






Empowering Regional Development with Quadruple Helix Creative Industry Model



Mohammad Yusri^{1*}, Abdul R. Cemda², Sasmita Siregar²

¹ Faculty of Social Science and Political Science, Universitas Muhammadiyah Sumatera Utara, 20238 Medan, Indonesia

² Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, 20238 Medan, Indonesia

* Correspondence: Mohammad Yusri (mohd.yusri@umsu.ac.id)

Received: 06-28-2022

Revised: 07-29-2022

Accepted: 08-09-2022

Citation: M. Yusri, A. R. Cemda, and S. Siregar, "Empowering Regional Development with Quadruple Helix Creative Industry Model," *J. Urban Dev. Manag.*, vol. 1, no. 1, pp. 17-25, 2022. <https://doi.org/10.56578/judm010103>.



© 2022 by the author(s). Published by Acadlore Publishing Services Limited, Hong Kong. This article is available for free download and can be reused and cited, provided that the original published version is credited, under the CC BY 4.0 license.

Abstract: This study examines how to support regional development with the quadruple helix creative industry model through descriptive qualitative analysis. The primary data were collected through observation, interviews, and FGDs (Focus Group Discussions) with academics, creative economy actors, community leaders, and government officials. The markets in Medan, North Sumatra, Indonesia were studied between October 2020 and October 2021. Purposive sampling technique was used to select informants, and snowball sampling approach was utilized to conduct the interviews. The findings revealed that the lack of roles in research and knowledge production by academic actors in Medan has increased the need for a network of academic actors to fill the gap; the government has not been able to play a role in providing funding support and incentives for business actors in creative industries, especially in creating innovations. The synergy between actors in the quadruple helix implementation has not been properly utilized, even in the case of the Medan City Government, which ought to be the main source of information in social media for the city's creative sector. Following up on these findings, the quadruple helix creative industry model was implemented as an innovation model to support the regional economy of the city of Medan.

Keywords: Creative industry; Synergy between actors; Local economic empowerment; Economic development; Development with regional dimensions

1. Introduction

The decentralized government of Indonesia provides power to local governments to handle household duties based on the initiatives and ambitions of the populace. Decentralization grants local governments the freedom to collect, govern, and manage their territories independently of the federal authority. Decentralization can promote independent development and, inadvertently, boost each region's competitiveness, which can all be beneficial for regional development [1]. Thus, each region must be competitive enough to continuously develop its economic potential.

Because innovation is viewed as a catalyst for economic development and growth, economic development policies and innovation policies are deeply linked to one another [2, 3]. The regional innovation system is one of the most well-liked and quickly evolving policy frameworks since the early 1990s. This is due to variations in regional and local factors that affect the degree of economic development and development with regional dimensions. The idea of competitiveness should be based on the science of innovation rather than on the accessibility of natural resources and the affordability of labor [4].

For a specific region, the interaction between actions is the key to enabling engagement and the interchange of innovative ideas that spark the production of innovations required for economic development and development with regional dimensions [5]. By fostering ties amongst participants, encouraging innovation in the creative sector will have an impact on regional economic development [6]. The most significant source of innovation is networks, which facilitate the interaction and exchange of novel ideas. The networking between actors has created several

innovation hubs in some regions and even the entire world. The pattern of interaction between regional players is inextricably linked with regional development ability [7, 8].

The significance of knowledge and innovation for enhancing competitiveness with knowledge-based regional development is now highlighted by the regional economic growth. An essential component of economic activity is the expansion of knowledge through utilizing ideas from human resources [9]. The idea behind an innovation system is to combine research and development activities from businesses and academic institutions that best represent the creative innovation model [10]. When creating innovation policy, the systematic approach to innovation also encourages caution and close attention to details [11, 12].

Medan has directed economic development toward the creative industry from 2019 to 2021, according to observations and interviews with a number of local inhabitants. This makes it possible for the region's economy to grow. To discover the best solution, regional development research—specifically, it is imperative to study the creative sector's quadruple helix and the restricted assistance provided by the Innovation Production Center. Given the limited support from innovation production centers, the quadruple-helix interaction pattern has never been tested. With the aid of quadruple helix, the discussion concerning creativity and innovation in the creative industries is still confusing and extremely constrained.

To spur economic growth, the Indonesian government is currently working to improve the quality of talents in the creative industry in a more innovative, creative, and proactive manner. To do this, the government needs to work with academics, entrepreneurs, and the community to form the quadruple helix. The most pertinent notion for enabling regional growth with actor synergies is the interaction pattern known as the quadruple helix concept. Many have investigated the interaction contents in and beyond Indonesia.

However, it appears that a triple helix is more popular in analyzing how the creative industry is being implemented in Indonesia. There has never been any research done on the role of the quadruple helix-based creative industry in enabling regional development. This highlights the significance of synergy between the public sector, academia, business, and the community, which can start a cycle of knowledge leading to innovation. There has not been much research on the quadruple helix-based creative industry and very little support from innovation production centers.

To identify the root causes and possible solutions, this study aims to characterize the quadruple-helix interaction pattern when applied to locations that receive little or no support from universities, a hub for innovation production. Regional innovation production centers assist sustainable regional growth, according to studies on the quadruple helix theory.

The quadruple helix concept was found to be a solution for the growth of creativity and creative industry innovation [13]. Andorf et al. [14] emphasized the occurrence of the innovation process from the angle of the quadruple helix model, and demonstrated the synergies between sectors embedded in the concept of quadruple helix. For small and medium-sized companies in the creative industry, Carayannis et al. [15] illustrated the inter-sectoral linkages in the quadruple helix model, which manages the innovations by identifying the key to success. Paredes-Frigolett [16] explained the quadruple helix model as a tool for collaboration between academic institutions, business, the government, and society, with each helix role playing an equal part in fostering innovation and creativity.

Following this train of thought, the authors carried out a previous study on the creative industries and quadruple helix. In this study, the purpose is to explore the implementation of the quadruple helix-based creative industry model in empowering regional development. This quadruple helix creative industry model basically analyzes innovation in a knowledge-based economic system. The model can dynamically respond to the dynamics and context of changes. Specifically, the authors analyzed the interplay between actors, as the quadruple helix creative industry model is implemented to empower regional development.

2. Literature Review

2.1 Regional Development

Regional development is an effort to enhance the construction of social, economic, cultural, educational, and health life in the context of regional development. Forje et al. [17] defined regional development as a skill decided by the parties linked with a specific area with current resources to enhance the quality of life in a certain area. Regional development is more specifically defined by Fath et al. [18] as the harmonious interplay between natural, human, and technological resources, while taking into account the carrying capacity of growing communities. The science of resource evaluation and planning, for example, needs to be supported by regional development, if it is to contribute to regional physical and economic growth [19].

The following five keywords are connected to the development goals: growth; connection enhancement; balance; independence; sustainability [20]. According to the above theory, regional development can be described as an effort to establish integration in the utilization of various resources, aiming to improve harmony between regions and integration across development sectors.

2.2 Quadruple Helix

When an innovation system originates or establishes itself at a micro-scale and has the potential to contribute to the growth of a specific region, the quadruple helix model can serve as an effective framework for solutions. Consequently, the quadruple helix model can be employed to successfully explain regional or local innovation systems. The interaction of the four helix actors—intellectuals, business actors, government officials, and society members—generates a climate that fosters innovation. The government, as the actor in charge of the regulation and policy of development programs to promote the performance of quadruple helix actors, interacts most strongly in this collaborative environment [21].

The quadruple helix is a means of fostering innovation, creativity, and technology in the creative sector. The support to innovation is closely associated with creativity and innovation. The government, university, business, and social policies and practices can interact intelligently, effectively, and effectively. In this study, all four concepts of quadruple helix concept interact to speed up the transfer of innovation, and each contributes to the innovation process. Armas and Calcaterra [22] further explained the roles of the four actors in the quadruple helix concept, in terms of technology, knowledge, products, services, and other outputs. A new era of creativity has been ignited by the significance of role-to-role interactions in the Helix system, and community support generates fresh concepts for incredibly unique products and services.

Actors are in a position to obtain information from other actors and to influence innovations or policies in products or services that promote regional and economic growth. This is consistent with research findings that support the quadruple helix theory, for the roles of actors can encourage the formation of an inventive and creative environment [23]. A bottom-up method is adopted to analyze the community participation of the actors involved in quadruple helix interactions. The quadruple helix model focuses on innovation and knowledge creation, with the goal to accelerate innovation for regional dimension development and economic growth.

2.3 Creative Industry

The development of creative industries requires renewal, an endeavor to make a firm more required and useful by managing a business to be of better economic worth. The growth of the creative sector has a significant impact on the economy, which brings high employment and lower unemployment. An industry is a business unit that operates in a certain area or place with the goal of producing products or services that may function independently in terms of its management [24].

The term "industry" has both micro and macro definitions; on the micro level, it refers to a group of businesses that create products with a wide range of shared qualities. At a macro level, industry is an economic sector that adds value [25]. Industrial design and engineering are examples of economic activities that transform raw resources for semi-finished or finished products into more value products. The establishment and exploitation of intellectual property rights can lead to the development of creative industries, which in turn generates income and employment [26].

Focusing on the creation and use of intellectual property works like art, films, games, and other fashion designs, creative industries incorporate creative services like advertising [27]. Activities in the creative industries display individual authenticity, talents, and skills and possess the potential to generate wealth and employment. Advertising, architecture, sculpture, design, fashion design, video and film, software, music, arts organizations, publishing, radio and television, museums, and tourism are just a few examples of the diverse sectors that collectively make up the creative industries [28].

According to the description above, it can be said that the creative industry develops through the application of ability, skills, and creativity. It emphasizes individual creativity and promotes the kind of innovation necessary for regional development and economic growth.

2.4 Quadruple Helix for Creative Industry

Through the development and use of their skills, the creative industries have the ability to provide employment and economic prosperity. They are activities that showcase individual authenticity, talents, and abilities. The emergence of the creative economy results from the development and application of personal creativity. Built on this, the creative industry, which is based on the quadruple helix, uses creativity by developing new enterprises and utilizing those that already exist in the community in specific locations, and takes interaction patterns into account to establish innovation-based policies. Gunia [29] claimed that the interdependence of the roles in the Helix system has inspired a period of creativity in which academics, communities, and the government all work together to develop fresh concepts for incredibly inventive products and services. This demonstrates the significance of the four parties working together in harmony to implement the quadruple-based creative industry. The four helixes are connected by the community, business actors, academia, and government. A quadruple helix model of the creative industry is presented in Figure 1 below.

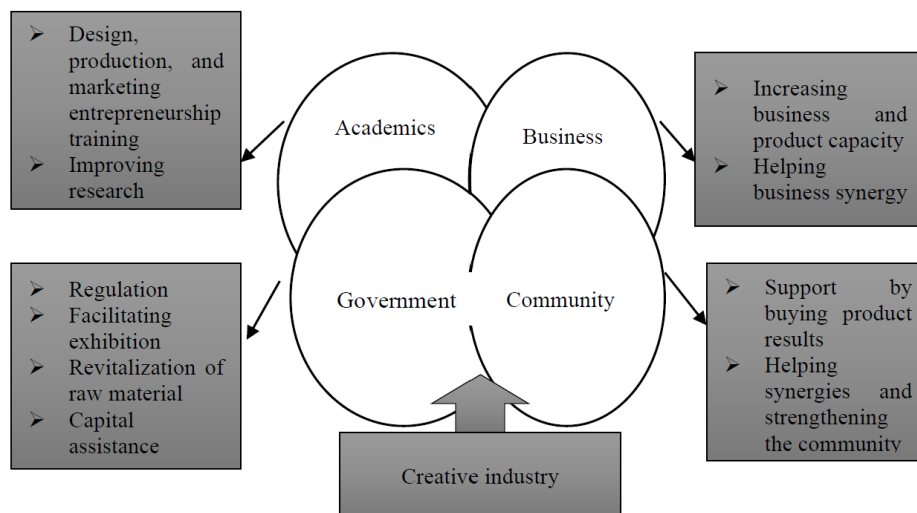


Figure 1. Creative industry model based on quadruple helix

It is clear from Figure 1 above that the quadruple helix creative industry model is a crucial factor in enabling regional and economic development. Researchers have explored extensively to answer how to manage a company through a creative process that will produce products and services. A form of interaction between actors that is suited for business players in the creative industry is developed by Hughes and Pertierra [30] in recognition of the significance of regional growth. It is anticipated that innovation performance would improve by creating innovative products and services.

3. Methodology

3.1 Research Type

Through a case study, this paper qualitatively analyzed the actors involved in the development of the creative industry, namely the government, academics, creative entrepreneur, and the community, targeting the creative industry in Medan City.

3.2 Research Focus

The quadruple helix creative industry model, which represents the four major groups in the quadruple helix concept, namely, the government, academia, business actors, and the community, is the main subject of this research. The market locations and hours in Medan City, North Sumatra, Indonesia were studied between October 2020 and October 2021. Purposive sampling was utilized to interview informants, and snowball sampling technique was then used to conduct the analysis.

3.3 Data Analysis Technique

To better understand and present all collected information, data analysis must systematically search for and organize the results of interviews, notes, and collected materials [31]. In this study, a qualitative descriptive data analysis was carried out to collect primary data through observations, interviews, and FGDs (Focus Group Discussions) with academics, creative entrepreneurs, community members, and government officials. As in Table 1 below.

The interactive data analysis starts with data collection, condensing, and display, and ends up with drawing conclusions [32].

Table 1. Research informants

| No. | Informant | Occupation | Reason |
|-----|------------------|-------------|---|
| 1. | Fatimah Hasibuan | Government | Always active in local government affairs |
| 2. | Fahri | Businessman | Business actors and investors |
| 3. | Taupik | Academics | Lecturer |
| 4. | Ibu Rahmah | Public | Business actors |
| 5. | Rafli | Public | Pelaku usaha |

4. Results

The research data were collected from a case study by thoroughly examining an individual, a group, an institution, or another type of social unit through observations, interviews, and FGD. The results show that the academic actors in Medan are unable to produce sufficient knowledge to overcome the lack of research and knowledge. To support the information and knowledge delivery, the academics must be supported by the meditating role of the government, which serves as the primary intermediary between business actors.

The community's involvement in the growth of the creative industry in Medan, meanwhile, is largely to promote the industry. Unfortunately, it is difficult for the public and the government to obtain the research from universities or academics that is necessary to create the creative industries. The position of the government as the primary actor who can connect them is essential for the existence of a separate function from the roles of community actors, economic actors, and university actors.

The formation of companies is another crucial element in the success of innovation centers, in addition to the active role played by universities. The academic or university research findings are what make innovation centers successful.

University or academic research findings are noted by businesspeople and monetized by investors. The absence of financially capable investors is what makes the growth of the creative industry in Medan different from that of the creative industries in other innovation hubs. It is challenging for business actors to find to reach investors in Medan for the development of creative industries. The creative industry in the city is less developed due to a lack of funding. With small networks, business actors may not always have the opportunity to contact with investors.

Government actors can spread information more quickly without the aid of third parties. Thus, it is well recognized that government actors have a significant impact on the growth of the creative industry in Medan. The government has not been able to support the creative sectors financially or with incentives, especially when it comes to innovation. The Medan City Government ought to be the representative who frequently acts as the information conduit in social media for the local creative sector.

The degree of resemblance between government actors and those who play a smaller role suggests a decreasing reliance on other players. The government should actively participate in connecting the quadruple helix to overcome the low degree of intimacy that other groups of actors, including academics and business actors, have. The Medan City Government needs to frequently act as a social media information center for developing the creative sector in Medan. It is advantageous for the growth of the creative industry because there are actors with high liaison value, especially for those actors who lack the power and resources to advance the creative industry. The formation of the network may be started or coordinated by the Medan City Government.

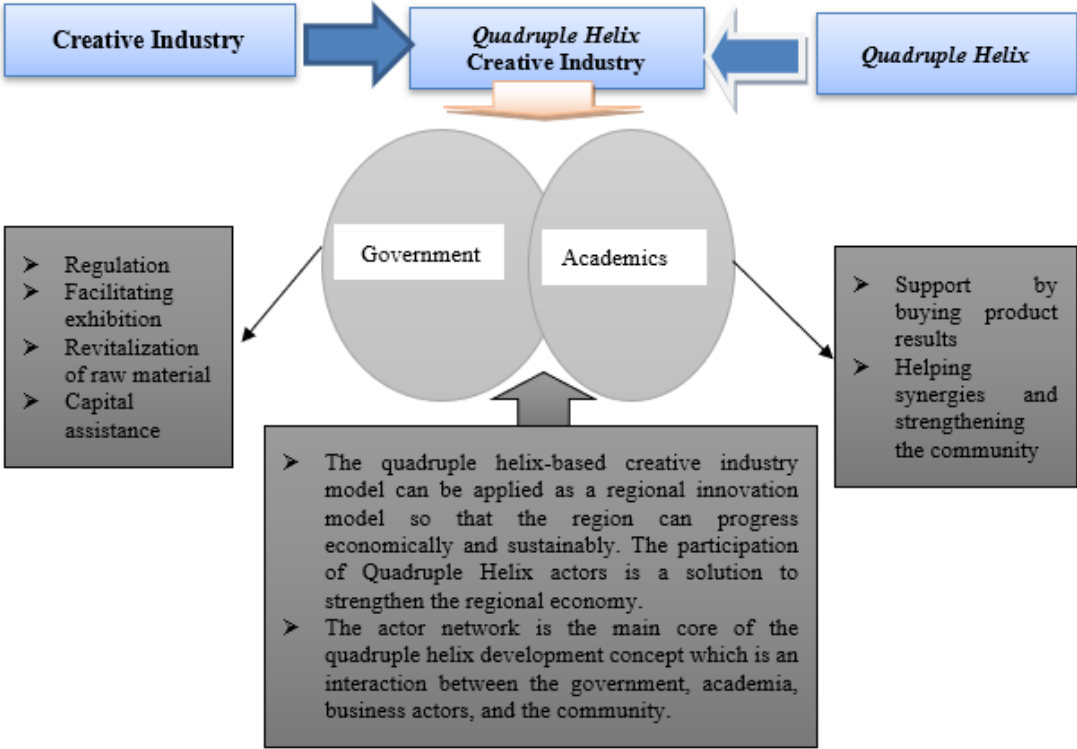


Figure 2. Creative industry model based on quadruple helix

This study determines the pattern of relationships that occur between actors and the exchange of resources between these actors through the relationships. These relationships are produced and developed between actors based on the function and contribution of each actor in creating the creative industry. The centrality network measurement was implemented to visualize the relationship between the actors in the network. This approach was chosen to ascertain an actor's influence and areas of interest in a network. Synergy is the must for these four actors to effectively play their parts.

In the quadruple helix concept, academics are responsible for new activities with bargaining power for market formation and creative people. Government funding has elevated academia or universities to major players as a result of the success of global innovation centers. Universities are responsible for putting existing knowledge to use and producing knowledge that will be used for economic growth, while the government is in charge of strengthening actor networks.

The quadruple helix creative industry model can therefore be used as a regional innovation model with the goal of enabling the region to advance economically and sustainably. In the light of these findings, the inclusion of quadruple helix actors is a way to boost the regional economy of the city of Medan. This can be achieved by applying a quadruple helix model of the creative industry with regional dimensions. Furthermore, the government has not been able to make the best use of the Medan Fair, an existing research center. In reality, Medan Fair has the potential to develop into a venue for exhibitions and support the creative sector in commercializing innovative ideas, in Figure 2 above.

The research results suggest that universities need to play two roles in innovation development, namely, research-based universities responsible for providing knowledge to develop innovation, and learning-based universities responsible for providing the creative industry with skilled and well-trained workers.

5. Discussion

This research overviews how to shape the regional development of creative industries to increase creativity and competitive advantage through contributions and interactions between university, business, government and civil society, and examines how to stimulate regional development by increasing creativity through approaches and interactions in the quadruple helix-based creative economy. In this context, the quadruple helix plays a significant role in supporting regional growth of creative industry.

The role played by universities in the world as academic actors is in line with the opinion of Ivanova and Leydesdorff [33], who stated that academics can act as knowledge factories, and provide the public with scientific insights. This study finds that academics played a very minor impact compared to other actors in the growth of Medan's creative industry. Even though Medan has a number of universities, none of them serve as a knowledge factory, despite their active involvement in fostering the growth of creative enterprises.

The ability to manage and enhance creativity will have a significant impact on the creative industry's capacity for innovation. Business actors in the creative industry can benefit from the elements found in the creativity aspect, which is the vital capital for survival in the creative business, to enhance their performance in innovation [34]. In terms of creativity, these elements help to generate fresh concepts that result in products and services that can compete with high standards of quality and value [35, 36]. The elements of the quadruple helix are necessary to further foster the inventiveness of business players in the creative industry, such as to improve innovation performance continuously and yield the greatest possible results. The reality is that creative business actors in the creative sector are better in generating products that are more innovative and have more added value.

During the implementation of the quadruple helix creative industry model, high creativity contributes to superior performance, which is backed up by positive interactions and contributions from academia, business, government, and civil society. The underlying result is that in order for creativity to assist the development of superior new goods and services, regional development must be empowered [37-39]. These demands having an open mind and sharing knowledge constantly. Moreover, a culture of innovation is required to empower regional development and create findings [40], and to maximize benefits for small businesses in the creative industry. The collaboration among four spheres—academic, commercial, social, and political—plays a critical role in advancing the creative industry. These four spheres cannot work separately to fulfill the values that are present in the creative industry. The four components of the helix are the primary forces behind the development of creativity, ideas, science, and technology, all of which are essential for the expansion of the creative sector.

By analyzing its role in empowering regional development, it is clear that the quadruple helix creative industry model is able to foster interaction and collaboration between academics (universities), businesspeople, government officials, and society, and give birth to creativity, ideas, and knowledge. Malik et al. [13] confirmed that the quadruple helix theory can create fresh creativity, ideas, skills, and knowledge. According to research on the impact of government support and universities on the transfer of creativity, creativity is born through the collaboration of academics (universities), business, the community, and the government, which establishes regulations that encourage the development of innovative and creative behavior in business actors.

Because academics play a crucial role in fostering creativity and invention and disseminating knowledge to

businesspeople in the creative industry, universities are crucial to boosting the growth of creativity. The government's job is to connect networks amongst actors so that a positive synergy can develop naturally. The growth of a strong and durable creative economy will depend on the intimate, mutually beneficial interaction and symbiotic mutualism between the four components, which are the foundations and pillars of the creative economy model.

Future research can use both qualitative and quantitative techniques to advance research theory and practice. In addition, the limitations of this work must be fully considered in future. The research data were collected through observation, interviews, and FGD, involving representative academics, creative economy actors, community members and government officials. The data collection leaves the room for inaccurate generalizations. The research subjects should be diversified to cover all kinds of creative business actors, and the research scope should be expanded to include other cities in North Sumatra and in Indonesia.

6. Conclusions

The network of actors is the core of the quadruple helix development, i.e., the interplay between the government, academia, business actors, and the community. The lack of knowledge production by academic players in Medan has increased the need for a network of academic actors to fill this gap in knowledge production. The research and knowledge needed by the creative industries in Medan are mostly from academic actors from outside. Meanwhile, the government fails to provide sufficient funds or incentives for creative industries, especially in innovation creation. These can be remedied using a creative industry model based on a quadruple helix with regional dimensions, which can be applied in a balanced and robust manner.

Future study can use qualitative and quantitative techniques to theoretically and practically advance the field. In fact, the collaboration between four spheres—academia, business, society, and government—plays a crucial role in regional and economic development. The quadruple helix creative industry model can therefore be used as a regional innovation model with the goal of enabling the region to advance economically and sustainably. There is no universal model that can be used in all fields, so the quadruple helix creative industry model must be created with the concept of customization, according to the resources available with the idea of independence and sustainability.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

References

- [1] A. Chikán, E. Czakó, B. Kiss-Dobronyi, and D. Losonci, "Firm competitiveness: A general model and a manufacturing application," *Int. J. Prod. Econ.*, vol. 243, Article ID: 108316, 2022. <https://doi.org/10.1016/j.ijpe.2021.108316>.
- [2] S. Elsen and L. Fazzi, "Extending the concept of social farming: Rural development and the fight against organized crime in disadvantaged areas of southern Italy," *J. Rural Stud.*, vol. 84, pp. 100-107, 2021. <https://doi.org/10.1016/j.jrurstud.2021.03.009>.
- [3] Y. Zhou, C. D. Buesching, C. Newman, Y. Kaneko, Z. Xie, and D. W. Macdonald, "Balancing the benefits of ecotourism and development: The effects of visitor trail-use on mammals in a Protected Area in rapidly developing China," *Biol. Conserv.*, vol. 165, no. 2013, pp. 18-24, 2013. <https://doi.org/10.1016/j.biocon.2013.05.007>.
- [4] A. Mulatu, "On the concept of 'competitiveness' and its usefulness for policy," *Struct. Chang. Econ. Dyn.*, vol. 36, pp. 50-62, 2016. <https://doi.org/10.1016/j.strueco.2015.11.001>.
- [5] M. Röber, S. Laroque, S. A. Lopez, T. Scheibel, and H. G. Börner, "Modulating the collagen triple helix formation by switching: Positioning effects of depsi-defects on the assembly of (Gly-Pro-Pro) 7 collagen mimetic peptides," *Eur. Polym. J.*, vol. 112, pp. 301-305, 2019. <https://doi.org/10.1016/j.eurpolymj.2018.12.045>.
- [6] M. Guerrero and D. Urbano, "The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy," *Technol. Forecast. Soc. Change*, vol. 119, pp. 294-309, 2017. <https://doi.org/10.1016/j.techfore.2016.06.015>.
- [7] Y. Kim, W. Kim, and T. Yang, "The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S.," *Res. Policy*, vol. 41, no. 1, pp. 154-166, 2012.

- <https://doi.org/10.1016/j.respol.2011.08.003>.
- [8] Z. I. Selim, R. M. Gamal, L. A. Araby, E. R. Badawy, and N. M. Gamal, "Collagen triple helix repeat containing 1 (CTHRC1) protein: A promising biomarker for evaluation of rheumatoid arthritis patients," *Egypt. Rheumatol.*, vol. 44, no. 1, pp. 11-14, 2022. <https://doi.org/10.1016/j.ejr.2021.07.003>.
- [9] M. J. Rodríguez-Gulías, S. Fernández-López, and D. Rodeiro-Pazos, "Innovation in cultural and creative industries firms with an academic origin (CCI-USOs): The role of regional context," *Technovation*, vol. 92, pp. 1-10, 2020. <https://doi.org/10.1016/j.technovation.2018.06.007>.
- [10] I. Rozentale and P. J. van Baalen, "Crafting business models for conflicting goals: Lessons from creative service firms," *Long Range Plann.*, vol. 54, no. 4, Article ID: 102092, 2021. <https://doi.org/10.1016/j.lrp.2021.102092>.
- [11] J. Zhou, J. Li, H. Jiao, H. Qiu, and Z. Liu, "The more funding the better? The moderating role of knowledge stock on the effects of different government-funded research projects on firm innovation in Chinese cultural and creative industries," *Technovation*, vol. 92, Article ID: 102059, 2020. <https://doi.org/10.1016/j.technovation.2018.11.002>.
- [12] L. Kiroff, "Nexus between creative industries and the built environment: Creative placemaking in inner Auckland," *Front. Archit. Res.*, vol. 9, no. 1, pp. 119-137, 2019. <https://doi.org/10.1016/j.foar.2019.08.004>.
- [13] A. Malik, P. Sharma, V. Pereira, and Y. Temouri, "From regional innovation systems to global innovation hubs: Evidence of a quadruple helix from an emerging economy," *J. Bus. Res.*, vol. 128, pp. 587-598, 2021. <https://doi.org/10.1016/j.jbusres.2020.12.009>.
- [14] C. M. Andorf, M. Kopylov, D. Dobbs, K. E. Koch, M. E. Stroupe, C. J. Lawrence, and H. W. Bass, "G-Quadruplex (G4) motifs in the maize (*Zea mays* L.) genome are enriched at specific locations in thousands of genes coupled to energy status, hypoxia, low sugar, and nutrient deprivation," *J. Genet. Genomics*, vol. 41, no. 12, pp. 627-647, 2014. <https://doi.org/10.1016/j.jgg.2014.10.004>.
- [15] E. G. Carayannis, Y. Goletsis, and E. Grigoroudis, "Composite innovation metrics: MCDA and the Quadruple Innovation Helix framework," *Technol. Forecast. Soc. Change*, vol. 131, pp. 4-17, 2018. <https://doi.org/10.1016/j.techfore.2017.03.008>.
- [16] H. Paredes-Frigolett, "Modeling the effect of responsible research and innovation in quadruple helix innovation systems," *Technol. Forecast. Soc. Change*, vol. 110, pp. 126-133, 2016. <https://doi.org/10.1016/j.techfore.2015.11.001>.
- [17] G. W. Forje, M. N. Tchamba, and M. Eno-Nku, "Determinants of ecotourism development in and around protected areas: The case of Campo Ma'an National Park in Cameroon," *Sci. African*, vol. 11, Article ID: e00663, 2021. <https://doi.org/10.1016/j.sciaf.2020.e00663>.
- [18] H. E. S. Fath, F. M. El-Shall, G. Vogt, and U. Seibert, "A stand alone complex for the production of water, food, electrical power and salts for the sustainable development of small communities in remote areas," *Desalination*, vol. 183, no. 1-3, pp. 13-22, 2005. <https://doi.org/10.1016/j.desal.2005.03.028>.
- [19] R. I. McDonald and T. M. Boucher, "Global development and the future of the protected area strategy," *Biol. Conserv.*, vol. 144, no. 1, pp. 383-392, 2011. <https://doi.org/10.1016/j.biocon.2010.09.016>.
- [20] S. R. Henderson, "City centre retail development in England: Land assembly and business experiences of area change processes," *Geoforum*, vol. 42, no. 5, pp. 592-602, 2011. <https://doi.org/10.1016/j.geoforum.2011.04.009>.
- [21] K. Nordberg, Å. Mariussen, and S. Virkkala, "Community-driven social innovation and quadruple helix coordination in rural development. Case study on LEADER group Aktion Österbotten," *J. Rural Stud.*, vol. 79, pp. 157-168, 2020. <https://doi.org/10.1016/j.jrurstud.2020.08.001>.
- [22] P. Armas and N. B. Calcaterra, "G-quadruplex in animal development: Contribution to gene expression and genomic heterogeneity," *Mech. Dev.*, vol. 154, pp. 64-72, 2018. <https://doi.org/10.1016/j.mod.2018.05.004>.
- [23] R. Gouvea, S. Kassicieh, and M. J. R. Montoya, "Using the quadruple helix to design strategies for the green economy," *Technol. Forecast. Soc.*, vol. 80, no. 2, pp. 221-230, 2013. <https://doi.org/10.1016/j.techfore.2012.05.003>.
- [24] A. V. Shipilov, S. X. Li, and W. Li, "Can you do Kung Fu and also act? New entrants' status attainment in the creative industries," *J. World Bus.*, vol. 55, no. 3, Article ID: 101043, 2020. <https://doi.org/10.1016/j.jwb.2019.101043>.
- [25] A. C. Pratt, "Creative hubs: A critical evaluation," *City Cult. Soc.*, vol. 24, Article ID: 100384, 2021. <https://doi.org/10.1016/j.ccs.2021.100384>.
- [26] A. Y. P. Chang and K. P. Hung, "Development and validation of a tourist experience scale for cultural and creative industries parks," *J. Destin. Mark. Manag.*, vol. 20, Article ID: 100560, 2021. <https://doi.org/10.1016/j.jdmm.2021.100560>.
- [27] E. van Laar, A. J. A. M. van Deursen, J. A. G. M. van Dijk, and J. de Haan, "Measuring the levels of 21st-century digital skills among professionals working within the creative industries: A performance-based approach," *Poetics*, vol. 81, Article ID: 101434, 2020. <https://doi.org/10.1016/j.poetic.2020.101434>.
- [28] G. Santoro, S. Bresciani, and A. Papa, "Collaborative modes with cultural and creative industries and

- innovation performance: The moderating role of heterogeneous sources of knowledge and absorptive capacity,” *Technovation*, vol. 92, Article ID: 102040, 2020. <https://doi.org/10.1016/j.technovation.2018.06.003>.
- [29] S. Gunia, “Impairment of telomeric quadruple helix formation-a possible event involved in the carcinogenicity of aromatic amines from the thermodynamic point of view?,” *Med. Hypotheses*, vol. 75, no. 1, pp. 123-125, 2010. <https://doi.org/10.1016/j.mehy.2010.02.005>.
- [30] K. A. Hughes and L. R. Pertierra, “Evaluation of non-native species policy development and implementation within the Antarctic Treaty area,” *Biol. Conserv.*, vol. 200, pp. 149-159, 2016. <https://doi.org/10.1016/j.biocon.2016.03.011>.
- [31] S. Siyoto and M. A. Sodik, *Dasar Metodologi Penelitian*, 1st ed, Literasi Media Publishing, 2015.
- [32] U. Shidiq and M. Choiri, *Metode Penelitian Kualitatif di Bidang Pendidikan*, Ponorogo: Nata Karya, Indonesia, 2019.
- [33] I. A. Ivanova and L. Leydesdorff, “Rotational symmetry and the transformation of innovation systems in a Triple Helix of university-industry-government relations,” *Technol. Forecast. Soc.*, vol. 86, pp. 143-156, 2014. <https://doi.org/10.1016/j.techfore.2013.08.022>.
- [34] M. Lutter and L. Weidner, “Newcomers, betweenness centrality, and creative success: A study of teams in the board game industry from 1951 to 2017,” *Poetics*, vol. 87, Article ID: 101535, 2021. <https://doi.org/10.1016/j.poetic.2021.101535>.
- [35] M. Zeng, F. Wang, S. Xiang, B. Lin, C. Gao, and J. Li, “Inheritance or variation? Spatial regeneration and acculturation via implantation of cultural and creative industries in Beijing's traditional compounds,” *Habitat Int.*, vol. 95, Article ID: 102071, 2020. <https://doi.org/10.1016/j.habitatint.2019.102071>.
- [36] P. Landoni, C. Dell'era, F. Frattini, A. Messeni Petruzzelli, R. Verganti, and L. Manelli, “Business model innovation in cultural and creative industries: Insights from three leading mobile gaming firms,” *Technovation*, vol. 92, Article ID: 102084, 2020. <https://doi.org/10.1016/j.technovation.2019.102084>.
- [37] K. Kwon, “Polycentricity and the role of government-led development: Employment decentralization and concentration in the Seoul metropolitan area, 2000-2015,” *Cities*, vol. 111, Article ID: 103107, 2021. <https://doi.org/10.1016/j.cities.2021.103107>.
- [38] P. Sun, L. Zhou, D. Z. Ge, X. X. Lu, D. Q. Sun, M. Q. Lu, and W. F. Qiao, “How does spatial governance drive rural development in China's farming areas?,” *Habitat Int.*, vol. 109, Article ID: 102320, 2021. <https://doi.org/10.1016/j.habitatint.2021.102320>.
- [39] Z. Chen, H. Hu, Y. Wu, Y. Zhang, G. Li, and Y. Liu, “Stochastic model predictive control for energy management of power-split plug-in hybrid electric vehicles based on reinforcement learning,” *Energy*, vol. 211, Article ID: 118931, 2020. <https://doi.org/10.1016/j.energy.2020.118931>.
- [40] M. F. Schmitz, D. G. G. Matos, I. De Aranzabal, D. Ruiz-Labourdette, and F. D. Pineda, “Effects of a protected area on land-use dynamics and socioeconomic development of local populations,” *Biol. Conserv.*, vol. 149, no. 1, pp. 122-135, 2012. <https://doi.org/10.1016/j.biocon.2012.01.043>.