The object of the research is a holistic economic evaluation system of R&D results under the circular economy conditions. The system is based on the example of an innovative product – a three-wheeled electric scooter for disabled people, developed by specialists of the Lviv Polytechnic National University (Ukraine). For this purpose, the prospects and problems of the market of the analyzed product in the context of circular economy development are studied and its market place is determined. The price indicators of the R&D result are substantiated based on the aggregation of cost, competitive and income methodological components of the holistic evaluation system, taking into account the provisions of the circular economy. Financial indicators of the project for implementing the R&D result based on the proposed holistic evaluation system are formed. The applied value of the developed holistic evaluation system is to provide the evaluator (developer, consumer, investor) with a range of price indicator values, among which one can choose the necessary, based on contractual conditions, market changes, etc. Unlike the existing methodological developments in the field of pricing for R&D results, the proposed holistic system makes it possible to aggregate the current evaluation approaches. Such aggregation is based on determining and choosing the optimum product price from a set of possible (suitable for the corresponding product, market, business, etc.). The system provides comprehensive economic evaluation, creates the basis for developing flexible management solutions and effective forecasting under the circular economy conditions

Keywords: holistic evaluation system, R&D result, circular economy, research and development

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THE HOLISTIC EVALUATION SYSTEM OF R&D RESULTS UNDER THE CIRCULAR ECONOMY CONDITIONS

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1. Introduction

A significant increase in the rate and uneven distribution of production and consumption by the world's population against the background of resource and energy saving problems actualized the need for countries to review the principles of economic development, in particular, determined the transition from a linear to a circular economy model. This model is based on the concept of choice: the use of fossil fuels in favor of renewable energy sources, the creation of added value through intellectualization, rational resource consumption, etc. Circular economy (CE) is defined by a closed loop: the outputs of product development from one chain become inputs for another. This approach reduces the dependence of producers on new raw materials and minimizes the negative human impact on the environment in the overall value chain.

In the regulatory plane, a significant number of documents have been developed in the world that regulate the implementation of CE, both at the macro and micro levels. In particular, "Circular Economy Action Plan" [1], which is an important component of the "European Green Deal" strategy [2], "A new Circular Economy Action Plan for a cleaner and more competitive Europe" [3], "United Nations Strategic Plan for Forests 2017–2030" [4], as well as a number of Ukrainian documents [5–7].

Despite the above documents, as well as numerous documents developed in each country, many problems arise when adhering to the principles of a closed-loop economy at the enterprise level. First of all, they are associated with excessive production and consumption. According to IPBES [8], only a quarter of the Earth's territory is actually unaffected by human activity. This number is expected to drop to one-tenth by 2050. One of the reasons for difficulties in establishing positive human-environment interaction is the low efficiency in implementing current regulatory documents or the lack of necessary methodological tools for their implementation.

The problem of omitting many elements of the CE model implementation is of particular importance in the field of research and development (R&D) results. Many manufacturers of innovative products face the task of reducing the level of energy and resource consumption even at the stage of their development, as well as developing eco-friendly environmental conditions for R&D results. However, such business entities are mostly not provided with sufficient methodological materials. Existing documents of the subject area are fragmentary, mainly taking into account point elements of production processes in the context of CE. There

are no holistic methodical developments that would contribute to a comprehensive evaluation of R&D results based on the principles of a closed-loop economy. Therefore, methods are needed that would allow taking into account unreasonable resource losses and considering alternative production options at the stage of planning and modeling the market launch of an innovative product.

2. Literature review and problem statement

There are more and more research works on CE and sustainable development in the world. For the most part, this issue is considered in a global context. In particular, scientists substantiate approaches to the interaction of CE and the Industry 4.0 concept [9], as well as a number of methods for ensuring sustainable development goals [10]. The relationship between CE and the principles of conducting a sustainable business in the context of digitalization is described in [11]. However, the authors of these works do not consider industry specifics that should be taken into account during the economic evaluation of R&D results on the basis of CE. This industry aspect is partially shown in the study [12], which provides a roadmap for industrial enterprises to use biotechnologies based on the CE concept. Fragmentary, industry features are outlined in [13], where drivers and barriers of CE business models are specifically indicated, which can serve as a valuable resource for forming a methodology for analyzing R&D results.

CE implementation has been considered by scientists in the context of certain industries and spheres of activity. For example, the work [14] identified critical factors for stimulating CE provisions in the field of waste disposal. The paper [15] sets out the principles of integration of the green economy, CE and bioeconomy into a strategic sustainable development system, and the work [16] describes various aspects of CE implementation. The work [17] substantiates the problems of ensuring conditions for sustainable energy-saving economic development of enterprises. The study of the mentioned developments makes it possible to take into account individual industry characteristics of products that are necessary for their cost assessment, but the above works do not cover methodological elements for implementing it.

It is important to consider the achievements of scientists in the subject area from the standpoint of business efficiency. In particular, the original author's approaches to the development of business models taking into account CE are presented in [18]. Innovative concepts regarding the understanding of the implementation of R&D results by business entities under the CE conditions for the markets of individual countries are described in [19]. The work [20] highlights models of innovative technology management in a digital economy, and in [21], applied cases of digital technologies acting as catalysts of innovative business models for CE are presented. However, the authors of these works do not pay attention to methodological tools for promoting R&D results to world markets. Modern methods and models for evaluating R&D results should be aimed at implementing CE: this allows complying with sustainable development principles in practice, saving resources and energy, etc.

Some scientifically original methodological elements for evaluating phenomena and processes based on CE are presented in [22–26]. In particular, the work [22] substantiates the criteria, indicators and factors of sustainable energy-saving economic development, the work [23] presents models for estimating the cost of R&D products of industrial enterprises, and [24] reveals aspects of holistic analysis of R&D results as a basis for CE. Innovative approaches in the field of business intelligence and modeling based on the provisions of CE should be noted [25]. A holistic approach to evaluating R&D products for commercialization within open innovation is proposed in [26]. However, the methodological tools in these works are described fragmentary. These and other existing developments are mainly devoted to working out management levers for ensuring the CE concept. There are almost no research papers, methodologies of the subject area, which would give a set of methods and techniques for evaluating R&D results from the specified perspectives.

An insufficient number of methodological developments on economic assessment and substantiation of the impact of factors that can increase or reduce the negative consequences of business processes slows down the pace of implementing CE principles in the field of R&D results. Therefore, it is advisable to develop an evaluation system that would ensure the effective implementation of all R&D stages based on a closed-loop economy.

3. The aim and objectives of the study

The aim of the study is to develop a holistic system of economic evaluation of R&D results under the CE conditions. Such a system will make it possible to substantiate energy and resource costs at the stage of developing R&D results from the standpoint of CE, provide eco-friendly environmental conditions, plan eco-centered business processes, etc.

To achieve the aim, the following objectives were set:

– to study the prospects and problems of the market of electric scooters (in particular, for disabled people) in the context of CE development, determine the place of this innovative product in the market;

– to substantiate price indicators of the R&D result based on the aggregation of the cost, competitive and income methodological components of the holistic evaluation system, taking into account the provisions of CE;

– to generate financial indicators for the project of implementing the R&D result based on the proposed holistic evaluation system.

4. Materials and methods

The object of the research is a holistic system of economic evaluation of R&D results under the CE conditions. To develop such a system, the following hypotheses were formed:

– hypothesis 1: the holistic evaluation system is universal for all types of R&D results, based on taking into account the principles of the CE model;

– hypothesis 2: the holistic evaluation system is suitable for all market conditions and can be applied to different forecasting time periods.

The tasks set in the work were studied on the example of the R&D result – a three-wheeled electric scooter for disabled people, developed by specialists of the Lviv Polytechnic National University (Lviv, Ukraine). Unlike those existing on the market, the analyzed three-wheeled electric scooter is characterized by improved technical and economic parameters. In particular, regarding ground clearance and

wheelbase length, ergonomics of modular design, smooth and maneuverable driving both in the city and off-road, the ability to withstand significant loads – 200–250 kg, etc. The electric scooter is equipped with sensors that help the driver avoid accidental collisions with other road users.

The described product is determined by structural elements based on the CE principles: a lithium-ferrum-polymer battery, which is much more environmentally friendly and energy-efficient than other types on the market (nickel-metal hydride, lead-acid, nickel-cadmium, nickel-zinc, etc. [27, 28]). The battery (48v30A) of the proposed electric scooter has significant advantages in charge-discharge efficiency, high charge density, and light weight. The box designed for the electric scooter prevents liquid ingress into the battery and electronics department. The patented fire extinguishing system protects the product in 80 % of cases.

A holistic evaluation system should be based on a combination of methodological components: cost, competitive, and income.

5. Results of developing a holistic evaluation system of R&D results

5. 1. Research of prospects and problems of the electric scooter market in the context of circular economy development

Based on research published by the *Statista* international organization [29], the US and European electric scooter markets are expected to reach 12 billion US dollars in 2023, and the Chinese market will reach 6 billion US dollars. Globally, the electric scooter market will reach about 32 billion US dollars by 2029. The size of the global electric scooter market in 2020 was estimated at 2.5 billion US dollars, and, according to forecasts [27], from 2021 to 2028, it will grow with a CAGR of 10.3 %.

Countries such as France, Spain, Germany and the USA have seen significant growth in the use of electric scooters over the past five years, in various segments of the population. This trend is expected to continue over the next decade. The global profit dynamics of the electric scooter business (2017–2026) is shown in Fig. 1.

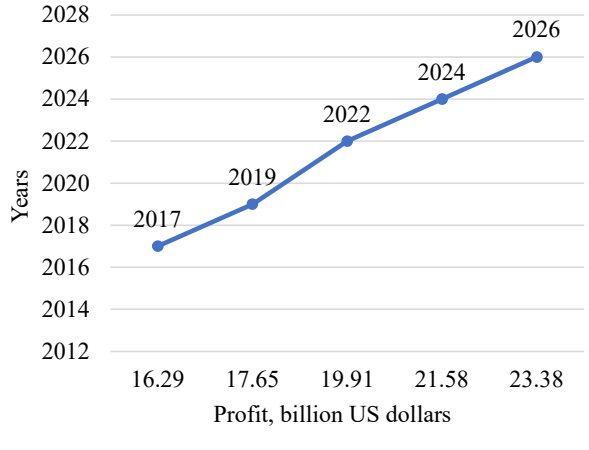

Fig. 1. Global profit dynamics of the electric scooter business, 2017–2026, billion US dollars [28]

Over the past 3–5 years, the portability of electric scooters has increased, and new approaches to their use for different age groups, in particular disabled people have emerged. The positive effect of increasing electric scooter market is important in terms of the projected growth in the number of disabled people in the world, 2016–2027.

According to the State Statistics Service of Ukraine [30], as of January 1, 2021, there are 2 million 703 thousand disabled people in the country, including 163.9 thousand children. Among them 222.3 thousand disabled people of the first group, 900.8 thousand of the second group, 1 million 416 thousand of the third group, a significant part of whom can move independently if there are appropriate conditions and transport support. Given the long-term armed conflict in Ukraine, it is logical to assume that the above indicators may continue to increase. At the beginning of 2023, the number of disabled people is already more than 6 % of the total population of the state. However, due to the unsuitability of electric scooters for disabled people, they are still not popular among them.

In terms of implementing the CE model, the participation of vehicle manufacturers and governments around the world in complying with zero-emission standards has greatly contributed to reducing carbon emissions by 2021. Governments are working to form policies aimed at driving the spread of micromobility products, in particular, electric scooters, offering various benefits to consumers, as well as manufacturers in the form of subsidies. Because electric scooters are battery-powered, they do not contribute to direct carbon or greenhouse gas emissions. Rising investments in clean energy and government initiatives to reduce CO_2 emissions are expected to boost demand for electric scooters. As regulatory authorities are focused on developing the concept of smart cities, electric scooters are expected to become increasingly popular, especially in the segment of disabled people.

5. 2. Substantiation of price indicators of the R&D result on the basis of a holistic evaluation system

From an economic point of view, one of the main methodological components of evaluating an innovative product for deciding on its production or commercialization on the basis of circular economic development is pricing. Based on the indicators of the price components, it is possible to reflect and assess the influence of factors caused by compliance or non-compliance with the principles of CE. Such price components can be formed using various pricing methods. In particular, some of the pricing methods from the group of the competitive methodological approach take into account the influence of CE elements in the price of the R&D result based on a comparison with competitive analogs. Methods from the group of the income methodological approach take into account the principles of CE in the time period. Methods of the cost approach give a general vision of price indicators, which can be the basis for applying methods from other approaches, comparing prices and deciding on the base price for a given R&D result.

In order to develop effective methodological tools for the economic evaluation of R&D results under the CE conditions, it is advisable to consider pricing as a holistic evaluation system. Such a system combines the use of specially selected methods from different methodological approaches and creates the basis for determining the market place of the obtained price, its compliance with the tasks set by the enterprise.

The definition of the cost component of the holistic evaluation system is considered. In order to form the price for a

three-wheeled electric scooter for disabled people, a list of direct costs incurred by developers and underlying this device was formed. In particular, such costs include: motor and conventional wheels, computer monitor, compressor, hydraulic disc brakes, battery extinguishing system, and other components, as well as consumables and turning operations. The costs of work/services performed by third-party business entities: development of feasibility studies, specifications and technical documentation, certification, production of a prototype, factory tests, etc. should also be taken into account.

The price structure (P_{costs}) for a three-wheeled electric scooter for disabled people formed by the "cost+" method (one of the most suitable among the methods of the cost approach) is shown in Table 1.

Table 1

Pricing for a three-wheeled electric scooter for disabled people

No.	Indicator, thousand UAH*	Value
1	Direct costs	64.1
1.1	Raw materials and supplies	23.14
1.2	Recyclables (subtracted)	–
1.3	Purchased products, semi-finished products and production services of third-party organizations	11.2
1.4	Fuel and energy for technological purposes	2.9
1.5	Wages of production workers	19.7
1.6	Benefits-related deduction	7.16
1.7	Reject losses	–
2	Indirect costs	27.34
2.1	Overheads	17.18
2.2	General administrative expenses	5.14
2.3	Other production costs	5.02
2.4	Selling costs	–
3	Cost	91.44
4	Profit	29.8
5	Price (P_{costs})	121.24

*Note: * – the values correspond to the NBU exchange rate at the time of the study: 36.03 UAH/USD.*

The break-even level (*bl*, units) of the analyzed electric scooter can be determined by the expression:

$$bl = \frac{f_c}{\left(S_p - vc\right)} = \frac{f_c}{P_u}, \quad (1)$$

where f_c is fixed costs (total), thousand UAH; vc is variable costs per unit of all products, thousand UAH; S_p is the sale price (units), thousand UAH; P_u is the profit from a unit of product, excluding fixed costs, thousand UAH.

Thus, for 121.24 thousand UAH, where direct costs are 64.1 thousand UAH, the break-even level is:

$$bl = \frac{27.34}{\left(29.8 - 27.34\right)} = 11.113 \approx 11 \text{ units}. \quad (2)$$

The "cost+" method is considered reasonable, since it takes into account all costs incurred and reflects the break-even level of the product. However, this method does not take into account market supply and demand, and, accordingly, does not give a holistic picture of the elements taken into account based on the CE model. The method can be used as a basis for pricing, but it should be supplemented with an assessment of market factors (competitive methodological approach) and forecast data on product development, market research or consumer survey (income methodological approach).

The competitive component of the holistic evaluation system is considered, which makes it possible to identify not only the competitive aspects of the analyzed products, but also to evaluate the consideration of CE conditions in them. An innovative product is compared with market analogs, in whole or by individual characteristics. Based on such a comparison, the main features are identified that determine the competitive position of the proposed R&D result in the market.

In particular, the key players in the micromobility market are: Yadea Technology Group Co., Ltd.; Xiaomi; Segway Inc.; Gogoro Inc.; Ampere Vehicles Pvt Ltd.; Air wheel Holding Limited; Yamaha Motor Co., Ltd.; Accell Group; AIMA Technology Group Co., Ltd.; Energica Motor Company S.p.A.; Govecs Group; Hero Eco Vehicles Pvt Ltd.; KTM AG; Mahindra GenZe; Shandong Incalcu Electric Vehicle Co., Ltd.; Sunra; Dongguan Tailing Electric Vehicle Co., Ltd.; Terra Motors; Piaggio Group; BMW Motorrad International; Zero Motorcycles; Vmoto Limited; Emflux Motors; Gogoro Inc.; Jiangsu Xinri Electric Vehicle Co., Ltd., etc.

To evaluate the author's electric scooter for disabled people, several features were allocated that distinguish it among competitors:

– overall height (over 23 cm), wheelbase length (over 80 cm);

– modular design, availability/possibility of removing the seat;

– smooth and maneuverable driving both in the city and off-road;

– protection system against liquid ingress into the battery, electronics department, etc.;

– power plant capacity;

– battery type;

– fire extinguishing system, etc.

All the selected functions contain elements dictated by the performance of the CE model.

To determine the competitive price of a three-wheeled electric scooter for disabled people, taking into account the above features, a number of manufacturers in the electric scooter market are analyzed using the competitive methodological approach.

In order to evaluate the R&D results by the competitive methodological approach, the matrix method was chosen, as it most accurately reflects the level of accounting for features in the prices of competitive products. To apply the matrix method, a gradation of quality estimates of signs of influence on product pricing has been developed: the weakest influence – 1.0–1.9; moderate – 2.0–3.9; medium – 4.0–5.9; significant – 6.0–7.9; strong – 8.0–9.9.

The selected analog objects meet the following condition: their number must be one more than the number of adjustment factors. These elements are taken into account when generating initial data in Table 2, which shows the evaluation results and prices of competitive products for the author's electric scooter in the Ukrainian market. 17 specialists of the subject area took part as experts, whose judgment consistency is 96.02 %. The obtained estimates are reduced by the arithmetic mean method to the group mean and weighed by a number of weighting factors.

Comparison of competitive analogs based on the data from Table 2 is expedient to implement by the expression [17]:

$$Pr_{int} = Pr_a + \sum_{j=1}^{m} \Delta Pr_{aj}, \quad (3)$$

where Pr_{int} is the price of the author's R&D result, mon. un.; Pr_a is the selling price of a competitive analog, mon. un.; m is the number of compared features; ΔPr_{aj} is the adjustment in the selling price (+, –) of a competitive analog by the j-th comparison feature. In a formalized form, it is advisable to present such a comparison as a system of linear equations, which, for ease of solution, are presented in the matrix expression: $\Delta XPr' = Pr$.

Based on the above expression, the matrices ΔX and Pr are compiled to determine the market price for a three-wheeled electric scooter for disabled people. The results of calculating the matrix ΔX^{-1} inverse to ΔX using the MATLAB software package are:

$$\Delta X^{-1} = \begin{Bmatrix} 1.2867 & 0.2840 & -0.1839 & -0.7382 & 0.8734 & -1.4892 & -2.6334 & 1.0385 \\ 0.3345 & 0.6129 & -0.8328 & -0.6348 & 0.6598 & -0.3285 & 0.1274 & -0.1270 \\ -0.6783 & -0.5496 & 0.9320 & 0.5283 & -0.4328 & 0.0037 & -0.2747 & 0.9528 \\ -0.9342 & -0.2840 & -0.1627 & 0.5982 & 1.0092 & 0.5632 & 0.5553 & -0.0328 \\ 0.7891 & -0.1739 & 0.5591 & -0.3253 & 0.1326 & -0.4887 & -0.0132 & 0.6328 \\ 0.2169 & -0.7395 & 0.3628 & -0.6165 & 0.4876 & 2.3426 & 0.7435 & 0.4852 \\ -0.2137 & 0.6752 & -0.1173 & 0.4233 & -0.7234 & -0.7165 & -0.1234 & 0.1743 \\ -0.6295 & 0.8891 & 0.4396 & -0.6675 & -0.7765 & -0.0098 & 0.9824 & -0.2651 \end{Bmatrix}. \quad (4)$$

Using the obtained results, we calculated the elements of Pr':

$$Pr' = \begin{Bmatrix} Pr_{int} \\ \Delta Pr_1 \\ \Delta Pr_2 \\ \Delta Pr_3 \\ \Delta Pr_4 \\ \Delta Pr_5 \\ \Delta Pr_6 \\ \Delta Pr_7 \end{Bmatrix} = \begin{Bmatrix} 123.87 \\ -2.6180 \\ 12.8977 \\ -1.9932 \\ 2.0653 \\ -13.8324 \\ 6.4478 \\ 4.9941 \end{Bmatrix}. \quad (5)$$

Pr_{int} is the average market price of a three-wheeled electric scooter for disabled people. The results of calculations show that taking into account the allocated competitive features, their aggregation on the basis of matrix formalization, it is advisable to set the price for the analyzed electric scooter at the level of 123.87 thousand UAH on the Ukrainian market.

The resulting price takes into account the specifics of the market in the analyzed time period. Other elements of the matrix (5) reflect the price adjustment of the device, in accordance with the defined economic content of the influence feature (Table 2). In particular, the level of the indicator:

– the design of the ground clearance height has a downward character (the price is reduced by 2.61 thousand UAH);

– the modularity of the electric scooter design tends to increase (the price is increased by 12.34 thousand UAH);

– the design of the protection system against liquid ingress into the battery, electronics department has a downward character (the price is reduced by 1.99 thousand UAH);

– the smooth and maneuverable driving both in the city and off-road tends to increase (the price is increased by 2.07 thousand UAH);

– the power plant capacity has a downward character (the price is reduced by 13.83 thousand UAH);

– the battery tends to increase (the price increased by 6.44 thousand UAH);

– the design of the fire extinguishing system tends to increase (the price is increased by 4.99 thousand UAH).

The advantage of the above method from the group of the competitive methodological approach is flexibility in forming the resulting indicators, while the disadvantage is the subjective opinion of evaluators.

Table 2

Evaluation results and market prices for competitive analogs of a three-wheeled electric scooter for disabled people (Ukraine)

Feature	Enterprise/estimate, points								
	Yadea Technology Group Co., Ltd.	Xiaomi	Yamaha Motor Co., Ltd.	Ampere Vehicles Pvt Ltd.	Shandong Incalcu Electric Vehicle Co.	AIMA Technology Group Co.	Govecs Group	Vmoto Limited	Author's electric scooter
Optimum ground clearance height and wheelbase length	9.2	6.9	8.0	8.1	8.3	7.3	8.1	8.9	8.3
Modular design, availability/ possibility of removing the seat	8.6	5.2	6.9	4.7	9.2	7.4	6.1	7.8	7.2
Protection system against liquid ingress into the battery, electronics department, etc.	5.1	6.1	5.2	5.9	7.1	7.6	6.3	7.8	8.1
Smooth and maneuverable driving both in the city and off-road	8.3	5.3	5.8	7.3	8.2	6.2	7.3	8.2	9.3
Power plant capacity	6.7	4.9	4.3	4.6	5.4	5.1	5.7	7.2	7.3
Battery type	5.0	3.9	5.7	4.6	6.3	7.1	5.9	4.5	8.1
Fire extinguishing system	4.2	2.7	4.1	5.7	6.5	5.8	3.4	3.8	9.2
Price* (P_{compet}), thousand UAH	112.83	67.9	91.22	89.75	154.2	151.5	98.4	160.2	X

Note: the prices of competitive analogs are obtained from open sources.

The methods of the income methodological approach make it possible to predict the market development of R&D results in a time interval. This contributes to a more detailed study of the impact of CE elements on the market taken into account in the product price, as well as partial forecasting of its market behavior. The income methodological approach determines the choice of a product commercialization option, on the basis of which market and price parameters will be modeled. Therefore, in the case of the author's R&D result, it is proposed to consider the kicksharing scenario (renting electric scooters). Kicksharing is one of the world's most popular micromobility businesses.

Based on the price of a three-wheeled electric scooter for disabled people 121.24 thousand UAH and market features of its kicksharing, initial data are formed to substantiate the price indicators of this product using the methods of the income methodological approach (Table 3).

Table 3

Initial data for substantiating the kicksharing project of three-wheeled electric scooters for disabled people

No.	Indicator	Value, unit
1	Region	Lviv, Lviv region
2	Average cost of the sharing service for disabled people*, including:	70 UAH
3	– the cost of unlocking one electric scooter	15 UAH
4	– the price of 1 min. usage	1.5 UAH/min. (on weekends and holidays 2 UAH/min.)
5	– average trip duration	30 min./day
6	– the cost of booking and pausing	0.5 UAH/min.
7	– minimum deposit	100 UAH
8	Average number of services provided per day by one electric scooter	8 pcs/day
9	Planned average number of electric scooters for kicksharing	10 pcs
10	Average revenue from kicksharing electric scooters per day	5,600 UAH

Note: the given data take into account the market research of kicksharing and the study of consumer sensitivity in the subject area

The above data are the basis for further planning of revenue volumes and periods, as well as cost parameters of kicksharing three-wheeled electric scooters for disabled people.

5. 3. Formation of financial indicators of the project for implementing the R&D result based on a holistic assessment system

Based on the collected data, financial indicators for the kicksharing project of three-wheeled electric scooters for disabled people were formed. The main resulting indicators are shown in Table 4.

Table 4

Financial indicators for the kicksharing project of three-wheeled electric scooters for disabled people

No.	Indicator, thousand UAH	Project implementation period, months								
		Launch			Implementation					
		1	2	3	4	5	6	7	8	9
1.1.1	Revenues: – excluding VAT	–	–	–	940.8	1.344,0	1.478,4	1.612,8	1.747,2	2.016,0
1.2	– including VAT	–	–	–	1.176	1.680,0	1.848,0	2.016,0	2.184,0	2.520,0
2	VAT	–	–	–	235.2	336.0	369.6	403.2	436.8	504.0
3	Costs of preparation and provision of services	–	–	–	352.8	504.0	554.4	604.8	655.2	756.0
4	Investments	548.72	604.44	46.84	–	–	–	–	–	–
5	EBITDA	–	–	–	352.8	504.0	564.0	604.8	655.2	756.0
6	Depreciation	–	–	–	35.119	50.17	55.187	60.204	65.221	75.255
7	EBIT	–	–	–	317.681	453.83	508.813	544.596	589.979	680.745
8	Income tax	–	–	–	57.18	81.69	91.58	98.027	106.196	122.53
9	Net income	–	–	–	260.501	372.14	417.233	446.569	483.783	558.215
10	Net cash flow	–	–	–	295.62	422.31	472.42	506.773	549.004	633.47

The price used for the above calculations, according to the income methodological approach (P_{income}), is 120.43 thousand UAH.

Investment indicators for the kicksharing project, calculated by the method of evaluating startups within the framework of the income methodological approach, are shown in Table 5.

Table 5

Investment indicators for the kicksharing project of three-wheeled electric scooters for disabled people

No.	Indicator, unit	Value
1	Project investments, mln UAH	1,200
2	Payback period, months	6
3	Analyzed period of project implementation, months	15
4	Net present value of the project (NPV), thousand UAH	5,018.51
5	Discount rate, %	15
6	Internal rate of return (IRR), %	+0.2165
7	Profitability index (PI)	4.18

The calculated indicators based on the use of the income evaluation component under pre-defined investment conditions prove the feasibility of the kicksharing project.

6. Discussion of the results of developing a holistic evaluation system of R&D results

As the study showed, scientists considering the problems of research and development products in the context of sustainable development mostly do not pay attention to specific methodological mechanisms for their economic assessment. Existing research works demonstrate a large array of justified factors, trends and prospects for sustainable development in the field of science and technology [9–16]. However, methodological tasks go beyond the scope of the

given studies. In particular, the considered works [17–20] partially indicate the need for methodological support of cost assessment of R&D results, but do not provide the necessary basis for its formation. Individual author's achievements [21–26] provide fragmentary methodological elements, industry parameters, business modeling elements, etc. The proposed holistic evaluation system for R&D results is designed to solve these gaps, which contributes to the substantiation of elements in the price structure that meet the principles of CE.

In particular, thanks to the author's approach to determining the influence of eco-factors of the production process of the R&D result, it becomes possible to justify them in its price, and therefore the charged value defined by the circular economy is transformed into the cost of the product. The proposed system ensures the comprehensive economic evaluation, creates the basis for developing flexible management solutions and effective forecasting under the CE conditions.

Unlike the existing developments of scientists in the subject area, the author's method gives the basis for the development of applied tools for evaluating R&D results based on CE provisions. The proposed holistic system aggregates the current evaluation approaches, taking into account the impact of CE in pricing elements on R&D results. The system makes it possible to comprehensively evaluate R&D results under the CE conditions.

The use of a holistic evaluation system, including methods of cost, competitive and income components, allowed us to obtain the following price options:

P_{costs}=121.24 thousand UAH,

P_{compet}=123.87 thousand UAH,

P_{income}=120.43 thousand UAH.

The price option obtained for the cost component should be used as a base for further calculations, since it indicates the cost level below which the price of the R&D result should not be reduced. The price option obtained using the competitive component is obviously the most illustrative in the analyzed case, since it takes into account all the competitive advantages and bottlenecks of the product at the time of implementing the kicksharing project. However, this component will not give a vision of the development of the R&D result over time – this problem can be solved using the income component. In the case of a three-wheeled electric scooter for disabled people, the income component showed that the effectiveness of the kicksharing project should be considered in a significantly longer time period. The obtained investment indicators (Table 5) are based on data that can be predicted at the moment, but in the process of kicksharing they can be significantly adjusted, which will change the values of the calculated financial and investment indicators.

Methods from the group of each methodological approach are selected based on the specifics of the analyzed product. Given that in the analyzed case we deal with an innovative product, its implementation is determined by significant risks, market uncertainty, and other features that should be taken into account in the relevant methods.

Each of the evaluation components takes into account the influence of elements defined by the CE model. Such elements can be most clearly seen and evaluated when applying the methods of the competitive methodological approach (for example, in the case of the analyzed product – Table 2: battery type, battery liquid ingress protection system, fire extinguishing system, etc.). It is in this component, during a detailed study of the technical and technological features of the product, that it is possible to increase the weight of competitive advantages that are responsible for implementing the principles of CE.

Hypothesis 1 put forward in the study is fully true. The developed holistic evaluation system is universal for all types of R&D results, since it gives the basis for evaluation, and the tools can be adjusted and refined within the framework of the described principles.

The holistic evaluation system is compiled taking into account the principles of the CE model, which, in particular, is determined during: the evaluation of competitive analogs (competitive component), formation of development and impact of value characteristics of R&D results (income component) on the market, etc. However, in each case when using this system, it is important to choose methods within the framework of methodological approaches that best correspond to the specifics of the evaluated R&D result.

Hypothesis 2 is not fully true: the holistic evaluation system is suitable for almost all market conditions, but it cannot be applied to different forecasting time periods. This system provides the greatest effectiveness in short-term planning, as it takes into account many changing factors affecting the price. Even a small change in such factors can lead to significant changes (distortion) in the price.

The results of the work show that an important and relevant issue for further research is to refine the existing holistic evaluation system by market types and scope of R&D results.

7. Conclusions

1. A study of the prospects and problems of the electric scooter market in the context of CE development showed that the size of the US and European markets, as well as the global market for this product, will grow over the next decade. This effect is valuable in terms of predicting changes in the number of disabled people in the world (increase). In particular, in Ukraine their number reaches more than 6 % of the total population. However, electric scooters are still not common among disabled people, as they are not adapted to their needs. Given that the regulatory authorities of Ukraine focus on developing the concept of smart cities, electric scooters will become increasingly popular, in particular in the segment of disabled people. This will require improving the technical characteristics of electric scooters, which will bring them to the level of innovative products and, accordingly, actualize the need to develop methodological pricing support.

2. Substantiation of the price indicators of the R&D result allowed us to prove the feasibility of implementing this based on the aggregation of cost, competitive and income methodological components of the holistic evaluation system. Aggregation is based on determining and choosing the optimum product price from a set of possible (suitable for the corresponding product, market, business, etc.).

The need to aggregate several methodological approaches is explained by the significant level of market uncertainty, in particular, when it comes to the market launch of R&D

results. A system of price indicators for three components will provide the evaluator (developer, consumer, investor) with a range of price indicator values, among which one can choose the necessary based on contractual conditions, market changes, etc.

3. Based on the results of aggregating the cost, competitive and income methodological components of the holistic evaluation system, the main financial indicators of the project for implementing the R&D result – a three-wheeled electric scooter for disabled people are calculated. In particular, it is determined that if the project is invested in the amount of UAH 1,200 million and its implementation period is within fifteen months, the payback period will be six months. The calculated financial indicators of the project under pre-defined investment conditions showed the feasibility of kicksharing.

The study showed that the developed holistic evaluation system is universal for any R&D results and all market conditions. This system gives the basis for evaluation, within which you can adjust or develop methodological tools. The holistic evaluation system will provide the greatest performance in short-term planning.

Conflict of interest

The authors declare that they have no conflict of interest regarding this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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The study was conducted without financial support.

Data availability

The data will be made available upon reasonable request.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the presented work.

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