

Creative Economy and Materials Science & Engineering

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Abstract: New materials are fundamental to the growth, security, and quality of life of human being sand open doors to technologies in civil, chemical, nuclear, aeronautical, mechanical, biomedical, and electrical engineering. Creative companies use multiple materials in the development of their activities, such as solid stone, fiber glass, concrete, and glass reinforced concrete, for example. Based on bibliographic research, the article examines the synergy between materials science & engineering and creative economy. The main argument indicates that this synergy creates solutions and functionalities that add value to existing products and allow the development of new products with competitive advantages. It may also contribute to the preservation of cultural values and promote sustainability.

Key words: Materials science, materials engineering, creative economy, creative industries, design, architecture.

1. Introduction

Creative economy uses skills and talents to generate income and employment by empowering the creativity of the person and the community [1]. In many creative industries, innovation brings the need for materials for the maintenance and preservation of cultural principles [2-4]. The cultural and technological knowledge may produce designs and materials that add value to products. Many technological developments in creative industries such as architecture and design, for example, depend on materials science and engineering [5].

New materials are fundamental to the growth, security, and quality of life of human beings and open doors to technologies in civil, chemical, nuclear, aeronautical, mechanical, biomedical, and electrical engineering [6-8]. Materials science & engineering influence the people's lives when they buy or use a new device, machine, or structure, for example. All properties of a material are intimately related to its structure, and it is possible to learn how this structure and the resulting properties are controlled by the processing of the material, which should be used in a

responsible and sustainable manner [9].

Creative companies use multiple materials in the development of their activities, such as solid stone, fiberglass, concrete, and glass reinforced concrete, for example [5]. The aim of the article is to examine the synergy between materials science & engineering and creative economy. The main argument indicates that this synergy creates solutions and functionalities that add value to existing products and allow the development of new products with competitive advantages. It may also contribute to the preservation of cultural values and promote sustainability.

2. Method

This article was organized following a logical and reflective structure, emphasizing interpretation and argumentation [11]. After exposing the definitions of materials science & engineering and creative economy, the methodology addresses the analysis of recent texts on the synergy between these areas. Items identified as corresponding—directly or indirectly—to the synergy between materials science & engineering and creative economy are examined in bibliographic research carried out in recent works. The analysis allowed a reflection through an approach in which the synergy between the two fields could be strengthened.

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3. Results and Discussions

The ability to combine creativity with technology, knowledge, and culture is fundamental to face economic competition, so that the emergence of creative economy is an alternative to economic development. It brings together scientific, cultural, and economic creativity supported by technology and contributes to social, cultural, and environmental aspects [11]. Creative industries may create opportunities for many marginalized groups, promote gender equality and stimulate the respect for differences regarding race, origin, and sexuality in local, national, and international levels [12-14].

The latest advances and innovations in materials technology can create added value and benefits for architects, designers, and users. These materials are developed through updating models, designs, raw materials, colors, weights, sizes, and environmentally friendly features for creative products. Solid natural stone, for example, can be used to beautify traditional architectural buildings. It is used for decoration, and stone-carving craft is an important creative activity in many countries. Because of the higher price of solid rocks in the context of the prohibition of many stone mining activities because of environment damages, some solid stone carving crafters try to find alternative solid waste stone materials that still fit the texture in accordance with the original ones. The development of fiberglass and concrete technologies was the result of various studies to improve the performance of materials. The innovation in materials science and engineering was a trigger for creative economic activities of small and medium enterprises [5].

Information about materials and their production processes is an essential part for the development of design projects, as well as elements and components for architecture. The difficulties in obtaining this information, both in technical aspects and in physical and sensory characteristics, during the development of projects end up delaying the process, and demand an

extra effort from professionals, faced with an enormous number of available materials, and not always with the necessary agility to obtain adequate information for their projects. In addition, the difficulty of accessing new materials ends up inducing a process of repeated use, crystallized in certain categories of products, which prevents innovation. The material collections can allow students, professionals, and suppliers to integrate. The commercial collections are focused on the partnership between material manufacturing companies and creative professionals and become a showcase for new materials and innovative processes. Independent collections allow free access to their contents, which are organized and maintained by professional associations. Academic collections seek to facilitate students' access to information and material samples to support teaching. However, there are still obstacles to the establishment of material collections for the creative economy, such as the cost of access to innovative materials, the predominant focus on the technical aspects of materials at the expense of their perceptual qualities and the access to suppliers, especially when considering multinational companies and imported materials, particularly in developing countries [15].

Some international institutions considered the important relationship between creative economy and materials science & engineering. The European Union, for example, has expressed its intention to foster synergy and collaboration between material researchers, engineers, and creative professionals to generate growth and jobs. According to the institution, the synergy can generate creative solutions and new functionalities in a non-traditional way thus adding value to existing products and allowing the development of completely new and often unforeseen products with strong competitive advantages. It can also boost communication along the value chain for new product development and increase potential for innovations in materials by reducing the gaps among

material developers, designers, and creative communities. New business models where design is integrated in the value chain and all actors capable of adding value to products and processes are considered upstream in material development [16, 17].

The convergence of creative economy and materials science & engineering has also received significant attention from innovation policy makers, such as the research at the nanoscale level of materials science. Advanced systems which combine multiple process steps or deploy different production technologies can be used to manufacture creative products for both niche high-value markets and mass markets. The hybrid systems—made up of combinations of different technologies, such as materials engineering technologies (cutting, turning, forming, pressing), mechatronics, measuring and sensing technologies—may shorten value chains and reduce organizational effort by using a single production process [18].

The flexible and adaptive production equipment and systems in creative economy ready for rapid reconfiguration require components based on smart materials. High-precision micro manufacturing machines require the production of 3D micro components using materials such as metal alloys, composites, polymers, and ceramics [19]. The integration of materials scientists and engineers into creative teams may facilitate design-driven innovation. For example, projects built on technological advances in materials have produced innovative processes that use nanotechnology, electrochemistry, and materials science to encapsulate fibers in textiles with metal and provide conductivity and electronic connectivity. Better integration of electronics and sensors into fabrics and textiles become possible [20].

The relation among intellectuals, business actors, and the government is fundamental for strengthening the connection between materials science & engineering and creative economy. Intellectuals use cultural values in the creative process to produce their

works. Materials engineers can produce environmentally friendly materials by minimizing the use of raw materials taken from the environment without leaving the concepts that have inspired creative sectors. The business actors invest in creative industries, which can have an added value in the products, and generate job opportunities for creative professionals. The government acts as a catalyst, regulator, facilitator, consumer, investor, and urban planner that creates a conducive business atmosphere and designs creative ecosystems in clusters, regions, and cities. It supports the development of creative industries in aspects related to legal certainty, marketing, and capital accessibility. The government is also responsible for the conservation of tangible and intangible cultural assets; capacity expansion and digital knowledge; education, training, and skills development; and industrial assistance through investment incentives, taxes, and concessions [5].

4. Conclusions

When people have access to the education for creative economy, they can integrate various sources of knowledge and information for selecting and combining materials in today's creative economy practice and education. The information about the aesthetic attributes and sensory or perceptual features of materials becomes more important in the material selection, which depends on functional requirements, manufacturing constraints, life cycle, sustainability, aesthetic and sensory material properties, and cultural and representative meanings [21, 22].

Acknowledgments

I would like to thank Henrique de Oliveira Santos Vieira de Jesus for his insightful comments on an earlier version of this paper.

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