SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2022
ORGANIZATION AND MANAGEMENT SERIES NO. 155

THE ROLE OF THE ENGINEERING PROFESSION IN DEVELOPING AND IMPLEMENTING SUSTAINABLE DEVELOPMENT PRINCIPLES

Radosław WOLNIAK

Politechnika Śląska, Wydział Organizacji i Zarządzania, Instytut Ekonomii i Informatyki; rwolniak@polsl.pl, ORCID: 0000-0003-0317-9811

Purpose: The aim of the paper is to analyze the role of the engineer in the process of implementing sustainable development principles in the industrial enterprise.
Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.
Findings: The analyses presented in the publication have drawn attention to the issue of the engineer's role in the implementation of the principles of sustainable development by an industrial enterprise. Particularly now, during the implementation of Industry 4.0, engineers should pay attention to the implementation of sustainable development principles in industry. These issues are also important as a result of the energy transition implemented in EU countries, which requires organizations to reduce their energy intensity, thus promoting sustainable development. The implementation of Smart City technologies also means that sustainability issues must be taken into account in engineering city planning.
Originality/value: Detailed analysis of all subjects related to the role of engineers in the sustainable development principles implementation.

Keywords: sustainable development, Industry 4.0, Smart City, engineer.

Category of the paper: literature review.

1. Introduction

Sustainability is now a very widely used concept in management and engineering. The term sustainable development was introduced in 1987 in a report published by the Burtland Commission. The title of the report was "Our Common Future", and in it the authors tried to link issues of economic development with environmental stability. In the report they defined Sustainable Development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987). This was the most quoted definition of the concept of sustainable development.

Nowadays the concept of sustainability is very tightly connected to the new concept of managing like: Industry 4.0 (Stawiarska et al., 2020; 2021; Grabowska et al., 2019; 2020; 2021; Kwiotkowska et al., 2021; Drozd, and Wolniak, 2021) and Smart Cities (Wolniak, and Jonek-Kowalska, 2021; 2022). Especially in the times of Industry 4.0 implementation engineers should have an extensive knowledge to adjust the technology to new principles (Gajdzik, and Wolniak, 2021; Wolniak et al., 2020).

Sometimes the concept of sustainability can be seen in a broader way. For example, John Ehnfried believes that sustainable development is not really a vision of the future. It is merely a modification of the current process of economic development. All modifications have some potential to mitigate or slow down the unsustainable trajectory of the globe, but they are all just quick fixes. He defines sustainability as the possibility that human and other life will always thrive on Earth (Ehrenfeld, 2008).

The aim of the paper is to analyze the role of the engineer in the process of implementing sustainable development principles in the industrial enterprise.

2. Sustainable development

The concept of sustainable development explores the relationship that exists between economic development, environmental quality and social justice. Sustainable development has three main dimensions: economic, environmental and social. These are often referred to as the triple bottom line [Figure 1] and are used to measure the success of a particular development programme or project. The triple bottom line concept was first used by John Elkington, founder of the British consultancy SustainAbility (Elkington, 1994).

We have three approaches to sustainability, each based on an emphasis on one of these dimensions. They are described in Table 1.

Table 1.
Main dimensions of sustainable development

Dimention	Characteristic
Economic approach: Income maximisation while maintaining a constant or increasing stock of capital.	The central idea of sustainable development is that present decisions should not worsen the prospects of maintaining or improving our standard of living in the future. This means that our economic systems should be managed in such a way that we can live in the future with the dividends of our resources. Sustainable economic growth means that real GNP per capita increases over time, and this growth is not threatened by "feedbacks" from biophysical (pollution, resource degradation) or social impacts. Sustainable development means basing development and environmental policies on a cost-benefit comparison and careful economic analysis that will enhance environmental protection and lead to increasing and sustainable levels of well-being.

Cont. table 1.

Ecological approach: Maintaining the resilience of biological systems and physical systems.	Sustainability is the maintenance of basic ecological processes and life support systems, the conservation of genetic diversity and the sustainable use of species and ecosystems. The term 'sustainable development' suggests that the lessons from ecology can and should be applied to economic processes. It encompasses ideas from the World Conservation Strategy, providing an environmental rationale through which development claims about improving the quality of (all) life can be challenged and tested.
Socio-cultural approach: Maintaining the stability of social and cultural systems.	Sustainable economic development is directly related to raising the living standards of the poor, which can be measured in terms of increased food, real income, education, health care, water supply, sanitation, and only indirectly to economic growth as a whole.

Source: own analysis on the basis: (Rogers et al., 2008).

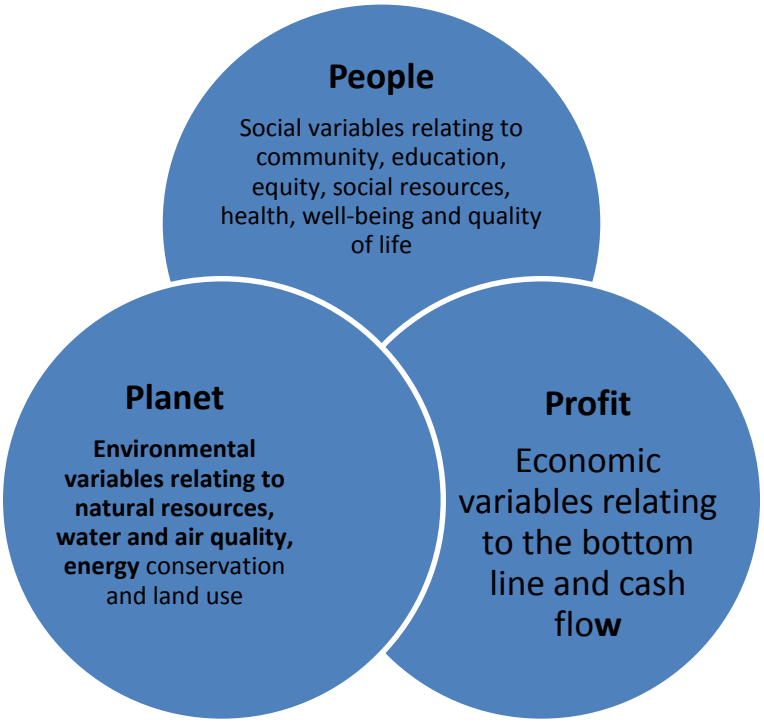

Figure 1. Interrelation of the elements of the triple bottom line concept. Source: (Dalibozhko and Krakovetskaya, 2018).

3. Implementation of sustainable development in business practice

In order to implement the objectives of sustainable development in business practice, we must carefully implement this concept in the entire business, political and social environment. An indispensable part of this process is the large role of civil society (Gębczyńska, and Wolniak, 2018). Civil society is an association of citizens (beyond their families, friends and business) who voluntarily commit to their interests, ideas and ideologies. From the

perspective of sustainable development, we can distinguish the following main roles of civil societies (Rogers, 2008):

- they demand rights to life and health,
- demand access to land, water and other services,
- forming user groups for sustainable management of resources under common ownership,
- mobilising individual households and social groups to improve the environment,
- sharing information and resources with other groups on common environmental and political issues,
- putting pressure on industry to clean up the environment and hold business accountable,
- Increasing the power of groups,
- putting pressure on governments to take seriously the rights and needs of marginalised people.

When we think about sustainability, there is a spectrum of views on the concept (Figure 2). At one end of the spectrum are those who suggest that we should protect nature at all costs, change the way we live and seek to reduce economic growth as a means of reducing consumption (Sułkowski, and Wolniak, 2016; 2018; Wolniak, and Sułkowski, 2015; Wolniak, Skotnicka-Zasadzień, 2014 Wolniak, 2011; 2013). At the other end of the spectrum are those who believe that necessity is the mother of invention and that technical solutions will be invented that will eliminate the need for such drastic measures.

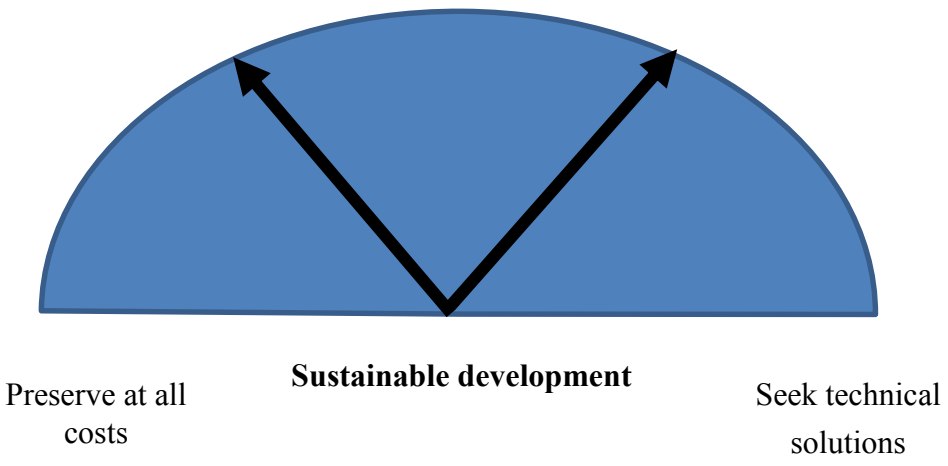

Figure 2. The spectrum of approaches to sustainable development. Source: (Brandon and Lombardi, 2005).

If humanity is to achieve the implementation of the concept of sustainable development, we should adopt its patterns that reflect natural processes (Wolniak, 2014; 2015; 2016; 2017). The role of engineers in sustainable development is very important and can be illustrated by the close relationship between the human ecosystem, and the natural ecosystem. Engineers contribute to the natural ecosystem in all its stages (Engineers, 2002):

- By developing, processing and transporting natural resources in closed-loop systems, we can reduce waste and increase resource efficiency.
- Harvesting renewable resources such as water, fish and trees, within the limits allowed by nature, will ensure a continuous supply of resources for people and natural ecosystems. Minimising the use of non-renewable resources, such as oil and rare minerals, and replacing them with environmentally friendly substitutes will also help increase the supply of natural resources.
- Processing natural resources efficiently and with little or no waste helps to conserve the earth's limited natural resources. We can further conserve resources by designing products and packaging for reuse and recycling, and by industrial processes and equipment that have minimal negative environmental impact throughout their life cycle.
- The transportation of goods is a major contributor to environmental pollution; to minimise these impacts, we can efficiently transport resources and manufactured goods to consumers by pipeline, river, rail, road, ship and aircraft, using technologies that have minimal impact on surrounding land use and meet consumer needs with little waste.
- The way we develop, process and transport resources can improve living standards in many ways. These include providing clean water, energy, residential and commercial buildings and streets and other forms of infrastructure, efficiently storing and distributing food, and meeting acceptable health standards, including high quality waste management and disposal.
- To keep the natural and built environment clean and unpolluted, we can reduce the amount of waste throughout the ecosystem cycle by continually recycling and recovering the remaining by-products from resource development, industrial processing and meeting consumer needs. A certain amount of waste in the system is inevitable, but it should occur in forms that have minimal long-term environmental impact. The impact of residual waste can be offset by continuing programmes to clean up and reuse old landfill sites, and by other forms of environmental restoration.
- The impact of energy source development on the atmosphere, land and water can be reduced through more efficient use of energy and production from non-fossil sources.

4. Sustainable engineering

The role of the engineer is very important in the supply chain in manufacturing and logistics of consumer goods. They should focus on improving processes to be more environmentally friendly. These processes should consider the following points at each stage of the production process of any goods and services (Azapagic, and Perdan, 2005):

- reduction of material requirements (total mass consumed),
- reduction of energy intensity (energy consumed at each stage of production),
- reduction of toxic dispersion (release of toxic substances into all media),
- increasing material recycling (reuse of materials or energy),
- maximising sustainable use of renewable resources (avoiding the depletion of finite raw materials),
- extending product life (optimising product life),
- increasing service intensity (creating added value while reducing environmental impact).

By combining the concept of sustainability with engineering knowledge, we obtain the so-called sustainable engineering concept (Wolniak, 2017; 2019; 2020, Wolniak, and Sułkowski, 2015; Wolniak et al., 2019). Sustainable engineering can be defined as a concept that considers the interactions in engineering activities of technical, ecological, social and economic systems and avoids transferring problems from one area to another (Sustainable engineering, 2015).

Twelve principles of sustainable engineering can be distinguished, which are described in Table 2. These principles are used in the development stage of new products/processes.

Table 2.
Principles of sustainable engineering

Principle	Approach	Impartance
Try to ensure that inputs and outputs of materials/energy are not hazardous	Reduce risk Reduce exposure	Reduces/minimises risks by reducing internal risks
Waste minimisation	A good design solution should use by-products	Lower purchase and disposal costs
Design for easy separation and cleaning	Plan for recycling and reuse	Easy separation/cleaning – easy waste management
All components must be designed for maximum weight, energy and efficiency	Smaller is better Reducing expenses	Lower expenditure
Avoid unnecessary weight/energy consumption	Production must respond to demand in real time	Minimising overproduction
Use entropy and complexity as a guide to make end-of-cycle decisions	Not all products should be subjected to the same treatment at the end of the cycle	Disposal solutions can no longer be seen as universal
The product should not be designed to last longer than necessary	Designing unnecessary features is wrong	Reducing accumulation of high-tech waste

Cont. table 2.

The product must not have unnecessary capacity/capacity	Design for realistic applications and conditions	Reduces/eliminates the use of required components
Minimise the variety of materials	Minimise the use of different materials, especially adhesives, sealants, coatings	Simplify waste management
Product development is only part of the life cycle	Consider the methods of extraction of the required raw materials and transport	Minimise the environmental impact of the associated life cycle stages
Evaluate products based on life cycle analysis	Consider the methods of extraction of the raw materials needed and transport	Minimise the environmental impact of the associated life cycle stages
Prioritise the use of renewable and readily available resources	Avoid the use of non-renewable energy sources, except where the use of renewable ones can be more damaging	Minimise the overall impact of resource use

Source: (The 12 principles, 2016).

A very important part of achieving the relevance of sustainability concepts in the work of engineers is adequate education. The practice of sustainable development requires a new approach from engineers, which will focus on participation in open decision-making processes (Abraham, 2006). The new role implies a different model of professional practice and requires a different approach to teaching and learning (Azapagic, and Perdan, 2005; Wolniak, and Hąbek, 2015; Wolniak, and Skotnicka, 2011; Wolniak, and Skotnicka-Zasadzień, 2008). The US Centre for Sustainable Engineering Study has prepared a report on the role of sustainable education in shaping. They believe that the long-term goal of 21st century engineering education is to enable practicing engineers to integrate sustainability principles into all stages of their practice, so that "sustainable engineering" eventually equates to "good engineering" (Bryne et al., 2010).

In 2004, the U.S. National Academy of Engineering formulated its Vision of the Engineer of 2020 (NAE, 2004). The report states that engineers should be conscious leaders of sustainable development and notes that this process should begin in educational institutions and be based on the basic tenets of the engineering profession and its activities (Wolniak, and Skotnicka-Zasadzień, 2010; Wolniak, and Sułkowski, 2016). The report suggests that engineering curricula should be reconsidered to prepare today's engineers for the careers of the future, with due regard to the rapid pace of global change and its inherent lack of predictability (Bryne et al., 2010).

In 2005. The Royal Academy of Engineers in London published twelve Guideline Principles for Engineering for Sustainable Development. These principles were as follows (RAE, 2005):

1. Go beyond your own locality and immediate future.
2. Innovate and be creative
3. Seek a sustainable solution.
4. Strive to involve all stakeholders.
5. Make sure you know the needs and wishes.
6. Plan and manage effectively.

7. Give sustainability a chance to address any concerns.
8. If polluters have to pollute, they have to pay.
9. Take a holistic approach, from cradle to grave.
10. Do things right, having decided what is right to do.
11. Beware of cost-cutting that masquerades as value engineering.
12. Practice what you preach.

The following year, the Canadian Council of Professional Engineers published the National Guidelines on Environment and Sustainability. This document outlined nine points to which professional engineers should adhere. It states that an engineer (CCPE, 2006):

1. should develop and maintain an appropriate level of understanding, awareness and monitoring system of environmental and sustainability issues related to the field in which he/she specializes;
2. he/she should draw on the relevant expertise of specialists in areas where the professional engineer's knowledge alone is not sufficient to address environmental and sustainability issues;
3. should use professional and responsible judgement in his/her considerations of the environment and sustainable development;
4. should ensure that environmental planning and management is integrated with all their activities that may have any adverse effects;
5. should include environmental costs as one of the primary factors used to assess the economic feasibility of projects for which they are responsible;
6. should recognise the value of environmental performance and sustainability, consider a full life cycle assessment to determine the benefits and costs of additional environmental management, and seek to implement effective, sustainable solutions;
7. should engage and solicit stakeholder input in an open manner and seek to respond to environmental issues in a timely manner;
8. should comply with legal requirements and strive to exceed or improve them by applying the best available, cost-effective technologies and procedures. Should disclose to appropriate authorities information necessary to protect public safety;
9. should actively work with others to improve understanding of the environment and sustainable practices;

In 2009, the Engineering Council in the UK set out six sustainability guidelines for the engineering profession. These points can be used by professional engineering bodies to develop guidance for their members. These included (ECUK, 2009):

1. contributing to a sustainable society, now and in the future;
2. using professional and responsible judgement and taking a leadership role;
3. doing more than simply complying with regulations and codes;
4. using resources efficiently and effectively;
5. seeking multiple perspectives to address sustainability issues;
6. managing risks to minimise negative impacts on people and the environment.

When we want to design a good programme on sustainability to teach engineers this concept, we should consider the following questions (Coral, 2009):

1. what competencies related to sustainability should an engineer acquire at university and how should they be defined?
2. how are these competences currently taught?
3. what are the advantages and disadvantages of different pedagogical strategies in teaching sustainability?
4. how can the teaching of sustainability be measured?
5. what do students learn in the different sustainability courses?
6. which pedagogical strategies are more effective in acquiring sustainability competencies?
7. What type of curriculum structure is most beneficial for enabling the necessary pedagogical strategies?
8. what recommendations can be made to university/school/department management and teachers to improve engineering education in sustainability in a systemic way?

On the basis of the answers to these questions, it is necessary to prepare courses in engineering studies that give engineers adequate knowledge and competences in the field of sustainable development (Azireiro, and Davim, 2020). J. Coral has made a detailed analysis of which engineering competences are closely related to sustainable development. He distinguishes four of them (Coral, 2009):

- critical thinking,
- systems thinking,
- inter-trans-disciplinarity,
- values and ethics.

Table 3.
Implikacje nowych koncepcji zarządzania przemysłowego dla inżynierów

Conception	Characteristic
Industry 4.0	We are now at the beginning of the fourth industrial revolution, where data and the interconnectedness of machines and the Internet of Things are driving new productivity and innovation. Engineering continues to be at the heart of this latest revolution. Engineers play an important role in these innovations, developing new ideas and scientific breakthroughs into new inventions and products that can help many countries accelerate their economic development.
Green infrastructure and smart cities with increasing urbanisation	With increasing urbanisation and urban growth, engineers are expected to develop new innovations in green infrastructure for smart cities and the development of low CO2 energy sources. Engineers play an important role in addressing climate change and implementing sustainable solutions for the use of depleting resources, especially water.
Demand for engineering in Asia, Africa and Latin America	There is a growing demand for engineers and engineering services in Asia, Africa and Latin America as the world's fastest growing economies urbanise and develop their infrastructure.

Source: own analysis on the basis (WFEO, 2008).

These competences are best suited to sustainability education and should be taught at every level of engineering education.

A very interesting concept for linking sustainability with engineering activities has been prepared by the World Federation of Engineering Organizations. In 2018, it prepared a Plan for achieving the UN Sustainable Development Goals through engineering by 2030. This plan considers the combination of engineering knowledge with new industrial management concepts such as Industry 4.0, Smart Cities, etc. The main implications of these concepts for engineers are described in Table 3.

5. Conclusion

The analyses presented in the publication have drawn attention to the issue of the engineer's role in the implementation of the principles of sustainable development by an industrial enterprise. Particularly now, during the implementation of Industry 4.0, engineers should pay attention to the implementation of sustainable development principles in industry. These issues are also important as a result of the energy transition implemented in EU countries, which requires organizations to reduce their energy intensity, thus promoting sustainable development. The implementation of Smart City technologies also means that sustainability issues must be taken into account in engineering city planning.

References

1. Abraham, M.A. (2006). *Sustainability Science and Engineering.* London: Elsevier.
2. Azapagic, A., Perdan, S., Clift, R. (2005). *Sustainable development in practice. Case Studies for Engineers and Scientists.* Chichester: Wiley.
3. Aziteiro, U.M., Davim, J.P. (2020). *Higher education and sustainability: opportunities and challenges for achieving sustainable development goals*. London: Taylor and Francis Group.
4. Brandon, P.S., Lombardi, P. (2005). *Evaluating sustainable Development in the built environment.* Kundli: Blackwell Science.
5. Bryne, E., Desha, Ch., Fitzpatrik, J., Hargoves, K. (2010). *Engeenering Education for sustainable development: a review of international progress.* 3rd International Symposium for Engineering Education. Ireland: University College Cork.
6. CCPE (2006). *Canadian Engineering Qualifications Board National Guideline on Environment and Sustainability*, Ottawa, ON, Canada: Canadian Council of Professional Engineers. http://www.engineerscanada.ca/e/files/guideline_enviro_with.pdf, 10.01.2022.

7. Coral, J.S. (2009). *Engineering for a sustainable future.* Barcelona: Universitad Politecnica de Catalunya.
8. Dalibozhko, A., Krakovetskaya, A. (2018). Youth entrepreneurial projects for the sustainable development of global community: evidence from Enactus program. *HS Web of Conferences, 57*, 01009.
9. Drozd, R., Wolniak, R. (2021). Metrisable assessment of the course of stream-systemic processes in vector form in industry 4.0. *Quality and Quantity*, 1-16, DOI: 10.1007/s11135-021-01106-w.
10. ECUK (2009). *Guidance on sustainability for the engineering profession*. London, England: Engineering Council UK. www.engc.org.uk/documents/EC0018_Sustainability Guide.pdf, 10.01.2022.
11. Ehrenfeld, J. (2008). *Sustainability by Design.* New Haven, CT, USA: Yale University Press.
12. Elkington, J. (1994). Towards the Sustainable Corporation: Win Win Win Business Strategies for Sustainable. *California Management Review, 36*, *2,* 90-100.
13. *Engineers and Sustainable Development, World Federation of Engineering Organizations' Committee on Technology*. (2002). https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwizrcbSoPXtAhWjBhAIHV9-D8oQFjABegQIAxAC&url=https%3A%2F%2Fwww.researchgate.net%2Fprofile%2FArvind_Singh56%2Fpost%2FHow_engineers_can_play_their_role_in_the_sustainable_development4%2Fattachment%2F5abcdd5b4cde269658663419%2FAS%253A609497244520449%25401522326875408%2Fdownload%2F2.pdf&usg=AOvVaw2SBkgCwaiJ2WjrCf4N1idt, 10.01.2022.
14. Gajdzik, B., Wolniak, R. (2021). Transitioning of steel producers to the steelworks 4.0 – literature review with case studies. *Energies*, *14(14),* 1-22.
15. Gębczyńska, A., Wolniak, R. (2018). *Process management level in local government.* Philadelphia: CreativeSpace.
16. Grabowska, S., Grebski, M., Grebski, W., Saniuk, S., Wolniak, R. (2021). *Inżynier w gospodarce 4.0.* Toruń: Towarzystwo Naukowe Organizacji i Kierownictwa – Stowarzyszenie Wyższej Użyteczności "Dom Organizatora".
17. Grabowska, S., Grebski, M., Grebski, W., Wolniak, R. (2019). *Introduction to engineering concepts from a creativity and innovativeness perspective.* New York: KDP Publishing.
18. Grabowska, S., Grebski, M., Grebski, W., Wolniak, R. (2020). *Inżynier - zawód przyszłości. Umiejętności i kompetencje inżynierskie w erze Przemysłu 4.0.* Warszawa: CeDeWu.
19. Jonek-Kowalska, I., Wolniak, R. (2021). Economic opportunities for creating smart cities in Poland. Does wealth matter? *Cities*, *114,* 1-6.
20. Jonek-Kowalska, I., Wolniak, R. (2021). The influence of local economic conditions on start-ups and local open innovation system. *Journal of Open Innovations: Technology, Market and Complexity*, *7(2),* 1-19.

21. Kwiotkowska, A., Gajdzik, B., Wolniak, R., Vveinhardt, J., Gębczyńska, M. (2021). Leadership competencies in making Industry 4.0 effective: the case of Polish heat and power industry. *Energies*, *14(14),* 1-22.
22. NAE (2004). *The engineer of 2020: visions of engineering in the new century, National Academy of Engineering.* Washington, DC, USA: The National Academies Press.
23. RAE (2005). *Engineering for sustainable development: Guiding Principles*. London, England: The Royal Academy of Engineering.
24. Rogers, P.P., Jalal, K.F., Boyd, J.A. (2008). *An introduction to Sustainable Development.* Glen Educational Fundation, London.
25. Stawiarska, E., Szwajca, D., Matusek, M., Wolniak, R. (2020). *Wdrażanie rozwiązań przemysłu 4.0 w wybranych funkcjonalnych obszarach zarządzania przedsiębiorstw branży motoryzacyjnej: próba diagnozy.* Warszawa: CeDeWu.
26. Stawiarska, E., Szwajca, D., Matusek, M., Wolniak, R. (2021). Diagnosis of the maturity level of implementing Industry 4.0 solutions in selected functional areas of management of automotive companies in Poland. *Sustainability*, *13(9),* 1-38.
27. Sułkowski, M., Wolniak, R. (2016). Przegląd stosowanych metod oceny skuteczności i efektywności organizacji zorientowanych na ciągłe doskonalenie. *Zeszyty Naukowe Politechniki Śląskiej. Seria Organizacja i Zarzadzanie, 67,* 63-74.
28. Sułkowski, M., Wolniak, R. (2018). *Poziom wdrożenia instrumentów zarządzania jakością w przedsiębiorstwach branży obróbki metali.* Częstochowa: Oficyna Wydawnicza Stowarzyszenia Menedżerów Produkcji i Jakości.
29. *Sustainable engineering* (2015). https://www.engineering.unsw.edu.au/civil-engineering/sustainable-engineering, 10.01.2022.
30. *The 12 principles of sustainable engineering* (2016). https://www.e-education.psu.edu/eme504/node/5, 10.01.2022.
31. United Nations General Assembly (1987). *Report of the world commission on environment and development: Our common future*. Oslo, Norway: United Nations General Assembly, Development and International Co-operation: Environment.
32. WFEO Engineering 2030 (2018). *A Plan to advance the achievement of the UN Sustainable Development Goals through engineering.* Paris: World Federation of Engineering Organizations.
33. Wolniak, R., Sułkowski, M. (2015). Motywy wdrażanie certyfikowanych Systemów Zarządzania Jakością. *Problemy Jakości, 9,* 4-9.
34. Wolniak, R., Skotnicka-Zasadzień, B. (2014). The use of value stream mapping to introduction of organizational innovation in industry. *Metalurgija*, *53(4),* 709-713.
35. Wolniak, R. (2011). *Parametryzacja kryteriów oceny poziomu dojrzałości systemu zarządzania jakością.* Gliwice: Wydawnictwo Politechniki Śląskiej.
36. Wolniak, R. (2013). A typology of organizational cultures in terms of improvement of the quality management. *Manager*, *17(1),* 7-21.

37. Wolniak, R. (2013). Projakościowa typologia kultur organizacyjnych. *Przegląd Organizacji, 3,* 13-17.
38. Wolniak, R. (2014). Korzyści doskonalenia systemów zarządzania jakością opartych o wymagania normy ISO 9001:2009. *Problemy Jakości, 3,* 20-25.
39. Wolniak, R. (2016). Kulturowe aspekty zarządzania jakością. *Etyka biznesu i zrównoważony rozwój, Interdyscyplinarne studia teoretyczno-empiryczne*, *1,* 109-122.
40. Wolniak, R. (2016). *Metoda QFD w zarządzaniu jakością. Teoria i praktyka*. Gliwice: Wydawnictwo Politechniki Śląskiej.
41. Wolniak, R. (2017). Analiza relacji pomiędzy wskaźnikiem innowacyjności a nasyceniem kraju certyfikatami ISO 9001, ISO 14001 oraz ISO/TS 16949. *Kwartalnik Organizacja i Kierowanie, 2,* 139-150.
42. Wolniak, R. (2017). Analiza wskaźników nasycenia certyfikatami ISO 9001, ISO 14001 oraz ISO/TS 16949 oraz zależności pomiędzy nimi. *Zeszyty Naukowe Politechniki Śląskiej. Seria Organizacji i Zarządzanie*, 108, 421-430.
43. Wolniak, R. (2017). The Design Thinking method and its stages, *Systemy Wspomagania Inżynierii Produkcji, 6,* 247-255.
44. Wolniak, R. (2017). The use of constraint theory to improve organization of work. 4th International Multidisciplinary Scientific Conference on Social Sciences and Arts. SGEM 2017, 24-30 August 2017, Albena, Bulgaria. Conference proceedings. Book 1, *Modern science. Vol. 5, Business and management*. Sofia: STEF92 Technology, 1093-1100.
45. Wolniak, R. (2019). Context of the organization in ISO 9001:2015. *Silesian University of Technology Scientific Papers. Organization and Management Series, 133,* 121-136.
46. Wolniak, R. (2019). Downtime in the automotive industry production process – cause analysis. *Quality, Innovation, Prosperity, 2,* 101-118.
47. Wolniak, R. (2019). Leadership in ISO 9001:2015. *Silesian University of Technology Scientific Papers. Organization and Management Series, 133,* 137-150.
48. Wolniak, R. (2019). Support in ISO 9001:2015. *Silesian University of Technology Scientific Papers. Organization and Management Series, 137,* 247-261.
49. Wolniak, R. (2019). The level of maturity of quality management systems in Poland-results of empirical research. *Sustainability*, *15,* 1-17.
50. Wolniak, R. (2020). Design in ISO 9001:2015. *Silesian University of Technology Scientific Papers. Organization and Management Series, 148,* 769-781.
51. Wolniak, R. (2020). Operations in ISO 9001:2015. *Silesian University of Technology Scientific Papers. Organization and Management Series, 148,* 783-794.
52. Wolniak, R. (2020). Quantitative relations between the implementation of industry management systems in European Union countries. *Silesian University of Technology Scientific Papers. Organization and Management Series, 142,* 33-44.

53. Wolniak, R., Sułkowski, M. (2015). Rozpowszechnienie stosowania Systemów Zarządzania Jakością w Europie na świecie – lata 2010-2012. *Problemy Jakości, 5,* 29-34.
54. Wolniak, R., Grebski, M.E., Skotnicka-Zasadzień, B. (2019). Comparative analysis of the level of satisfaction with the services received at the business incubators (Hazleton, PA, USA and Gliwice, Poland). *Sustainability, 10,* 1-22.
55. Wolniak, R., Hąbek, P. (2015). Quality management and corporate social responsibility. *Systemy Wspomagania w Inżynierii Produkcji, 1,* 139-149.
56. Wolniak, R., Jonek-Kowalska, I. (2021). The level of the quality of life in the city and its monitoring. *Innovation (Abingdon), 34(3),* 376-398.
57. Wolniak, R., Jonek-Kowalska, I. (2021). The quality of service to residents by public administration on the example of municipal offices in Poland. *Administration Management Public, 37,* 132-150.
58. Wolniak, R., Jonek-Kowalska, I. (2022). The creative services sector in Polish cities. *Journal of Open Innovations: Technology, Market and Complexity, 8(1),* 1-12.
59. Wolniak, R., Saniuk, S., Grabowska, S., Gajdzik, B. (2020). Identification of energy efficiency trends in the context of the development of industry 4.0 using the Polish steel sector as an example. *Energies*, *13(11),* 1-16.
60. Wolniak, R., Skotnicka, B. (2011). *Metody i narzędzia zarządzania jakością – Teoria i praktyka, cz. 1.* Gliwice: Wydawnictwo Naukowe Politechniki Śląskiej.
61. Wolniak, R., Skotnicka-Zasadzień, B. (2008). *Wybrane metody badania satysfakcji klienta i oceny dostawców w organizacjach.* Gliwice: Wydawnictwo Politechniki Śląskiej.
62. Wolniak, R., Skotnicka-Zasadzień, B. (2010). *Zarządzanie jakością dla inżynierów.* Gliwice: Wydawnictwo Politechniki Śląskiej.
63. Wolniak, R., Skotnicka-Zasadzień, B., Zasadzień, M. (2019). Problems of the functioning of e-administration in the Silesian region of Poland from the perspective of a person with disabilities. *Transylvanian Review of Public Administration, 57E,* 137-155.
64. Wolniak, R., Sułkowski, M. (2016). The reasons for the implementation of quality management systems in organizations. *Zeszyty Naukowe Politechniki Śląskiej. Seria Organizacji i Zarządzanie, 92,* 443-455.