



Print ISSN: 2233-4165 / Online ISSN 2233-5382

JIDB website: <http://www.jidb.or.kr>doi:<http://dx.doi.org/10.13106/jidb.2023.vol14.no7.27>

Management and Development Potential of the Wig Industry in the Beauty Tech Era

Eun-Jung SHIN¹, Ki Han KWON²

Received: February 26, 2023. Revised: July 18, 2023. Accepted: July 25, 2023.

Abstract

Purpose: The new technological innovation caused by the Fourth Industrial Revolution will bring about a major change in the scalp healthcare market and the wig industry. This review paper is an empirical analysis focusing on the development potential of the Korean beauty tech market and the wig industry. **Research design, data and methodology:** This review of the wig industry and consumer experience is an important literature review. The PRISMA flow chart was used. Beauty Tech; Beauty Industry; Wig Industry; Wig; Scalp Healthcare; was used as Keywords as records verified through database screening. A total of 513 references were finally selected through major journal search sites such as PubMed, Google Scholar, RISS, Scopus, and Research Gate. Among the selected references, a total of 52 papers were selected in the final stage from 2001 to 2022. **Results:** For the sustainable development of wig industry management, consumers' desire for new and convenient products should be secured through technologies related to the 4th industrial revolution, and creative thinking was presented throughout manufacturing, distribution, and customer service. **Conclusions:** Hair loss reduces the quality of life due to mental stress and affects social life. The continuous development of wig companies, such as information on wigs and quality improvement, should be supported.

Keywords : Beauty Tech, Beauty Industry, Wig Industrial Management, Scalp Healthcare, 4th Industrial Revolution

JEL Classification Code: I11, I15, J24, O1, O14, O32, Q01

1. Introduction

The 4th Industrial Revolution has a tremendous impact on society, on the world, on the way people live, especially on the labor market (Bikse et al., 2022). With the advancement and convergence of the service industry worldwide, the service economy is actively progressing. The concept of "Industry 4.0" is understood differently in different countries, where "Industry 4.0" can point to key tools for implementing national strategies such as innovative development (US), industry leadership (UK), and modern

industrial reform (France) (Li, et al., 2021). WEF (2016) suggested that the demographic, social, and economic impacts of the 4th Industrial Revolution would include 'changes in the working environment and labor flexibility (44%)', 'growth of the middle class in emerging markets (23%)', and 'climate change'. , 'Restriction of natural resources and the transition to a green economy' (23%), and 'Expansion of geopolitical volatility (21%)' were predicted to show high rankings (Jung & Khoe, 2018). It was combined with technology innovation business models in various fields according to the era of the 4th Industrial

1 First Author. Ph.D. Candidate, Department of Beauty Arts Care, Dongguk University, Korea. Email: choishin0732@naver.com

2 Corresponding Author. Professor, College of General Education, Kookmin University, Korea, Email: kihan.kwon@kookmin.ac.kr

© Copyright: The Author(s)

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Revolution. It is predicted that it will lead to the spread of services using mobile reflecting new demand, service creation, sericitization of products, and personal intentions (Baek, 2018). The 4th Industrial Revolution appears to have the ability to leverage convergence technologies to create a more inclusive, human-centered future (Mhlanga & Stakeholder, 2022). The global beauty industry, which permeates the international market and our lives, has increased demand for trendy and innovative products with various characteristics (Jones, 2011). As a result, the beauty industry has been on a rapid growth trajectory for many years. Most of the rapidly growing industries now are based on the convergence of products and services (Park et al., 2017). To strengthen the competitiveness of the service industry through the 4th Industrial Revolution, major countries around the world are promoting corporate activities and high-value-added economic service by strengthening innovation capabilities such as service science and service engineering (Jeon, 2017).

Currently, the beauty healthcare industry has actively applied artificial intelligence (AI), big data analysis, and virtual reality (VR). A new type of Beauty Tech era has developed when sustainable and innovative technology and beauty industry meet with personalized products and services (Kim, 2022). With new technological innovations, humans have created new jobs that require new capabilities. Although it may take time to acquire expertise in new jobs, the employment rate will remain stable in the long run (Katz & Margo, 2014). The 4th Industrial Revolution requires creative thinking throughout manufacturing, distribution, and customer service. The beauty industry is a representative service industry that satisfies the human desire to pursue beauty. In our society ahead of the age of 100, the interest in health care and appearance has become an important (Kam & Shin, 2020). In addition, with the entry into an aging society, as interest in appearance increases regardless of gender and age, the beauty industry is developing, and among them, the wig industry is in the limelight (Lee, 2021).

Accordingly, the government developed promising technologies using dermatological applications and leading technologies of the 4th Industrial Revolution to respond to the 4th Industrial Revolution in the beauty and cosmetics industry. Developing new markets and training global professionals and working-level experts through the development of future-type leading technologies for the 4th industry are presented as national tasks and countermeasures are being promoted (Beak, 2019). Wigs are not just decorative concepts but are being used to smooth social life and add confidence. Interest in overall wigs and partial wigs, which are necessary means for hair loss prevention, rapid growth of scalp-related markets, and hair styling, is increasing rapidly (Kang & Song, 2018). Efforts to become

beautiful are a reality of modern society that can be seen not only by women but also by men (Shin, 2011). In this reality, hair, which takes a large part in determining the external image, can change an individual's image and supplement body defects, and plays an important role in appearance and image management as an important means of self-expression and communication (Ko & Go, 2010). A wig is a functional tool that complements hair loss as a form of hairstyle that can express beauty and change the external image. In addition, it is used as a part of beauty means to express the desire for beauty and to express one's individuality (Ryu & Kim, 2011). This paper is an important literature review of the wig industry and consumer experience. It is to present specific growth strategies and practical development plans for the management and development potential of the wig industry in the era of beauty technology following the 4th industrial revolution.

2. Literature Review

2.1. Fourth Industrial Revolution

The 4th Industrial Revolution refers to cutting-edge information and communication technologies such as artificial intelligence (AI), big data, cloud computing, Internet of things (IoT), and mobile. It refers to the innovative next-generation industrial revolution that emerges from the convergence of the economy and society as a whole. The 4th Industrial Revolution is characterized by superintelligence and hyperconnectivity, and has a greater impact with faster velocities and a wider scope than the existing industrial revolution. Virtualization, a convergence phenomenon between the virtual world and the real world, is expected to spread throughout the physical daily and economic activities of members of society as virtual reality or augmented reality experience technologies develop. The 4th Industrial Revolution is signaling a major change in the economic and industrial sectors (Ahn & Lee, 2016).

2.2. Beauty Tech

Beauty Tech is a compound word of beauty and technology. It means a change to incorporate various technologies such as artificial intelligence (AI), Internet of Things (IoT), big data, cloud, nanotechnology, and mobile into the beauty industry. The smart beauty craze that combines ICT (Information & Communication Technology) at home and abroad is introducing a variety of products and services, and its spread is expected to increase faster and faster (Kim, 2017). The introduction of ICT (Information & Communication Technology), which provides computer-

based information and information systems, is leading to interest in the beauty industry to maintain healthy beauty beyond health care. The spread of these mobile services extends to wellness, and the combination of health and appearance in health is seeking completion (Park, 2020).

2.3. Wig Industry

Wigs are used as part of a cosmetic means to express the desire for beauty and individuality along with functionality. Wigs play a role in weaving clothes, makeup, and designs. (Yoo, 2010). Modern wigs vary greatly in design, material, wearing method, and wear pattern. We are expanding the use of wigs in new areas and forms, such as

wigs, partial wigs, wigs used in cultural contents of plays, movies, musicals, and dramas, and custom wigs considering the characteristics of cancer patients. (Han, 2006). The wig industry is an indigenous industry with more than 40 years of history in Korea. The wig industry has had a profound impact on Korea's economic development, and has undergone various changes in the environment of each era. Associations related to the domestic wig industry include the Korea Scalp and Hair Professionals Association, the Korean Wig Association, the Korea Hair Loss Experts Association, the International Scalp and Hair Association, and the Korean Dermatological Association.

3. Materials and Methods

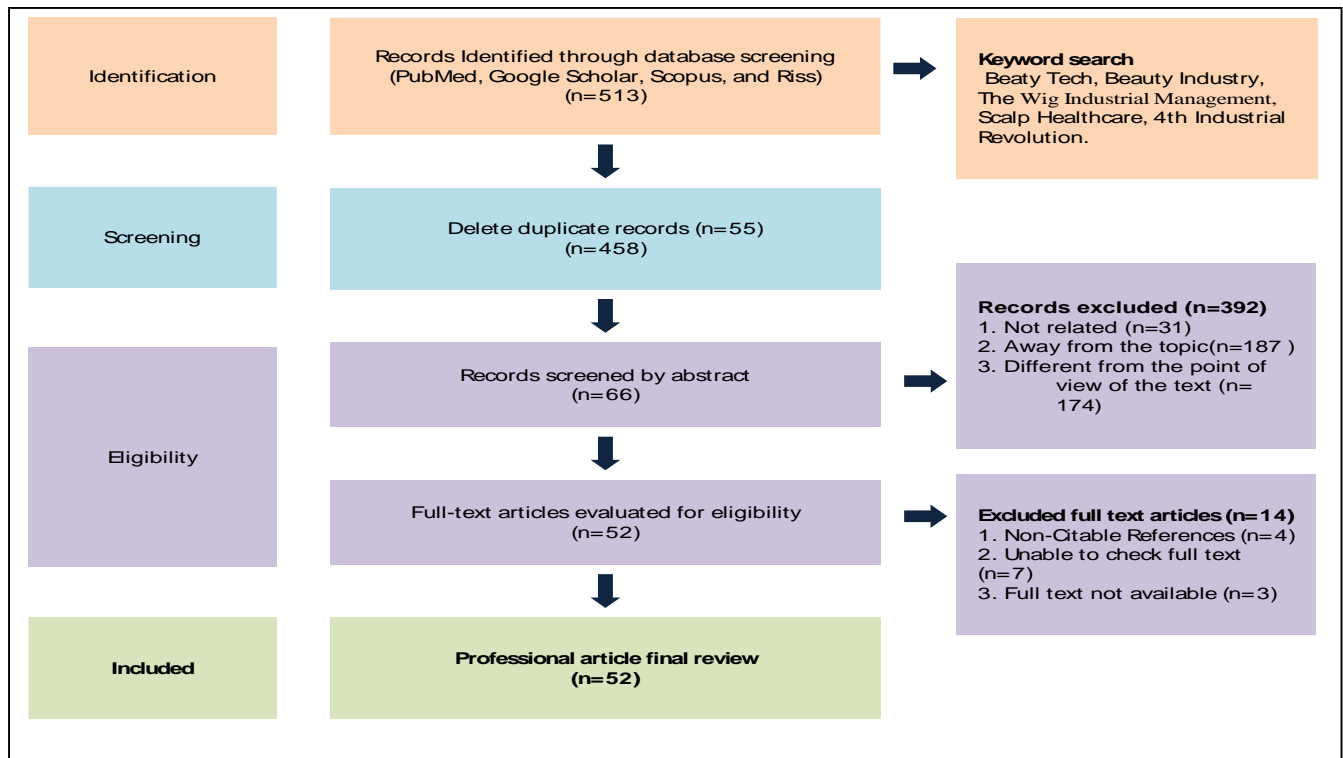


Figure 1: PRISMA flowchart for literature search results

This study is a literature review, and a narrative review approach has been used for this study. We used leading academic journal search sites such as PubMed, RISS, Google Scholar, Research Gate, and Scopus. A total of 523 references were retrieved using the PRISMA flow chart. Accordingly, a total of 61 papers were successfully selected in the final stage of this paper from 2008 to 2022. Figure 1

shows the PRISMA flow chart.

4. Result

4.1. Sustainability of the 4th Industrial Revolution and Beauty Tech

We are currently experiencing the 4th Industrial Revolution, called Industry 4.0 worldwide, fundamentally changing all production processes and social structures. It will affect education and health systems, work, communication, self-expression, information habits, lifestyle, and travel patterns. Specifically, as the number of high-tech, high-touch jobs that understand technology and humans in a balanced way is expected to increase, the need for human resource development with convergence capabilities is emerging (Lee et al., 2018). Industrial revolutions have occurred throughout history and should be seen in the context of new technology development when new technologies and new ways of recognizing the world trigger profound changes in economic systems and social structures (Schwab, 2021). As human lifespan continues to increase, the age of 100 is approaching. In 2013, the average life expectancy of OECD countries was 80.5, an increase of about 10 years compared to 1970. As of the end of 2013, the average life expectancy in Korea is 81.8 years, and the number of physically and mentally healthy populations is rapidly increasing in developed countries such as France, Japan, and the United (Secchi et al., 2016). As society advances, well-being and emotions are emerging as new consumption trends. Consumers have become interested in physical and mental health, and at the same time, demands for beauty are diversifying. The cosmeceuticals industry continues to grow and is a high-demand market, especially in Asia (Juhász et al., 2018). 'Cosmeceuticals', a product group that has recently become an issue in Korea, is defined as a combination of medicines and cosmetics with proven

medical effects (Shin & Park, 2019). Recently, consumers wanted to expand into cultural spaces. They pursue these desires, excitements, and fantasies. They want to change their mood through the product, to be free and to collect new information. With the psychological desire to escape from this reality, consumers have gradually pursued fun. Cantered on the MZ generation, which has emerged as a new cosmetics consumer, millennials, and Z generations, called the 'SNS generation' worldwide, pay attention to consumption trends. Millennials (born 1981-1996) and Gen Z (born 1997-2010) share a similar upbringing. Because of the commonality of the 'digital generation', they are collectively referred to as the MZ generation (Lee & Kwon, 2022). Due to the 4th Industrial Revolution, the beauty market is also developing into a sustainable and safe beauty service by combining technology (Tech) and smart beauty care. Beauty Tech is a compound word of beauty and technology and refers to a solution that allows consumers to conveniently experience beauty services tailored to their taste by combining various technologies with the beauty industry. The beauty industry, which supplies products and services used for appearance management, is changing rapidly as it is further subdivided according to customer needs and technological innovation. The main drivers of the changing trends in this industry are digitization, customization, sustainability and premiumization. Sustainable development (SD) is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Kim et al., 2021). Smart beauty care services are being provided in a wide range of areas, including the combination of existing beauty services and smart devices, on-demand services, artificial intelligence customized product recommendation services, and content (Won et al., 2018). shown as a Table 1.

Table 1: Sustainability of the 4th Industrial Revolution and Beauty Tech

Author	Schwab (2016)	Secchi et al. (2016)	Juhász et al. (2018)	Won et al. (2018)	Shin and Park (2019)	Kim et al. (2021)	Lee and Kwon (2022)	Lee et al. (2018)
Title	1. 14 The Fourth Industrial Revolution: What It Means and How to Respond	Assessing eco-innovations in green chemistry: Life Cycle Assessment (LCA) of a cosmetic product with a bio-based ingredient	The use of natural ingredients in innovative Korean cosmeceuticals	A Study on Strategic Direction of Beauty Care Service using Smart Mirror	Antiaging Cosmeceuticals in Korea and Open Innovation in the Era of the 4th Industrial Revolution: From Research to Business	Developing Sustainable Competitive Strategies in the Beauty Service Industry: A SWOT-AHP Approach	Mobile shopping beauty live commerce changes in COVID-19 pandemic focused on fun contents of MZ generation in Republic of Korea	Introduction and activation strategies for smart training of corporate

Discussion	It is fundamentally changing the whole production process and social structure	In the case of developed countries, the size of the physically and mentally healthy population is rapidly increasing	Well-being and emotions are emerging as new consumption trends	Sustainable smart beauty care service is being implemented	'Cosmeceuticals' is defined as a combination of pharmaceuticals and cosmetics with proven medical effects	Sustainable development (SD) is defined as "development that meets the needs of the present generation"	With a psychological desire to escape from reality, consumers gradually pursued fun	The need for human resource development with convergence capabilities is on the rise
Journal name	World Economic Forum	Journal of cleaner production	Journal of Cosmetic Dermatology	Journal of Communication Design	Sustainability	Sustainability	Journal of Cosmetic Dermatology	The Journal of Industrial Distribution & Business
No	1	2	3	4	5	6	7	8

4.2. The History and Market of the Wig Industry in Korea

In the late 1950s, wigs' hair styles became popular around the world, mainly in the United States. The wig industry began in 1963 in Korea. In 1964, \$14,000 was first exported, and in the following year, \$1,550,000 was exported nearly 100 times. In 1970, it accounted for 9.3% of Korea's total exports with about \$100 million. In 1972, it became the number one exporter of the United States. At one time, the market share of the world market was 90-93%. In the mid-1970s, as the demand for wigs in the United States, which accounted for more than 70% of the global market, plunged, leading companies in the wig industry shifted their industries.

As labour costs have risen since 1987, due to the weakening of price competitiveness, the Korean wig industry has gradually moved its factory to China, Indonesia, Africa, and Vietnam, and the domestic market has significantly shrunk. Since the mid-2000s, as synthetic fibres (artificial hair) for wigs have been developed, strategies such as mechanize, gigantic scale, and make small items have been taken. The government supported the gigantic scale and mechanization of the wig industry (Lee, 2021). In the case of wig yarn technology, it has risen to the global ranks within 10 years, enough to have attempted to leak the technology abroad. Sales of Korean wig companies that have entered the African market are also showing steady growth. The hair loss population continued to increase, further intensifying quality competition among high-end wig manufacturers. Among the recent hair loss patients, 13 percent of those in their teens or younger and 46 percent of those in their 20s and 30s.

In addition, in the data analysing 3,045 hair loss patients from 2007 to 2015, it was reported that the number

of young female hair loss patients in their 20s and 30s continued to increase, accounting for 52.3 percent of the total. In the era of 10 million people with hair loss, the market for hair loss prevention and scalp is growing rapidly. Wigs, shampoo, pharmaceuticals, usage (Barber Shop), beauty (hair shop) companies, department stores, and large discount stores are also releasing scalp and hair loss-related products and expanding their stores. Companies in related fields are implementing scalp and hair care through scalp scaling, massage, and device management using self-developed products. Some companies are selling products to general consumers. The scalp care market is growing rapidly, and research on factors related to sensitive scalp is being conducted in many countries.

We evaluated the sensitizing factors. In the case of Korean adult women, the average body temperature was significantly different between the non-sensitive scalp (NS) group and the sensitive scalp (SS) group. There are concerns about heat, dandruff, erythema of the scalp, history of atopic dermatitis, history of hair loss, scalp disease, and scalp care. Most SS group participants had dry scalp and itching was (Park et al., 2019). Hospitals such as plastic surgery and dermatology practice scalp and hair care by combining drug therapy and surgical therapy. Oriental medicine clinics provide treatment with acupuncture, massage, herbal care, percutaneous acupuncture, and herbal medicine. It is implemented as a basic program that soothes the hair and keeps it in an optimal condition. Hair and scalp aging characteristics of Korean women. Purpose: To investigate the physical and biological factors of a sufficient number of participants to understand the aging characteristics of hair. Endogenous aging causes various changes in hair and scalp characteristics of Korean women after their 40s. It shows that the aging characteristics of Korean women's hair can be partially different from

women in other (Kim et al., 2013).

Natural consequences of scalp micropigmentation. Scalp micropigmentation has developed rapidly in recent years to the extent that it is considered the primary means of treating hair loss, along with medications and hair transplantation. Conclusion Scalp micropigmentation is a widely used technique to disguise various scalp scars and alopecia. It is important to know the principles and skills necessary to achieve natural results (Park &, 2022). Therapeutic efficacy of autologous platelet-rich plasma and polydeoxyribonucleotide on emale pattern hair loss. Background Autologous platelet-rich plasma (PRP) has a positive therapeutic effect on hair thickness and density in patients with pattern hair loss. As a result, to apply autologous fat transplantation to the treatment of pattern hair loss, a lot of experience in surgical treatment and

transplantation is required (Lee et al., 015). The size of the domestic wig market has grown 5.6 times in 10 years from 250 billion won in 2008 to 1.4 trillion won in 2018. According to the Health Insurance Review and Assessment Service, the era has come when one in five people are worried about hair loss. Among hair loss patients in Korea, those in their 30s accounted for the highest proportion at 26.9%. Combined, those in their 20s and 30s account for about 49% of the total hair loss treatment population. The estimated size of the wig market in the business world far exceeds KRW 1.5 trillion, and the actual fashion wig market is being distributed cheaply through the Internet. In accordance with the increase in demand in the domestic wig industry, related research is also being actively conducted (Kang & Song, 2018). shown as a Table 2.

Table 2: The History and Market of the Wig Industry in Korea

Author	Kim et al. (2013)	Lee et al. (2015)	Kang and Song (2018)	Park et al. (2019)	Lee (2021)	Park and Ho (2022)
Title	Characteristic features of ageing in Korean women's hair and scalp	Therapeutic efficacy of autologous platelet-rich plasma and polydeoxyribonucleotide on female pattern hair loss	The Effect of Wig Wearers' Perception and Self-Efficacy on Satisfaction	Evaluation of factors triggering sensitive scalp in Korean adult women	Korea's Entry into the Wig Market and the Birth of Korean Wig Workers	Natural results of scalp micropigmentation: A review
Discussion	Characteristics of hair and scalp aging in Korean women	Autologous platelet-rich plasma (PRP) has a positive therapeutic effect on hair thickness and density in patients with pattern hair loss	Among hair loss patients in Korea, those in their 30s accounted for the highest proportion at 26.9%	Factors associated with sensitive scalp are being studied in many countries	As labor costs rose, the Korean wig industry gradually moved factories to China, Indonesia, Africa, and Vietnam	Scalp micropigmentation is a widely used technique to disguise various types of alopecia
Journal name	British Journal of Dermatology	Wound Repair and Regeneration	Journal of The Korean Society of cosmetology	Skin Research and Technology	Critical Review of History	Journal of Cosmetic Dermatology
No	1	2	3	4	5	6

4.3. Beauty Tech New Growth Wig Industry

As the 4th Industrial Revolution era begins, various technological revolutions are rapidly changing the organizational behaviour of companies and individuals (Morrar et al., 2017). As the influence on digitalization, the Internet of Things, smart knowledge, and systems has been strengthened due to the progress of the 4th Industrial Revolution, research on countermeasures by individual industries is being activated (Friess & Ibanez, 2014). Smart

beauty care is a new type of service that combines digital technology and beauty care. Smart beauty care services are being provided in a wide range of areas, including the combination of existing beauty services and smart devices, on-demand services, artificial intelligence customized product recommendation services, and content curation. Beauty Tech is a compound word of beauty and technology and refers to a solution that allows consumers to conveniently experience beauty services tailored to their taste by combining various technologies with the beauty

industry. In the hair shop and wig industry, the use of smart mirrors has increased remarkably by being equipped with various functions such as styling recommendations, previews, dyeing effects, price lists, treatment types, and entertainment contents. In the long run, the convergence of beauty and IT technology is expected to evolve into a customized service, with customers being able to easily choose the hairstyle that suits them. 3D printing technology is innovatively changing manufacturing, production, and marketing methods in each industry.

The wig industry is also using 3D printing technology to produce wigs. 3D shape reconstruction using 3D vision is to obtain accurate 3D geometric information of an object from a series of image information about the object and quantitatively determine the characteristics of the (Park & Lee, 2001). The 3D wig manufacturing technique first sets seven representative landmark points for the head shape and creates a standard three-dimensional head shape, which is an ideal head shape. Then, using the designed robot arm, the 3D location information for the 5 measurement points is extracted. Based on the data, the three-dimensional head of the person to be measured was created using the FFD (Free Form Deformation) algorithm (Choi et al., 2018).

Among the products currently being developed as wig yarns, studies on the flame retardancy of wig yarns, which are recognized as products close to human hair in many ways and are called 'next-generation wig yarns', are being actively conducted (Kim, 2010). Manufacture of flame-retardant wig yarn based on super engineering plastic Artificial hair used as wig fibre requires vivid colour, lightness, heat resistance, soft touch and flexibility, curl formation and curl retention, as well as flame retardancy and heat resistance (Yang et al., 2017). Since artificial hair is used in connection with the scalp or wig wearer's hair, flame retardancy should be given to protect the wearer from burns

during flame contact. PES and PEI wig yarns, which have similar fineness and strength to existing commercial wig yarns, do not add flame retardants, simplify the process and are environmentally friendly, so they can be used as alternatives in the flame-retardant wig yarn market. In addition, it is suitable for reproducing the characteristics of human hair according to race because fibres with various diameters can be manufactured according to the winding speed control and spinning process (Choi et al., 2020).

Environmental concerns regarding plastic components have led to the search for sustainable high-performance thermoplastics that can be partially or entirely derived from bio-derived thermodynamic properties and feedstocks to replace petrochemicals. This has limited the expansion of renewable thermoplastics in industry and created opportunities in academia. Thermoplastics are classified in the order of general-purpose plastics < engineering plastics (EP) < super engineering plastics (SEP) according to their superior thermal performance and mechanical performance (Nguyen et al., 2018). Super engineering plastic (SEP) has excellent thermal stability, metal strength, and heat resistance at a continuous temperature of 150°C or higher compared to conventional plastics (Park, 2019). As a human safety evaluation experiment of wig adhesives, human safety was verified through volatile organic compound emission analysis and cytotoxicity analysis for four types of acrylic and silicone-based adhesives used most frequently in Korea. The purpose is to secure basic safety data for the development of eco-friendly adhesives that can be applied to the beauty field. As a result of VOCs evaluation of wig glue, in the safety evaluation using cell analysis, the cell viability of the silicone adhesive showed a relatively higher cell viability than that of the acrylic adhesive (Kim & Lee, 2019). shown as a Table 3.

Table 3: Beauty Tech New growth wig industry

Author	Park and Lee (2001)	Kim (2010)	Friess and Ibanez (2014)	Morrar et al. (2017)	Yang et al. (2017)	Choi et al. (2018)	Park et al. (2019)	Kim and Lee (2019)
Title	System Integration of Custom Shoe & Wig using 3D Scanning Technology	Study on the Compatibility of Brominated Epoxy Resin with Nylon 6 and the Characterization of the Blends	Putting the internet of things forward to the next level. In O. Vermesant & P. Friess	The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective	Preparation and characterization of novel super-artificial hair fiber based on biomass materials	Automatic 3D Wig Generation Method Using FFD and Robotic Arm	Sustainable and recyclable super engineering thermoplastic from bio renewable monomer	Health Safety Assessment of Wig Adhesives
Discussion	The convergence of beauty and IT	Research on the flame retardancy of wigs is	Research on countermeasures by individual industry is	It is rapidly changing the organizational behavior of	Artificial hair requires flame retardancy and heat	Extract 3D location information using the designed	Super engineering plastic (SEP) has very good properties	It is intended to secure basic safety data

	technology is expected to evolve into customized services	actively underway	being activated	businesses and individuals	resistance	robot arm	compared to conventional plastics	for the development of eco-friendly adhesives
Journal name	Journal of the Korean Society for Precision Engineering	Textile Coloration and Finishing	Internet of Things Applications –From Research and Innovation to Market Deployment	Technology innovation management review	International Journal of Biological Macromolecules	Journal of Korean Institute of Information Technology	Nature Communications	Polymer
No	1	2	3	4	5	6	7	8

4.4. Development Potential of Korea's Wig Industry in the Era of the 4th Industrial Revolution

Currently, the beauty service industry, a future growth industry that can create high added value, is emerging in Korea. In terms of services provided, it can be said to be an industry with high potential for future development in that it reflects industrial trends that are becoming advanced, subdivided, and specialized (Lee, 2020). The 'beauty service industry,' a Highvalue-added industry in the 21st century, is one of the industries that is rapidly growing into an "increasing desire for youth and beauty" due to the improvement of people's income levels. The purpose of modern people wearing wigs can be summarized in two ways. One is the psychology of wanting the existence of 'I' to be expressed as someone else, not as myself. Another is the psychology of wanting the existence of 'I' to be expressed entirely as 'I'. Aspire to highlight external beauty by wearing fashion, partial wigs, or custom wigs, and wish to present a desirable image to others (Choi & Kim, 2007).

The higher the recognition level of wig wearing, the higher the self-efficacy and satisfaction with wig wearing. Specifically, among the sub-domains of self-efficacy in wig wearing, the correlation coefficient between image management ability and satisfaction is the highest. It means that the higher the management ability to positively create one's image after wearing a wig, the higher the satisfaction level (Kang, 2016). Wigs are used as a part of cosmetic means to express one's individuality and desire for expression of beauty along with functionality. The wig plays the role of interweaving clothes, makeup, and design. The use of elegant and dramatic colours and unexpected jewels is also integrated into the expressive image of the human body artwork, which is connected from the structure of the head to the structural flow of clothes (Kim, 2004). Hair loss people should choose wigs in consideration of social, functional, hygienic, efficient, and aesthetic aspects (Jang,

& Bae, 2008). Modern wigs are very diverse in terms of material, design, wearing form and wearing method. It is expanding the use of wigs in new forms and areas such as customized wigs such as wigs and partial wigs, customized wigs considering the characteristics of cancer patients, and wigs used in cultural contents of plays, movies, musicals, and dramas (Kim, 2013).

The wig industry is a Korean indigenous industry with a history of more than 40 years. The wig industry has had a great impact on economic development among the historical facts of Korea, moreover, has undergone various changes in the environment of each era. Associations related to the wig industry in Korea include the Korea Wig Association, the Korea Scalp and Hair Experts Association, the International Scalp and Hair Association, the Korea Hair Loss Experts Association, and the Korean Society of Dermatology. Currently, the Korean Wig Association is an organization that serves as the world headquarters of the International Federation of Scalp and Wig Experts, was established with the goal of standardizing domestic wig and scalp education. It supports education at headquarters in each country such as the United States and China. It oversees efforts to strengthen the competitiveness of the domestic wig industry and serves as a medium for information exchange and cooperation between popular companies related to wigs at home and abroad. It provides educational activities, information provision activities, and support for various related events to strengthen the global competitiveness of the wig industry (Lee, 2021).

In the future society, the convergence of beauty and IT will evolve further into customized services. To strengthen the competitiveness of the beauty market in the ever-changing era of the 4th Industrial Revolution, the following strategies are necessary. As part of various marketing methods, opportunities for ordinary people to try wigs without burden, such as indirect experience or hands on experience, should be provided frequently. It is believed that

the generalization and popularization of the use of wigs will be possible if wigs that are comfortable to wear and can produce natural styling are continuously developed (Jang, 2013). shown as a Table 4.

Table 4: Development potential of Korea's wig Industry in the Era of the 4th Industrial Revolution.

Author	Kim (2004).	Choi and Kim (2007)	Jang and Bae (2008)	Kim (2010)	Jang (2013)	Lee (2015)	Kang (2016)	Lee (2020)
Title	Transactions : Interaction Effects of Two Salient Cues on Males Fashion Images: Hair Lengths & Hair Colors	The Forms of Man's Wig in Seventeen-Eighteen Century: Focused on the movie "Pirates of The Caribbean - The Curse of the Black Pearl"	The influence of wearing wigs on the quality of life the female cancer patients who started losing hair	Finding of the Fashion Wigs - Middle Aged Women Centered	The effect of Personal Wig Utilization Status and Service Quality on Customer Satisfaction and Relationship Orientation	Impact studies on the non-profit corporation business purposes participation : Focusing on the Korea Wig Association	The Effect of Wig Wearers' Perception and Self-Efficacy on Satisfaction	A study on The Development Strategy of Korean Beauty Service Industry Using the SWOT-AHP Method
Discussion	The wig plays the role of interweaving clothes, makeup, and design	Desperate for the external beauty to be highlighted, I want to present a desirable image to others	Hair loss people should choose wigs in consideration of social, functional, hygienic, efficient, and aesthetic aspects	It is expanding the use of wigs in new forms and areas such as wigs	The convergence of beauty and IT will further evolve into customized services	The wig industry has undergone various changes in the environment of each era	It means that the higher the management ability to positively create one's image, the higher the satisfaction level	Korea's beauty service industry is emerging as a future growth industry that can create high added value
Journal name	Journal of the Korean Society of Clothing and textiles	Journal of the Korean Society of Fashion & Beauty	The Journal of the Korea Contents Association	Journal of Investigative Cosmetology	Journal of the Korean Society of Cosmetology	Critical Review of Histor	Journal of The Korean Society of cosmetology	The Korea Service Management Society
No	1	2	3	4	5	6	7	8

4. Discussions

The 4th Industrial Revolution refers to the fusion of technologies in which the boundaries of physical space, digital space, and biotechnology space are diluted based on digital revolutions such as IT and electronic technology (the 3rd Industrial Revolution) (Schwab, 2016). The 4th industrial revolution is also known as the 4th industry (industry 4.0) and is defined as innovation through technology convergence, and disruptive changes in business models are taking place, changing the structure of the labour

market. In the field of beauty industry, the 4th industrial revolution is making various changes. In Korea, K-beauty is developing into a major national industry, and its importance is emerging. The Korean government is developing skin science applications and promising technologies for the 4th Industrial Revolution to respond to the 4th Industrial Revolution in the beauty industry. It is pushing for countermeasures such as developing new markets and training working-level experts through the development of future-oriented technologies for the 4th industry. In the era of the 4th industrial revolution, sustainable "nature" and "science" were grafted onto the beauty tech industry.

Personalized products and services are provided to beauty industries such as scalp management by combining artificial intelligence technology, Augmented Reality technology, Big Data technology, and 3D printing technology (Baek, 2019). For the beauty industry to secure sustainability, consumers' desire for new and more convenient products must be secured through technologies related to the 4th Industrial Revolution. Amid the development of industry and technology, Covid-19, which hit the world, has changed the values and lifestyles of beauty consumers, resulting in a change in the purchase form of beauty products. In the COVID-19 pandemic situation, it was found that the MZ generation in Korea prefers to emphasize individuality and taste among mobile shopping, beauty, live commerce, and fun content (Lee & Kwon, 2022).

As a country with advanced information technology, Korea shows a warm, beautiful, yet new, fast, and young image. In addition, beauty services were applied to the formation of the image of K-beauty (An, 2013). Korean entertainment is popular not only in Indonesia but also in other parts of the (Halim & Kiatkawsin, 2021).

Korean low-cost beauty brands offer beauty products in a wide range of price ranges and are especially popular in Indonesia. Provides a price-performance ratio when comparing North American brands to European counterparts (Chan et al., 2013; Aziz et al., 2019; Chung & Cho, 2017). The beauty service industry has become a part of the life of the MZ generation and modern people who pursue beauty and individuality at the same time through continuous development in the service aspect. In addition, it has developed into an attractive industry that has led to continuous purchases by consumers (Park & Park, 2011). Rapid changes due to industrial development are pouring out harmful substances along with various environmental pollution. The development of the Internet is convenient, and the stress of rapidly changing life is also increasing (Park & Park, 2011). Recently, childhood hair loss, youth hair loss, and hair loss due to the treatment of cancer patients have been shown to be due to mental problems caused by complex social structures. Hair loss patients are increasing due to various factors such as genetic factors and stress, not natural hair loss due to aging.

A person with hair loss wears a wig as an aesthetic means to cover a shortcoming with respect to hair. Wigs are a form of hairstyle that can express beauty and make external image changes. It is used not only as a functional tool to compensate for hair loss, but also as a part of beauty means that expresses the desire for beauty and expresses one's personality. Recently, the wig industry has shown great growth. At a time when fashion wigs are becoming more common, related research is also being actively conducted due to the increase in demand in the domestic wig industry. Accordingly, this literature review paid attention to the

development potential of scalp health care and wig industry in the sustainable beauty tech market in the era of the 4th industrial revolution. The 4th industrial revolution requires creative thinking throughout manufacturing, distribution, and customer service. Nevertheless, prior research on the development direction of the beauty industry in the era of the 4th Industrial Revolution is relatively insufficient. It is a very important task to actively respond to improve the sustainability of the beauty service industry in the era of the 4th Industrial Revolution. (Yoo, 2010).

5. Conclusions

The sustainability of consumption, distribution, and management of the beauty industry should be established through technologies related to the 4th industrial revolution. The wig industry should strive to meet the needs of consumers in an era where convenient and new products and individuals are being strengthened in corporate management. As part of various marketing methods for the development of the wig industry and corporate management, opportunities such as indirect experience or experience that the general public can use wigs without burden should be provided frequently.

If wigs that are easy to wear and can produce natural styling are continuously developed, it will be possible to generalize and popularize the use of wigs. Through constant research and development for digital innovation in the global beauty market, products that satisfy customers' emotions and various services that provide brand experiences should be implemented. Even before the spread of COVID-19, the meaning of beauty was gradually changing to a meaning connected to global and well-being. The beauty industry, which is very sensitive to changing customer tastes and fashion and trends, should continue to make efforts to respond to various changes even after the pandemic. In the era of beauty tech, the wig industry must implement various services that provide products and brand experiences that satisfy customers' emotions through constant research and development for digital innovation in the global beauty market.

References

- Abdaziz, D. Z., Khalilomar, M., & Ariffin, S. (2019). The effects of celebrity endorsement towards purchase intention among students in one public university Malaysia. *International Journal of Academic Research in Business and Social Science*, 9(5), 498-507.

- Ahn, S.H., & Lee, M.H. (2016). "Fourth Industrial Revolution Impact: How it Changes Jobs. *Leading Future Agendas of Business & Society*, 20, 2334-2363.
- An, H. K. (2013). The Study on the Phenomenon and Development Methods of Beauty Korean Wave, K-Beauty. *The Korean Beauty Management Journal*, 1(2), 223-233.
- Baek, H. Y. (2019). A Study on the Development of Beauty Industry in the Era of the Fourth Industrial Revolution. *Korean Society of Cosmetics and Cosmetology*, 9(3), 455-462.
- Bikse, V., Grinevica, L., Rivza, B., Rivza, P. (2022). Consequences and Challenges of the Fourth Industrial Revolution and the Impact on the Development of Employability Skills. *Sustainability*, 14(12), 6970.
- Chan, K., Leung Ng, Y., & Luk, E. K. (2013). Impact of celebrity endorsement in advertising on brand image among Chinese adolescents. *Young Consumers*, 14(2), 167-179.
- Choi, C. H., Rahman, M. S., Kim, Y. P., & Kim, S. (2018). Automatic 3D wig Generation Method using FFD and Robotic Arm. *Journal of Korean Institute of Information Technology*, 16(1), 35-43.
- Choi, H. J., Gong, D. J., Youn, C., & Yeo, S. Y. (2020). Preparation of Flammability Artificial Hair based on Super Engineering Plastic. *Textile Coloration and Finishing*, 32(2), 103-110.
- Choi, M. O., & Kim, S. N. (2007). The Forms of Man's Wig in Seventeen-Eighteen Century Focused on the movie. *Journal of the Korean Society of Fashion and Beauty*, 5(3), 105-110.
- Chung, S., & Cho, H. (2017). Fostering parasocial relationships with celebrities on social media: Implications for celebrity endorsement. *Psychology & Marketing*, 34(4), 481-495.
- Friess, P., & Ibanez, F. (2022). Putting the Internet of Things Forward to the Next Nevel. *Internet of Things Applications- From Research and Innovation to Market Deployment* (pp. 3-6). River Publishers.
- Halim, T. M., & Kiatkawsin, K. (2021). Beauty and celebrity: Korean entertainment and its impacts on female indonesian viewers' consumption intentions. *Sustainability*, 13(3), 1405.
- Jang, M. H., & Bae, S. K. (2010). "Recognition Change Before and After Wearing Wigs of the Female Cancer Patients." *The Journal of the Korea Contents Association*, 10(4), 198-205.
- Jang, S. H., Kim S. H., & Jin, Y. M. (2013). A Study on the Effect of Attitude towards Customized Wig on Quality of life, Willingness to Re-use and to Spread of Word of Mouth, *Journal of the Korean Society of Cosmetology*, 19(2), 277-284.
- Jones, G. (2010). *Beauty Imagined: A History of the Global Beauty Industry*. Oup Oxford.
- Juhasz, M. L., Levin, M. K., & Marmur, E. S. (2018). The use of natural ingredients in innovative Korean cosmeceuticals. *Journal of Cosmetic Dermatology*, 17(3), 305-312.
- Jung, J. S., & Khoe, K. (2018). The strengthening of export competitiveness through the 6th agriculture industrialization and the 4th Industrial Revolution. *The Journal of Industrial Distribution & Business*, 9(3), 31-43.
- Kam, H. K., & Shin, Y. J. (2020) The Effect of Economic Value Added on Stock Returns: Focusing Beauty Industry on Korea. *The Korea Academia-Industrial cooperation Society*, 14(1), 1-20.
- Kang, H.S., & Song, Y. S. (2018). The Effect of Wig Wearers' Perception and Self-Efficacy on Satisfaction. *Journal of The Korean Society of cosmetology*, 24(2), 312-319.
- Katz, L. F., & Margo, R. A. (2014). Technical change and the relative demand for skilled labor: The united states in historical perspective. In *Human capital in history: The American record* (pp. 15-57). University of Chicago Press.
- Kim, G. M. (2017). A study on the changes of the fourth industrial revolution and global beauty market. *Journal of cultural product & design*, 50(50), 221-231.
- Kim, H. C. (2010). Study on the Compatibility of Brominated Epoxy Resin with Nylon 6 and the Characterization of the Blends. *Textile Coloration and Finishing*, 22(2), 155-162—
- Kim, J. S. (2004). Transactions : Interaction Effects of Two Salient Cues on Males Fashion Images: Hair Lengths & Hair Colors, *Journal of the Korean Society of Clothing and textiles*, 28(10), 1320-1328
- Kim, J. W., & Lee, J. H. (2019). Health Safety Assessment of Wig Adhesives. *Polymer*, 43(3), 485-490—
- Kim, M. J., & Kim, J. H. (2010). A Study on the Recognition and Worn by the Fact -Finding of the Fashion Wigs -Middle Aged Women Centered, *Journal of Investigative Cosmetology*, 6(2), 151-157
- Kim, S. N., Lee, S. Y., Choi, M. H., Joo, K. M., Kim, S. H., Koh, J. S., & Park, W. S. (2013). Characteristic features of ageing in Korean women's hair and scalp. *British Journal of Dermatology*, 168(6), 1215-1223—
- Kim, Y. J., Lee, J. H., Lee, S. G., & Lee, H. H. (2021). Developing sustainable competitive strategies in the beauty service industry: a SWOT-AHP approach. *Sustainability*, 13(19), 10852.
- Ko, E. J. (2017). Competition in the global beauty industry is changing. *LG Economic Research Institute*.
- Ko, K. S., & Go, S.G. (2010). The Effects of Beauty Art Students' Self-Concepts on Their Receptivity of the Hair Trend and Their Store Choice Tendencies. *The Korean Society Of Beauty And Art*, 11(3), 67-84.
- Lee, E. H. (2021). Korea's Entry into the Wig Market and the Birth of Korean Wig Workers. *Critical Review of History*, 135, 394-425.
- Lee, J., & Kwon, K. H. (2022). Mobile shopping beauty live commerce changes in COVID-19 pandemic focused on fun contents of MZ generation in Republic of Korea. *Journal of Cosmetic Dermatology*, 21(6), 2298-2306.
- Lee, J., & Kwon, K. H. (2022). Sustainable and Safe Consumer Experience NFTs and Raffles in the Cosmetics Market after COVID-19. *Sustainability*, 14(23), 15718.

- Lee, J. E., Kwon, S., & Jung, H. (2018). Introduction and activation strategies for smart training of corporate. *The Journal of Industrial Distribution & Business*, 9(5), 83-91.
- Lee, J. H. (2020). A study on the development strategy of the Korean beauty service industry (K-Beauty) using the SWOT-AHP method. *The Korea Service Management Society*, 2020(6), 77-78.
- Lee, S. H., Zheng, Z., Kang, J. S., Kim, D. Y., Oh, S. H., & Cho, S. B. (2015). Therapeutic efficacy of autologous platelet-rich plasma and polydeoxyribonucleotide on female pattern hair loss. *Wound Repair and Regeneration*, 23(1), 30-36.
- Li, C., Qiu, Z., Fu, T. (2021). The Role of Policy Perceptions and Entrepreneurs' Preferences in Firms' Response to Industry 4.0: The Case of Chinese Firms. *Sustainability*, 13(20), 11352.
- Mhlanga, D. (2022). Stakeholder Capitalism, the Fourth Industrial Revolution (4IR), and Sustainable Development: Issues to Be Resolved. *Sustainability*, 14(7), 3902.
- Morrar, R., Arman, H., & Mousa, S. (2017). The fourth industrial revolution (Industry 4.0): A social innovation perspective. *Technology innovation management review*, 7(11), 12-20.
- Schwab, K. (2016). *1.14 The Fourth Industrial Revolution: what it means and how to respond*. World Economic Forum (pp. 1-7).
- Nguyen, H. T. H., Qi, P., Rostagno, M., Feteha, A., & Miller, S. A. (2018). The quest for high glass transition temperature bioplastics. *Journal of Materials Chemistry A*, 6(20), 9298-9331.
- Park, E. J., & Park, O. L. (2011). Study on Human Service and Customer's Revisit According to Their Big Five Personality Trait in the Beauty Shop Setting. *J. Korean Soc. Cosmetol.* 17, 94-104.
- Park, J. H., Ho, Y. H., & Manonukul, K. (2022). Natural results of scalp micropigmentation: A review. *Journal of Cosmetic Dermatology*, 21(11), 5509-5513.
- Park, J. S. (2020). Changes in beauty service industry in era of the fourth industrial revolution and aging: Focused on expandability of the smart beauty care market. *The Journal of Humanities and Social science*, 11, (1), 205-220.
- Park, K. H., Kim, J., Oh, B., Lee, E., Hwangbo, J., & Ha, J. (2019). Evaluation of factors triggering sensitive scalp in Korean adult women. *Skin Research and Technology*, 25(6), 862-866.
- Park, M. S., Lee, D. H., & Choi, J. A. (2017). Analysis on the Industrial Linkages between Manufacturing and Service Sector in Daegu and Gyeongbuk Region. *Journal of The Korean Regional Development Association*, 29(1): 99-120.
- Park, S. A., Jeon, H., Kim, H., Shin, S. H., Choy, S., Hwang, D. S., ... & Oh, D. X. (2019). Sustainable and recyclable super engineering thermoplastic from biorenewable monomer. *Nature communications*, 10(1), 2601.
- Park, S. K., & Lee, B. K. (2001). System Integration of Custom Shoe & Wig using 3D Scanning Technology. *Journal of the Korean Society for Precision Engineering*, 18(5), 12-16.
- Ryu, H. S., & Kim, J. D. (2011). A Study on Wig-wearing, Care Realities, and Recognition in People with Alopecie Hair. *Korean Society of Cosmetics and Cosmetology*, 1(1), 25-43.
- Secchi, M., Castellani, V., Collina, E., Mirabella, N., & Sala, S. (2016). Assessing eco-innovations in green chemistry: Life Cycle Assessment (LCA) of a cosmetic product with a bio-based ingredient. *Journal of cleaner production*, 129, 269-281.
- Shin, K. O., & Park, H. S. (2019). Antiaging cosmeceuticals in Korea and open innovation in the era of the 4th industrial revolution: From research to business. *Sustainability*, 11(3), 898.
- Won, J. W., Han, G. H., & Oh, M. S. (2018). A study on strategic direction of beauty care service using smart mirror. *Journal of Communication Design*, 63(63), 61-74.
- Yang, L., Guo, J., Zhang, S., & Gong, Y. (2017). Preparation and characterization of novel super-artificial hair fiber based on biomass materials. *International journal of biological macromolecules*, 99, 166-172.