INTEGRATING ARTIFICIAL INTELLIGENCE IN THE DEVELOPMENT OF CHINESE CRAFTS

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Abstract:
Artificial intelligence (AI) is playing an increasingly important role in developing various sectors of the economy, however, its application in the craft area remains poorly studied. The article presents the results of a bibliographic and content analysis of articles indexed in the Scopus database and devoted to crafts and AI. The text focuses on presenting current observations on the application of artificial intelligence in the craft sector in China, identifying specific areas of its use, and analyzing evolving trends and progress in this area. The available materials have made it possible to identify a group of examples of AI application in crafts, as well as under-researched areas, including issues within the economic sciences - economics, finance, business, and management.

Keywords: Chinese craft; Artificial Intelligence/ AI; development of crafts; cultural economics.

Introduction

Crafts develop along with the society in whose culture they are rooted. As Anna Kouhia (2012) notes, this development can be seen, among other things, in the very changes occurring in the definitions of the term 'craft'. This researcher has detailed 8 frames of meaning for craft: functional, material, aesthetical, expressive, experiential, multi-sensory, collaborative, and narrative (Kouhia, 2012). Craft can be viewed through: production by hand or with small tools, the way of working, skills mastered, non-agricultural economic activity, utility, aesthetic preference, creation process, tourist souvenirs, various scientific disciplines, society (within which it is supported), cultural heritage, national cultural identity, as well as the development of technology and adaptation.

Among the group of new technologies crucial to transforming economies is artificial intelligence (AI), also known as 'artificial intelligibility' (Moran, 2024). Despite the growing importance of AI in various sectors of the economy, its application in crafts remains relatively understudied. Within the creative industry, by contrast, AI has received relatively strong interest from the scientific community in the space of art. According to Anjan Chatterjee (2022), AI is an increasingly powerful tool for artists and even acts as their partner, influencing views on beauty, creativity, and understanding the nature of art. Yan Shen and Fang Yu (2021) note that through AI, the creation of art is becoming richer, and the expression of content is intelligent, interactive, and data-driven. Generative AI can increase human creative productivity and value as measured by the likelihood of receiving a favorite work (Zhou & Lee, 2024). The application of AI in the context of the arts also involves education. It enables, among other things, increased learner engagement, experimental, creative, and more personalized learning, simulated interactive experiences, measurement, and assessment of knowledge (Black & Chaput, 2024). The use of AI in creative processes can inspire teachers to analyze the specifics of crafts and reflect on the tensions (such as copyright issues) and trade-offs of implementing generative AI in the context of craft practices (Vartiainen & Tedre, 2023).

Within the People's Republic of China (PRC), the market size of AI is expected to show an annual growth rate (CAGR 2024-2030) of 28.61%, reaching by 2030 the market volume of US$154.80bn (Statista, 2024). China is a strong competitor to the U.S. for the title of world leader in AI, leading by example in the AI research publication space (Ommar, 2024). AI is seen as both an enabler of the PRC's future economic development and a "strategic imperative" of the development direction being taken (Di Liello, 2019). The author assumes that China's rapid development in the area of new technologies, supported by an innovation-focused strategy, creates an opportunity to use artificial

intelligence (AI) solutions aimed at craftsmen as good practices for craft sectors in other countries. The aim of this article was to fill a gap in the so far limited research interest in the application of AI to crafts. To this purpose, an analysis based on bibliographic research is presented to identify recent observations on the use of AI in Chinese crafts, to identify its specific applications, and to analyze changing trends and developments in the field.

Methods

The study focuses on bibliographic and textual analysis of papers indexed in the scientific text database Scopus. The selection was made on the basis of specified three groups of keywords connected by the AND operator: 1) 'craft' OR 'craftsmanship' OR 'craftsmen', 2) 'AI' OR 'artificial intelligence', 3) 'China' OR 'Chinese', through which the article title, abstracts and keywords were searched. A file with a CSV extension was downloaded from the Scopus database, including a list of 23 publications. The analysis of the texts followed a three-path approach:

i) Within Excel (MS Office), the number of results were analyzed regarding: publication period, publication language, document type, affiliation, funding institutions, subject areas and citations.

ii) Titles and abstracts were selected separately from the file, from which word clouds of the most frequent terms were created in WordArt.

iii) VOSviewer was used to analyze the bibliographic and textual data by generating maps: links between collaborating organizations, showing the number of citations by author and country, and visualizations of term clusters with overlay and density visualization.

When generating visualizations in VOSviewer, the following narrowing was applied:

i) Co-authorship – authors: full counting method, minimum number of documents of an author: 1, 22 meet the threshold,

ii) Co-authorship – organization: full counting method, minimum number of documents of an organization: 1, 45 meet the threshold,

iii) Visualization maps: title and abstract fields, full counting method, minimum number of occurrence of a term: 10, 9 meet the threshold.

Results

The analyzed publications appeared in print in the period 2009-2024, with the most intensive publishing period beginning in 2022 (7 texts), details are presented in Figure 1. The selected texts were mostly (74%) published in English, and the remaining - less than 1/3 of papers (26%) were written in Chinese.
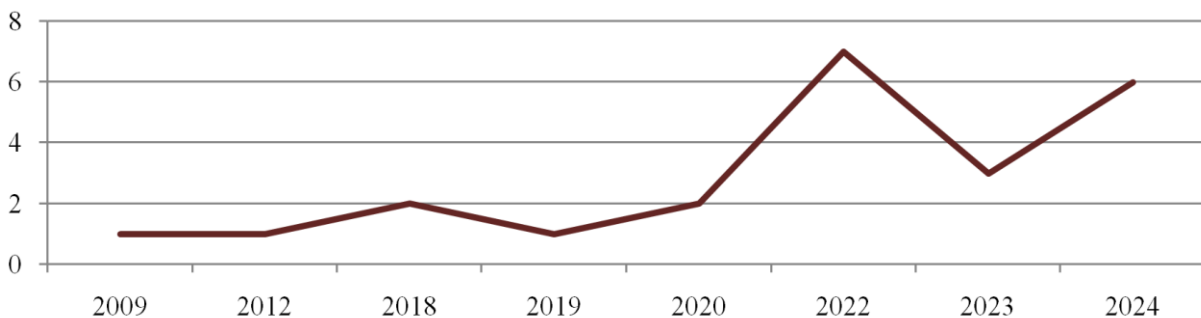

Figure 1. Documents by year; number of results.

Analyzing the type of papers, journal articles (52%) and conference papers (39%) predominated, the remaining texts were books and reviews (4% each). The largest number of affiliated texts was in China (83%), followed by Hong Kong and the United States (9% each).Macao and the United Kingdom each produced 4% of papers. The texts were sponsored by 15 institutions, of which the Natural Sciences Foundation of China was the most frequent (i.e. twice) funding sponsor. The authors were affiliated by 36 different institutions. Within them, 5 of them collaborated with each other to create the analyzed texts (Figure 2).
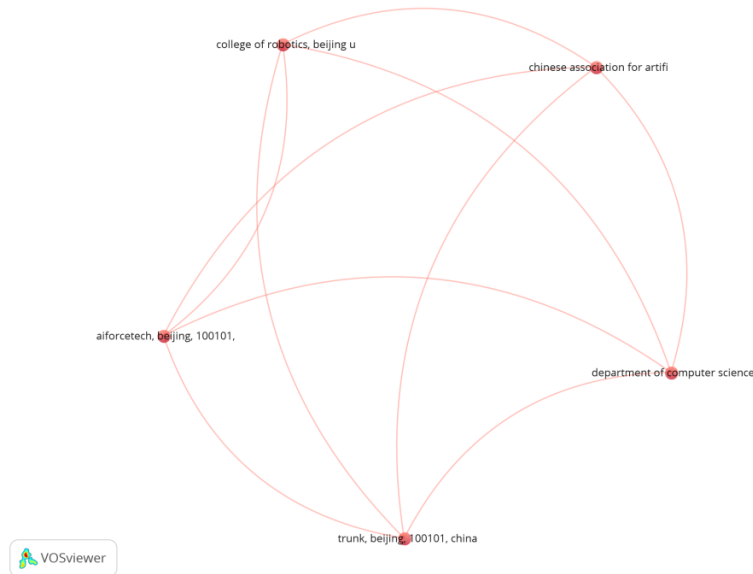
Figure 2. Maps presenting cooperation of the organizations; VOSviewer.

The dominant subject areas included Computer Sciences, Social Sciences, Engineering and Material Sciences. The areas of Economics, Econometrics and Finance, as well as Management and Accounting were represented with only one text each (Figure 3).
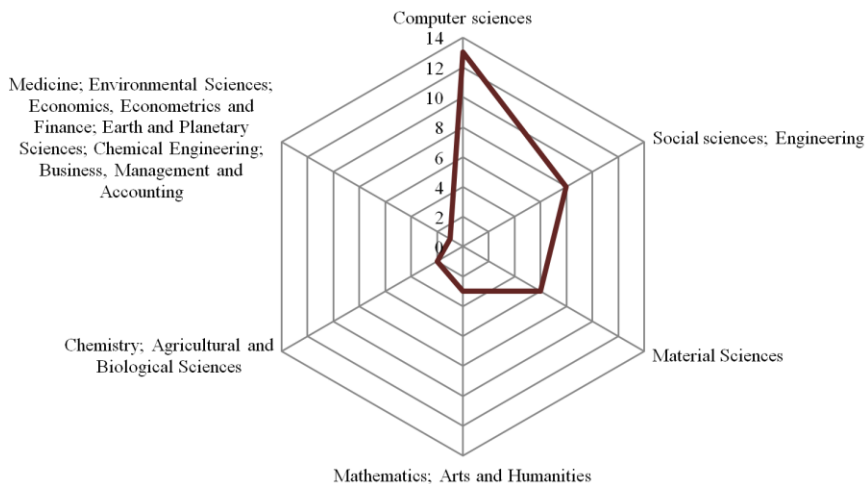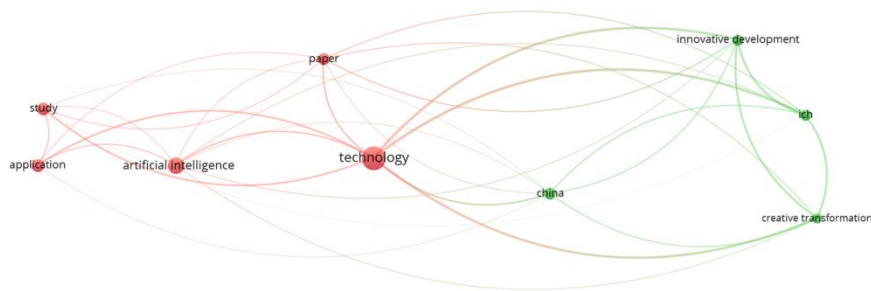

Figure 3. Subject areas; number of results.

The most cited authors within the scope of the subject under study include the authors of the 2018 publications. - Adrienne Mayor (130 citations), Li Daoliang and Yang Hao (83 citations) and 2022. - Niu Haoran, Li Min, Yang Lina, Xu Baochun, Li Mingyue, Wang Hongfei, Guo Qiuquan, Meng Zhaosheng, Liu Yijian, and Chen Da (15 citations) - see Figure 4a. By affiliate country, the most citations attributed to the US (130 citations of two papers) and China (125 citations of 19 papers), followed by Hong Kong (7 citations of 2 papers) - see Figure 4b.

a) Author citations   b) Citations within countries
Figure 4. Maps presenting a) author citations and b) citations within countries; VOSviewer.

An analysis of the frequency of appearance of terms within the titles and abstracts of the texts analyzed shows that the quantitatively dominant words within the titles are: 'design', 'development', 'image', and 'application' (see Figure 5a). Focusing on the terms included in the abstracts, only 'develop' is duplicated, supplemented by: 'innovate', 'costume', and 'intangible' (see Figure 5b).

a) Titles   b) Abstracts
Figure 5a-b. Most frequently appearing words in a) titles and b) abstracts; WordArt.

An analysis of the co-occurrence of terms appearing in the titles and abstracts made it possible to distinguish two thematic clusters: 1) technological (highlighted in red at Figure 6) and 2) development and transformation (green). In the first cluster, the dominant terms are: 'application', 'artificial intelligence', and 'technology'. The second cluster is much younger than the first. Within it, the terms: 'China', 'innovative development', 'their', and 'creative transformation' appear in publications issued between 2023 and 2024 (see Figure 6b). Of all the terms - 'technology' is shown in Figure 6c with the most intense shade of yellow - indicating that this term is significantly more explored within the analyzed texts. Of the listed terms, 'artificial intelligence' and 'innovative development' have the most connections to the other terms (Figure 7a-b).

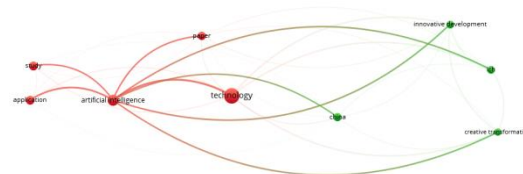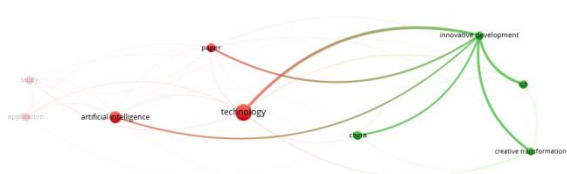a) Cluster visualisation
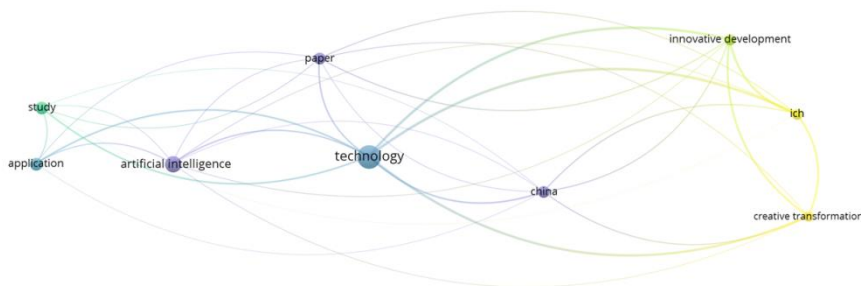
b) Overlay visualisation
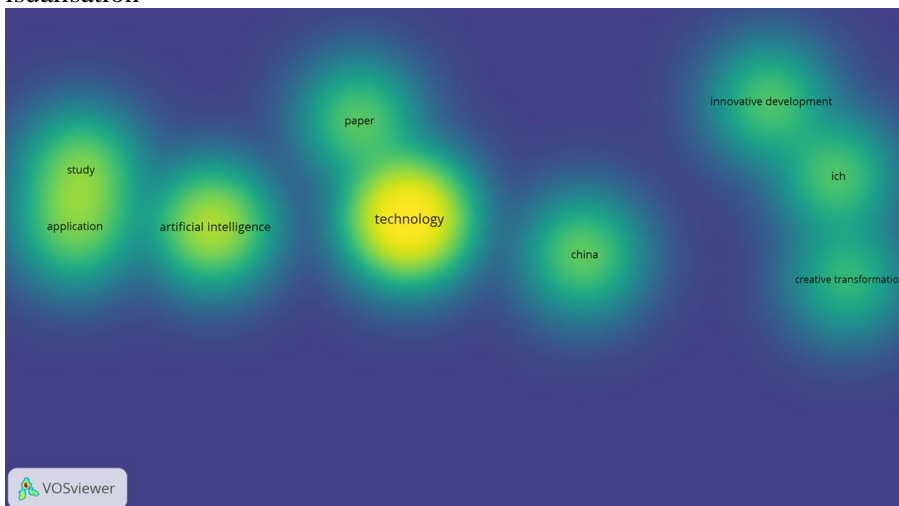
c) Density visualisation

Figure 6a-c. Visualizations of terms: a) cluster', b) overlay, c) density; VOSviewer.

a) Term 'innovative development'   b) Term 'artificial intelligence'

Figure 7a-b. Network map for terms: a) 'innovative development' and 'artificial intelligence'.

Discussion

The analysis made it possible to distinguish five groups of terms significant from the point of view of the chosen research questions:

i) The most common terms within titles → 'design', 'development', 'image',
ii) The most common terms within abstracts → 'develop', 'innovate', 'costume', 'intangible',
iii) The most relevant terms from the point of view of links to other terms → 'artificial intelligence', 'technology', 'innovative development', 'ich', 'creative transformation'
iv) The most recent terms → 'creative transformation', 'ich', 'innovative development',
v) The most explored terms → 'technology'.

The term 'technology'

AI is described as the most modern and important technology in the world - a technology that has influenced many spheres of human life (Ghosh & Thirugnanam, 2021). It is also described as the defining technology of the last decade (Boucher, 2020). In the context of Chinese craftsmanship, the topic of technology is addressed in the aspects discussed in the following sections: information technology, augmented reality technology, text-to-image technology, digital technology, digital-intelligence technology, and the integration of culture and technology to preserve an intangible cultural heritage.

In addition to the above, the topic of technology also appeared within the framework of issues related to the education of kindergarten teachers, increasing technological skills with which they can prepare to build pro-innovation awareness in children. In this case, the aspect of craftsmanship provides a link to the idea of the 'spirit of craftsmanship' promoting the attitudes of an exemplary worker (Meng et al., 2022). The need to educate Chinese craftsmen (here as workers in Chinese industry) and develop the 'spirit of craftsmanship' is also addressed in an article on the energy industry. In this case, the 'spirit of craftsmanship' includes the following elements: psychological qualities, acceptance of responsibility, energy immersion and continuous innovation (Ni, 2020). Meanwhile, the reference to Chinese folk craftsmanship of dough figurines is shown in the context of inspiration in the production of inexpensive, large-area and multi-functional, as well as stretchable and non-invasive electronic tattoos (e-tattoo/ e-tattoo technology), which are designed to adapt to skin deformation and collect bioelectric signals (Niu et al., 2022).

The terms 'design', 'image', and 'creative transformation'

The group of these terms are related to the application of business intelligence (BI) tools in the crafts business space and the use of AI in the classification and design of applied crafts, including arts and crafts. Within their framework, AI can be used to:

-   creating and supporting production management systems and craft business management (including production optimization, data management, quality management, outsourcing processing management, personnel and payroll management, equipment and parts management, and cost management (Li, 2009)),
-   applying text-to-image technology to modernize the ancient Chinese craft of repoussé (artisanal craftsmanship with gold and silver), which can be used in jewelry design (Shao, 2003),
-   implementing intelligent design technologies with a knowledge base management system for shipyard work (Ji et al., 2019),
-   classifying and creating handicraft designs - computer-aided design for arts and crafts, especially useful in staying abreast of market expectations (Xiang et al., 2022),
-   integrating AI with design to foster creativity and innovation - the example of the Chinese Batik fabric dyeing technique, the essence of which lies in folding and covering fabric to achieve the effect of dyeing individual pieces of fabric (Luo et al., 2024).

The terms 'develop', 'development', and 'innovative development'

Today, craftsmen, engineers and scientists are operating in an era of 'human-machine co-creation' creating inventions and making discoveries (Li et al., 2024). The development of crafts using AI involves, among other things, streamlining work (e.g., automation during seal carving), design and high-speed mechanical engraving. It also makes it possible for those unfamiliar with the craft to make

personalized seals in a given calligraphic style (e.g., popular during the Han Dynasty[1]) (Yin et al., 2020). Craftsmanship, however, is not only the design and creation process itself, but also the business activities associated with it. AI has its applications during business practices, among others, facilitating the ability to keep up with trends within retail - such as the functionality of smart cash registers, facial recognition during the payment process, purchase management, inventory sales, and customer profile analysis - facilitating craftsmen not only in management processes, but also those related to customer communication, including marketing communication (Chen et al., 2022). AI also provides an educational tool for the self-regulated development of teaching and learning. Generative AI tools provide the opportunity to, among other things, increase student attention, stimulate active engagement in learning, generate immediate feedback, influence increased self-confidence, satisfaction with learning, and improve teaching strategies. (Kong & Yang, 2024). Integrating AI with the inheritance of traditional handicraft features can be useful for greater understanding of cultural heritage, its protection, and its application and development (Zhao et al., 2022).

The terms 'ich' and 'intangible'

The rapid development of technology has been linked to a 'new innovation push' in Intangible Cultural Heritage (ICH) product projects (Luo et al., 2024). The role of modern technologies in promoting the transformation and development of ICH, as well as their contribution to society, the economy and cultural diversity, among other things, is the central theme of a publication by Wang Wei and Yuan Xu Xin (2024). Among the key technologies enabling creative transformation and innovative development of ICH, these authors detailed: digital technology, virtual and augmented reality, big data analytics, artificial intelligence, cloud computing and the Internet of Things. An interesting solution proposed by these researchers is the listing of 10 examples for the applicability of modern technologies in creative transformation and innovative development of ICH, which included (Wang & Yuan, 2024):

- folk literature → folk literature ICH database → ICH + new media,
- traditional music → digital music archives → music digital virtual platform,
- traditional dance → stage technology assisted VR/AR → Interactive dance,
- traditional drama → holographic imaging immersive scene → traditional drama "intangible heritage + short video",
- quyi[2] → full media communication → combining electronic music innovation,
- traditional sports, amusement and acrobatics → modern equipment and virtual events → development of related electronic games and applications,
- traditional fine arts → online galleries and virtual exhibitions → digital painting art,
- traditional skills → online teaching courses and video tutorials → virtual experience platform,
- traditional medicine → modern medicine research and verification → technology-assisted drug research,
- folklore → documenting and disseminating through documentaries → innovating digital festival methods

The team of Guo et al. (2023), studying folk print handicrafts and Batik dyeing, in turn, emphasizes that new technologies can also be used to describe handicrafts - through the stacked local-global channel attention network (SLGCAN). New technologies are being used to catalog ICH, here an example is Xiangjin brocade handicrafts - Chinese silk-woven portraits and landscape paintings. The selection of new and unique AI technology, can create a new idea of inheritance, preservation and development of traditional skills - expand the channels of inheritance of artistic traits: family inheritance and the inheritance of industrialization and digital inheritance (including a digital museum, graphic tutorials, recording craft skills through sound, video and animation, experience development games) (Zhao et al., 2022). An AI decision support system is also being used to enhance the technical progress of Jingdezhen porcelain culture (Li & Liu, 2022).

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[1] The Han Dynasty ruled from 206 BCE to 220 CE.

[2] Quyi [曲艺] - folk art forms that include: ballad singing, storytelling, comic dialogues, cross talks, clapper talks, etc. (PONS, n.d.).

The term 'costume' and 'creative transformation'

Latent Diffusion Model (LDM) enables the modernization of the Miao minority ethnic costumes. These costumes are not only aesthetic handicrafts, they also serve an important function within the cultural and tourism activities of several Chinese provinces. The application of AI solutions enables the development of homogeneous costumes for this minority, and thus can contribute to balancing the aspects of cultural preservation, development and economic viability of costume design. The model analyzes the features of Miao ethnic costumes (including style, colors, patterns and accessories), and then transfers specific features to create new designs. The advantage of creative transformation is that ethnic costumes can be revitalized, combining traditional style with modern fashion trends, as well as tailoring products to different consumer groups (Yu & Zhang, 2024). Similarly, the results of a study by the team of Zhang et al. (2024) indicate that AI can play an important role in promoting, disseminating and developing craft culture. It can improve the innovative capacity of apparel design and influence market competitiveness. Among other things, it makes it possible to extract colors and images of specific elements of craft culture and translate them into promoting more colorful and shape-differentiated garments.

Conclusions

Nowadays, the combination of craft and AI topics is not a popular topic of scientific research. However, an increase in interest in this topic is evident, accompanying the development and application of AI in the conduct of business and creative work. The article, through a bibliographic and content analysis of selected texts, lists groups of Chinese crafts in which AI technologies are applied. Examples of its application are approximated in Table 1.

The term 'technology'	
Application	- Following current trends, - Emphasizing the need for continuous education/improvement of craft skills, - Emphasizing drawing inspiration from not only *new technologies* to *crafts*, but also from *crafts* to *new technologies*.
Examples of crafts	- Dough figurines.
The terms 'design', 'image', and 'creative transformation'	
Application	- Supporting for management systems: production, data, quality, processing, personnel, payroll, equipment, spare parts, costs, - Modernizing craft products, - Stimulating creativity and innovation of craftsmen, - Classifying crafts, - Designing crafts.
Examples of crafts	- Crafts repoussé, - Handicrafts of printing and dyeing Batik,
The terms 'develop', 'development', and 'innovative development'	
Application	- Preservation and revealing of traditional arts and crafts, - Analysing of traditional styles, artistic features, - Designing, - Increasing the efficiency of the seal carving process. - The ability to make handicrafts in a given traditional style, - The ability to create crafts without expertise in the field, - Facilitating business management processes, including those related to customer and marketing communications, - Improving pedagogical strategies, - Intelligent inheritance of ICH.
Examples of crafts	- Seal carving, - Xiangjin brocade.
The terms 'ich' and 'intangible'	
Application	- Fostering innovation within ICH, - Fostering the preservation of heritage under changing ICH

	succession models, - Describing, cataloging and creating ICH databases, - Increasing accessibility to ICH.
Examples of crafts	- Handicraft printing and dyeing Batik, - Xiangjin brocade, - Jingdezhen porcelain.
The terms 'costume' and 'creative transformation'	
Application	- Modernization of costume, - Adapting costume style to market expectations, - Contributing to sustainability within the craft.
Examples of crafts	- Miao minority ethnic costumes.

Table 1. Application of AI in Chinese crafts. Source: own study.

The analysis also made it possible to extract terms indicating research trends and gaps. Trends include aspects of using AI in the design space, heritage preservation and craft education. In contrast, relatively little has been explored in areas related to craftsman' concerns, including data security, copyright, etc.; as well as BI tools to facilitate workplace/ business operations. The latter topic can support market-active craftsman in analyzing their customers' preferences, customizing products to meet market needs (individual customer needs), communicating with a wide range of craft stakeholders, analyzing trends, assessing risks, as well as for improvements in the production process management space, optimizing material consumption, predictive maintenance, supply chain optimization, etc. Thus, AI has tremendous potential to make a significant contribution to the further development of crafts and an adaptation to emerging changes.

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