

UDC 34.004
JEL: L86; M16; M19
DOI: <https://doi.org/10.32983/2222-4459-2025-7-74-81>

BUSINESS MODEL AND OPEN DATA ANALYSIS IN THE ERA OF ELECTRONIC TRANSFORMATION

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Mshvidobadze T. I., Mamulashvili L. S. Business Model and Open Data Analysis in the Era of Electronic Transformation

Over the last decade, data has risen to the top of national and global policy agendas, as nations seek to develop their economies, use data to address social challenges and respond to citizen concerns about the uses and abuses of data. Data has become the infrastructure on which modern economies are built. The growing ubiquity and abundance of data make it vital in every sector, and businesses of every size increasingly depend on it. Against this backdrop, open data has the potential to create significant value for society and the economy when leveraged in partnership with the private sector. At the same time, the reuse of open data in Europe is still in its infancy and requires further research and implementation efforts to fully express its potential for public and private value creation. This paper reviews the research conducted over the past two decades on how information generated by the public sector and published in open data format can be intentionally reused by commercial and non-commercial private entities. The main aim is to identify relevant principles that can be useful in promoting the flourishing of sustainable open data ecosystems. The analysis shows how the reuse of open data can be seen as a multi-billion dollar and multi-dimensional opportunity for corporations, small and medium-sized enterprises (SMEs) and startups, with the potential to unlock value-creation processes that impact companies' balance sheets and societal well-being. Businesses that use open data in their operations can benefit from favorable economic conditions that can positively impact their profitability, once a sufficient level of competitive advantage is created. Artificial intelligence (AI) and blockchain, in fact, represent a useful technological evolution to support the sharing, reuse and monetization of open data, contributing to a smarter, safer and more automated data economy.

Keywords: business models, Artificial intelligence, technology, open data, blockchain technology.

Fig.: 4. Bibl.: 18.

Mshvidobadze Tinatin Ia. – Doctor of Sciences (Engineering), Professor, Gori State Pedagogical University (53 Ilia Chavchavadze Ave., Gori, 1400, Georgia)

E-mail: tinikomshvidobadze@gmail.com

ORCID: <https://orcid.org/0000-0003-3721-9252>

Scopus Author ID: <https://www.scopus.com/authid/detail.uri?authorid=54898057800>

Mamulashvili Leila S. – Professor, Gori State Pedagogical University (53 Ilia Chavchavadze Ave., Gori, 1400, Georgia)

E-mail: lmamulashvili@gmail.com

ORCID: <https://orcid.org/0009-0004-5338-3807>

УДК 34.004
JEL: L86; M16; M19

Мшвидобадзе Т. Я., Мамулашвілі Л. С. Бізнес-модель та аналіз відкритих даних в епоху електронної трансформації

За останнє десятиліття дані піднялися на перше місце в національних і глобальних політичних програмах, оскільки країни прагнуть розвивати свою економіку, використовувати дані для вирішення соціальних проблем і реагувати на занепокоєння громадян щодо використання та зловживань даними. Дані стали інфраструктурою, на якій будується сучасна економіка. Зростаюча повсюдність і велика кількість даних роблять їх життєво важливими в кожному секторі, і підприємства будь-якого розміру все більше залежать від них. На цьому тлі відкриті дані мають потенціал створити значну цінність для суспільства та економіки, якщо їх використовувати в партнерстві з приватним сектором. Водночас повторне використання відкритих даних у Європі все ще перебуває на початковій стадії та вимагає подальших досліджень і впроваджень, щоби повністю реалізувати свій потенціал для створення державної та приватної цінності. У цій статті розглядаються дослідження, проведені протягом останніх двох десятиліть, щодо того, як інформація, згенерована державним сектором та опублікована у форматі відкритих даних, може бути навмисно повторно використана комерційними та некомерційними приватними організаціями. Головна мета полягає у визначенні відповідних принципів, які можуть бути корисними для сприяння процвітанню стійких екосистем відкритих даних. Аналіз показує, що повторне використання відкритих даних можна розглядати як багатомільярдну та багатовимірну можливість для корпорацій, малих і середніх підприємств (МСП) та стартапів, з потенціалом для розблокування процесів створення цінності, які впливають на баланси компаній та добробут суспільства. Підприємства, які використовують відкриті дані у своїй діяльності, можуть отримати вигоду від сприятливих економічних умов, які можуть позитивно вплинути на їхню прибутковість, як тільки буде створено достатній рівень конкурентної переваги. Штучний інтелект (ШІ) та блокчейн фактично являють собою корисну технологічну еволюцію для підтримки обміну, повторного використання та монетизації відкритих даних, сприяючи розумнішій, безпечнішій та автоматизованішій економіці даних.

Ключові слова: бізнес-моделі, штучний інтелект, технології, відкриті дані, технологія блокчейн.

Рис.: 4. Бібл.: 18.

Мшвидобадзе Тінатін Ясонівна – доктор технічних наук, професор, Горійський державний педагогічний університет (просп. Іллі Чавчавадзе, 53, Горі, 1400, Грузія)

E-mail: tinikomshvidobadze@gmail.com

ORCID: <https://orcid.org/0000-0003-3721-9252>

Scopus Author ID: <https://www.scopus.com/authid/detail.uri?authorid=54898057800>

Мамулашвілі Лейла Сограбієвна – професор, Горійський державний педагогічний університет (просп. Іллі Чавчавадзе, 53, Горі, 1400, Грузія)

E-mail: lmamulashvili@gmail.com

ORCID: <https://orcid.org/0009-0004-5338-3807>

Every industry is affected by the digital transformation but no single metric is able to capture its space and extent [1]. Due to their pervasive nature, digital technologies are profoundly transforming economies and societies [2]. The innumerable ways in which the digital transformation is affecting production activities, both manufacturing and services, impede efforts to provide an all-encompassing definition of this multifaceted phenomenon [3]. Recent OECD work assesses the digital intensity of sectors by looking at the technological components of digitalization (tangible and intangible ICT investment, purchases of intermediate ICT goods and services, robots), the human capital required to embed technology in production (ICT specialist intensity), and the ways in which digital technology impacts how firm's interface with the market (online sales). While the digital transformation progressively touches all sectors in the economy [4], it does so with differing speeds and extents. Only one sector, ICT services, stands out as being the most digital-intensive, as measured by the seven different metrics of sector digital intensity [5]. European data from ICT use in business surveys, which allows a granular look at uptake of digital technologies along business value chains, shows that ICT services is the most digital-intensive sector. The presence of websites is rather high for businesses in every sector, and hence does not explain sectoral variations, while the use of Big data analytics is still in its infancy in almost all industries. What really discriminates digital intensity across sectors is the use of more sophisticated digital tools such as cloud computing, enterprise resource planning (ERP), and customer relations management (CRM).

One of the preconditions for the adoption of open data within existing or new business processes by corporate entities is the recognition of the opportunity lying behind the exploitation of such resources made available by the public sector in terms of value generation and capture. Over the last two decades, a number of scholars and professionals embarked on trying to provide an estimation of the potential value of open data, a challenging task given the cross-cutting nature and wide-ranging influence of the information released by the public sector.

A preliminary attempt to systematize the literature was conducted by the Open Data Institute [6] in 2022, and a more recent and comprehensive effort was sponsored by the European Commission and carried out by Capgemini Invent in 2020 [8]. According to the latter, findings show a narrow range of results on open data market size when converted in terms of share of gross domestic product. Applying the median share percentage (1.19%) to the estimations present in the different studies, the open data market size for the EU-27 in 2019 was reported to be EUR 184.45 billion,

with growth expectations for 2025 ranging from EUR 199.51 billion in a baseline scenario to EUR 334.2 billion in a more optimistic scenario (Fig. 1). Such projections represent an indication of the impact (EUR 134.69 billion) that policies and investments aimed at sustaining the expansion of open data reuse could attain in terms of growth potential. If compared to the data economy at large, the impact of open data plays a significant role. As a matter of fact, 12% of the value creation in the data economy is directly created by open data, and about 45% is indirectly impacted by open data, i.e. it is created by the contribution brought by open data in combination with other data sources.

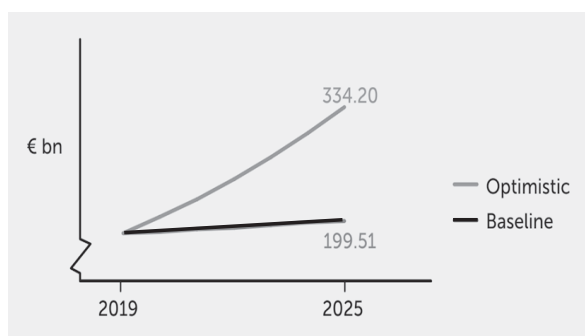


Fig. 1. Scenarios of EU open data market growth

Capgemini Invent [7] singled out two different clusters of sectors from which 15.7% of the open data growth is supposed to originate. One is a high-impact cluster including public administration; professional, scientific and technical activities; information and communication and information and communication technology; and transportation and storage. The other is a high-potential cluster containing agriculture; financial services and insurance, health, education, wholesale, retail and trade; and real estate activities. In contrast, a study conducted by McKinsey & Company [8] identified a shortlist of seven domains with a high likelihood of being significantly impacted by open data. According to the estimations provided in the study, widespread use of open data within these domains may generate an economic impact ranging from USD 3.2 to USD 5.4 trillion (Fig. 2).

Shifting the focus from the expected benefits of open data to the wider economy to the benefits it can bring to individual organizations, the main reasons for leveraging open data were found to be enhancing services, making informed decisions and increasing efficiency by optimizing business operations [9]. Depending on the levels of labor intensity, the total impact changed due to significant differences in value creation per employee across the sectors. When looking at open data value creation as a whole, opportunities might not lie only in growth due to an increase

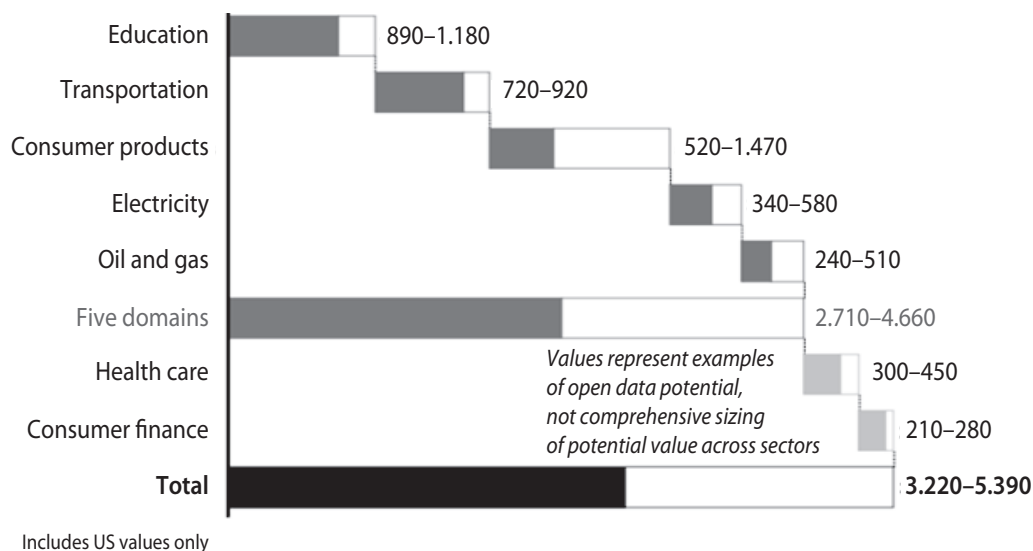


Fig. 2. Domains in which open data can help unlock economic value

in the size of the workforce, but also in the way value is and will be created in the future by leveraging the opportunities offered by new exponential technologies such as blockchain and AI.

Understanding data-driven business models framework. The discussion about which business models may be adopted in the exploitation of open data mainly applies to private organizations, as they are more challenged by finding financial sustainability while leveraging a public good. It is important to underline that the discussion does not merely offer an account of the activities conducted or the position covered in the value chain. As a matter of fact, to provide actionable insights to a would-be open data entrepreneur, it is essential to depict the key pillars of the value architecture through which an organization creates, delivers and appropriates value [10].

As highlighted in Fig. 3, in the case of PSI reuse, the epicenter of the business model lies in a public resource (i.e. one or many datasets) which is accessible by everyone when released in accordance with the open data paradigm (i.e. without technical, legal and price barriers). Subsequently, such a raw resource is elaborated in order to become an enterprise-specific asset that distinguishes the respective owner from the rest of the world. Such processed data is an ingredient of the value proposition that the enterprise offers to the market.

In return for such a value, customers generate revenues for the enterprise through alternative forms of payment. The process of transformation of open data from a public resource to an enterprise-specific resource may leverage the combination of PSI with a number of other items coming from a data spectrum [11] that may present great differences in terms

of size (small, medium, big), origin (personal, commercial, governmental), accessibility (internal access, named access, group-based access, public access) and reusability (copyrighted, Creative Commons, public domain). When it comes to designing the business model for a new venture or business line relying on open data, three key design choices need to be made. The first decision has to do with the types of elaborations employed to turn data into relevant knowledge, which may include data aggregation, structuring and classification, geo-referencing, validation, creation of data mash-ups and visual analytics or training of AI algorithms. The second relevant decision is to define the role of open data in the value proposition that will be offered to the market.

Open Data Archetypes and Business Models. Although the Business Model Canvas is widely used in the analysis of business models and open data, a certain level of heterogeneity in the presentation of results can be observed in the literature. Below is a collection of the main business models identified, along with a brief description of each.

Freemium. A business model that relies on giving away a core product/service for free and selling a premium product/service. With technology improvements, the marginal cost of some products becomes very low, which enables its distribution for free.

Open source. A business model using open source offers source code that can be publicly accessed, edited and distributed. This framework enables businesses to use their source code for free but charge on an 'added-value' basis and through dual licensing.

Infrastructure razors and blades. The idea is to sell an initial product at an attractive price or give it out for free (razor), which later encourages users to follow up by purchasing further products or services

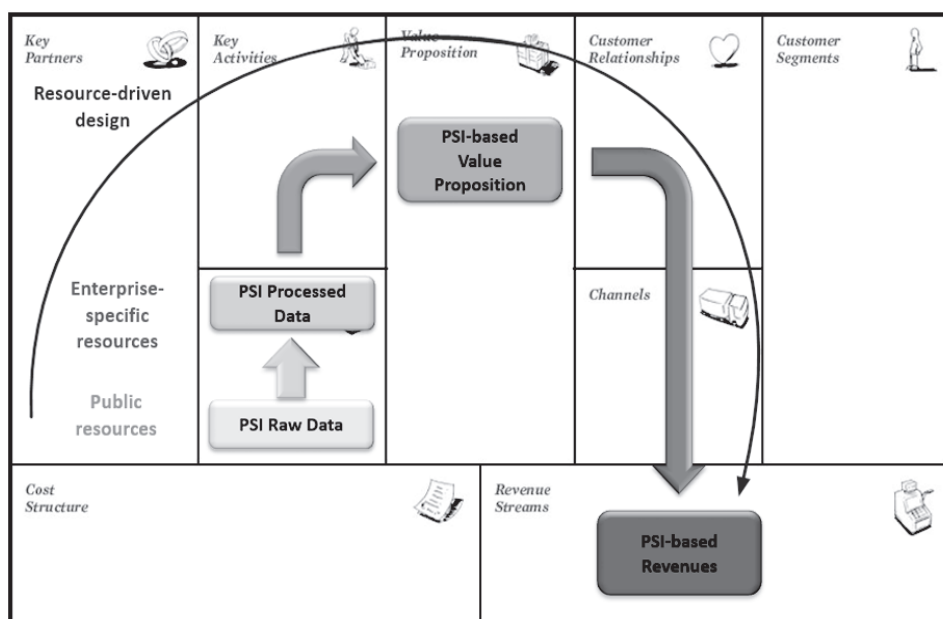


Fig. 3. Framework for open data business model analysis

(blades). In this model, the products (blades) are usually classified as inelastic, i.e. unaffected by changes in income or price. This creates a high margin and makes the business profitable.

Demand-oriented platforms. This model offers customised open datasets. The business charges its customers for the added value built into the original raw open data through aggregation, curation and enrichment activities that allow aligning the final output with the client's most pressing needs. Supply-oriented platforms. The concept of this business model is to manage, store and maintain data for any data holder. Its revenue model is based on a monthly fee that customers pay in order to get their data maintained, saved and easily accessible. Free, as branded advertising. This model is about leading customers towards a brand or company by enhancing their visibility with open data. The service provider helps brands make their data accessible, which can be seen as a marketing cost

Sponsorships. The sponsorship business model lies in giving away a product for free while receiving money from sponsors. The business obtains revenue from organizations that believe a specific dataset should be accessible to the public.

Supporting primary business. This model may be used when releasing open data naturally supports the primary business goal of the organization. For example, it may be applied to bicycle-hiring services offered as part of corporate social responsibility activities, where releasing open data about the bikes drives the development of apps that, by combining it with PSI, make it easier for potential customers to use the scheme, thus bringing in revenue to the core business. As it is possible to notice, a number of common traits

are present among some of the business models presented above.

Artificial intelligence and open data. The advent of AI has had a transformative impact on various sectors of the economy, including the public sector and the data ecosystem. Examples of AI applications span across sectors such as climate, manufacturing, mobility and health, with the potential to generate significant benefits for the European society and economy. Not surprisingly, a growing number of AI companies have emerged and AI technologies have penetrated into almost every crevice of the economy.

Taking an evolutionary perspective, AI may be said to come in three generations [12]. The first one is able to automate processes that are routine and do not change over time. The second generation of AI is able to adapt to and learn from changes in the automated process, while the third generation proactively provides new and innovative insights by being able to analyse and learn from its previous actions. Currently, this third generation of fact, open data and AI have the potential to support and enhance each other's capabilities in a mutually reinforcing. On the one hand, open data can improve AI systems. In general, exposing AI systems to a larger volume and variety of data increases the chance of the system returning accurate and useful predictions. As such, open data can be a supply of large amounts of diverse information for AI systems. In this way, the availability of open data contributes to better performing AI. Open data contains rich information and complex patterns from which insights can be derived. As a powerful analysis tool, AI can thereby leverage the value of open data.

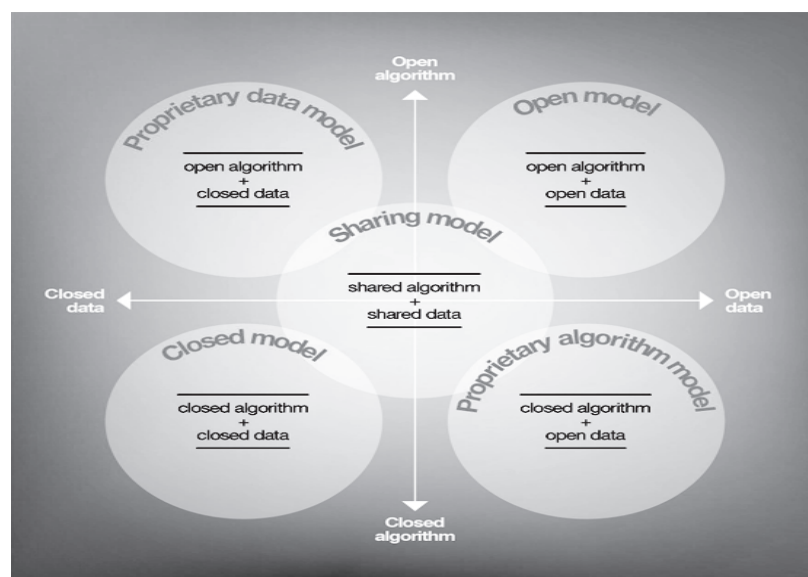


Fig. 4. The AI business model matrix

Artificial intelligence (AI) is permeating all sectors of the economy. However, little is known about the specific types of AI technologies and approaches being used in each sector, or the purposes for which they are being developed. In 2013, there were about 6 000 AI-related companies in the United Kingdom alone, according to data from Glass AI, a company that interprets open web text (i.e. sentences and paragraphs) at scale. About 2 800 of these companies make explicit mention of AI activities on their website. These companies appear to combine different AI-related technologies and approaches, depending on their field of application or area of activity. For instance, about 400 companies focus on deep learning, and rely on automation-related technologies and, to a lesser extent, data analytics. About 300 companies currently advancing the use of AI in robotics, the Internet of Things (IoT) and virtual reality (VR) are concentrating on automation and, to a lesser extent, natural language processing. About 250 AI companies are directing their attention to analytics coupled with recognition-related technologies with a view to developing e-commerce-related AI technologies. A similar number of companies rely on different combinations of the same technologies for data mining and business solution-related developments.

AI companies in key sectors Companies engaging in AI-related activities belong to a wide range of sectors. More insights about the types of AI technologies that these companies are developing and applying can be gained by focusing on a few key sectors of the UK economy. In particular, Financial services, Professional services, and ICT manufacturing and service activities accounted for 22.7% of total employment (7.3 million persons, up from 6.0 million in 2010) and

for 53% of investment (i.e. gross fixed capital formation, GFCF) in ICT equipment in 2017. Of the 2 800 UK companies in the Glass AI sample which stated that they were actively pursuing AI-related activities, 829 appear to operate in ICT manufacturing and services activities, 693 in Professional services activities and 162 in Financial and insurance activities, representing 60% of the sample. The other 40% is distributed across ten sectors ranging from agriculture to real estate and construction. Some of these companies are developing and using several types of AI-related technologies, whereas others appear to be focused on a specific area. In addition, different technologies appear to be developed to relatively different extents. UK AI-active companies in ICT manufacturing and services are focusing their efforts on technologies related to language processing, business solutions, and deep learning. Companies in Professional services are especially concerned with language processing, image recognition and robotics, Internet of Things (IoT), and virtual reality-related technologies.

Transforming production Robots. Advances in fields such as Big data, 3D printing, machine – to machine communication, and robots are transforming production. Comparable and representative data on the deployment of industrial robots in 2022 show that Korea and Japan lead in terms of robot density in manufacturing (i.e. the stock of robots relative to employment). Robot density in these economies is about three times that of the average OECD country. The average density in BRIICS (Brazil, the Russian Federation, India, Indonesia, China and South Africa) is significantly lower, but has increased at twice the pace of the average of the top 25 economies between 2010 and 2022. Sales of service robots are also on the rise.

In 2023, the International Federation of Robotics (IFR) identified more than 700 service robot manufacturers, both for professional and personal use [13]. For the first time, statistics on the use of both industrial and service robots, and of 3D printing have been collected within European surveys of business ICT usage. In 2023, on average, 7% of respondent enterprises with more than ten employees were deploying robots, and 4% used 3D printing. The highest penetration rates are observed in manufacturing of metal products, chemical products and machinery.

Blockchain and Open Data. Blockchain technology has the potential to revolutionize the way data is managed, shared, and reused across a variety of sectors, including the public sector.

Digital currency/payments, land registration, identity management, notarization, supply chain traceability, healthcare, education, corporate registration, data management, auditing, energy markets, taxation, voting systems, and legal entity management are some of the areas where blockchain is currently being tested for public services [14]. Blockchain technology is now expanding beyond financial applications to include sustainability, transparency, traceability, and empowerment. As the Organisation for Economic Co-operation and Development has noted, blockchain technologies can also contribute to more convenient public services, improved transparency and the eradication of corruption.

The most notable initiative launched by the Commission in this area is the European Blockchain Services Infrastructure, a collaborative effort for decentralized governance consisting of a peer-to-peer network of interconnected nodes that manage a blockchain-based services infrastructure. It allows public organisations to develop applications that connect to and use a common infrastructure across Europe, which will eventually be extended to private organisations.

Blockchain technology should respect and enhance Europe's evolving digital Identity framework. This includes compatibility with e-signature regulations such as eIDAS, and supporting a sensible, pragmatic decentralised and self-sovereign identity framework.

- ✦ *Cybersecurity.* Blockchain technology should be able to provide high levels of cybersecurity.
- ✦ *Interoperability.* Blockchains should be interoperable between themselves and legacy systems in the outside world. Looking now at blockchain-related private ventures, a survey of 80 start-ups analysed their business models in an attempt to clarify the main pillars of their value proposition and the benefits that may stem from them.

As in the case of most innovations relying on information and communication technologies, one major benefit offered by blockchain applications is represented by the reduction of transaction costs which result from uncertainty or unforeseen contingencies and from writing and enforcing contracts [15]. It is possible to distinguish between three core benefits of blockchain with regard to transaction cost reduction (security by design, auditability and smart contracts). Blockchains are secure by design, as the decentralised ledger renders entries tamper-proof. For example, start-ups operating in the field of government registry services, voting and house access solutions benefit from this feature. Instead, auditability refers to the transparency afforded by blockchain's ability to review past entries and a token's history. This feature is primarily exploited by start-ups in the areas of donation tracking, pharmaceutical authentication, voting and logistics. Finally, smart contracts reduce transaction costs because expenses for writing and enforcing contracts are significantly lowered. Smart contracts are particularly effective in lowering transaction costs when transactions are highly standardised and occur frequently, as in the energy sector, or when they occur between parties otherwise unknown to each other, as in ride-sharing or real estate funding. With respect to access to the market, digital technologies promoted a shift towards direct company–customer interaction throughout industries [16].

CONCLUSIONS

Open data is a source of power. It can and must be deployed for the public good, as a resource for tackling social challenges, enabling collaboration, driving innovation and improving accountability [17]. As an international community, we have to recognise that top-down pressure from policy alone is unlikely to improve the state of ecological data availability and accessibility [18]. A collaborative effort is thus required to harness the entrepreneurial spirit of new generations of innovators and the strength of established corporations. The analysis presented in this discussion paper shows how open data reuse may be regarded to be a multi-billion and multi-dimensional opportunity for European corporations, SMEs and start-ups, with the potential to unlock value-generation processes impacting top and bottom lines of companies' balance sheets and the well-being of society at large. Businesses making use of open data can benefit from favourable economics that may exert a positive impact on their profitability once a sufficient level of competitive advantage is generated. Sources of competitive advantage may vary depending on the type of barriers encountered in the processes of data acquisition and analysis and can come from the combination of open data with company-specific assets (skills, data, re-

lationships, etc.) or the adoption of innovative business models relying on emerging technologies. AI and blockchain, in fact, represent useful technological evolutions in supporting the sharing, reuse and monetisation of open data, contributing to a smarter, more secure and automated data economy. ■

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УДК 005.591.6:614.2:004.9

JEL: I15; M13; O33

DOI: <https://doi.org/10.32983/2222-4459-2025-7-81-89>

ФОРМУВАННЯ СМАРТ-СТРАТЕГІЇ РОЗВИТКУ СТАРТАПІВ У СФЕРІ ЦИФРОВОЇ ОХОРОНИ ЗДОРОВ'Я В УМОВАХ ЦИФРОВІЗАЦІЇ

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УДК 005.591.6:614.2:004.9

JEL: I15; M13; O33

Самусь П. О. Формування смарт-стратегії розвитку стартапів у сфері цифрової охорони здоров'я в умовах цифровізації

У статті досліджено теоретико-методологічні засади формування SMART-стратегії розвитку стартапів у сфері цифрової охорони здоров'я в умовах активної цифровізації галузі. Під впливом трансформацій, спричинених впровадженням електронних медичних сервісів, інтернету медичних речей (IoMT), телемедицини та штучного інтелекту, зростає роль стартапів як провідників інноваційних рішень у медичному середовищі. Автором обґрунтовано необхідність чіткого стратегічного підходу до розвитку таких проєктів, оскільки за відсутності ефективної стратегії більшість стартапів стикаються з труднощами масштабування, інституційних бар'єрів та обмеженості ресурсів. У дослідженні виділено структурні компоненти SMART-стратегії (конкретність, вимірюваність, досяжність, релевантність, обмеженість у часі), адаптовані до умов цифрової медицини. До ключових переваг впровадження принципів SMART у сфері цифрової охорони здоров'я автором виокремлено формування прозорих і зрозумілих цілей, що сприяє підвищенню довіри з боку інвесторів, партнерів і стейкхолдерів; гнучкість і адаптивність стратегії, що дозволяє швидко реагувати на загрози кібербезпеки та зміни в цифровому середовищі; покращення взаємодії всередині команди та посилення позицій стартапу на ринку через цілеспрямованість і конкурентоспроможність технологічних рішень. Особлива увага приділена етапу аналізу ринку та ідентифікації потреб, що включає вивчення нормативного середовища, оцінку технологічних трендів, сегментацію цільової аудиторії та аналіз конкурентного ландшафту. Розглянуто ключові чинники успіху медичних стартапів, зокрема здатність до інтеграції в державну систему eHealth, дотримання стандартів кібербезпеки та орієнтація на користувацький досвід. На основі синтезу міжнародного та вітчизняного досвіду автором сформовано модель розробки смарт-стратегії, що передбачає поетапне впровадження інноваційного продукту, використання гнучких бізнес-моделей, активну взаємодію з медичними установами та постійне коригування стратегічного курсу на основі даних. У статті запропоновано практичний інструментарій для стратегічного планування в галузі цифрової охорони здоров'я, що може бути використаний як підприємцями, так і політиками, які працюють у сфері розвитку eHealth-екосистеми.

Ключові слова: SMART-стратегія, цифрова охорона здоров'я, медичні стартапи, eHealth, телемедицина, кібербезпека, інноваційні технології, стратегічне планування, цифровізація медицини.

Рис.: 3. **Бібл.:** 11.

Самусь Павло Олегович – аспірант кафедри підприємництва, торгівлі та логістики, Національний технічний університет «Харківський політехнічний інститут» (вул. Кирпичова, 2, Харків, 61002, Україна)

E-mail: pavlo.samus@emmb.khpi.edu.ua

ORCID: <https://orcid.org/0000-0002-8563-2650>

Scopus Author ID: <https://www.scopus.com/authid/detail.uri?authorid=59951710100>