

# Informacioni sistemi kao determinanta ekološke održivosti

## Information systems as determinant of ecological sustainability

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**Apstrakt:** Održivi razvoj privrede moguć je samo ukoliko se obezbedi uravnoteženost sve tri dimenzije: ekonomske, društvene i ekološke održivosti. Kao rezultat uticaja ljudskog društva na prirodu, u poslednjim decenijama dvadesetog veka povećalo se zanimanje za ekološku održivost i analizu svih determinanti ovog koncepta. Pojavile su se brojne inicijative sa težnjom da se zaustavi ili uspori proces uništenja prirodnog blaga. Ekonomska nauka se, takođe uključila kroz istraživanje svih raspoloživih potencijala. Cilj ovog rada je da predstavi mogućnosti informacionih sistema u procesu unapređenja ekološke održivosti iz perspektive organizacija, imajući u vidu da ekološki proizvodi i usluge u dominantnom broju slučajeva ne omogućavaju konkurentsku prednost, jer podrazumevaju veće troškove. Informacioni sistemi omogućuju da se položaj ovih organizacija poboljša kroz povećanje eko-efikasnosti, razvoj eko-kapitala i dostizanje eko-efektivnosti. U radu su obuhvaćeni mogući načina na koje informacioni sistemi i tehnologija utiču na navedene koncepte. Analizirane su mogućnosti automatizacije, informisanosti i transformisanja. Poseban osvrtom je dat na situaciju u ovoj oblasti u Srbiji.

**Ključne reči:** informacioni sistemi, ekologija, održivi razvoj, eko-efikasnost, eko-kapital, eko-efektivnost

**Abstract:** Sustainable economic development is possible only by ensuring a balance of all three dimensions: economic, social and environmental sustainability. As a result of the impact of human society on nature, interest in environmental sustainability and analysis of all possible determinants increased in the last decades of the twentieth century. Also, numerous initiatives have emerged from the tendency to stop or slow down the destruction of the natural resource. Economic science is also involved in research of all available resources. The aim of this paper is to present the possibilities of information systems in the process of improving the environmental sustainability from the perspective of the organization, keeping in mind that environmentally friendly product and services do not provide a competitive advantage, because of the higher costs. Information systems make can improve the position these organizations through increased eco-efficiency, eco-equity and achieving eco-effectiveness. This paper covers the possible ways in which information systems and technology (ICT) impact on these concepts. The possibilities of automating, informing and transforming are covered. Special emphasis is given to the situation in this field in Serbia.

**Key words:** information systems, ecology, sustainable development, eco-efficiency, eco-equity, eco-effectiveness

## Introduction

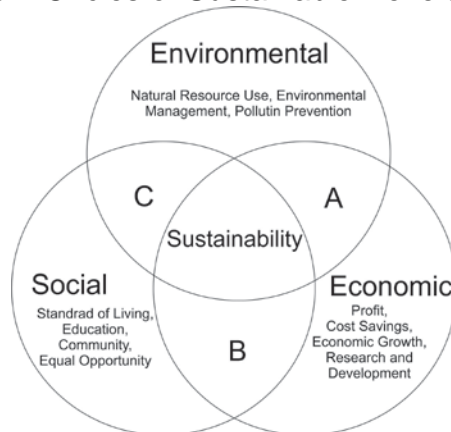
By the end of the nineteenth century, scientists were faced with the dilemma of whether Earth natural resources are limited (Basiago, 1999). Malthus (1798) was among the first noted that the population is increasing by geometric progression, while resources can only magnify following arithmetic progression and that this fact will significantly affect life on Earth. After these first indications, economic theory loses interest in studying the concept of environmental sustainability for a long period. However, coping with intensive use of non-natural renewable resources, the topic has become extremely relevant. It has become clear that humans must learn to live within the biophysical environment. This means that the main prerequisite for environmental sustainability is preservation of natural capital. Or further, "*holding the scale of the human economic subsystem (= population x consumption, at any given level of technology) to be within biophysical limits of the overall ecosystem on which it depends*" (Goodland, 2002). As a result of facing with the potential consequences of natural capital depletion numerous researches have been implemented with the aim to find opportunities for sustainability social development while preserving natural capital. One part of these research studies included the potential of information systems to support the process of environmental sustainability.

At the first part of the paper we defined phenomenon of sustainability and three main pillars, economic, social and environmental sustainability. At the second part we focused on ecological sustainability as a component of environmental sustainability and explained its economic goals: eco-efficiency, eco-effectiveness and eco-equity. We show that information systems can be good support for achievement listed goals. Finally we presented the current situation in Serbia.

### 1. Economic, social and environmental sustainability

The idea of sustainability has its roots from 1970ies. It was a major topic of the United Nations Conference on the Human Environment in Stockholm in 1972. The concept was coined explicitly to suggest that it was possible to achieve economic growth and industrialization without environmental damage (Adam, 2006). After the first attempts, ideas about sustainability were developed through the World Conservation Strategy (1980), the Brundtland Report (1987), and the United Nations Conference on Environment and Development in Rio (1992), as well as in national government planning and wider engagement from business leaders and non-governmental organizations of all kinds. Generally the sustainability can be defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Bruntland Commission, 1987). The core of mainstream sustainability thinking has become the idea of three dimensions: environmental, social and economic sustainability (Adam, 2006). In most papers these dimensions are presented as pillars, concentric circles or interlocking circles. We find that interlocking circles presented in Figure 1 are most appropriate way to understand interdependence of these dimensions.

Figure 1 Circles of Sustainable Development



Source: *Sustainability Report (2002, p. 8)*

Economic sustainability means the economic growth in balance with eco-system. Social sustainability relies on the social reducing poverty, peace and the social justice, while environmental sustainability is related with the consciousness for planet and all the resources that must be protected. In the overlaps of the circles we can find key efforts regarding sustainability: A) Environmental-economic: energy efficiency and subsides / incentives for use of natural resources; B) Economic-social: business ethics, fair trade and worker's rights and C) Social-environmental: environmental justice and natural resources stewardship locally and globally.

## 2. Goals of ecological sustainability

Ecological sustainability is a component of environmental circle within sustainable development. The main problem is that most companies pay attention only to economic sustainability without concerns of natural resources as a key element of long-term viability. In many cases eco-friendly technologies and practices are not cost-efficient, especially in the short term, so companies avoid using them. Even bigger problem exist in developing countries, in perennial debt crisis, because they "do not have the financial capital to acquire new ecologically friendly technologies" (Shrivastava, 1995). On the one hand, information systems can play an important role in raising awareness of and controlling energy efficiency in a variety of areas, such as smart cities and smart buildings, traffic control, and utility management. Therefore, we can talk of designing information systems for sustainability or analyze the way how information systems can contribute to ecological sustainability in organizations (Pernici, 2012; Chen, 2008). Authors (Chen, 2008; Guenster, 2011) did research studies and empirical analysis based on framework which is relied on three goals of ecological sustainability: eco-efficiency, eco-effectiveness and eco-equity. Each goal can be supported with information systems in particular way.

*Eco-efficiency.* Efficiency means doing more with less, or "doing thing right", but in the connection with ecology this term can be described as "the combination between economic and ecologic efficiency, reducing an ecologic impact while adding economic value" (Munck, 2013). Companies tend to offer goods and services at competitive prices with respect of ecology. World Business Council for Sustainable Development (WBCSD) identified seven elements of eco-efficiency: reduction of material intensity, reduction of energy intensity, reduction of the dissipation of toxic substances, enhancement of recyclability, maximisation of the use of renewable

resources, extension of product durability and increase in service intensity (Wang & Cote, 2011). Information systems can support eco-efficiency through *automation*, which reduces human work to minimum and also through *information efficiency* enhancement. Most important savings are effects of new ways of telecommunication and digitalization. For instance, communication over Internet reduces cost for workspace or travels and digitalization minimizes the use of paper. As a result of that companies can achieve less cost for their goods and services, and environment is less exposed to pollution or deforestation.

*Eco-effectiveness*. Effectiveness means capability of producing a desired result or “doing the right thing”. Eco-effectiveness questions whether the resource is being used in an environmentally appropriate manner and it should be supported by eco-efficiency to manage the environmental consequences. Information systems role in achieving eco-effectiveness can be seen as a support for fundamentally changing of relationship among enterprises, i.e. as an organizational issue. Networks, telecommunications and information systems enabled organizations to connect across time and space and change the *transfer* process. Transfer have important role in reorganization of systems, where a good example is open source software development (Vukićević & Milošević, 2012). During the development of open source software there is no need for any physical connection between the participants in the production, which basically changes the organizational chart production.

*Eco-equity*. Eco-equity is the right of all nations in relation to natural resources, and also implies that resources must be allocated equally among the generations of people in Earth. This goal is very hard to achieve because of main characteristics of industrial production, as we mentioned above. Basically, eco-equity lies between society and business. The main role of information systems in the process of achieving eco-equity is through the development of awareness toward ecological problems, by increasing certainty, transparency and emotivity, through the *informate* process. The widespread use of the Internet has greatly facilitated fast and easy dissemination of information regardless of geographical areas. The use of an appropriate medium can create an enduring emotional impact on the audience through increased certainty, transparency and emotivity, i.e. seal hunting or deforestation (Chen, 2008).

Empirical evidence shows (Taha Ijab, Molla, 2011) that companies usually applied three methods in order to achieve environmental sustainability: pollution prevention, product stewardship and sustainable development. Pollution prevention can be reached through the automation and transformation. Product stewardship is a product-centered approach to ecology protection where everyone involved in the production process take up responsibility to reduce its environmental, health and safety impacts (USEVP) and it can be reached through transformation. Finally, sustainable development involves the use of technology solutions in business processes that enable resources conversation, energy efficiency, reducing environmental pollution and low waste (Hart, Kolk & Sharma, 2012) and can be supported by information systems and technology in all three processes: automation, transfer and informate.

### 3. Serbia

#### Conclusion

Green IS can contribute to sustainability through automating, informing and transforming products, processes, behaviours, and relationships to support environmental sustainability. Thus, in the same way information systems have transformed modern business to provide significant productivity improvements, IS has the potential to enable sustainable ecological, economic and social practices. IS researchers are therefore presented with opportunities to investigate and provide solutions to transform the impact of individuals, organisations and society and thus provide leadership in sustainability.

#### References

- Adam, W.M., (2006), *The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century*, Report of the IUCN Renowned Thinkers Meeting, 29-31 January 2006, The World Conservation Union.
- Basiago, A.D., (1999), Economic, social, and environmental sustainability in development theory and urban planning practice, *The Environmentalist* 19, p.p. 145-161.
- Chen, A.J.W., Boudreau, M., Watson, R.T., (2008), Information systems and ecological sustainability, *Journal of Systems and Information Technology*, Vol. 10, No. 3, pp. 186-201.
- Goodland, R., (2002), *Sustainability: Human, Social, Economic and Environmental*, *Encyclopedia of Global Environmental Change*, John Wiley & Sons.
- Guenster, N., Bauer, R., Derwall, J., Koedijk, K., (2011), The Economic Value of Corporate Eco-Efficiency, *European Financial Management*, Vol. 17, No. 4, pp. 679-704.
- Hart, S.L., Kolk, A., Sharma, S., (2012), Sustainable Global Enterprise: Perspectives, *Journal of Management Inquiry*, p.p. 161-178.
- Malthus, T., (1798), *An Essay on the Principle of Population*, Printed for J. Johnson, in St. Paul's Church-Yard.
- Munck, L., Cella-de-Oliveira, F.A., Bansi, A.C., (2013), Eco-Efficiency: A Construct in the Eyes of Organizational Competences, *Business Management Dynamics*, Vol. 2, No. 8, pp. 01-07.

Pernici, B., Aiello, M., vom Brocke, J., Donnellan, B., Gelenbe, E., Kretsis, M., (2012), What IS Can Do for Environmental Sustainability: A Report from CAiSE'11 Panel on Green and Sustainable IS, *Communications of the Association for Information Systems*, Vol. 30, Article 18.

Shrivastava, P., (1995), The Role of Corporations in Achieving Ecological Sustainability, *The Academy of Management Review*, Vol. 20, No. 4, pp. 936-960.

Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus, (2002), Center for Sustainable Systems, University of Michigan.

Taha Ijab, M., Molla, A., (2011), The Study of Green Information Systems from the Theory of Practice Perspective, *MCIS 2011 Proceedings*, [works.bepress.com/mohamadtaha\\_ijab/4/](http://works.bepress.com/mohamadtaha_ijab/4/) .

U.S. Environmental Protection Agency, USEPV, [www.epa.gov/epawaste/consERVE/tools/stewardship/index.htm](http://www.epa.gov/epawaste/consERVE/tools/stewardship/index.htm).

Vukićević, S., Milošević, S., (2012), IT, Innovations and Sustainability, *Book of Proceedings, Symopis 2012*, pp. 1818-1822.

Wang, G., Cote, R., (2011), Integrating eco-efficiency and eco-effectiveness into the design of sustainable industrial systems in China, *International Journal of Sustainable Development & World Ecology*, Vol. 18, No. 1, pp. 65–77

Whiteman, G., Walker, B., Perego, P., (2013), Planetary Boundaries: Ecological Foundations for Corporate Sustainability, *Journal of Management Studies*, 50:2, pp. 307-336.

World Commission on Environment and Development's (the Brundtland Commission) report *Our Common Future*, Oxford: Oxford University Press, 1987.