates its capability to offer exceptionally customized recommendations to its clientele. These algorithms meticulously consider individual preferences, body morphology, budgetary constraints, and prevailing fashion trends. As a result, customers receive a meticulously curated selection of apparel products that align with their unique style preferences. This personalized approach significantly enhances customer retention and conversion rates, setting Stitch Fix apart from conventional e-commerce

platforms. By providing tailored suggestions, they establish a devoted client base and gain a competitive edge in the fashion industry (Lake, 2018).

Figure 7. Match feedback matrix.

| match feedback |  |  |  |  |  | explicit client features | | | C_i | latent client features | | |
|---|---|---|---|---|---|--------------------------|------|-----|-------|------------------------|---|-----|
|  | ? | 0.83 | ? | 0.54 | ? | 0.47 | 0.23 | ... | | ? | ? | ... |
|  | 0.27 | ? | 0.92 | ? | 0.13 | 0.59 | 0.14 | ... | | ? | ? | ... |
|  | ? | ? | 0.85 | 0.76 | ? | 0.62 | 0.90 | ... | | ? | ? | ... |
| s_j | explicit style features | 0.21 | 0.74 | 0.53 | 0.26 | 0.85 | | | | | | |
| | | : | : | : | : | : | | | | | | |
| | latent style features | ? | ? | ? | ? | ? | | | | | | |
| | | : | : | : | : | : | | | | | | |

Source: (Colson et al., n.d.)

Stitch Fix takes consumer input on a regular basis to enhance its suggestion system. It detects trends and refines its algorithms by studying feedback to better understand client preferences and give more accurate suggestions over time. The company has recently experimented with DALL-E 2 technology to increase revenue and enhance consumer satisfaction by providing better styling services (Harreis et al., 2023). The goal of this project was to create visual representations of Stitch Fix's items based on key criteria like color, fabric, and style. During the trial phase, for example, if a client ordered a "soft, olive green, great color, pockets, patterned, cute texture, long, cardigan" DALL-E 2 was used to produce photos of that specific item, as seen on image. A stylist may then use these photographs to find a similar product in their inventory (Wiggers, 2022).

Figure 8. A DALL-E 2 generation from Stitch Fix's pilot.



Source: (Wiggers, 2022)

Regardless its pioneering status in the use of artificial intelligence, Stitch Fix has strategically opted to engage in collaboration with DALL-E 2 to consistently refine its operational procedures and augment both its sales performance and customer experience. This particular instance

exemplifies the immense capacity of Generative AI and underscores the prospective applicability for organizations seeking to optimize their current workflows.

This case study has provided a valuable insight into the beneficial integration of Generative AI to improve a company's processes and will guide the development of the framework in the following section.

5.2 CONCEPTUAL FRAMEWORK

Integrating new technologies into business activities is a challenging task for companies. It requires effective coordination among various business segments and departments (Chapman, 2006). To achieve this, companies need a clear visualization of each step and involvement of stakeholders throughout the process. This is where a framework comes into play (Aarntzen, 2016). It facilitates understanding of tasks by all parties involved and provides a common language and set of tools for effective communication and collaboration within businesses (Richardson, 2005).

Therefore, in this part, we will present a general conceptual framework for the integration process of Generative AI into different business activities based on all the previous information. Our conceptual framework is given in figure 9 and we are going to explain each one of the segments in the following subsections.

5.2.1 DETECTION OF PROBLEMS OR POTENTIAL IMPROVEMENT

The initial step for a company aiming to integrate Generative AI into their operations is to identify potential problem areas that can be addressed or existing activities that can be enhanced using generative modeling. It is crucial to consider activities that allow for technology to autonomously adapt and generate new outputs without relying heavily on human intervention, ultimately leading to increased profitability for the company. This increase in profits can be achieved through the implementation of new activities that add value to clients or the improvement of existing activities that minimize output costs.

Fashion companies, given their unique needs and diverse range of activities, may require different approaches. However, here are some general examples that can serve as ideas for future managers seeking to implement innovative strategies or activities improvement in their fashion companies, all very related from our application section:

Table 3. Summary of some applications of Generative AI.

| Activity | Description |
|--------------------------|---|
| Targeted recommendations | As Stitch Fix did in their experiment with DALL-E 2, companies can use Generative AI to generate images of the products that they are looking for to be able to provide more accurate recommendations. |
| Forecasting of sales | The Generative AI is already used in other industries to forecast potential sales based on past trends and historical data. Then they will automatically update themselves and improve the prediction in the process. |
| Design process | As discussed in the applications section, a promising enhancement for the fashion industry is the integration of Generative AI into the fashion design process. Managers must carefully evaluate whether implementing this technology will lead to process improvement or cost reduction, considering that the objectives may vary depending on the type of fashion company. |
| Digital Try-on | Generative AI empowers consumers to make informed purchasing decisions through enhanced information provided by personalized digital "try-on" experiences. In this context, managers need to evaluate whether the potential cost reduction resulting from reduced refunds and increased customer satisfaction outweighs the implementation costs associated with this technology. |

Source: Own elaboration

5.2.2 FIND THE NECESSARY RESOURCES

Once the initial strategy is defined, the company must acquire the required resources to facilitate the implementation of the change. This process involves two primary inputs. Firstly, the technological input, which entails obtaining the necessary AI technology for executing the initial idea. This can be sourced either internally, through the expertise of company personnel, or externally, by engaging with third-party providers in the market.

Secondly, the company needs to secure the appropriate workforce to manage the activity daily. This can be achieved by either recruiting new employees externally or providing training and reskilling opportunities to existing personnel.

In the fashion industry, external resource acquisition is often the most cost-effective choice, as the existing workforce and internal technology may not be well-suited for technological changes. In contrast, market opportunities typically offer lower costs of adaptation and better performance.

However, these decisions may also involve replacing the labor force or showing distrust towards current employees, resulting in discomfort among the workforce and potentially incurring high intangible cost that could heavily affect the company culture and overall performance.

It is very important for the manager to correctly assess which is the best option for both cases and that will improve the overall performance of the company.

5.2.3 CREATION OF A TRANSFORMATION OFFICE AND DEPARTMENT

To enable the successful integration of the new solution or improved activity, effective coordination between the new division and existing departments within the company is crucial. Therefore, the next step involves establishing a dedicated transformation office, using the acquired talent and technology from the previous step. A transformation office increases and accelerates the impact of the transformation by driving accountability, transparency, and holding functional owners within the business units responsible for their specific targets. The transformation office sets a strict cadence of meetings, monitors progress, and ensures that the transformation is progressing on schedule (Angevine & Bates, 2019).

In the perspective of the framework, this team should be operating during all the following phases of the process and is crucial to create it with adequate team members, that may vary depending on the needs and type of the company. Normally the office will be led by a C-suite-level executive (Angevine & Bates, 2019), such as a chief transformation officer, and followed by members from other departments, technical team proficient with the technology (obtained from the last step), and sometimes also external consultants.

Once the transformation office is established, it will actively develop and create the initial new or upgraded department within the activities of the company. This department will be composed of the workforce obtained during the previous step. The transformation office takes on the responsibility of structuring and organizing the new department, aligning it with the overall objectives of the company.

5.2.4 DEFINE A DATA STRATEGY

After the department is set, we can start thinking about the data strategy that the company will follow to define, acquire, and process the data that will be used to generate the output.

The first step is to define which type of data the company will need to generate the desired output. For instance, this could involve collecting images of clothes for AI-generated fashion designs or

acquiring customer-specific text data for personalized recommendations, as seen in the business case study.

Once defined the type of data, the team should think how to obtain that data, considering various sources such as external data acquisition from third parties or specialized big data companies, or internal sources like market research, operational data, or customer data within the company.

Is important to note that data acquisition may be subject to constraints such as regulatory limitations, lack of reliable sources, or high costs. For example, challenges may arise with copyright issues related to image data or when customers value their privacy and are hesitant to provide candid responses to sensitive survey questions. Additionally, certain information may not be accessible from third parties. In such cases, the company must rethink the whole strategy to either change the desired output or redefine again the desired type of data.

Lastly, data processing involves preparing the data that will allow the Generative AI algorithm to generate the desired output data. It is crucial to ensure a proper alignment between the acquired data from the previous steps and the defined data requirements. This may involve performing data cleaning procedures before processing. For instance, survey responses obtained from clients may contain typos or data types that could impede the algorithm to generate accurate outputs. Similarly, if the images used in the dataset have low resolution or poor pixel quality, it can adversely impact the output image quality as well.

The data strategy could vary a lot between two different applications due to the difference of desired outputs, but the general ideas provided by our framework should be the same for all the applications. The key to success in these steps is to combine both business and technical knowledge from all team members and search for the most suitable, efficient, and feasible solution that will meet the initial goal.

5.2.5 IMPLEMENTATION OF THE STRATEGY

After defining and executing the data plan, the team will have a robust initial database that serves as the foundation for the algorithm to generate the first output. At this stage, the team's technical expertise comes into play as they adapt the generative model to align with the specific requirements of the activity. This may involve activities such as technology adaptation and model tuning. Once all the necessary adjustments are made, the algorithm can be executed to obtain the desired output.

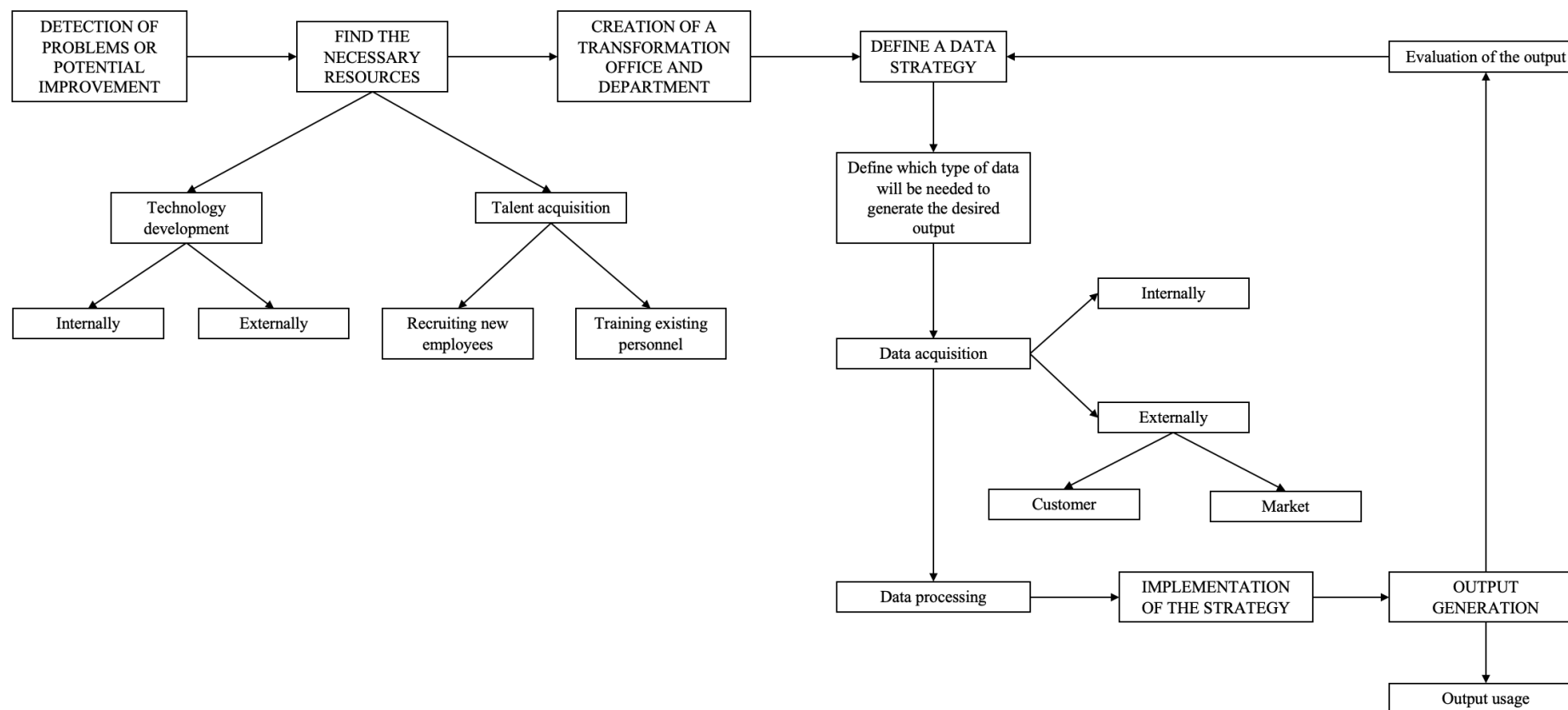
5.2.6 OUTPUT GENERATION

Once the desired output is generated, it serves two distinct purposes. Firstly, it fulfills the initial objective for which the output was created (Output Usage). It is important to emphasize that this output can be synergistically combined with other technologies or human expertise to generate the ultimate project outcome. For instance, Stitch Fix utilized it to generate images that aided their workers during the recommendation process. Secondly, the output data enables the company to evaluate whether the results align with their initial expectations and assess the added value of the new activity to the overall company (Evaluation of the output).

This evaluation phase plays a critical role in determining the effectiveness of the implementation and identifying areas for further improvement. This assessment can be conducted in various ways, depending on the type of application. For instance, evaluating Generative AI-generated designs can involve soliciting feedback from clients or real designers. Similarly, comparing forecasted data with actual outcomes over time can provide insights into the accuracy and reliability of the Generative AI-generated predictions. Additionally, assessing the utility of a recommendation system can be assessed through customer satisfaction surveys.

Moreover, thanks to the capabilities of Generative AI, a portion of the generated output can be reused during the strategy implementation phase, creating a continuous feedback loop for further improvement. It is important to emphasize that even though the process may appear automated, the team must continue to evaluate the model performance, output quality, and the accuracy of input-to-output conversion. This ongoing scrutiny guarantees the system's efficacy and ensures optimal results.

Figure 9. Framework for the integration of Generative Artificial Intelligence in a company.



Source: Own elaboration

6. CONCLUSIONS

This dissertation has proven that Generative AI possesses immense potential to revolutionize various aspects of the fashion industry including design, personalization, supply chain management, and customer engagement. However, as seen in the literature review, this field is yet to be fully explored, since technological changes are recently affecting this industry, and therefore, are only a few academic works. Despite that, through our academic investigation with the available resources, it was evident that advanced generative models like DALL-E 2, as seen in our case study, enable fashion companies to improve their operations by offering personalized recommendations, streamlining the design process, and optimizing production efficiency.

Generative AI integration in the fashion sector has the power to innovate, improve productivity, and meet the evolving requirements of clients in the digital era. Fashion businesses may improve decision-making, manage supply chains, and provide individualized experiences on a broad scale by embracing this technology.

The recognition of the multitude of opportunities presented by Generative AI is crucial. However, it is equally important to acknowledge the existence of challenges. Ethical considerations, encompassing data privacy and responsible AI usage, must be prioritized during implementation. Furthermore, continuous research and collaboration among academia, industry, and policymakers are essential for tackling emerging issues, enhancing algorithms, and fostering a sustainable and inclusive future for Generative AI in the fashion industry.

Moreover, the successful implementation of Generative AI necessitates meticulous consideration of numerous factors. Our framework points out the crucial matter to address and guides the companies on the implementation of this technology, such as acquiring resources (including talent and infrastructure), ensuring the availability of expertise, and computing power, having a robust data strategy to effectively utilize vast amounts of fashion-related data while upholding its quality, security, and compliance; etc.

In conclusion, this dissertation has unveiled the transformative power of Generative AI in the fashion industry, showcasing its ability to enhance design processes, personalize experiences, optimize supply chain management, and improve customer engagement. While the findings highlight its significant business utility, there is a need for further research and discussions to address ethical considerations, establish evaluation methods, overcome implementation challenges, and stay abreast of technological advancements. By embracing Generative AI and continuing to explore its possibilities, fashion companies can unlock new opportunities, drive innovation, and navigate the dynamic landscape of the fashion industry.

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