HUNGARIAN AGRICULTURAL ENGINEERING
N° 38/2020
Published online: http://hae-journals.org/
DOI: 10.17676/HAE.2020
HU ISSN 0864-7410 (Print) / HU ISSN 2415-9751(Online)

PERIODICAL OF THE COMITTEE OF
AGRICULTURAL AND BIOSYSTEMS ENGINEERING OF
THE HUNGARIAN ACADEMY OF SCIENCES
and
SZENT ISTVÁN UNIVERSITY
Faculty of Mechanical Engineering

Value-creating processes of circular business models in the development of IT systems

Authors:
Fogarassy, C.[1] – Ivanyos, D.[2] – Bori, T.[3] – Ozsvari, L.[4]

Affiliation:
[1,3] Szent István University, 2100 Gödöllő, Páter Károly u. 1., Hungary; [2,4]University of Veterinary of Medicine Budapest, 1078 Budapest, István utca 2., Hungary

E-mail address:
fogarassy.csaba@szie.hu; ivanyos.dorottya@univet.hu; tamas.bori@askell-agro.com; ozsvari.laszlo@univet.hu

Abstract: The profitability of "mainstream" economic systems lies in outsourced external factors, which make it cheaper to waste resources than to track and eventually recover them. However, non-circular economic models, that is, without feedback, carry many risks. These include deficiencies in primary resources, including resource price volatility, declining supply chain efficiency, increasing bans on waste trading, declining costs of renewable energy sources, etc., and these unfavorable patterns can also be termed "linear risks". Through the analysis of open and closed business models and the presentation of the value-creating processes of the ReSolve matrix, we want to demonstrate how modern IT systems and digital solutions can increase the efficient use of resources and reduce production risks.

Keywords: business model; circular economy; value-creation; IT application; linear risk; circular value chain.

1. Introduction

The use of new IT tools has opened up new channels on the front of working with partners and reaching customers. According to Amit and Zott (2012), the importance of business transformation has received increased attention due to the development of information technology (IT). Chesbrough (2010) clearly states that an excellent business model around an ordinary product offers much better opportunities than a great product used in a medium business model. What and Massa (2011) confirm this statement is that products should always be complemented by appropriate business models. Although this area of research has received special attention in recent years, the basic concept still lacks comprehensive elaboration. The most accurate description so far comes from Teece (2010), who sees the concept of business models in bringing the mechanisms of value creation, value transfer, and value preservation to a common nomination. In his view, the business needs to clearly identify the needs of customers and find ways to respond to them. Customers'

investments turn into profits if certain elements of the value chain are tuned accordingly, ie these processes come together in the value chain (form a value chain). The growing role of business planning is explained by Schaltegger et al. (2012) on corporate sustainability, identifying business model innovation as one of the key elements of corporate sustainability. In recent years, several authors (Gauthier and Gilomen, 2016; Breitbarth et al., 2018) have reported on the practical experiences of successful businesses, in which entrepreneurs create outstanding social and environmental values while also generating significant financial revenues. Armas-Cruz, Gil-Soto, and Oreja-Rodríguez (2017) focused their studies on the potential for green business proliferation and concluded that the low profitability of such initiatives does not motivate corporate decision makers to move away from conventional business models. The same idea is supported by Fogarassy et al. (2017), who argue that traditional firms respond only to emerging market demands. Therefore, the transformation of mainstream economic thinking should offer higher financial value than in previous systems (Schaltegger et al., 2012). Otherwise, sustainability businesses will remain just case studies, rather than becoming trends. The position is in line with Ramkumar et al. (2018) who see environmental solutions as market expectations rather than complementary functions. The authors argue that the current benefits of BAU (Business As Usual) processes will soon pose a threat to companies in many ways. These include deficiencies in primary resources, including resource price volatility, declining supply chain efficiency, increasing bans on waste trading, declining costs of renewables, etc., and these unfavorable patterns can also be termed "linear risks". Recent studies (Brooks et al., 2018; Horvath et al., 2018) support the above when they argue that the profitability of "mainstream" economic systems lies in outsourced external factors, i.e., it is cheaper to waste resources than to monitor and eventually regain them. However, this situation seems to be changing soon as dominant global players (e.g. China, Kenya, Bangladesh) have exited the waste markets. It can therefore be assumed that the transition from a "take-make-waste" approach, the creation of closed resource loops, will be a basic requirement for companies and economic actors in general. This is one of the reasons why the European Commission (2015) has announced its "Closing the Loops" Action Plan, which is already in the introduction, urging the transition to a circular economy. The Circular Economy Action Plan, or 'CE' for short, rejects the traditional characteristics of economic growth (e.g. mass production, use of non-renewable resources, production of preserved goods, etc.) but offers innovative solutions to preserve natural capital and enhance social well-being. Achieving the best possible circular flow of materials and energy through economic processes and avoiding resource leaks is a top priority (Ellen MacArthur Foundation, 2015). Contrary to previous sustainability efforts, these circular initiatives are receiving increased attention from the business sector.

According to a recent study by the World Business Council for Sustainable Development (WBCSD), 80% of companies surveyed say that accelerating growth and increasing competitiveness depend on the use of circular strategies. The remaining 20% identified risk reduction as the main motivation for developing business models (WBCSD, 2017). These results suggest that the application of circular strategies has reached the realm of business model research. In interpreting the concept of circular business models, Scott (2013) argues that circular initiatives should use recyclable biological materials or use their technical raw materials continuously. Both activities are expected to be harmless to ecosystems and can

be operated without waste. According to Mentink (2014), circular businesses need to create value and capture material flows in a closed material cycle. However, he points out that a business model alone cannot be a circular system. Loop closure can be achieved more through a network of businesses. Bocken et al (2017) classify circular businesses based on their environmental strategies. It was found that companies can influence resource loops in three different ways. The first option is to slow down the flow of resources by expanding product use. This option requires the design of durable goods. Another method is to close the loops through recycled materials. The last solution is to narrow the loops, which means reducing resource use, increasing material and energy efficiency. Lewandowski (2016) considers enterprises to be sustainable in a circular way if their model includes basic 'CE' properties (e.g., resource optimization, loop closure, etc.). In summary, circular strategies and business models are evolving together in current business practices. According to Kraaijenhagen et al. (2016), their mutual application is inevitable for two reasons. On the one hand, a country-wide circular transformation cannot be carried out without bottom-up initiatives, and on the other hand, business models can only work effectively today if they incorporate circular and constantly evolving system features. Manninen et al. (2017) also share this view, but add that scientific research shows a growing interest in developing a circular business model, which is of paramount importance because if the business models to be introduced are preceded by thorough scientific research, their introduction , their application stands on safer foot. Previous studies do not examine the business-level changes of circular progress, ie what circular elements and solutions the currently used business models use, and what phase of the linear-circular transformation they are in. Therefore, the main goal of our studies was to evaluate current business models in terms of their fit to circular solutions. Some studies (Bocken et al., 2015; EMF, 2015; Aminoff et al., 2017; Fogarassy, 2017) hypothesize that linear-circular transformations start most in the knowledge-intensive and innovative industries, and therefore as a research area. we can mark outstandingly active changes in biotechnology. The sector is expected to be the most important area of the economic era following the financial crisis, in 2015 the second highest amount of global investment was invested in this sector (Ernst & Young, 2017). By examining the new generation of biotechnology business models, we want to answer at what stage the application of circular strategies is at the business level. In addition to recognizing the circular elements of biotechnology enterprises, research results can contribute to the evaluation of models used in practice to determine how the process of linear-circular transition can be accelerated for knowledge-intensive enterprises that prefer digitalization.

2. Examining some features of business models

Exploring the business models used in digital technology and exploring their operational background is mostly possible through the analysis and review of Belgian biotechnology companies (Doranova, 2016). Belgium has small biotechnology companies with a market capitalization of € 286 million (2016), the second highest value in Europe. Seven of Europe's top ten biotech companies are in the country, and the world's 10 most influential pharmaceutical companies are doing some research in Belgium. This excellent biotechnology ecosystem has a strong scientific background and an efficient, innovative SME

community. In addition, national regulations and financial incentives provide strong support to sector actors. Belgian law allows companies to shorten and complete Phase I biotechnology trials, clinical trials within 15 days, resulting in the highest position in Europe in terms of the number of clinical trials (Essenscia, 2017). In his work published in recent years, Segers (2017) identified 22 different business models in the field of biotechnology. According to his observations, companies use a combination of certain models. He recognized that joining collaborative networks was a trigger for the evolutionary breakthrough of biotechnology businesses. Therefore, during the evaluation and classification, the main grouping aspect was the innovation sharing practice of the companies, on the basis of which closed and open business models can be distinguished. In the case of closed models, the company relies significantly on internal resources, but mostly on the efficient use of its own knowledge, licenses and know-how, which basically also means the usual form of business models. However, current trends show that large companies are outsourcing certain activities to smaller companies to better focus on their core business. This phenomenon leads to the sharing of innovation and the development of open business models. In the case of open business models, the presence of affiliated small businesses that contribute to the creation of a real, viable or sustainable business ecosystem is prominent (Sagers, 2017). The methodological background for the evaluation of sustainable business models was developed in 2013 by the staff of the Ellen MacArthur Foundation (2013), which examines the system properties of business models based on circular evaluation criteria. This method was given the name 'ReSolve', which Lewandowski further specified and developed in 2016.

Table 1: The ReSOLVE framework

Activity	**Descriptions**
Regenerate	use of renewable materials and energies
	preserving and restoring the healthy functioning of ecosystems
	the return of recovered biological resources to the biosphere
Share	increase the usefulness of products by sharing use, access, or ownership
	prolonging the life of products by reusing, maintaining (eg repairing, renovating) or designing durable products
Optimize	optimizing the use of resources by increasing performance or outsourcing certain activities
	waste avoidance in production and supply chains
Loop	closure of material flows by remanufacturing, re-use, recycling or recovery
Virtualize	dematerialization of products or services by digital systems
Exchange	use of new technologies, materials or processes

Source: based on Lewandowski, 2016

Table 1 provides a detailed description of the defining components of Ellen MacArthur's framework. It can be seen from the table that the acronym ReSOLVE consists of the initials of the English names of the activities supported by the circular economy.

3. Open and closed business models in practice

Based on the circular criteria introduced, Table 2 provides an overview of the first generation of pharmaceutical companies (closed models) and highlights key patterns that meet the requirements for circular operation.

Table 2: Closed business models of the Belgian pharmaceutical biotechnology industry

Business model	Features
Product based	• Vertical integration; • full control over the value chain; • high capital requirements; • large enterprise model.
Platform based	• Carries out early-stage research; • develops research tools and platform technologies and then sells their licenses to other companies; • less risk; • low capital requirements.
Hybrid version	• A mix of Product and Platform Based Models; • offers services and deals with the later stage of product development; • there is the possibility of short-term revenues.
Based on royalties	• It is popular with those with few financial resources; • conducts early-stage research; • sells royalties on its results • to large companies who complete research work and bring the product to market.
No research - only development	• It buys "discarded" products from large corporations; • complete the research period; • brings the product to market.
Based on licensing	• It operates in the initial stages of the value chain; • issues but does not sell licenses for its results to other companies.
Based on research service	• It offers a research service; • specifically fills market gaps in the value chain; • it can move in two directions: pre-clinical and clinical trials; biological and chemical products and medicines.
Initial public distribution	• Non-income start-ups; • they are evaluated on the basis of their research and publicly announced results; • in the absence of revenue, the exit strategy is not available.

(Source: based on Horvath- Khazami – Ymeri - Fogarassy, 2019)

The first three models show the traditional forms of biotechnology enterprises (Table 2). A common feature of the other models is that they are suitable for starting businesses with a capital shortage. They operate at an early stage in the value chain and try to grow further by selling their intellectual property or special services. Their only circular feature is the service provided to large corporations, which is one of the principles of sharing or sharing. A sympathetic exception is the "*No Research - Only Development*" model, which deliberately positions itself at the end of the value chain. This business solution offers a biotechnology module for one of the top priorities of the circular economy: 'to extend life with reuse'. If a large company "throws out" a product at a later stage of development, we can lose all the energy and materials previously invested. This model is able to save these products and the energy invested in them by buying expired drugs and performing the innovation associated with them. The model prevents the generation of unnecessary material and energy flows that would be required for research and development of new active ingredients. In the case of the business model in question, we can see that its profile not only contains circular elements, but is built specifically on it. The emergence of open business models shows that knowledge sharing has become a key factor - even in an industry where intellectual property protection plays a prominent role (Table 3). Businesses can become each other's service partners if their roles will be changing.

Table 3: General open business models of the Belgian pharmaceutical biotechnology industry

Business model	Features
R & D based on open innovation	• Companies outsource R&D to operate more efficiently in their own profile.
Networking	• The open form of the traditional, vertically integrated model; • partnerships of varying intensity and form tailored to current needs; • more efficient resource management using the assets of other companies.
EFQM[1] excellence	• Self-assessment according to the following criteria of the European Foundation for Quality Assurance: implementation of key activities, achieved results.
Fully diversified	• Large enterprise model; • expanding the company profile to produce related products; • tools used: licensing, collaboration, corporate merger, acquisition.
Based on intellectual property	• It is based on property rights and patents; • the protection of intellectual property is key; • sells or leases all items in your portfolio.

Re-utilization and technology intermediary	• Reuser: Utilizes molecules under development or existing for other purposes than their intended use (e.g., use of old drugs to treat new diseases); • patent management is key. • Technology Intermediaries: The discovery of a molecule in a company's portfolio and then its transmission to another company.
Shared partnership	• Discovering products that look promising; • purchasing the product at an early stage of product development and finding its applicability interface; • selling the product to other pharmaceutical companies; which complete product development.
Result-driven	• It is based on the principle of performance-based pay; • uses various methods to evaluate performance; • it has a great influence on pricing when patenting accepted drugs.

Source: based on Horvath- Khazami – Ymeri - Fogarassy, 2019

The common features of open models can be summarized based on three aspects. First and foremost, sharing innovation (e.g. between a large company and an SME) and the presence of collaboration are essential in open innovation. Second, the use of informatics becomes paramount due to the rapid and efficient exchange of information. Eventually, the rapid flow of information has led to higher customer awareness, which also results in the emergence of a need for personalization. These new considerations indicate that the digital revolution is also strongly influencing pharmaceutical biotechnology. The above assessment therefore distinguishes between standard open business models and those whose operation is highly dependent on the use and management of data.

4. Discussion and conclusions

As a result of digitalization, the paradigm shift that has taken place in the biotechnology industry with open business models. This has allowed companies to focus broadly on their core competencies by outsourcing some of their R&D activities. The use of external resources by large companies has allowed small businesses and start-ups to enter the biotech market by targeting certain gaps in the value chain. Today, the presence of these biotech SMEs is extremely important not only in practice but also in terms of innovation for the whole sector and even for the economy as a whole. The digitalisation of technological development processes of biological systems have contributed to the creation of business ecosystems where innovation is carried out through a collaborative, platform based network of companies of different sizes and disciplines. This mechanism reduces operating costs and value chain dependency. Based on the analysis, it can be concluded that models of digital based circular business solutions in biotechnology have contributed to the creation of a real values of business ecosystem. This mechanism reduces operating costs and dependence on value chains. In addition, it opens up new revenue channels by connecting its players to the local market. The proliferation of open business models shows that knowledge sharing is becoming a key factor even in industries where intellectual property protection plays a prominent role.

Acknowledgements

Special thanks to the „Európai Mezőgazdasági Vidékfejlesztési Alap: a vidéki térségekbe beruházó Európa - European Agricultural Fund for Rural Development: Europe investing in rural areas" program. Program ID: 1906020653

References

[1] Aminoff, A., Valkokari, K., Antikainen, M., & Kettunen, O. (2017). „*Exploring disruptive business model innovation fort the circular economy."* In G. Campana, R. Howlett, R. Setchi, & B. Cimatti (Eds.), Sustainable Design and Manufacturing 2017 – Smart Innovation, Systems and Technologies, 68, 526-636. https://doi.org/10.1007/978-3-319-57078-5_50

[2] Amit, R., & Zott, C. (2012). Creating value through business model innovation. *MIT Sloan Management Review*, 53(3), 41-49.

[3] Armas-Cruz, Y., Gil-Soto, E., & Oreja-Rodríguez, J. R. (2017). Environmental management in SMEs: organizational and sectoral determinants in the context of an Outermost European Region. *Journal of Business Economics and Management*, 18(5), 935-953.

[4] Bocken, N. M. P., Rana, P., & Short, S. W. (2015). Value mapping for sustainable business thinking. *Journal of Industrial and Production Engineering*, 31(1), 67-81.

[5] Breitbarth, T., Schaltegger, S., & Mahon, J. (2018). The business case for sustainability in retrospect: a Scandinavian institutionalism perspective on the role of expert conferences in shaping the emerging "CSR and corporate sustainability space". *Journal of Public Affairs*, 18(3). https://doi.org/10.1002/pa.1855

[6] Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. *Science Advances*, 4(6). https://doi.org/10.1126/sciadv.aat0131

[7] Chesbrough, H. (2010). Business model innovation: opportunities and barriers. *Long Range Planning*, 43(2-3), 354-363.

[8] Doranova, A. (2016). *Regional Innovation Monitor Plus 2016 – Regional Innovation Report Flanders* (Production related bio-technology). Technopolis Group: Brussels, Belgium. https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/report/innovation (accessed on 20 May 2020).

[9] EMF (2015). *Delivering the circular economy – a toolkit for policymakers*. Ellen MacArthur Foundation Publisher, Cowes, UK, pp. 13-54. https://www.ellenmacarthurfoundation.org/assets/downloads/publications/ (accessed on 20 May 2020).

[10] Ernst & Young (2017). *Beyond Borders Staying the Course* – Biotechnological Report. Ernst and Young LLP, London, UK. https://www.ey.com/Publication/vwLUAssets/ey-

biotechnology-report-2017-beyond-borders-staying-the-course/$File/ey-biotechnology-report-2017-beyond-borders-staying-the-course.pdf (accessed on 20 May 2020).

[11] Essenscia (2017). Belgium showcases expertise on Immunotherapy at the world's largest Biotechnology Conference. Press release on the BIO International Convention 2017 Conference in San Diego, 19-23 June, 2017. Essenscia, Brussels, Belgium. http://www.essenscia.be/en/PressRelease/Detail/16653 (accessed on 20 May 2020).

[12] EU CL (2015). *Closing the loop - An EU action plan for the Circular Economy*. Link: http://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF (accessed on 20 May 2020).

[13] Fogarassy, C. (2017). *The Theoretical Background of Circular Economy and the Importance of it's Application at Renewable Energy Systems.* Reykjavík University Renewable Energy Summer Course 2017, Szent Istvan University Publishing House, Gödöllő, http://egt-newenergy.szie.hu/sites/default/files/learning/Circular%20Booklet_RU_SZIE.pdf (accessed on 20 May 2020).

[14] Fogarassy, C., Horvath, B., & Magda, R. (2017). Business model innovation as a tool to establish corporate sustainability. *Visegrad Journal on Bioeconomy and Sustainable Development*, 6(2), 50-58.

[15] Gauthier, C., & Gilomen, B. (2016). Business models for sustainability: energy efficiency in urban disctricts. *Organization & Environment*, 29(1), 124-144.

[16] Horváth, B., Mallinguh, E. & Fogarassy, C. (2018). Designing Business Solutions for Plastic Waste Management to Enhance Circular Transitions in Kenya. *Sustainability*, 10 (5) 1664.

[17] Horvath, B., Khazami, N., Ymeri, P., & Fogarassy, C. (2019). Investigating the current business model innovation trends in the biotechnology industry. *Journal of Business Economics and Management*, 20(1), 63-85.

[18] Kraaijenhagen, C., van Open, C., & Bocken, N. (2016). *Circular business – collaborate and circulate*. Ecodrukkers: Nieuwkoop, Netherlands, pp. 5-30

[19] Lewandowski, M. (2016). Designing the business models for circular economy – towards the conceptual framework. *Sustainability*, 8(1), 43.

[20] EMF (2013). *Towards the Circular Economy: Opportunities for the Consumer Goods Sector*. Ellen MacArthur Foundation Publishers, Cowes, UK, 112. p.

[21] Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A. (2017). Do circular economy business models capture intended environmental value propositions? *Journal of Cleaner Production*, 171, 413-422.Mentink (2014)

[22] Ramkumar, S., Kraanen, F., Plomp, R., Edgerton, B., Walrecht, A., Baer, I., & Hirsch, P. (2018). *'Linear risks' - how business as usual is a threat to companies and investors.* Circle Economy Program, Amsterdam, The Netherlands.

[23] Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. (2012). Business cases for sustainability: the role of business model innovation for corporate sustainability. *International Journal of Innovation and Sustainable Development*, 6(2), 95-119.

[24] Scott, J. T. (2013). *The sustainable business a practitioner's guide to achieving long-term profitability and competitiveness* (1st ed.). Abingdon, UK: Routledge.

[25] Segers, J. P. (2017). *Biotecnology business models:* Catch-22 or best of both worlds? Working Paper, Hogeschool PXL, Hasselt, Belgium.

[26] Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, 43(2-3), 172-194.

[27] WBCSD (2017). *World Business Council for Sustainable Development, 8 Business cases for the circular economy*. World Business Council for Sustainable Development, Geneva, Switzerland. https://www.wbcsd.org/Programs/Circular-Economy/Factor-10/News/8-Business-Cases-to-the-Circular-Economy