International **EU**ropean **J**ournal of **M**anagerial **R**esearch
Dergisi (EUJMR)
ISSN: 2602 – 4179 / Yaz / Cilt: 7 / Sayı: 12
Araştırma Makalesi

YEŞİL EKONOMİ GİRİŞİMCİLİĞİ İÇİN İNOVASYON STRATEJİSİ OLARAK BİYOMİMİKRİ*

Müge KINAY[1]

ÖZET

Covid-19'un gelişi çevre farkındalığından işletmeye birçok alanda yankısı hissedilen bir dönüşüm çağının da başlangıcı oldu. Değişen değerlerle birlikte, işletmelerin yeni Pazar taleplerini karşılamak için yeni değerlerle uyum içerisinde inovasyon yapmaları gerekli hale geldi. Covid sonrası global ekonomik kriz ve artan enflasyon oranları nedeniyle, rekabet her zamankinden daha da yoğun bir hal aldı. Çetin ekonomik güçlüklerin baskısı altındaki işletmelerin de iyi düşünülmüş inovasyon stratejilerine başvurmaktan başka bir seçeneği kalmadı.

Bir inovasyonun başarılı olabilmesi için, güçlü bir değer önerisi gereklidir. Yeni bir disiplin olan biyomimikri, bilhassa çevre bilinci yüksek tüketicilerin taleplerini karşılamak için güçlü değer önerisi olan inovasyonlar üretebilmenin bir yolu sunabilir. Ürün ve hizmet tasarımı, kaynak kullanımı, örgüt yapıları ve karbon ayak izini azaltma gibi konularda sürdürülebilir çözümler sunan biyomimikri, rekabet etmeye istekli girişimciler için, inovasyon süresini hızlandırmak ve güçlendirmek için doğayı model alan ideal bir ar-ge aracıdır. Biyomimikri tasarım ilkelerini izleyen girişimciler sadece güçlü değer önerisi ile daha fazla müşteriyi cezbedip piyasa talebini karşılamada rekabeti avantajı elde etmekle kalmaz, aynı zamanda da büyük ölçüde yeşil ekonominin yükselişine de katkı sağlarlar.

Anahtar Kelimeler: Yeşil ekonomi, Biyomimikri, Inovasyon, Yenilik, Girişimcilik, Doğa

Jel Kodları: L26, A10,A13,A12

BIOMIMICRY: AN INNOVATION STRATEGY FOR GREEN ECONOMY ENTREPRENEURSHIP

ABSTRACT

The advent of Covid-19 marked the beginning of an age of transformation reflecting itself in any field varying from environmental awareness to business. Since the values have also been transformed, business enterprises need to innovate in line with the changing values to meet the emerging market demands. The competition is fiercer than ever, especially due to the rising inflation rates and post-Covid financial crisis across the world. Under the pressure of severe financial challenges, business enterprises have no other choice but to resort to well-thought innovation strategies.

For an innovation to succeed, a strong value proposition is needed. Biomimicry, a new discipline, offers a way to innovate with a strong value proposition, particularly to meet the demands of environmentally conscious consumers. Offering sustainability solutions in product and service design, use of resources and organizational structures and lowering down the carbon footprint,

*The abstract of this work was orally presented in the 7th International Entrepreneurship Social Sciences Congress (June 20-22, 2022, Tashkent, Uzbekistan).

[1] MSc,Yildiz Technical University, mgkistanbul@outlook.com.tr, (ORCID: 0000-0002-6478-3433)

biomimicry is an ideal research and development tool modelled on nature to accelerate and reinforce the innovation process, for the entrepreneurs who are willing to compete. Following the design principles of biomimicry, entrepreneurs not only might have a competitive edge to meet the market demand by attracting more customers with its strong value proposition but also will contribute to the rise of green economy to a great extent.

Keywords: Green economy, Biomimicry, Innovation, Entrepreneurship, Nature
JEL Codes: L26, A10, A13, A12

INTRODUCTION

Innovation is all about adding values. There are certain biological and social values for humans. According to Schwartz (2012), these are [1] self-directing (the ability to chase your dreams and to have the right of free decision making), [2] encouragement (Encouragement (the need for diversity and positive reinforcement), [3] hedonism (Seeking pleasure and satisfaction in life), [4] success (reputation and appreciation), [5] power (status, prestige, control, dominance), [6] security (a person's consistent alignment with his environment), [7] harmony (avoiding actions and tendencies that will disrupt the social norms and social expectations, [8] tradition (common experiences and belief that will make a group unique, [9] philanthropy (caring for the people's welfare and wellbeing) and [10] universalism (caring for all people's and nature's wellbeing, protecting it and understanding it).

However, in the 21st century, values have changed due to several historical turning events such as radical terrorist attacks, the great pandemic Covid 19, natural disasters, regional wars, and great migration waves. The century began with an attack on twin towers in the United States (Myjer & White, 2002), which overturned all political and social balances across the world. This event was followed by a series of wars in the Middle East, an atmosphere of chaos and a great migration wave on global scale. Global warming, climate change, coastal flooding, tsunamis, earthquakes, and several natural disasters also damaged the areas they hit. All combined had a significant impact on the economy and changed the way humans perceive future, eventually reflecting itself on the value perception of mankind. People lost their homes, life and property during wars, terrorist attacks, natural disasters and pandemics. Hence, safety and security has been more important than ever. Innovations focusing on safety and security and promising a better tomorrow started to thrive. There has been a stronger emphasis on optimism, universalism and philanthropy as people realized they need each other at times of difficulties. With climate change, severe droughts and coasting flooding risks, there has been a need to hear something promising about the world's future and green innovations, green economy and sustainable lifestyle gave people the hope they were looking for.

The Great Pandemic Covid-19 had a final strike on the world's fragile economy and business ecosystem and triggered several financial recession waves across the world. In order to overcome the financial challenges of the post-Covid world, business enterprises and entrepreneurs will have no choice but to innovate. They need to innovate not just for their product or service designs, but also for their management styles, marketing, business models and leadership strategies. In other words, they need to innovate in any way they can if they want to compete. And they will survive the competition if they concentrate on the changing values of the consumers and invest more in sustainable and green solutions. This study introduces biomimicry as an innovation tool for the organizations. As a multidisciplinary scientific field in its infancy, it offers new perspectives to the problems in human world and a fresh approach to innovation by modelling nature in a range of businesses and business-related fields varying from architecture, automation, management, leadership. It aims to build the bridges between biomimicry, innovation, and green economy and to introduce biomimicry as a source of inspiration for the green entrepreneurs who have no choice but to innovate in line with the changing values of the 21st century so that they can compete in the post-Covid world.

Since current research and market conditions lack quantitative study options, the study focuses on existing literature and samples on biomimicry-based innovations, green economy, and sustainable entrepreneurship to suggest an innovation tool that can serve to multiple industries as a multidisciplinary approach.

1. BIOMIMICRY

Human is a curious species and therefore, curiosity has always been an innate part of mankind. It has always driven him to study his social and environmental surroundings. Hence, he has always closely monitored nature and mimicked what fascinates him. However common modelling nature can be, it was not until recently that mimicking nature got recognized as a field of scientific study. There has been a variety of terms suggested so far; including the term "bionic" by Jack E.Steele (Chiu and Tseng, 2015), the term "biomechanics" by Nikolai Alexandrovich Bernstein (Feigenberg, 2014), the term "biomimetics" by Otto Schmitt (Harkness, 2002) and the term "biomimicry" by Janine Benyus (2002). Benyus (2002) defines nature as not just a capital that humans need to extract resources but also as a sustainable system from which humans can learn from it. The energy production in nature is green since it relies solely on solar energy and it has a smart way to consume that energy, which makes it an ideal resource for efficiency. Nature recycles everything and has a unique way to generate maximum efficiency with minimum resources.

In biomimicry, there are three key roles suggested for biomimicry (Dicks, 2016):

- Model: Humans may model nature to develop novel forms, functions, systems, processes, and strategies
- Criterion: Humans may benefit from the ecological standards and criterion to evaluate the sustainability of innovations
- Mentor: Nature is a great source of know-how and humans may use it as a research development tool from which one can learn

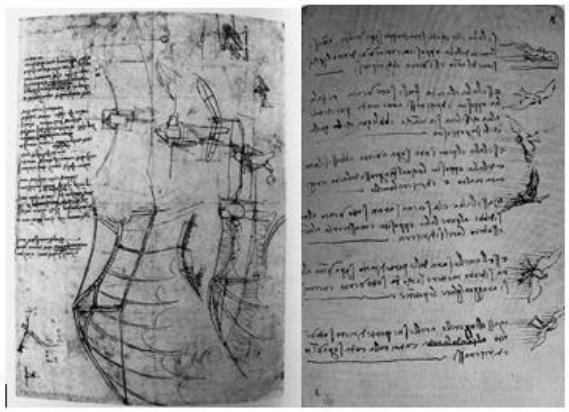
The fields of business and entrepreneurship have several commonly used terms referring to natural systems. First and foremost, the whole universe of entrepreneurship is defined as an ecosystem. The term "ecosystem" initially stood out in an article by James Moore in Harvard Business Review. In this article, Moore (1993) compares business ecosystem to a biological ecosystem in which many different elements combine to form a complex structure. He also compares the lifecycle of business enterprises to the biological lifecycles of organisms and states that business enterprises also go through the processes of birth and growth.

1.1 Innovating with Biomimicry

Humans have always been curious about nature and inspired by what is offers. Nature also served as an inspiration to the most well-known genius minds of the history while innovating.

Da Vinci had a way of thinking ahead of his time. He designed his ornithopter by observing birds and their wing movements (Güss, Ahmed and Dörner, 2021). He examined the flexibility of bird muscles and suggested an artificial wing design (Richardson, 2005).

Figure 1: Da Vinci's Wing Designs Inspired by Birds and His Notes on Bird Flight (Debolini, 2006)



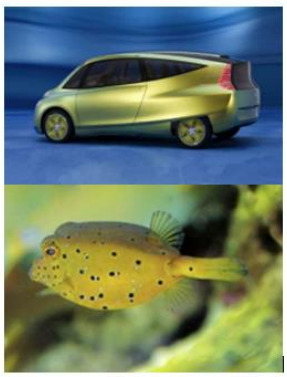
Wright Brothers also studied birds. They were particularly interested in pigeon flight and after observing pigeons for some time, their observations enabled them to design the first air vehicle in history in 1903 (Shukor, 2015).

The Spanish genius Gaudi was another prominent figure of the period, who focused his energy on studying nature. In mid 1800s, he was able to start a new architectural movement by using nature as a mentor and as a model and created several masterpieces (Orman, 2013). He was strongly impressed by the quality and resilience of natural materials such as trees, muscles and tendons and introduced an innovative thinking into art and architecture by mimicking them in his constructions (Orman, 2013).

Figure 2: Samples from Gaudi's Works Inspired by Bones (Orman, 2013)

Nature as a source for innovation has never been limited to architecture. It also significantly contributed to engineering. In 2005, world-famous automotive brand Mercedes Benz developed its first bionic vehicle inspired by the boxfish as a result of the brand's cooperation with biologists. The design team was on a quest for a new vehicle, carrying out extensive research and development strategies. They wanted to come up with a product design that could check certain criteria such as efficiency, economic principles, aerodynamic performance, environmental sustainability. However, the vehicles were also supposed to accommodate four passengers. They soon realized that boxfish is a creature with a high crash-resilient and pressure-resistant carcass. The fish saves its metabolic energy and is capable of quickly manoeuvring at times of danger. These characteristics inspired the team to build the first bionic concept vehicle for Mercedes-Benz (Yang, Hung, Wang & Lien, 2019).

Figure 3: The first bionic concept vehicle by Mercedes- Benz inspired by boxfish (Yang et al., 2019)



Nature also offers innovative approach to air-conditioning systems. An office building in Zimbabwe modelled the air-conditioning system used in termite mounds and they were able to ventilate the buildingwithout using air-conditioners. Termites construct chimneys for ventilation in their tall buildings. By adapting the ventilation chimneys from termite mounds into the office building in Zimbabwe, the engineers were able to keep the building cool in hot Zimbabwe climate in the most possible green and energy efficient way (Vierra, 2011).

Figure 4: Eastgate ventilation system inspired by Termite Mounds (Vierra, 2011)

Biomimicry is a great research and development resource to create innovative solutions in many different fields. Massachusetts Institute of Technology developed artificial leaves as a mobile energy generation system so that people living in impoverished countries can store sunlight and use it wherever they go (Stecker, 2011). Solar technology companies are now inspired by hornets to design more efficient solar cells for their energy panels (Plotkin et. al, 2010). One of the world's fastest trains, the Japanese bullet train Shinkansen, relies on the beak design of Kingfisher bird to solve its sound blast problems (Hargroves & Smith, 2006).

Such technologies have the potential to create a profound positive impact on the life quality, not just

in developing but also in developed countries. Biomimicry creates considerable research and development opportunities not merely for the innovations in product design, yet business model, leadership and management strategies in growing start-ups and enterprises, as well. Beehives and swarms have already been inspiring organizational management, route management, supply chain management and internet of things for some time (Huo, AbduRahman, Wang & Siaw-Chuing, 2017). Wolf-packs are now being analysed to develop better leadership models in business management (Akkaya & Yazici, 2020). There are so many lessons that can be learnt from nature. For instance, the way seeds disperse themselves in spring and during forest fires to secure their survival should be under the business microscope to develop augmented distribution, marketing, and crisis management strategies.

As it can be clearly seen, when nature is used as a resource for modelling, mentoring, it offers a great potential to create life-changing innovations with ecologically, economically, and socially added value. Therefore, it offers companies great advantage in competition.

2. BIOMIMICRY AND THE GREEN ECONOMY

Although the sustainable development concept had already been common, it was not until 1989 when the term "green economy" was coined by a group of environmental economists in a report for the British Government (Pearce, Markandya & Barbier, 2013). The authors suggest that economic policy cannot be considered without its impact on environment, and it is possible to design an economic growth on microeconomic and macroeconomic level without risking the chances of survival for the next generations. And the prescription relies on the consumption of environmentally friendly products and promoting environmental capital. (Pearce et al., 2013)

In order to secure the survival of their nations, it is indispensable for countries to invest in green technologies, green businesses and green innovations. Hence, the Green economy's share is constantly on the rise. According to a data issued by the Low Carbon and Environmental Goods and Services Sector, Green economy had more than 20% rise in the US just from 2017 to 2019, accounting for $1.3 trillion US dollars (Georgeson & Maslin, 2019).The recent economic challenges brought by Covid-19 also necessitate more investment in green economy since governments need to preserve their natural resources and use them in the most efficient and sustainable way possible. To achieve this, countries may benefit from the criteria mentioned in a 2017 OECD report and regularly check their achievement score in Green Economy. This study adapts those criteria into check-up questions for nations, corporations, and business enterprises to assess their efficiency in Green Economy.

Here are the signs of Green Growth (OECD, 2017):

i. Is the economy productive in terms of environment and resources?
ii. Are the natural assets intact and within sustainable thresholds?
iii. Do the environmental conditions lower the quality of life?
iv. Are there any investments and policies encouraging green culture?
v. Are green objectives in line with the social goals?
vi. Do the policies allow flexibility to encourage quick adaptation?

These criteria (OECD, 2017) suggest that a government, nation, corporation, business enterprises or an entrepreneur aiming at green growth needs to ensure that innovations, technologies, business activities, policies.

- contribute to an environmentally productive and resource-wise efficient economy,
- keep the natural assets within sustainable and healthy limits
- encourage environmental conditions with positive effect – or at least no negative impact – on life quality
- aim at making green investments and green policies
- align the green goals with social goals
- make policies flexible enough to adapt.

However, the question on how to ensure the above remains. In 2011, The United Nationals Environmental Management Group published a report on Green Economy and showed the way forward for the whole world. According to the report (UNEMG, 2011), for a successful transition into a strong green economy, organizations must invest in green infrastructure and green sectors, meet Millennium Development Goals (MDGs) set by the United Nations (Ki-Moon, 2013) and need to integrate environment into social life, innovation, and technology. According to the United Nations Sustainable Development Goals (2022), the world's water-related ecosystems and thus the life quality of some 3 billion people are currently at risk due to more than 85% loss in the wetlands. The loss of water has a tremendous impact on life quality as it is directly linked with basic hygiene and sanitation requirements for mankind. In line with UNEMGs 2011, the green energy infrastructure has slight but positive progress and rise by a quarter from 2010 to 2019 (United Nations, 2022). On the other hand, there is still a need for improvement in life quality since 99% of the world's cities are exposed to air pollution and 13.3% of the world's food resources is lost in the post-harvest process even before reaching supermarkets. The lack of sustainability and recycling in the food production has a negative impact on the life quality as it boosts poverty and inequality in certain parts of the world. (UN Nations, 2022).

Biomimicry is an ideal tool that will help organizations innovate for faster green economic growth as it already meets UNEMGs and United Nationals Sustainable Development Goals (UNSDGs) standards

with its nature-focused approach. It offers energy efficiency, sustainability, life quality improvement, recycling, and economic progress by using as a model, a criterion, and a mentor (Dicks, 2016).

CONCLUSION

Biomimicry is a relatively new and rarely known scientific field and as a result, research opportunities are limited. There are very few companies operating on biomimicry principles, meaning quantitative research opportunities are not available for business and entrepreneurship ecosystems, yet. Its possible impacts on overall economy and on entrepreneurship ecosystem can be examined further for future studies in business field. Future studies comparing regional data with the global one will provide a better insight for more precise biomimicry-based business strategy designs. Therefore, the dispersion phase for entrepreneurship with biomimicry-designed innovation needs to be monitored closely for the next decade, which will provide more precise results.

However, this study on literature review suggests that biomimicry's contributions will be significant to the growth of green economy due to its correlations with sustainability and green innovation.

First of all, biomimicry is a tool centred around nature which makes it possible to innovate for the changing values in the 21st century and it is capable of creating sustainable business and entrepreneurship opportunities that will eventually contribute to the green economy.

Secondly, with limited resources and great demand for innovation, biomimicry will support the green entrepreneurship ecosystem as a research and development technique with an efficiency already tried, tested, and proven for 3.8 billion years. Its contribution to green economy will be considerable since it creates opportunities for sustainable entrepreneurship.

When innovations are created as a product of biomimicry, the outcome leads to high ecological and social value-added results, with economic savings and a considerable competitive advantage in commercial ways.

In addition to being an ideal tool for service and product design innovation, biomimicry can also be useful for management. A leadership modelled on biomimicry will result in adaptability, efficiency, agility, and cooperation. Organizational structures modelled on biomimicry will pave the way for the solutions to organizational problems. Swarm thinking and beehive designs are the exemplary models for biomimicry-based organizational management.

Last but not least, using nature as a research development lab offers limitless opportunities for creativity and innovation and most of these opportunities are based on solutions already tested in 3.8 billion years. Therefore, biomimicry is an ideal research and development tool for the entrepreneurs who would like

to compete and make profit with limited resources under the difficult circumstances of financial recovery period in post-Covid world.

With the rise of these eco-friendly, sustainable products and services, the 21st century values will be met, and the green economy will thrive.

REFERENCES

Akkaya, B., & Yazici, A. M. (2020). Comparing Agile Leadership With Biomimicry-based Gray Wolf: Proposing A New Model. Business & Management Studies: An International Journal, 8(2), 1455-1478.

Benyus, J. (2002). *Biomimicry: innovation ınspired by nature*. New York: Perennial.

Chiu, W. T., & Tseng, S. C. (2015, July). The influence of bionic creatures and natural condition on design inspirtation. In 2015 IIAI 4th International Congress on Advanced Applied Informatics (713-714). IEEE.

Debolini, F. (2006). Art Book Leonardo da Vinci. Ankara: Dost Kitabevi Yayınları, 92-93.

Dicks, H. (2016). The philosophy of biomimicry. Philosophy & Technology, 29(3), 223-243.

Georgeson, L., & Maslin, M. (2019). Estimating the scale of the US green economy within the global context. Palgrave Communications, 5(1), 1-12.

Feigenberg, J. M. (2014). Nikolai Bernstein From Reflexes to the Model of the Future. Studies in Sports History. (Vol. 17). LIT Verlag Münster, vii

Güss, C. D., Ahmed, S., & Dörner, D. (2021). From da Vinci's Flying Machines to a Theory of the Creative Process. *Perspectives on Psychological Science*, 16(6), 1184–1197.

Hargroves, K., & Smith, M. H. (2006). Innovation inspired by nature Biomimicry. Ecos, (129), 27-30.

Huo, L. K., Abdul-Rahman, H., Wang, C., & Siaw-Chuing, L. (2017). Bee inspired route management approach and use of internet of things. The Journal of Modern Project Management, 5(2).

Ki-Moon, B. (2013). The millennium development goals report 2013. United Nations Pubns, 365, 366. https://www.un.org/millenniumgoals/pdf/report-2013/mdg-report2013_pr_global-english.pdf Access: 15.6.22

Moore, J. F. (1993). Predators and prey: a new ecology of competition. Harvard business review, 71(3), 75-86.

Myjer, E. P., & White, N. D. (2002). The Twin Towers Attack: An Unlimited Right to Self-Defence?. Journal of Conflict and Security Law, 7(1), 5-17.

OECD (2017), Green Growth Indicators 2017, OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264268586-en. Access: 12.6.22

Orman, B. (2013). Art Nouveau & Gaudí: The Way of Nature. JCCC Honors Journal, 4(1), 2.

Pearce, D., Markandya, A., & Barbier, E. (2013). *Blueprint 1: for a green economy*. Routledge.

Plotkin, M., Hod, I., Zaban, A., Boden, S. A., Bagnall, D. M., Galushko, D., & Bergman, D. J. (2010). Solar energy harvesting in the epicuticle of the oriental hornet (Vespa orientalis). Naturwissenschaften, 97(12), 1067-1076.

Richardson, J. (2005), "Leonardo: why the inventor failed to innovate", Foresight, Vol. 7 No. 5, 56-62. https://doi.org/10.1108/14636680510623379 Access: 20.5.22

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. Online readings in Psychology and Culture, 2(1), 2307-0919.

Shukor, S. F. A. Avian-Centric Design. Nature's Yield and Wonders of Art (NYAWA) 15, 81 https://core.ac.uk/download/pdf/153825146.pdf Access: 14.6.22

Stecker, T. (2011). Artificial Leaf Might Provide Easy, Mobile Energy. Scientific American. https://www.scientificamerican.com/article/artificial-leaf-might-provide-mobile-energy/ Erişim: 16.5.22

United Nations Environment Management Group (UNEMG). (2011). Working towards a Balanced and Inclusive Green Economy: A United Nations System-Wide Perspective. https://sustainabledevelopment.un.org/ Access: 12.6.22

United Nations (UN). (2022). The Sustainable Development Goals Report. https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf, Access: 1.6.22

Vierra, S. (2011). Biomimicry: designing to model nature. *Whole Building Design Guide*, 1-10.

Yang, C. M., Hung, J. Y., Wang, Y. L., & Lien, Y. H. (2019) Analysis of Mercedes-Benz concept car using biomimicry design spiral and template analysis–an exploratory study, *International Journal of Innovation in Management*, *7*(2), 49-56