The Management and Engineering Model for Sustainable Development in an organization

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ABSTRACT

The paper presents a management and engineering model for sustainable development taking into consideration organizational levels of organizations and management systems. Developed the management and engineering model based on nine modules have the feature of the adjustment to changes in the macro and competitive environment, and tracking all the changes. The model combines the concept of innovation with a set of activities and resources necessary for its implementation, enabling the organization to achieve those objectives, and contribute to sustainable growth.

Keywords: Sustainable development, engineering, management, commercialization, systems

1. INTRODUCTION

The main contribution to ecological and environmental development was made during the United Nations' *Conference on Environment and Development* in 1992, which took place in Rio de Janeiro [1]. Result of the conference was developed documents such as *Agenda 21* [1] and Rio Declaration on Environment and Development. Recommendations of Agenda 21 should be implemented by nations, local authorities, as well as business units. According to this document, every unit (acting globally, nationally or locally) should concentrate on few, general areas of focus. First one concerns environment protection and reasonable management of natural resources. It combines reduction of wastes and pollution, as well as protection of endangered species. Second area of focus concerns economic growth and fair split of profits; for example grants and donations for development of less developed entitles. The last main area considers social development and it mainly includes provision of common access to welfare and education.
Examination of the concept of sustainable development at the business unit level means reducing material consumption, energy intensity of production, raising productivity of environmental resources and reducing contaminants while achieving economic, and social goals [2]. This implies, therefore, the efficient use of natural resources and environmental protection and management systems. A tool that will enable the sustainable development management system. To fully implementation of sustainable development concept at the business level it is necessary the most important international standards, which are presented as follows (Figure 1 The management and engineering model for sustainable development).

[1] Agenda 21 is a plan of actions which should be taken globally, nationally and locally in order to achieve sustainable development in economic, social and ecological dimensions.

2. THE PRINCIPLES OF THE MODEL

The goal of developed model is to provide the framework in which each organization operates. This allows to ensure ongoing access to people, capital and natural resources. This in turn helps organizations to deliver better return for shareholders, manage risk effectively, reduce environmental impacts, cut operating costs and provide more business development opportunities. Activities toward sustainable development lead to a development of product/technology which relies on the rational application of raw materials, water and energy, at all stages of the product life cycle at simultaneous reducing the impact on the environment. Such approach should be supported by strategies and international standards or a set of different tools for eco-design and manufacturing. Thus, the model describes how to manage organization today in understanding of an interaction between its elements of systems, and the ability to harmonize and seeking an appropriate balance between the different dimensions of activity: economic, social, environmental [3].
In this paper, it was assumed that the constructed model of Management and Engineering for Sustainable Development will be universal and can be applied to companies operating in both manufacturing and service. The model will be aimed at optimizing and streamlining business processes focused on the implementation of green innovation. Extension of innovation issues, however, requires a broader form of expression analysis of the needs of business and legal regulations on environmental protection and implementation of new systems and process management methods have led to conducting research in this area and to define the model.

The basic premise of the model is designed to prepare organizations to operate in the new organizational model that provides effective and aimed at sustainable development of the business processes. Model should be implemented to ensure that the processes provided by the organizations meet the expected quality requirements of customers.

It was proposed to make the business model consisted of the following modules, shown schematically in Figure 1 in relation to the individual identified elements included in its scope (the module should implement the functions defined in the system for each module separately). The whole creates a kind of adhesive for the business model to take account of the processes, methods, management systems that enable the smooth functioning of the company. Nevertheless, the following characterizes each of the modules in order to more fully explain their methods of operation in the overall model.

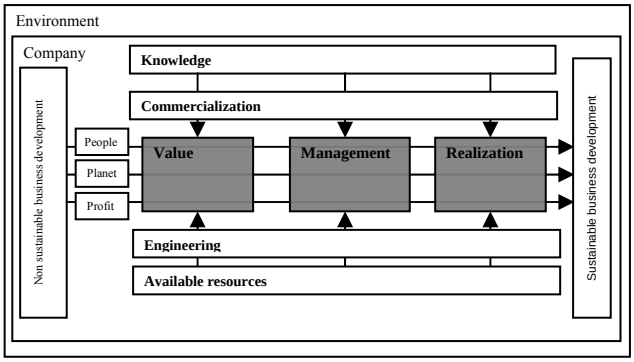

Figure 1 The management and engineering model for sustainable development)

The presented model consists of nine modules, each dependent (resulting from the integration of activities) between structural elements of the company:

1. Non – sustainable development of the company
2. Available knowledge
3. Management
4. Engineering
5. Available resources
6. Value
7. Realization
8. Commercialization
9. Sustainable development of the company

Non-sustainable development of the company: Each company operates in a turbulent environment. Changing ways of doing business, management systems, the values that guided the organization and the expectations of stakeholders. The result is a structurally unbalanced development, due to the unlimited exploitation of resources [4].
Currently, the public expects more companies' involvement in building a better quality of life and growth of enterprises in such a way that "it does not affect a significant irreversible environmental and human life, would not lead to degradation of the biosphere, which menaces laws of nature, economics and culture"[5]. Companies struggle with their place in the market and the need to measure itself against the best in the conditions of constantly changing environment the need to impose on the undertakings of its development.

Available knowledge: Knowledge is primarily, although not exclusively, scientific knowledge, it mainly deals with the epistemology and philosophy of science. In most organizations have become parties collect and process knowledge. Knowledge is identified in the database record of the different forms of knowledge. It is associated with factors such as culture, ethics, values, intuition, working conditions, management style, which creates conditions for the assimilation of new information in the form of all sorts of documents, standards and procedures [6]. Organizations that have the resources they are "able to prepare a proper strategy to their competence", defining thus the transition to a module which is *"available resources"* defined as the intellectual capital of organizations and intangible resources. Thus, knowledge has become a cohesive link information, human resources, IT systems, available technology in the process of intra-organizational activities.

Management: Knowledge management or information storage and processing of all data used in computerized systems. IT systems are one of many factors determining the effectiveness of using knowledge. They support all processes in the organization. The development of organizational knowledge is based on information processes[2] occurring in the enterprise and ICT. The use of information systems involves the need to make significant investments in tools and technologies. For information systems are based on even standard management systems, which include quality management systems, environmental systems, management systems, occupational health and safety. Presented systems can be integrated into one integrated management system. The basis for building an integrated system is ISO 9001, ISO 14001 and PN-N 18001, because these standards have a similar approach to the management and relatively consistent requirements. Application of the above information technology affects the acceleration processes in the organization [7]. Remain a pillar of the IT systems for customer relationship management CRM (Customer Relationship Management), which integrated with other applications such as: supply chain management (SCM) create an environment conducive to the sustainable management of the organization.
The most universal management concept in the organization is a comprehensive Quality Management. TQM should be understood as a holistic approach to management of the organization including management functions such as planning organizing, directing staff focused on the rational use of company resources while maintaining proper relations with the environment.

Engineering: In order to effectively use the principles of TQM in organizations, a number of techniques, methods, tools and management systems were developed. These tools can be divided depending on the programs of action into projective activities (field) in the range of:

- qualitative (QFD, FMEA, SPC, "SixSigma"
- environmental (clean production, recycling, CO2)
- occupational health and safety (PY, 5S, Keizen)
- social (codes, best practices).

Available resources: "Company resources are called all of its assets, capabilities, skills, organizational processes, attributes the company, information, knowledge, etc. controlled by the enterprise, enabling him to conceptualize and apply strategies for enhancing the efficiency and effectiveness*."* [8;9]. Companies, whose motto is to work towards sustainable development (who want to move towards sustainable development) should determine the available resources of knowledge and those resources that are impossible to achieve as a result of this strategy. In this way it becomes possible to define the strategy competence.

[2] A. Domanski defines as "a distinct temporal and spatial information processing system, which is a set intentionally interrelated elements, which are: data sources, methods of their collection and processing, information flow channels, material and human resources and the destination information", Introduction to Informatics, Author: Niedzielska E., Publisher PWE, Warszawa 1993.

”New working methods, modern machinery and equipment, new legislation (...), new technologies and new motivation strategies (...)” [10] are the resources that may become a source of competitive advantage, while being a source of sustained and sustainable development of enterprises, which enable company to operate in a competitive environment.

The sustainable development: The idea of sustainable development is the assumption of continuous economic and social progress harmonized with natural environment. It is a challenge to balance the activities in the areas of environmental, economic and social, while respecting the goods of nature “in order to ensure the possibility of satisfying the basic needs of individual communities or citizens of both the present generation and future generations” [11]. The contribution to ecological and environmental development was described in *Standards & guidelines: preliminary report* [12], in which there were included opportunities to maintain relationship between natural processes and human activity with improved practices that in turn reflect and sustain the contributions of ecological system services. This development leads to increased business competitiveness through sustainable investments carried out in accordance with the principle of so-called triple bottom line[3]. This concept is based on the description of three factors: the financial result (profit) combined with social responsibility (people) and concern for the ecological dimensions of activity (planets) that should form the basis for measuring and evaluating the functions of organizations in sustainable development. Companies that implement the objectives of sustainable development recognize the primacy of ecological requirements of economic activities, “all undertaken actions take into account the needs of future generation**”** [13;14].

The concept of sustainable business development is often associated with the concept of CSR (Corporate Social Responsibility). The idea of CSR is based on activity-based initiatives for sustainable development, respecting the economy, ecology and ethics. In a narrow sense, a commitment to business in favor of ethical conduct and contributing to economic development while demonstrating respect for people, communities and care for the environment. In supporting the idea of CSR can help the Global Compact principles, which are a kind invitation to drive in all spheres of activity, the ten principles of human rights, labor standards, environmental protection and anti-corruption. Compliance with these rules leads to making positive changes in the sphere of business operations.

By implementing a strategy for sustainable development organization based on social responsibility becomes possible to develop innovative solutions (eco-products). The innovation process should be involved all staff members who should be encouraged to develop sustainable solutions in a continuous and systematic. This ensures that all departments understand the organization recognize the impact of organization on the environment, economy and society.

Realization: Designing technologies in the field of sustainable development (environmental or ecological called), depending on their business, organizations should take into account the following criteria:

- sustainable production,
- “model of sustainable community”,
- protection and restoration of ecosystems and natural areas,
- efficiency in energy use,
- renewable energy,
- use of alternative energy sources in order to obtain solar and wind energy, geothermal source,
- environmentally friendly transport,
- waste, air pollution, water pollution, noise.

In the aspect of sustainable design / construction products interact with other concepts and forms of production organization, providing changes in the process and system of governance, mainly such as:

- Lean Management – slimming management so the idea is to simplify all processes and flows, in order to avoid errors and waste. It is visualized in the phase of construction or a change in production techniques and organization of work. The most popular Lean tools include: 5S, Kanban, SMED, TPM and standardization work (some of the tools described in the module, “Engineering”);
- Total Quality Management - a comprehensive quality management;
- Computer-Integrated Manufacturing (CIM), based on information technologies, which include Computer Aided Design (CAD), Computer Aided Engineering (CAE) and Computer Aided Quality (CAQ) as well as Flexible Manufacturing Systems. Through CIM is meant to assist the functions of product development, development of production planning and control of the production process, as well as the process to ensure quality [15].

Commercialization: This module is one of the factors, and also a module of the business model which has an impact on the process of enterprise sustainability management. Commercialization is to convert innovative ideas into ready to enter the market products. The introduction of technology to the market requires a lot of research and development and is also associated with huge costs and risks, which are accompanied from the moment a concept of technology. Commercialization process begins with a thorough diagnosis of the advantages of new technology (check the basic elements or components of the product in a laboratory environment and real, and then build a prototype product, and the final phase of the demonstration version of the product in use) and to assess the potential effectiveness and feasibility of the technology. The effectiveness of the commercialization of technology depends on market value, on the applicability of the technology in the economy. First of all, new technology has to find buyers. In the case of technology, environmental technology find buyers when it is competitive compared with other technologies for environmentally friendly, energy efficient, safe, and above all efficient. This last factor raises the most controversy in obtaining the necessary permits required for the release of technology on the market [16]. Choice of implementation strategies for product/technology on the market (including the sale of property rights, licensing, joint ventures, spin-off/out) depends on the organization and is linked to compliance with all legal requirements, environmental and financial.

Sustainable development of the company: Integration of activities grouped in the various modules leads to the concept of sustainable development companies. It appears that expectations for sustainable investment clients (environmental technology) to reduce the consumption of energy and raw materials reduce

[3] „Triple bottom line”, a concept for reporting business activities, introduced by John Ellington and described in his book titled: *Cannibals With Forks : The Triple Bottom Line of 21 Century Business,* New Society Publishers, Stony Creek, CT, 1998.

waste and pollution, "forcing" from peeling the right business strategies. European organizations also require the preparation of reports on the activities of the company, its influence on the development of the environment and showing that the company is able to strike a balance between the different aspects of your business.

3. CONCLUSIONS

More and more is spoken about the concept of an economy based on sustainable development in the context of production and service. Category of sustainable development of organizations associated with a range of systems, methods, tools and regulations to protect the environment. Hence, it has been proposed to build a model of the management and engineering for sustainable development model, using the strengths in existing and new areas of business activities. Proposed model described in the paper:

- combines the concept of innovation with a set of activities and resources necessary for its implementation, enabling the organization to achieve those objectives, and contribute to sustainable growth;
- takes into account elements of the business organization and management systems and essential to the knowledge of management science, in modern terms, using methods and tools and technologies;
- may be applied in contemporary managed enterprises.

It will allow for an adequate response to the frequent changes in the market and the changing needs of customers. This is possible only when companies begin to compete against themselves for the availability of manufacturing technology, capacity, and above all, quality customer service and offered them services.

4. REFERENCES

[1] A. Wycislik, B. Gajdzik, 2008, *Jakość, środowisko i bezpieczeństwo pracy w zarządzaniu przedsiębiorstwem* (Quality, environment and industrial safety in business management) Silesian Technical University, Gliwice, op. cit.; p.83 (http://en.wikipedia.org/wiki/Earth_Summit, (accessed on August 17th 2011).

[2] Mazur-Wierzbicka E., 2005, "Koncepcja zrównoważonego rozwoju jako podstawa gospodarowania środowiskiem przyrodniczym (Concept of sustainable development as the basis for the management of the natural environment)", [In:] Funkcjonowanie gospodarki polskiej w warunkach integracji i globalizacji (The functioning of the Polish economy in terms of integration and globalization), Department of Microeconomics of University of Szczecin; p.33-44; also available at http://mikro.univ.szczecin.pl/bp/pdf/18/2.pdf (accessed on August 17th 2011).

[3] Witek-Crabb A., 2005, Zrównoważony rozwój przedsiębiorstw – więcej niż ekorozwój. *Zrównoważony rozwój przedsiębiorstw a relacje z interesariuszami (*Sustainable development companies - more than sustainable development. *Sustainable development and business relations with stakeholders*) (red.) H. Brdulak, Oficyna Wydawnicza SGH, Warszawa, s. 561-568.

[4] Klos L., 2005, "Ekorozwój jako podstawa aplikacyjna założeń polityki ekologicznej (Sustainable developmet as a basis for environmental policy)", [In:] Teoretyczne aspekty gospodarowania (Theoretical aspects of management), Department of Microeconomics of University of Szczecin, p. 211-218; also available at http://mikro.univ.szczecin.pl/bp/index.php?a=f17g22 (accessed on August 17th 2011).

[5] Kozlowski S., 1996, Czy transformacja polskiej gospodarki zmierza w kierunku rozwoju zrównoważonego? (Does the transformation of the Polish economy tend towards sustainable development?) [In]: Mechanizmy i uwarunkowania ekorozwoju (Mechanisms and Determinants of Ecodevelopment), Bialystok University of Technology, Bialystok, p.19

[6] Davenport T.H., Prusak L, 1998, How Organizations Manage What They Know, Harvard Business Review.

[7] Lech P., 2003, Zintegrowane systemy zarządzania EEP/ERP II. Wykorzystanie w biznesie, wdrażanie"(Integrated management systems ERP/ERPII. Use in business, implementation), Difin, Warszawa.

[8] Daft R.,1987, Organization Theory and Design, New York, West, p.143.

[9] Word Commision on Environment and Development (WCED), 1987, Our common future, Oxford Univeristy Press, Oxford.

[10] Piasecki B. (eds.), 1999, Ekonomika i zarządzanie małą firmą (Small Business Economics and Management), PWN, Warszawa-Łódź, s.226.

[11] Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska: Dz. U. z 2001 r. Nr 62, poz. 627 (Act of 27 April 2001 Environmental Protection Law: Law Acts, 2001, No. 62, item. 627).

[12] Acknowledgments Product Development Committee, Standards & guidelines: preliminary report, Sustainable Site Initiative, 2007, p.5-17.

[13] Kozlowski S., 1994, Droga do ekorozwoju (The Way Towards Ecodevelopment), PWN.

[14] Pakulska P., Poniatowska-Jaksch M., Rozwój zrównoważony – „szeroka i wąska" interpretacja (Sustainable development – „broad and narrow interpretation", [In:] [online], available at www.sgh.waw.pl (accessed on August 17th 2011).

[15] Durlik L., 2004, Inżyniera zarządzania. Strategia i projektowanie systemów produkcyjnych (Engineering Management: strategies and designing productions systems), Publisher „Placet", Gdansk, p.149.

[16] Kluczek A., 2009, Komercjalizacja technologii dla zrównoważonego rozwoju (Commercialization of technologies for sustainable development), Przegląd Techniczny, 24/2009.

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