

## TOOL FOR SELF-ASSESSMENT OF PRODUCTION-ORIENTED ORGANISATION'S ENVIRONMENTAL MATURITY

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**Purpose:** The aim of the research was to build a tool designed to perform a self-assessment of the level of environmental maturity of a production-oriented organisation, which was not previously available. An attempt was made to arrive at an answer to the following question: what competences of an organisation determine a high level of its environmental maturity?

**Design/methodology/approach:** The targets set were achieved by: conducting an analysis of literature on the subject, which was necessary to identify self-assessment criteria, carrying out survey research covering experts and using the resulting self-assessment tool in a given organisation.

**Findings:** Based on the results obtained, it was found that the key competences that determine an organisation's environmental maturity include the ability: to accept responsibility for a product throughout its whole life cycle, to observe circular economy rules or to deploy energy consumption control systems. It was demonstrated that the level of environmental maturity in an organisation can be measured by using the proposed self-assessment tool.

**Research limitations/implications:** The study presents the process of creating a tool for manufacturing organizations. It was conducted in southern Poland in a very narrow telecommunications industry, it is difficult to find other works on the selected topic in this specific market area. As a result of the research, it was also found that the tool should be created adapting it to a specific organization - limited universality. The tool created in this article can only be used to examine the environmental maturity of an enterprise.

**Practical implications:** Examining the environmental maturity of an enterprise gives senior management an opportunity to create a detailed strategy for the development of the organization in a selected area. Additionally, the organization receives an easy-to-use method for self-diagnosis and for comments from lower management staff.

**Social implications:** A company's awareness of its environmental weaknesses allows it to eliminate them from its processes. The environmental maturity diagnosis allows the organization to react "here and now", thanks to which it can eliminate emissions and impact on local communities even before the legal obligation.

**Originality/value:** Based on the literature and their own research, the authors created a new, simple tool for examining environmental maturity.

**Keywords:** organisation's environmental maturity, self-assessment, Industry 4.0.

**Category of the paper:** Research paper.

## 1. Introduction

Globalisation, the development of new technologies, emerging crises lead to the great volatility and complexity of environments, and this fact must be accepted by organisations to ensure they are competitive. Contemporary consumers pay attention not only to the quality of a product, but also to the method it is manufactured or the way it affects the environment. This means that the development of an organisation's competences has grown in importance. An organisation's technological transformation requires that a strategy be changed, innovativeness be increased, which allows for generating profits (Węgrzyn, 2009; Marciniak, 2010).

Aware stakeholders expect managers to be socially responsible, e.g. to eliminate the emissions of harmful and noxious compounds. A quality-oriented approach (e.g. the implementation of a quality management system according to the ISO 9001 standard) or taking eco-friendly actions (e.g. the implementation of an environmental management system according to the ISO 14001 standard) was already very common in the last century, which popularised integrated management systems (Węgrzyn, 2007). Nowadays, a decisive factor behind the competitiveness of an organisation is associated with its competences that determine the use of a variety of interactions in cyberspace, cognitive thinking (utilising artificial intelligence). What has gained popularity today is, among other things, a SMART WORLD concept based on the Internet of Things (IoT), which requires an organisation's quality- and ecology-oriented development (Adamik, 2020), enhancing the effectiveness of raw material consumption management in a process, or of the control of emission levels (Polska Cyfrowa, 2020).

A contemporary organisation must pay attention to technological aspects related to the environment, ecology and society. In the global economy, an organisation's competences started to be considered the intangible building blocks of values (Urbanek, 2011). Hence the concept of competences is associated with the maturity of organisations, the level of their orientation towards the excellence of existing solutions (Skrzypek, 2014). Greater and greater importance is being attached to knowledge and other resources that determine the efficiency of an organisation's operations, but also the effectiveness of limiting its negative impact on the natural environment (Jabbour, 2015).

The following hypothesis was formulated in this paper: the level of environmental maturity of an organisation can be measured by performing a self-assessment of existing solutions. The principal aim of the research was to build a tool designed to perform a self-assessment of the level of environmental maturity of a production-oriented organisation. What is of relevance is to arrive at an answer to the following question: what competences of an organisation determine a high level of its environmental maturity? The targets set were achieved by: conducting an analysis of literature on the subject, carrying out survey research covering experts

(scientists involved in the issue being examined) and using the resulting self-assessment tool in a given organisation.

## 2. An overview of the literature

Environmental maturity of an organisation is a component of its quality maturity (Łukasiński, 2015). Due to a dynamically changing and complex environment, an organisation is required to shape the solutions that determine permanent and sustainable development, taking into account the needs of the natural environment and society. This means that organisations are expected to be orientated towards ensuring the solutions that determine the implementation of the cleaner production concept, the development of infrastructure necessary to achieve that, personnel competences (Adamik, 2020). Organisations take various actions with a view to improving the eco-friendliness of their processes, often relying on ecological benchmarking (Chen, 2022). An organisation's eco-friendly approach enables it to increase the level of its maturity, understood as the effectiveness and efficiency in perfecting the competences that determine ecological security, which is achieved by pursuing a sustainable development policy (Łukasiński, 2015). Reaching environmental maturity entails investment in technologies, changing a mindset, making a strategy eco-friendly. Collaboration with stakeholders, including clients' participation in a product designing process, or treating competitors as partners for co-operation, is also of key relevance. Consequently, an organisation can become the best in its class, be the leader, setting trends and defining the norms of environmental policy.

Table 1 shows the areas which, based on the literature review, must be considered vital in the process of an organisation's environmental maturity development.

**Table 1**

*Description of Areas that Determine Organisation's Environmental Maturity*

<b>Specification</b>	<b>Justification</b>
Eco-friendly strategies (an environmental management system, e.g. ISO 14001, EMAS, a Cleaner Production strategy)	It is important that an organisation is orientated towards developing solutions that eliminate emissions, minimising a waste of resources, reducing costs. This can be achieved through monitoring, the control of an organisation's impact on the natural environment (Preisner, Pindór, 2014; Bordun, 2020). The control of raw materials consumption has a bearing on: the optimisation of manufacturing costs, the elimination of inefficiency and ensuring the effective response to deviations from the norm. Bottlenecks need to be identified (Stojadinovic, Majstorovic, Gaška, Śladek, Durakbasa, 2021; Reschke, Gallego-García, 2021; Won, Kim, Park, Eun, 2021; Denkena, Bergmann, Stiehl, 2021; Lawrenz et al., 2021; Martínez-Cámara, Santamaría, Sanz-Adán, Arancón, 2021).

Cont. table 1.

Circular economy – responsibility for a product throughout its whole life cycle	Implementing an LCA enables an organisation to foster its awareness of the consumption of resources. What needs to be considered as early as at the designing stage is the consumption of secondary raw materials and what will happen to a product after it is worn out (Borys, 2015; Biernacki, 2018; Ciechan-Kujawa, Sychta, 2018). Waste which is generated must be managed reasonably, most preferably, when it is processed and used for production (Wengierek, 2014). A socially responsible organisation should be capable of recovering components from worn-out products and managing them properly (Woynarowska, Żukowski, 2012). Using recycles for a process input reduces the amount of waste to be managed (Pietrzyk-Sokulska, 2016; Białasz, 2018).
Energy from alternative sources, using cleaner fuels, saving water and energy	Own energy sources lower costs, reducing an organisation’s detrimental impact on the environment, being a determining factor behind reaching zero emissions by it (Kuziemska, Pieniak-Lendzion, Trębicka, Wieremiej, Klej, 2015; Bieńkowska-Gołasa, 2016). Using biofuels is recommended. It is necessary to change the technology used to propel, e.g. material handling industrial trucks, from LPG to hydrogen or electricity (Fidos, 2017). Controlling the consumption of energy or water makes it possible not only to reduce organisation’s costs, but also results in lower environmental costs (Szczepaniak, 2014).
Competences of leaders and employees – co-operation, minimising the importance of human errors, the ability to imitate perfect solutions	Competent personnel allow for streamlining processes identified in an organisation, are orientated towards designing cleaner processes (Pabian, 2011; Kacak, 2015). Co-operating with universities and research institutes provides an organisation with improved access to knowledge of the subject that is interesting to it, which determines the development of human resources, is conducive to changes in the mindset, encourages creativity (Nazdrowicz, 2017). Nowadays, it is essential to use computer systems that aid process designing and are able to focus employees’ attention on what and how should be done (Podostek, 2022). In practice, there is a variety of useful management concepts, e.g. benchmarking which allows for applying best practices and technologies in an organisation (Jabłoński, Chodyński, Jabłoński, 2005).

Source: Own elaboration based on the literature on the subject shown in the table.

The ecology of production is based, to a large extent, on creating a closed-loop material flow, which requires selecting a proper supplier of components. According to Kuen-Suan Chen et al, this should enhance the quality and availability of products, as well as ensure that modifications, defects or scrapping during the production process occur less frequently. Selecting a proper supplier may reduce the frequency of maintenance of machinery or replacement of components after purchase. This is conducive to the reduction of CO<sub>2</sub> emissions, hence it fits in with the Cleaner Production concept (Chen, 2022). The use of the blockchain technology is rising in importance, e.g. in the management of the national power grid, which is based on distributed renewable energy resources (Juszczak, Shahzad, 2022). Environmental maturity of an organisation is manifested through its ability to employ innovative, but also cost-effective methods, e.g. for reducing CO<sub>2</sub> emissions at plants. One of them includes an amine flushing method, which is implemented to “flush” gases emitted by a company (Afif, 2022).

### 3. Research methods

This paper attempts to identify criteria for a self-assessment of an organisation's competences that determine its environmental maturity. The aim was to develop a tool for a self-assessment of an organisation's environmental maturity. A self-assessment is a tool used during the evaluation of an organisation's potential and performance, allowing for the identification of its strengths and weaknesses. A self-assessment is useful during the planning, organisation and monitoring of actions aimed at improving and correcting organisational solutions. The following self-assessment functions deserve mentioning: diagnostic (obtaining information about an organisation), verifying (carrying out appraisals of employees, analysing, compiling a report and assessing) or comparative (benchmarking against other entities). Its implementation makes it possible to initiate changes, providing an environment conducive to an organisation's growth (Gabryelczyk, 2016). Table 2 shows what actions determining the accomplishment of the objective were taken.

**Table 2**  
*Actions Performed*

Partial Objective	Description
Literature Analysis	To define the criteria determining the self-assessment of an organisation's environmental maturity
Building a database that contains contact details of scientists involved in the issue being examined	Purposive selection of respondents was used, experts had to have at least a PhD degree and operate in the scientific field related to production and management. 500 people were selected from among employees of Polish universities (searched on university websites) to participate in the study. These people were then asked via e-mail to participate in the study. Ultimately, 60 responses were collected.
Preparing a questionnaire, conducting the research, determining the weights of criteria	Developing a survey questionnaire, sending emails with invitations to take part in the research. The survey was distributed between April and May 2022. Eventually, the survey questionnaire was filled in by 60 experts.
Developing a self-assessment tool	Knowledge gained made it possible to determine the weights of individual criteria. A tool was created, and it could be used by a selected organisation in order to perform a self-assessment.

Source: Own elaboration.

In the 1st stage, a survey questionnaire was prepared for experts-scientists. Based on an extensive literature review, 22 criteria were defined. Experts' task was to select 10 criteria which they believed to be the most important of those defined. Weights for individual criteria were determined, taking into account how many times a given criterion was chosen. The sum of answers was referred to the number of all possible selections. This stage involved 60 scientists (holding at least a PhD degree) from all around Poland.

Once the self-assessment tool was built, it was used in a selected organisation. To this end, after securing consent for the research, management was asked to designate specialists and a link to the self-assessment tool was sent out. In total, 10 persons participated in the research, whose task was to assess the level of environmental maturity of the organisation they worked for, using the criteria determined and a scale ranging from one to five. The meaning of individual maturity levels was communicated to the respondents (Table 3).

**Table 3.**  
*Levels of Organisation's Maturity*

Level 1 Initial Phase	The organisation operates, however, it is not oriented towards the improvement of existing solutions.
Level 2 Orientation Towards Improvement of Existing Solutions Phase	The organisation starts to evaluate the flow of processes and mechanisms that determine its operation. It is willing to assimilate knowledge, nevertheless it lacks competences necessary to use that knowledge. A budget is allocated for investments designed to improve existing solutions.
Level 3 Systemic Approach Phase	The organisation is aware of actions being taken and starts to decide on itself, to adopt a systemic approach to the improvement of existing organisational solutions, investments are made to develop identified processes.
Level 4 Active Maturity Shaping Phase	The organisation knows how to ensure the effectiveness of processes. It is able to self-develop, there are opportunities for carrying out projects ensuring its sustainable development, social responsibility.
Level 5 Excellence Phase	The organisation's competences enable it to become the best in its class, it introduces innovations, develops and helps others.

Source: Own elaboration.

To measure the level of the organisation's environmental maturity, the products of weights and maturity levels for respective criteria were added up.

#### 4. Results of the research

The self-assessment was carried out at an organisation operating in the telecommunications sector, based in the southern part of Poland, with a headcount of more than 250 staff. The self-assessment process involved representatives of the following units: Production Management Team, Production & Supplies Quality Control Team, Production Process Team (three people from each unit) and the Warehouse Management Specialist. The representatives were selected based on their seniority in the organisation and taking into consideration the fact that they managed the organisation (participated), which translated into the level of knowledge about the issues being examined.

The environmental maturity of the organisation being examined was assessed at 2.174. To calculate that score, the products of weights (determined on the basis of the scientists' selection) and marks (an arithmetic mean of 10 answers given by the organisation's representatives for the level of maturity relating to a criterion being examined) received for individual criteria were added up. The score obtained indicates level 2 of maturity, namely the organisation's orientation towards the improvement of existing solutions. This may give cause for concern, however, the willingness to take part in the evaluation of the present state must be seen as the first step of the organisation towards improvement. Detailed information is shown in Table 4.

**Table 4.***Self-Assessment Tool – Level of Environmental Maturity of Organisation Being Examined*

<b>Criteria</b>	<b>mark</b>	<b>weight</b>	<b>score</b>
Responsibility for a product throughout its whole life cycle	2.8	0.08	0.224
Observing circular economy rules	1.7	0.07	0.119
Using energy consumption control systems	1.9	0.07	0.133
Implementing environmental management system, e.g. ISO 14001, EMAS	3.9	0.06	0.234
Developing technologies supporting the reduction of waste, the utilisation of resources	1.6	0.06	0.096
Developing competences of employed staff (e.g. designing eco-friendly products and processes)	2.2	0.06	0.132
Employing the Cleaner Production strategy	2	0.06	0.12
Using “green” energy sources – the ability to generate electricity, e.g. a photovoltaic farm, wind turbines	1.3	0.06	0.078
Optimal utilisation of resources, cost minimisation	2.2	0.06	0.132
Ecological reviews, regular environmental audits at the organisation	3.7	0.05	0.185
Developing the technology that determines the processing of production waste at a plant	1.6	0.05	0.08
Using recycled components for the manufacturing of a product	1.4	0.05	0.07
Organising waste collection, e.g. for electronic waste	2.9	0.04	0.116
Ecological education of local society (e.g. classes at schools)	2.7	0.03	0.081
Ecological benchmarking, co-operation with universities, research institutes	1.9	0.03	0.057
Sewage treatment capacity (e.g. own sewage treatment plant)	1.2	0.03	0.036
Developing ecological initiatives among employees	3	0.03	0.09
Arranging mass transport for employees, promoting the concept of travelling by car together	1.5	0.03	0.045
Using the Industrial Internet of Things technology	1.4	0.03	0.042
Developing human-machine integration systems to eliminate errors, avoid a waste of raw materials	2.3	0.02	0.046
Employing big-data technologies for data processing and analysis	1.5	0.02	0.03
Applying the Blockchain technology (tracking raw materials and a product throughout their life cycle)	1.4	0.02	0.028
<b>Level of environmental maturity</b>			<b>2.174</b>

Source: Own elaboration based on own studies.

The basic indicator for an ecologically mature organisation is responsibility for a product throughout its whole life cycle. According to the experts, that area – as it is now, received a mark of 2.8. This level demonstrates that actions in this regard are being performed, e.g. the identification of the cause of complaint. The information obtained will allow for introducing corrective and preventive measures. Attention is focused on components used for production, e.g. the control of suppliers, using recycled materials, the separation of waste and engaging specialist waste collection companies to collect waste. Responsibility for a product requires that the material loop within a plant be closed. The level of solutions in this regard was assessed at 1.7, which means that waste separation needs to be addressed as a matter of utmost urgency. It is recommended that trainings be provided and instructions for employees be drawn up in order to reduce the percentage of products which have been incorrectly manufactured. The closed loop will make it possible to initiate co-operation with a company having waste processing capacity. Own recycling technologies and the ability to use waste for manufacturing a product were assessed at 1.6 and 1.4. The implementation of such solutions needs to be considered, as preventive measures and waste processing are conducive to the reduction of

a company's emissions. In the future, financial penalties contingent on emission levels might be imposed, hence it is well worth developing own infrastructure. Own waste processing technologies may be the key to success. The current level of solutions in that area was assessed at 1.6. The scarcity of optical fibre processing plants creates an opportunity for the development of waste recycling, which, at the same time, will contribute to closing the waste loop. Waste processing capacity should result in the possibility of making extra profits on the collection of waste from others and processing them for own purposes.

The organisation operates on many foreign markets. Having the ambition of being competitive, it implemented the ISO 14001 environmental management system. According to the respondents, the system works well (a mark of 3.9). Its implementation entails performing an audit and certification. The mark obtained in this regard was 3.7. Its further development based on the existing competences is required. Nowadays, considerable importance is attached to the Cleaner Production Strategy. The mark scored was 2.0, which implies that it is worth taking appropriate actions, especially because the experts considered it the key competence that determines environmental maturity.

Contrary to appearances, controlling the consumption and waste of energy is easy to introduce. In the course of the self-assessment process, the mark of 1.9 was given. The mark of 2.2 for the criterion called optimal utilisation of resources, cost minimisation is also a matter of concern. In the future, it will be necessary, for example, to fit taps and light switches with timers so as to ensure that water or light is turned on only when required. Room ventilation needs also to be standardised (windows must not be opened when air conditioning is switched on). Water consumption can be controlled with sensors fitted on taps and light switches. The capacity of using "green" energy sources in the organisation was assessed merely at 1.3. The company is planning to install photovoltaic panels in the future. In addition, it may decide to erect energy storage systems.

Proper competences of leaders and employees enable the organisation to expand. The level of personnel training stood at 2.2. This means that appropriate professional development paths for employees need to be built. An emphasis laid on ecology may bring notable economic benefits, because by reducing the consumption of resources, without affecting the production capacity, it is possible to cut down production costs and increase the percentage share of a margin. The utilisation of resources can be minimised by choosing proper trainings for employees, drawing up detailed instructions.

The other criteria were regarded by the experts as less significant. The scores achieved are shown in Table 4. The organisation being examined reached level 2 of environmental maturity, meaning that it is only learning the processes and mechanisms based on which it operates. Therefore the organisation is focused on gaining knowledge by employing new specialists, or by relying, for instance, on benchmarking, consulting. What requires attention is the fact that the present state of affairs was evaluated and the future plans of the organisation were not taken into account. The low level of environmental maturity may imply that there are no eco-friendly



solutions that could be applied in the sector in which the organisation operates. A narrow circle of component manufacturers can limit waste treatment opportunities.

## 5. Discussion

The available literature portrays a self-assessment of an organisation as an effective and comprehensive method of self-development (Skrzypek, 2012). Striving to increase the effectiveness of existing organisational solutions is of relevance. An organisation's success is conditional on the ability to perfect the flow of processes, optimise the utilisation of data. The results of P. Sliz's research revealed that the maturity of an organisation operating in the automotive industry is categorised as level 2 (37%) or level 3 (41%) (Śliz, 2016). The organisation examined in this paper is also classified between maturity level 2 and 3. This means that there is clear willingness to implement solutions which are nowadays seen as necessary. Hence the organisation being examined is in the group of approx. 70% of organisations which reached a relatively low maturity level (2 and 3).

An interesting alternative in the form of an assessment of environmental maturity of an organisation operating in the industry based on the level of carbon footprint reduction was presented in the Czech Republic in 2021. After analysing 35 maturity models, authors (Zoubek, Poor, Broum, Basl, Simon, 2021) developed their own tool for environmental maturity assessment. In aggregate, 6 levels (0-5) were defined for the tool, which are expressed as a percentage reduction of carbon footprint. Subsequently, they implemented it in several stages in an organisation being examined. The organisation was assessed by external experts during four meetings. In the course of the study, none of the areas being investigated achieved a level higher than level 2 on the scale proposed by the authors. This means that the plant only partially implemented technical solutions in production processes, which allowed it to reduce a carbon footprint by 30%. A comparison between the organisation being examined and the one evaluated in the Czech Republic demonstrates that both industrial plants are at a similar level of environmental maturity, since there is environmental awareness of the organisation and attempts have been made to improve the situation and reduce the impact (Zoubek, Poor, Broum, Basl, Simon, 2021).

The optical fibre sector, in which the organisation being examined operates, is struggling with the environmental transformation. Research conducted in 2017 in the USA sought to determine a carbon footprint generated by the optical fibre sector, and more precisely, the manufacture of cables. The whole process was reviewed, from the extraction of raw materials, through supplies, to a finished cable product. Next, an attempt was made to carry out an organisation assessment process, with attention being focused on the reduction of a CO<sub>2</sub> footprint over several years. It was found that in aggregate the general carbon footprint

increased slightly, compared to a substantial growth of production volumes. Authors emphasise that OFC should focus on selecting better raw materials and streamline the processes which are based on natural gas, i.e. high temperature processes, such as combustion (Inakollu, Morina, Keefe, 2017).

In its report called “Best Environmental Management Practice in the Telecommunications and ICT Services sector”, the European Commission presents instruments that support organisations operating in the telecommunications sector in carbon footprint reduction. The production plant being examined, which operates in the optical fibre sector, should read that document and choose solutions which are available to it in terms of complexity and implementation costs (Paolo, Pierre, Ioannis, Marco, 2020).

## 6. Conclusions

The environmental maturity level of an organisation improves its competitiveness. Focus must be on gaining knowledge and obtaining financial resources which will be utilised for reducing a carbon footprint an organisation generates. Most organisations will have to address the need for the development of competences that determine an increase in the level of their maturity. The fact that approx. 70% of companies is at a similar level of development should encourage them to take on competitive leadership.

To this end, the research was performed, as a result of which the tool for a self-assessment of environmental maturity was developed, however, the possibility of its configuration to adapt to a sector to be examined requires consideration. The limitation of the study is the need to take into account individual characteristics of an organisation and the market on which it operates. The questionnaire was prepared based on an analysis of literature and an examination of the experts’ opinions, which allowed for determining the criteria for a self-assessment of an environmentally mature organisation. The most important of them were deemed to include: responsibility for a product throughout its whole life cycle, observing circular economy rules, or using energy consumption control systems. The hypothesis put forward was proved successfully. It was demonstrated that environmental maturity of an organisation can be measured by performing a self-assessment of existing solutions. It can be claimed that the application of the tool proposed:

- Contributes to determining the level of development of an organisation’s competences necessary for reaching a high level of environmental maturity;
- Makes it possible to obtain information ensuring that development activities are undertaken effectively, a strategy being pursued can be updated;
- Is orientated towards creating an organisational structure, implementing organisational solutions that determine the effective execution of a strategy.

It is difficult to find a similar study in the literature. This can be an indication that managers at organisations do not know that method or there are certain limitations which hinder their self-assessment of an organisation's environmental maturity. Perhaps there are problems with the preparation and utilisation of the tool determining the effective evaluation of the present situation. In the future, it will be required to continue the research, in order to prove the possibility of the generalisation of results obtained and the improvement of the tool proposed. Before beginning the development of a self-assessment tool, it is necessary to consider the sector in which an organisation being examined operates and what area of its operations requires an evaluation. This method may be applied also to the evaluation of technical and technological, or economic maturity of an organisation. This creates an opportunity for building a flexible, multidimensional tool, which has a very broad scope of application.

## 7. The contribution of the authors

Wiesław Łukasiński – concept, description of the method, interpretation of results, substantive supervision – 50%.

Wiktor Lis – literature review, conducting research, interpretation of results – 50%.

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