

Visual Design Sustainability

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The United Nations established 17 sustainable development goals (SDGs) in 2015, but research on these goals in the visual design industry remains limited.

Keywords: multi-criteria decision making (MCDM) ; visual design sustainability ; fuzzy analytic hierarchy process (FAHP)

1. Introduction

Visual design seeks to captivate, inspire, and encourage people to engage with messages in order to achieve positive outcomes. These outcomes are aligned with the objectives of the organisation commissioning the design, whether it is to reinforce brand identity or drive sales. Objectives may include changing behaviour, advocating messages, or disseminating information. The process of visual design involves strategic planning, incorporating market research, creativity, problem solving, and technical expertise in areas such as colour theory, layout, typography, and visual hierarchy. Visual designers communicate ideas and information through a variety of media, using both traditional tangible skills and strategic design thinking to establish credibility and effectively influence target audiences in design and marketing contexts ^{[1][2][3]}. In the meantime, Albadi et al. ^[4] and Martins et al. ^[5] reported that the concept of visual design encompasses a broader spectrum, including posters, typography, illustration, web design, packaging design, and visual identity design, all of which find application in various sectors within the creative industries. Also, Huang ^[6] presented new perspectives on the positioning and capability needs of the visual design industry in the post-epidemic era. She mentioned that visual design industry practitioners should continue to improve their cross-disciplinary skills, especially techniques related to achieving sustainable development goals, in order to meet new challenges and opportunities in the post-epidemic era.

In 2022, Li ^[7] addressed the overlooked perspective of employee perception in design's impact on brand equity in 2022. This is one of the latest studies to explore the concept of green design from the perspective of employees in the post-epidemic era. It examined how green design concepts influence employee perceptions and behaviours. The results indicated that green design elements influence employee perceptions, which in turn promote positive behaviour and brand equity, mediated by green design concepts.

As global attention on caring for the health of the planet and ensuring shared prosperity for humanity continues to grow, the United Nations (UN) established a set of global goals ^[8]. These goals are known as the 17 Sustainable Development Goals (SDGs), which are further broken down into 169 specific targets that detail the content of each SDG ^[9]. Since then, much related research has been developed and published. For example, Zamora-Polo et al. ^{[10][11]} proposed some case studies on the application of the SDGs in higher education. They have found that higher education institutions can raise students' awareness of the SDGs with the right pedagogical framework. Meanwhile, university students majoring in education and health-related disciplines are more attentive to the SDGs and perform better than students in other disciplines. Also, Nakamura et al. ^[12] proposed a case study in 2023 for the investigation of people's willingness to participate in energy and environment-related policy issues in Japan and Taiwan through use of the Morality-as-Cooperation Questionnaire (MAC-Q). They mentioned that Taiwanese respondents had a better understanding of environmental issues and a greater willingness to engage in civil dialogue, a more positive attitude towards dialogue, and a broader scope of cooperation than Japanese respondents. The research work of Nakamura et al. ^[12] is one of the latest research results on the willingness of Japanese and Taiwanese people to participate in the SDGs. Moreover, Chang et al. ^[13] investigated the coverage of the SDGs in university course syllabi in Kaohsiung. They reported that the relationship between university curriculum syllabuses and SDGs depended on the subject characteristics and diversity of the university.

Furthermore, some scholars ^{[14][15][16][17]} explored the relationship between the service industry and SDGs from the perspective of service quality. Among them, Stamenkov et al. ^[14] used a sustainable service quality measurement model for the online service industry and contributed to the realisation of SDGs in the online service industry. Ozdemir et al. ^[15]

proposed the concept of sustainable service quality in higher education by developing a set of measurement tools from the perspective of campus services. The views of Ozdemir et al. ^[15] were quite novel at the time and had a guiding role in the implementation of SDGs on higher education campuses. Johnson et al. ^[16] presented their opinions on improving the sustainable service competitiveness of Thai telecom operators. Enquist et al. ^[17] proposed a value-based sustainable service quality evaluation method for commercial services. They reported that the core values of a company play an important inspiring role in improving the sustainability of the company.

In addition, some scholars proposed relevant research results from the perspective of creative and design industries. For example, Tu ^[18] proposed sustainable approaches and suggestions of the product design industry. Clark et al. ^[19] discussed the sustainable trend of product design and development. They reported that ecological design factors will be an important indicator for the future industrial design industry to achieve SDGs. Goubran et al. ^[20] proposed a novel analytical drawing tool to help architectural designers achieve the SDGs, which can inform architectural practice in the private and public sectors and contribute to the theory and practice of sustainable building design. Fan et al. ^[21] utilised the Porter's Diamond Model as a research tool to put forward strategies and suggestions for the sustainable development of China's animation industry from multiple aspects such as production, demand, supply chain, corporate strategy, cultural factors, and government. Chen et al. ^[22] collaborated with designers to create a board game on the SDGs. Their findings are not only one of the most recent studies to introduce a design approach to the field of education in the post-coronavirus era, but also prove that games can be effective in promoting the SDGs, whether they are used in the classroom or played outside the classroom, by stimulating players' interest in the SDGs.

2. Fuzzy Analytic Hierarchy Process

Analytic hierarchy process (AHP) was proposed by Saaty in 1980 ^[23]. It is one of the most complete techniques for solving MCDM issues in many areas and has been confirmed by many studies ^{[24][25][26]}. This method can better systematise complex issues, decomposing them at different levels to make a comprehensive evaluation after quantitative judgment ^{[27][28][29]}.

Meanwhile, some scholars have applied AHP to the sustainable design field. For example, Arukala et al. ^[30] presented a case study of sustainability performance assessment of the built environment in India using AHP. They found that applying the AHP method to assess the sustainability performance of the built environment in developing countries is effective and feasible. Also, Dai et al. ^[31] proposed an integrated method of AHP and QFD from the perspective of sustainable development to provide relevant suggestions for suppliers to achieve sustainable development goals. Moreover, Tu et al. ^[32] utilised Theoria Resheneyva Isobretatelskehuh Zadach (TRIZ) and AHP to establish sustainable development rules for product design and to contribute to the realisation of sustainable development goals in the product design industry.

Although AHP can be used to address the above problems, unfortunately, it falls short when it comes to explaining problems that involve uncertain phenomena or imprecise solutions. Therefore, Chang ^[33] first proposed integrated techniques consisting of fuzzy theory and AHP in 1996, called Fuzzy AHP (FAHP), which is used to handle and calculate decision-making problems caused by imprecise phenomena. Since then, FAHP has been widely applied and proven as a highly reliable and valid research method on MCDM problems ^{[34][35][36][37][38]}.

In the view of this, some scholars have applied FAHP to find answers to questions related to sustainable development within these decades. For example, Larimian et al. ^[39] developed a FAHP model for the evaluation of sustainable environment design factors in Tehran city. They discovered that factors related to environment design are the most vital scheme for promoting environmental sustainability by establishing a sense of ownership and responsibility in citizens. Rehman et al. ^[40] used FAHP as a research tool to put forward relevant strategies and suggestions for the manufacturing industry to achieve SDGs. Wang et al. ^[41] proposed a case study on the siting of renewable energy power plants in Vietnam using a hybrid approach of FAHP, data envelopment analysis (DEA), and The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Mostafa et al. ^[42] evaluated the forest management plans by implementing FAHP. Alyamani et al. ^[43] utilised FAHP to assess and select a sustainable project. They found that the most important criterion to consider in sustainable project selection was project cost, followed by novelty and uncertainty. Pan ^[44] applied FAHP to the evaluation and selection of sustainable bridge engineering methods, demonstrating the feasibility of FAHP in solving problems in the field of sustainable engineering. Ashour et al. ^[45] applied FAHP to explore the obstacles that the interior design industry may encounter in achieving SDGs. They reported that sufficient sustainable design modules, effective design specifications, and client interest in SDGs are important factors for the interior design industry to remove obstacles and achieve SDGs.

3. Grey Rational Analysis

Grey rational analysis (GRA) was proposed by Deng in 1982 ^[46]. Its primary focus lies in addressing system models characterised by uncertainty or incomplete information. This approach is adept at managing “uncertainty”, “multivariate input data”, or “discrete” information through techniques such as system correlation analysis, model development, predictive analysis, and decision making ^[47].

In the meantime, GRA finds necessary information from some known and unclear conditions through parameter correlation and then clarifies the interactive relationship between parameters. Afterwards, the degree of correlation between the two series is indicated by the degree of grey correlation ^[48]. Therefore, these features make GRA an effective method for solving MCDM problems with multiple attributes or with multiple scenarios ^{[49][50][51][52]}.

Also, Hu et al. ^[53] and Javanmardi et al. ^[54] reported that GRA is very suitable in its application to solve sustainable development issues. Muhammad Muneeb et al. ^[55] proposed a case study of the Pakistan telecommunication industry for achieving SDGs using GRA. Liu et al. ^[56] implemented GRA to analyse and develop the general sustainability indicators for the Australian renewable energy industry. They found that their general indicators are suitable for the sustainability assessment of four systems with different combinations of grid, solar photovoltaic, and wind renewable energy.

Moreover, Bai et al. ^[57] evaluated the sustainability of the supplier chain using GRA. The main contribution of their research was to introduce an analysis and application of the method, as well as a clear assessment and insights into the sustainability attributes of the supply chain industry for providing relevant recommendations for the supply chain industry to achieve the SDGs. Manjunatheshwara et al. ^[58] proposed a decision-making model for the sustainable materials selection of tablet device enclosure based on GRA. Zheng et al. ^[59] applied GRA to evaluate the energy-saving performance of the building industry, demonstrating the feasibility of using GRA for the sustainable development of the building industry.

Furthermore, Gumus et al. ^[60] proposed a fuzzy-based hybrid approach of AHP and GRA for solving the problems of the energy-saving industry. Zhang et al. ^[61] proposed an algorithm to evaluate load balancing in a hybrid wireless environment using FAHP and GRA. Paul et al. ^[62] and Ilankumaran et al. ^[63] applied the hybrid model of FAHP and GRA to mutual fund performance evaluation and wastewater treatment technology.

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