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Eco-design and eco-manufacturing consulting microenterprises as part of the circular economy strategy - role and risks

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Abstract. Over the last decades, a high degree of importance was given to the sustainable development of our world. At European level, the European Union developed a series of standards and fiscal regulations in order to support the achievement of sustainable development goals. An important step is the transition from a linear economy to a circular economy and a primary role in this transition is played by the adaptation of design and manufacturing processes to modern environmental and energy efficiency standards. This process of transformation can be achieved either by an internal department working within the company or by a specialised third-party consulting company. The second option is preferable due to the fact that it does not require a further specialisation process for some employees in order to enable the company to develop a project. As a response to these market requirements, at a European level, within the Common Market, specialised consulting companies started to emerge and develop. This paper details the role and the risks a consulting services microenterprise active in the field of eco-design and eco-manufacturing has to assume in the current socio-economic context; particularly in regard to factors that facilitate the transition from a linear economy to a circular economy.

Keywords. Circular economy, sustainable development, microenterprise role, risks

1. Introduction

In the general context of priorities at the European Union level in regard to combating and mitigating the effects of climate change, considering the necessity of partially coercive measures in the fiscal-legislative and regulatory field, a transformative macro-level adaptation of corporate planning policies is expected. This transformative process will prioritize the development and implementation of methods and technologies for the purpose of adapting the design and manufacturing processes to new environmental and energy efficiency standards aimed to be implemented throughout the Common Market in order to achieve the Sustainable Development goals outlined by the European Union. These fiscal-legislative measures target the exponential reduction of not only the pollutant emissions, but also of the consumption and waste of resources, especially in industry, in order to reach climate neutrality by 2050 and to move from a linear economy to a circular economy [1].

A key aspect of assessing the evolution of the Common Market is the use by European institutions – especially the European Commission – of fiscal instruments, designed for promoting and sustaining environmental standards, as special and acceptable measures to protect and increase European competitive advantages in relation to external actors – primarily

China and the United States. In practical terms, these measures are designed to limit or prevent access to the Common Market for products that do not comply with progressively stricter rules regarding not only energy efficiency, but also the consumption of resources used in the production process and the impact of technological processes on the environment, in situations where manufacturing activities do not take place in the territory (under the jurisdiction) of the European Union.

Given the European context and outlook for expected fiscal-legislative developments on environmental norms, regulations and standards in industry, companies in this sector will prioritize conformity to the new conditions, either by developing their own expertise and experience or by contracting external actors (consultants) that will provide the necessary services regarding the adaptation of their design and/or manufacturing processes to eco-design and eco-manufacturing norms.

Consequently, in the industrial sector in particular, the demand for services designed to facilitate the transition of a company to new environmental management requirements will increase in the next decade. Subsequently, the increased demand will facilitate the emergence and development of microenterprises providing consulting services designed to allow the adaptation and conformity of already functional production lines to existing or anticipated eco-technological norms, as well as development services for product design processes focusing on implementing advanced eco-design methodology (ISO 14006:2020 [2]); the socio-economic outcome manifesting itself in products that have tangible economic and environmental benefits.

This paper aims to present and explain the role that these companies have in facilitating the transition from a linear economy to a circular economy, as well as the market risks and difficulties they face in the current economic context. The information presented is based on research conducted by the author during postdoctoral studies and is referring in particular to data regarding microenterprises headquartered and active in Romania.

2. Understanding eco-design and eco-manufacturing as part of the circular economy

This section will introduce general research data by presenting the importance of implementing eco-design methodology and eco-manufacturing requirements in industry as main contributions to the transition to a circular economy and primary factors for the achievement of sustainable development goals.

What is the circular economy? The circular economy can be defined as the sustainable development strategy through which natural resources are carefully and sustainably used to protect the environment while the economy develops, in order to gradually achieve higher efficiency and a low-cost economy in which pollutant emissions are reduced and the recycling rate is high [3].

The European Commission defines the circular economy as an *economy where the value of products and materials is maintained as much as possible; waste and resources usage are kept to a minimum and resources do not leave the economic flow once they have reached the end of their life but are reused and continue to create value* [4].

In comparison to the linear economy, in the circular economy the products and materials used in their production process go through different loops that aim to maintain the potential of products and materials to create value [5]. Figure 1 illustrates this type of process. In practice, the circular economy is a model of production and consumption that involves sharing, reusing, repairing, renovating, and recycling existing materials and products, as much as possible [6]. Consequently, the life cycle of products is extended due to the fact that, when a product reaches the end of its life, the materials from which it is made are kept in the economic cycle, whenever possible. The materials can be re-used, implicitly creating additional value [5-6].

Fig. 1. Products and materials flow in a circular economy [5]

Fig. 2. Circular economy model [6]

As it can be inferred from figure 2, the design and manufacturing of products plays a crucial role in the circular economy. The durability of a product and its ability to be repaired, recycled, and reused, as well as its components and materials, depend largely on the original design of the product [6, 7, 8]. This connection determined the necessity to introduce eco-design methodology in the industrial process, as highlighted in a 2017 communique issued by the European Commission, underlining the importance of implementing the action plan for transitioning to the circular economy.

What is eco-design? ISO 14006:2020 defines eco-design as a systematic approach that considers environmental aspects in design and development with the aim to reduce adverse environmental impacts throughout the life cycle of a product. Eco-design has initially focused on the energy efficiency of products [9-10], however the European Commission has already extended this definition to include circular economy considerations such as repairability, sustainability, resilience, or recyclability, among other factors [1].

What is eco-manufacturing? Eco-manufacturing can be defined as environmentally friendly manufacturing. A type of manufacturing economically sensible and essential in order to achieve sustainable growth that focuses on reducing energy consumption, gas emissions, fluids and other elements that can affect the environment [11-12]. Implementation of eco-manufacturing for a product is not 100% possible if the design of that product did not respect the norms and regulations imposed by the eco-design methodology.

The integration and implementation of eco-design guidelines into the environmental management systems of a company and conformity to an eco-manufacturing process, as well as the legislative requirements imposed by the new EU measures, can result in the expenditure of a substantial amount of time and resources for an industrial company. Consequently, the emergence and development of microenterprises that will offer this type of services to industrial companies can confidently be predicted as a necessity for future economic development.

3. Microenterprises in the field of eco-design and eco-manufacturing – role and risks

This paper section will introduce the main characteristics, role and risks that a consulting microenterprise in the field of eco-design and eco-manufacturing may have or may encounter within the current economic and social context.

3.1. Main characteristics and role

The number of companies providing services in eco-design and eco-manufacturing is substantial compared to previous decades. Consequently, in order to concentrate the study to a

specific content, it is necessary to outline the characteristics of the microenterprises taken into account for this study.

Main characteristics of the SME's on which subsequent research will focus:

- type of microenterprise - limited liability company;
- services provided:
 - evaluation and improvement of the product design process in accordance to eco-design norms (ISO 14006: 2020 standard);
 - evaluation and improvement of the manufacturing process in accordance to the regulations within the ISO 14000 family of standards on environmental management.
- number of employees: maximum 9.

The primary function of these companies is to propose measures that aim to achieve sustainable development through products, technologies or services, and to support the transition to a low carbon and resource efficient economy – a circular economy. In essence, the companies provide advice on modernizing the design and/or production process so that the customer/end-user can comply with environmental management regulations, as well as to enable the client to implement the principles of the circular economy in their activity.

Taking into account the strategic viability of economic activities carried out in the field of eco-technology, this type of microenterprise should have as a primary objective the input of expertise (know-how) for the implementation of modern eco-design methodology in order to adapt products and manufacturing processes to a socio-commercial system that emphasizes a high degree of efficiency in the use of resources, while simultaneously ensuring a substantial limitation of adverse effects on the environment, effects inherent in any manufacturing process. Implicitly the company will implement measures and provide services that will directly contribute to achieving the European sustainable development goals, energy efficiency and resource consumption objectives, as well as the development of technologies necessary to achieve environmental objectives.

The target market is focused on small and medium-sized companies active in the field of product development within the European Economic Area, specifically companies that aim to adapt their design process and production lines to the European standards on sustainable development and environmental protection.

Extending the adoption of modern product and manufacturing design and processes at the industrial SME's level is the fundamental platform on which a consulting microenterprise can develop by gaining access to an extensive range of customers.

Despite the fact that the adoption of these practices and policies is essentially unavoidable due to social and legislative pressures, significant delays can still be caused by managerial reluctance, risk aversion and cost optimization for the purposes of short-term profitability, as well as a lack of information regarding strategic risks facing companies that do not participate in the process of transitioning to a sustainable economy.

Consequently, a new company that offers eco-design and eco-manufacturing consulting services should have an aggressive positioning in a (currently) niche market by introducing reduced tariffs compared to the existing market competition, especially in developed countries within the EEA. This competitive strategy has the advantage of allowing the provided services to be accessible to customers, at least within an exploratory (evaluation) framework, especially for SME's with limited production facilities. In the long run, as the portfolio of qualitative guarantees accumulates and the capacity to implement and offer services develops, competitiveness policies can evolve from financial advantages to qualitative advantages.

The opportunities that an eco-design consulting company can benefit from are:

- fiscal-legislative measures that require the conversion from classic technologies and production processes to ecological ones;
- reprofiling of European consumer preferences towards products with low environmental impact;
- competitive and normative pressures exerted on industrial actors in order to adopt processes and methods related to environmental protection in the context of achieving sustainable development goals.

Threats that should be taken into account:

- lack of strategic vision, especially in the case of companies with limited resources and capabilities;
- the development of industrial SME's internal capabilities and resources dedicated to the implementation of ecological processes and eco-technologies;
- the appearance of competing price offers;
- the postponement of the introduction of regulatory frameworks regarding the implementation of standards in the field of sustainable development within industrial companies.

Critical success factors:

- *the increase of demand for consulting services in the company's field of activity* due to regulations introduced by the European Union for the implementation of environmental management standards developed in order to continuously improve environmental performance in industrial companies;
- *the quality of the provided consulting services* – emphasis should be placed on providing personalized services adapted to the clients' needs, services that will be carefully planned, performed by specialists, constantly discussed with the clients and delivered within the established deadlines;
- *highly qualified human resources* – the employees should be design and manufacturing processes specialists, with a high degree of technical understanding of environmental protection standards, measures and methods;
- *integrity* – one of the important criteria for building a successful business is integrity; the company should always show honesty in its relations with employees, customers, suppliers, associations, investors, etc.

3.2. Possible risks

Every business activity implies certain elements of risk. Evaluating and understanding these risks is an essential organisational factor [13-14]. The primary risks identified and the possibilities and options envisioned in order to address or manage these risks are presented in Table 1.

Table 1. Risks identified and the options to address or manage them

Risk no.	Risk	Risk characteristics	
1	Reduced demand for the services provided by the	Risk type	Market risk
		Trigger	The crisis generated by the Covid-19 pandemic has led to a general decrease in the demand for goods and services. Consequently, there is a high probability that companies may choose to limit investment in services for environmental management.

Table 1. Risks identified and the options to address or manage them

Risk no.	Risk	Risk characteristics	
2	Intensifying competition	Probability	Possible
		Impact	Medium
		Consequences	Lower ability to attract customers in the short term
		Option for addressing the risk	An extensive market research study should be carried out and the advertising efforts should be targeted towards companies that have been less affected by the crisis generated by the Covid-19 pandemic.
		Risk type	Market risk
		Trigger	The emergence of new companies with a similar activity profile or the internal development of the industrial companies' capabilities to adapt technological lines to environmental management requirements introduced by the European Union.
3	Incomplete market and/or demand coverage	Probability	Possible
		Impact	Medium
		Consequences	Loss of customers / inability to attract new customers.
		Option for addressing the risk	The company should try to offer a competitive price for services and an advantageous project delivery schedule, in conjunction with sustained and continuous efforts to adapt to customer requirements.
		Risk type	Market risk
		Trigger	Lack of human resources experience or unavailability of human capital in relation to market or project demands.
4	Inadequate	Probability	Rare
		Impact	Medium
		Consequences	Loss of customers / inability to attract new customers.
		Option for addressing the risk	A prolonged drive to attract human capital by offering long-term packages and personal and professional development options.
		Risk type	Market risk
		Trigger

Table 1. Risks identified and the options to address or manage them

Risk no.	Risk	Risk characteristics	
5	Increased project delivery time or delays	Trigger	High service provisioning costs and expenses
		Probability	Possible
		Impact	High
		Consequences	Impossibility to attract customers / loss of customers
		Option for addressing the risk	The company should carry out regular studies of competition prices and expenses, so that a competitive but sustainable price offer can be developed in relation to existing market actors and competitors.
6	Liquidity risk	Risk type	Market risk
		Trigger	Unavailability of specialized human resources
		Probability	Possible
		Impact	Medium
		Consequences	Impossibility to attract customers / loss of customers
		Option for addressing the risk	A detailed analysis of the services offered by the competition and project delivery schedules should be completed, and, based on the obtained data, the manager should evaluate the necessity of increasing human capital availability in order to reduce the time to complete a project, if and when necessary.
		Risk type	Financial risk
		Trigger	Delayed payments by customers or non-payment of services due to the inability of customers to pay.
		Probability	Rare
		Impact	Medium
		Consequences	Impossibility to pay salaries and other expenses of the company
		Option for addressing the risk	Customers should be carefully selected, preferably no contracts should be concluded with those potential customers who have recorded substantial losses in the last years of activity and are at risk of payment default. A preliminary fee of 30% should be requested when signing contracts with a value equal or higher to 1000 euros.

Table 1. Risks identified and the options to address or manage them

Risk no.	Risk	Risk characteristics	
7	Postponement of the adoption of legislative measures regarding environmental management	Risk type	Legislative risk
		Trigger	A direct consequence of the significant global economic difficulties caused by the complex medical situation is the increased risk of delaying the implementation of legislative measures aimed at economic conversion to a system focused on sustainable development.
		Probability	Possible
		Impact	High
		Consequences	Impossibility to attract customers due to the fact that companies will not want to incur expenses that can be postponed
		Option for addressing the risk	Marketing and advertising actions undertaken by the company should emphasise the importance and long-term necessity of transitioning to a circular economy from a competitive point of view, within the particular context of an individual enterprise.

The main identifiable market risks are the price competition and the delivery time constraints for a specific project, in relation to companies already active in this sector. The availability of specialized human resources offers existing companies an advantage especially in regard to their ability to carry out similar projects with a shorter implementation schedule, compared to the intervals that can be offered by a new competitor. Nevertheless, the shorter duration of the evaluation and implementation phases of an eco-technological modernization project is not a decisive factor for the client. Due to the major market and competitive risks arising from the absence of an eco-technological modernization project in relation to competitors, companies may tend to opt for the offers that present, at a competitive/similar price, the shortest interval of delivery/implementation for the project.

In terms of price competition and related risks, the primary risk factor is the ability of major companies to accept low value, non-complex from a technological point of view and requiring low inputs of technical and human capital, contracts, in parallel with main projects in which they are engaged.

Due to the fact that, typically, contracts that require a small volume of technical and human resources can be the fundamental axis of development for small companies, the risk implicit to losing this type of contracts can be major. This risk is fundamentally connected to the low financial capacity of small companies to maintain small margins and low prices in direct competition with companies that can run secondary contracts, even while incurring marginal losses, either for the purpose of gaining new customers or for the purpose of maintaining certain elements of the company engaged in active projects despite possible net financial losses per project.

The inherent costs in carrying out regular economic activities are not normally a major risk factor in the company-specific field of consultancy, and maintaining constant financial flows is not an absolute priority. Despite this, the financial risks implicit to any projects, including risks

related to late payments or unplanned costs, especially in the event of technical and equipment necessities, may cause major fluctuations in the company's ability to carry out economic activities on a regular basis.

From the point of view of medium and long-term planning, in the absence of capital inflows, the company will not be able to expand its technical and human capital base and, consequently, will not be able to increase its possibilities to contract and carry out large-scale projects. Although the expansion or development of technical and human capacity is not a priority, in the absence of these developments, the company may remain vulnerable to inherent fluctuations in the frequency and financial scale of projects/contracts.

In the near future, restrictive/negative legislative pressure is not expected to be exerted on eco-technology activity. On the contrary, the major risk arises not from the implementation of legislative changes, but from the slowing down of legislative reform aimed at the development of production methods and processes that reduce the consumption of raw materials, emissions, pollutants, etc.

On a short-term basis, as a direct consequence of the significant global economic difficulties caused by the complex current medical situation, the potential risk of slowing down economic conversion to a system focused on sustainable development is amplified. The primary legislative vectors that will determine the developments in the next period are strictly related to the strategic policies pursued at national and global levels. Thus, a deceleration of the policies of globalization and integration of manufacturing lines and systems is foreseen, and in certain vital areas, a reorganization oriented towards ensuring strategic manufacturing capacities at a local and regional level is foreshadowed, especially in the Europe and North America.

From this perspective, it is possible that certain legislative changes will be undertaken to adopt temporary derogations from the current environmental protection rules, in order to accelerate the strategic relocation processes. This type of normative changes can have an immediate, moderately negative impact for a microenterprise that offers consulting services in the field of eco-design and eco-manufacturing.

On a medium- and long-term basis, the foreseeable legislative risks are minimal, given the strategic factors in play at the European Union level, factors that dictate the policy of converting design and manufacturing systems to a model focused on low resource consumption and environmental protection.

4. Conclusions

This paper presented and discussed the role and risks implicit to the activity of microenterprises in the field of eco-design and eco-manufacturing consulting as part of the wider circular economy strategy.

As a consequence of the expected fiscal-legislative developments targeting environmental norms and standards in industry, the demand for services developed in order to facilitate the transition of economic activities to modern environmental management requirements will increase in the next decade. Consequently, the emergence and development of microenterprises that will offer consulting services for eco-technology adaptation to industrial companies can be predicted with a satisfactory degree of confidence.

The second section of the paper addresses the importance of eco-design and eco-manufacturing as an integrated part of the circular economy strategy and the role their implementation in the structure and operational design of industrial companies has in the transition to a circular economy and the achievement of sustainable development goals. The information presented in this section constitutes the basis of the primary subject of the paper.

The third section of the paper presents the roles, opportunities, success factors, threats, risks, and the options of addressing these risks for an eco-design and eco-manufacturing consulting microenterprise.

The primary roles fulfilled by these consulting microenterprises are to develop, propose and advance economically viable measures that aim towards achieving sustainable development through eco-friendly products, technologies or services, and to support the transition to a low carbon and resource efficient economy – a circular economy.

Consequently, even if business risks exist, as is the case with any other economic enterprise, companies active in this field can be confident of overall long-term success on the European market primarily due to the fact that demand for this type of services is driven not only by economic considerations but also by regulatory priorities adopted and implemented by the European Union in order to achieve the sustainable development goals established for 2030.

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