TOWARDS MEASUREMENT OF SUSTAINABLE DEVELOPMENT: SYSTEMS OF INDICATORS

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Abstract. The aim of the paper is to review the international organizations' approaches to the measurement of sustainable development and explore the system of indicators provided by the considered organizations. The systems of proposed indicators to measure sustainable development are being juxtaposed, specific features, advantages and disadvantages revealed. Organizations for sustainable development were founded to review progress at the international, regional and national levels in the implementation of sustainable development policy, to take part in legislative process, to control balance between economic development, social development, and environmental development.

1. Introduction

A lot of opinions related to the estimation of sustainable development in scientific literature can be found. Separate group of scientists deals with the issues of analysis of the chosen system of indicators (e.g. Tvaronavičienė *et al.* 2008, Grybaitė, Tvaronavičienė 2008). Systematisation of prevailing approaches serves as the purpose of presented publication. The ultimate aim of systematisation is seen as a step towards partial unification of sustainable development estimation, which in its turn, would serve as a premise of more efficient process control. Speculations about applicability of any system of currently available institutional indicators are seen as the urge towards further accomplishments. On the institutional level, the concept of Sustainable development was introduced in 1980 and appeared in the World Conservation Strategy. "For development to be sustainable it must take account of social and ecological factors, as well as economic one". (The World Conservation Strategy 1980). The

concept was developed by the World Commission on Environment and Development (WCED) in its report *Our Common Future*, more commonly known as "the Brundtland Report" (Brundtland 1987). It was defined as "ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is not a fixed state of harmony but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs" (Brundtland 1987). It was emphasized that the economic growth is not enough. Sustainable development involves more than growth. In its broadest sense, the strategy for sustainable development aims to promote harmony among human beings and between humanity and nature. Sustainable development requires that societies meet human needs both by increasing productive potential and ensuring equitable opportunities for all. (UN 1987). In

the 1992 UN Conference on Environment and Development in Rio de Janeiro (the "Earth Summit"), it was emphasized that "sustainable development can be defined simply as a better quality of life for everyone, now and for generations to come. It is a vision of progress that links economic development, protection of the environment and social justice, and its values are recognized by democratic governments and political movements the world over" (UN Conference on Environment and Development 1992). Sustainable development is a big challenge for the societies and the main goal. Strategies, plans, policies and processes are crucial in achieving this. The European Union presented the sustainable development strategy in 2001, which was renewed in 2006. The main purpose of the strategy is to provide the EU-wide policy framework to deliver sustainable development, i.e. to meet the needs of the present without compromising the ability of future generations to meet their own needs (The Council of the European Union 2006). Not going into discussion about various aspects of Sustainable development comprehension, we point out that a multitude of facets of considered category has been reflected in the sets of indicators composed by various institutions. The aim of the paper is to reveal similarities and, even more, differences of institutional approaches towards Sustainable development. A range of institutions tackling the issue of sustainable development has been established. From analytical point of view, the system of indicators is required for estimation and later provision of policy recommendations. Let us take a closer look at the systems of indicators, suggested by the considered international institutions. To monitor sustainable development, the set of indicators are needed. They have to reflect three aspects of sustainable development: economic, social and ecological. In 1992 the United Nations Conference on Environment and Development emphasized the importance of sustainable development indicators, which can help the countries to make informed decisions concerning sustainable development. The indicators can help measuring the progress towards sustainable development and providing early warning to prevent social and environmental setbacks, leading to better decisions and more effective actions (United Nations 1992).

2. Estimated Facets of Sustainable Development

Multi-effort trials to provide definition of Sustainable development on the institutional level (even

more ample on scientific one, which is not being considered within the framework of given paper) verify complexity of estimation task. Naturally, complex phenomenon can be characterized only by a system of indicators. The European Commission emphasizes, "the indicators selected should not be seen in isolation but rather as different elements of the same picture" (European Commission 2000). Hence, composing of appropriate in terms of all relevant facets reflection, indicators' system is seen as an ultimate aim. It is worth to notice that a question "how" to integrate extended system is not being raised. Before going to the latter question, let us have a look at the systems of indicators introduced by different institutions. The European Union institutions use systems of indicators, which could be seen as three sets. The set of *Short-term indicators* is supposed to be used for the assessment of cyclical situations and performing of forecasts. The most *Short-term indicators* are collected to provide frequent and up-to-date reflection of the economy development processes. Short-term indicators' set is considered as not suitable for comparison of the countries' development level. Short-term indicators are divided into eight areas: balance of payments, business and consumer surveys, consumer prices, external trade, industry, commerce and services, labour market, monetary and financial indicators and National Accounts (EUROSTAT). The set of *Structural indicators* are supposed to be more suitable and are actually used (Tvaronavičienė *et al.* 2008, Tvaronavičienė *et. al.* 2009)) for the countries' comparisons as they embrace main macroeconomic indicators and cover such policy domains as general economic background, employment, innovation and research, economic reform, environment and social cohesion (European Commission, Eurostat 2010). The set of structural indicators are being revised depending of the main strategic goal. In 2000 the European Union set a strategic goal „of becoming the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion " (European Council 2000). In 2005 a greater focus was on growth and jobs. From 2010 a revised set of structural indicators has been presented to monitor the progress towards the goals defined in the Lisbon Strategy. The main attention focus on the three main goals: „creating value by basing growth on knowledge, empowering people in inclusive societies, creating a competitive, connected and greener economy" (EU 2020 Strategy). The structural in-

dicators reflect the main themes: general economic background; employment; innovation and research; economic reform; social cohesion; environment. The systems of indicators are not stable and are being changed according to the main goals. The indicators are being improved and some indicators are replaced by better ones, some new added. For better convenience, a short list of 14 indicators is used. The set of *Sustainable development indicators* resembles *structural indicators'* set. They have the same periodicity as *Structural indicators* and are partly overlapping (including e.g. GDP per capita, unemployment, poverty rate). The impression is that the indicators of sustainable development can be treated as a variation of structural indicators. The main difference is that these two sets put emphasis on different aspects of development. While the indicators of sustainable development tackle social and environmental facets, structural indicators put stress on economic development. Here it is worth mentioning that some indicators attributed either to *Sustainable development indicators* or to *Structural* ones in some cases are interrelated and the performance of one affect value of other. The series of such estimations are being performed (Tvaronavičius, Tvaronavičienė 2008; Tvaronavičienė 2006). The systems of institutional indicators, as a rule, do not pay attention to factor of overlapping. On the contrary, the impression is that the increase in a number of facets embraced serves as an ultimate goal, while the issues related to any kind of analysis of provided information are not being taken into account.

3. Sustainable Development Indicators

As it was mentioned above, *Sustainable development* indicators reflect environmental, social and economic aspects of development. Nevertheless, 5 main compositions of *Sustainable Development indicators* can be distinguished:
EUROSTAT Sustainable development indicators;
United Nations indicators;
European Environment Agency;
OECD indicators;
SIBIS indicators.

Sustainable development indicators (EUROSTAT) are divided into 10 themes: socio-economic development**;** Sustainable consumption and production; Social inclusion; Demographic changes; Public health; Climate change and energy; Sustainable transport; Natural resources; Global partnership; Good govern-

ance. The purpose of the indicators is to display a picture of the countries' achievement towards sustainable development. In every indicator group several tracks or sub-groups have been distinguished. The indicators are attributed to different sub-groups taking into account their content. Some indicators characterize specifically, e.g. females, males, different age, education and other groups. As was mentioned above, the systems of indicators are not stable and are being changed according to the main goals. The indicators are being improved and some indicators are replaced by better ones, some new added. As shown below, a number of indicators changing and new contextual indicators have been added to the system. The first indicator group is named *Socio-Economic development.* This group is being composed of 3 sub-groups: Economic development, Innovation, Competitiveness and Eco-efficiency and Employment. *Socio-Economic development* group contains 16 indicators (previously – 15). The second group is *Sustainable Consumption and Production*. This group contains 18 indicators (previously – 17), which are being attributed to the following sub-groups: Resource use and waste, Consumption patterns, Production patterns and two Contextual indicators. The third indicator group is *Social inclusion* that also contains 3 sub-groups that, in their turn, have 20 indicators (previously – 15), plus 1 contextual indicator. The fourth group's *Demographic changes* sub-groups are: Demography, Old age income adequacy and Public finance sustainability, which altogether contain 8 indicators and plus 4 contextual indicators. The fifth group *Public health* is comprised of Health and Health inequalities, Determinants of Health (12 indicators) respectively. The sixth group *Climate change and energy contains 2 sub-groups.* Those Sustainable development facets are being reflected by 12 indicators. The seventh group *Sustainable Transport is of 2 sub-groups: Transport and mobility and Transport impacts (instead of former 3 -* Transport growth, Transport prices and Social and Environmental impact of transport) (12 indicators) and 1 contextual indicator)) that are seen as urgent issues. The eighth group N*atural resources* contains the following sub-groups: Biodiversity, Marine ecosystems, Fresh water resources, Land use (11 indicators, previously – 13). The ninth group is *Global partnership*, it embraces the following three aspects or subgroups: Globalisation of trade, Financing for Sustainable development, and Global resource management; the group contains 11 indicators (previously - 13 and 3 contextual indicators). And the

last, the tenth group is *Good governance*, characterized by Policy coherence and effectiveness, Openness and participation and Economic instruments sub-groups, including 6 indicators. This classification adopts specific approach, when division of indicators into groups and, later, into subgroups, let rather easily perceive aspects of Sustainable development under consideration. Again, interrelationship between indicators within one group, or those, attributed to different groups (e.g. between governance and innovations, (Tvaronavičienė, Korsakienė 2007) and many other interrelations (Tvaronavičienė, Grybaitė 2007; Tvaronavičius, Tvaronavičienė 2008; Tvaronavičienė, Tvaronavičius 2006)) are not being considered.

United Nations indicators' system cover 15 themes (Poverty, Governance, Health, Education, Demographics, Natural hazards, Atmosphere, Land, Oceans, seas and coasts, Freshwater, Biodiversity, Economic development, Global economic partnership, Consumption and production patterns), which can be divided into 4 general groups: Social, Environmental, Economic, and Institutional. The first two sets of sustainable development indicators developed between 1994 and 2001. The larger set of indicators contains 96 indicators and the shorter core set – 50. The set of 96 indicators provide more comprehensive assessment of sustainable development. Similar approach, as in the case of *Eurostat* Sustainable Development indicators, has been adopted: in each theme specific aspects or subthemes are distinguished. The first theme, *Social* indicators, highlights the following facets: Health, Education, Poverty, Demographics, and Natural hazards. In their turn, those facets are composed of sub-themes. Poverty facet is composed of Income poverty, Income inequality, Sanitation, Drinking water, Access to energy and Living conditions sub-themes. *Health* facet contains 4 sub-themes: Nutritional Status, Mortality, Health care delivery, Health status and risk. *Education* is seen as composition of Education level (4 indicators) and Literacy aspects. Demographics facet is reflected by Population and Tourism sub-themes. Natural hazards facet contains two sub-themes: vulnerability to natural hazards and Disaster preparedness and response. *United Nations Social* indicator group is very different from other classifications: *Eurostat* classification has *Poverty and social exclusion*, *Ageing society* and *Public health groups*. *United Nations* provide more information about health and about poverty than education. Distinctive feature of *United Nations* is attention to

natural hazards. It is obvious that emphasis on different aspects of social side of Sustainable development is being put. The second general group of *United Nations* Sustainable development indicators is *Environmental* indicators. That group emphasizes 5 facets: Atmosphere, Land, Oceans, Seas and Coasts, Fresh water, Biodiversity. Atmosphere facet is reflected by 3 sub-groups: Climate change, Ozone layer depletion, Air quality. Land facet includes 4 sub-groups: Agriculture, Forests, Desertification, and Land use and status. Oceans facet has 3 sub-groups: Coastal zone, Fisheries and Marine environment. Fresh water facet contains 2 subgroups: Water quantity (2 indicators), Water quality (3 indicators). Biodiversity is composed of 2 sub-groups: Ecosystem (4indicators), Species (3 indicators). To conclude, *United Nations* classification has the largest list of indicators. *Eurostat* classification introduces Climate change and Energy. Considered institutions do not divide *Environmental* indicators into sub-groups, i.e. specific aspects are not distinguished. Hence, *United Nations* Sustainable development *Environmental* indicators seem to be more extensive and thoroughly systematized.

The third general group is *Economic* indicators. The following facets of economic development are distinguished: Economic development, Consumption and Production patterns and Global economic partnership. Economic development is represented by 5 subthemes, such as Macroeconomic performance (indicators: GDP per capita, Investment share in GDP, Gross saving, Adjusted net savings as percentage of GNI, Inflation rate (again, many theoretically grounded and quantitatively estimated interrelations (Tvaronavičienė, Grybaitė 2007; Tvaronavičius, Tvaronavičienė 2008; Tvaronavičienė, Tvaronavičius 2006)) are not being taken into account), Sustainable public finance (Debt to GNI), Employment (Employment-population ratio, Labour productivity labour costs, Share of women in wage employment in the non-agricultural sector), Information and communication technologies (Internet users per 100 population, Fixed telephone lines per 100 population, Mobile telephone subscribers per 100 population), Research and Development (Gross domestic expenditure on R&D as a percent of GDP)(impact of stare policy on the latter indicator is not being taken into account (Tvaronavičienė, Korsakienė 2007)), Tourism (Tourism contribution to GDP). The Tourism sub-theme in Social Theme, Demographics sub-theme contains different indicator - Ratio of local

residents to tourists in major tourist regions and destinations. Global economic partnership contains two sub-themes: Trade and External financing. Consumption and production patterns include the following sub-themes: Material consumption, Energy use, Waste generation and management, Transportation. Notably, those economic indicators are being emphasized. If not consider the mentioned interrelations between the indicators (Tvaronavičienė, Grybaitė 2007; Tvaronavičius, Tvaronavičienė 2008; Tvaronavičienė, Tvaronavičius 2006; Tvaronavičienė, Korsakienė 2007), the provided system could be characterized as a rather comprehensive one. The last general group is *Institutional* indicators. It consists of one theme – Governance that contains two sub-themes: Corruption (Percentage of population having paid bribes) and Crime (Number of International homicides per 100,000 population). *Eurostat* classification measures good governance and global partnership. The themes distinguished by Eurostat and United Nations contain different indicators. Global partnership and public participation are not being taken into account in the United Nations system of indicators.

European Environment Agency's indicators are devoted exclusively to the environmental issues. The European Environment Agency is an agency of the European Union, which started its functioning in 1994. The European Environment Agency's indicators are grouped into 23 (previously – 24) main themes. As the system of structural indicators was changed, *the European Environment Agency* changed the system of indicators: some new indicators were added to the system, the names of some of them were changed, i.e Air to Air pollution, Biodiversity change to Biodiversity, Households to Household consumption, Policy analysis to Policy instruments, Waste to Waste and material resources. The new ones added: Environment and health, Environmental scenarios, Land use, Noise. The indicators removed from the system: Regions, Nature, Air quality, Ozone depletion, Human health. The remaining indicators: Agriculture, Chemicals, Climate change, Coasts and seas, Energy, Fisheries, Industry, Natural resources, Population and economy, Soil, Tourism, Transport, Urban environment, Water. Not going into all the themes, just take a look at major characteristics of the system. Hence, in this system sub-groups are not distinguished; indicators are attributed to the listed facets. After considering indicator systems provided by other institutions, it would seem that approach adopted, e.g. by *United Nations* is more acceptable. Recall, that

United Nations Environmental indicators presented facets reflected by the following sub-themes: Atmosphere (Climate change, Ozone layer depletion, Air quality), Land (Agriculture, Forests, Desertification, and Land use and status), Oceans, Seas and Coasts (Coastal zone, Fisheries and Marine environment), Fresh water (Water quantity, Water quality), Biodiversity (Ecosystems, Species). Juxtaposition of *United Nations Environmental* and *European Environment Agency's* classifications leads to a conclusion that the latter is rather poorly structured. In some cases facets under consideration overlap (e.g. *Air* and *Air quality*, each related to various kinds of emissions and pollution). Distinguished facets of households, nature waste leave a vague impression about issues being tackled. The impression is that *European Environment Agency's* indicators could be better structured. This institution does not provide sufficient information for each year, what makes adopted system inappropriate for analytical purposes (Tvaronavičienė *et al.* 2008). On the other hand, the advantage of this classification lies in providing given policy issues and its' assessment for each *Environmental* facet. E.g. *Transport* indicators are related to pollution, energy, and access to services, fuel, and transport infrastructure, age of vehicle, costs of transport, freight transport, passenger transport, and traffic noise; i.e. transport theme provides a wide range of indicators. *Water* indicators embrace accidents by ships, water quality, and classification of water, pollution, drinking water, use of water, water prices. Some indicators are attributed to Water facet, but they could be included into Coasts and seas facet equally successfully, we reckon. 13 Indicators represent Agriculture facet. Climate change, Air and Air quality (the latter two already mentioned above) are distinguished into separate facets. Climate change is being estimated by the following indicators: Global and European temperature, Atmospheric greenhouse gas concentrations, Greenhouse gas emission projections, Greenhouse gas emission trends, Transport emissions of greenhouse gases by mode, North Atlantic Oscillation, The North Sea cod (Gadus morhua) stock. Natural resources indicators should be included into Nature theme, which is represented by 8 indicators. Natural resources theme has only 2 indicators and overlap with Nature theme indicators. Human health theme contains 3 indicators: Emissions of primary particles and secondary particulate precursors, Transport contribution to air quality and Transport accident fatalities. The more coherent approach would be achieved if those indi-

cators were attributed to Transport theme. Tourism indicators are: Tourism eco-labelling, Tourism intensity, Tourism travel by transport modes, Household expenditure for tourism and recreation. Hence, given indicators show the impact of tourism on environment. Notably, some indicators from Urban environment themes (e.g. municipal waste generation, water uses by sectors, drinking water quality) overlap with Waste, Agriculture, Households themes of indicators. To conclude, environmental issues are thoroughly discussed in the European Environment Agency classification but facets and indicators attributed to each of the facet could fall under criticism.

The Organization for Economic Co-operation and Development (OECD) was established in 1947. It helps its member countries to achieve sustainable economic growth and employment. The OECD, similarly to European Environment Agency is concentrated on environment issues of Sustainable development. In 2001 the OECD established a short list of indicators to meet countries' need to inform societies and to support wider communication with the community. The OECD classification embraces the so-called, *Issues*, *Available* indicators and *Medium term* indicators. *Available* indicators are indicators for which data are available for a majority of the OECD countries. These indicators are: CO2 emission intensities index of greenhouse gas emission, Indices of apparent consumption of ozone depleting substances, SOx and NOx emission intensities, Waste water treatment connection rates, Intensity of use of water resources, Intensity of use of forest resources, Intensity of use of fish resources, Intensity of energy use, Endangered species. *Mediumterm indicators* are indicators that require further specification and development (availability of basic data sets, underlying concepts and definitions). *Mediumterm indicators are*: Index of greenhouse gas emission, Indices of apparent consumption of ozone depleting substances plus aggregation into one index of apparent consumption of ozone depleting substances, Population exposure to air pollution, Total waste generation intensities and indicators derived from material flow accounting, Pollution loads to water bodies, Intensity of water resources plus sub-national breakdown, Intensity of forest resources, Intensity of use of fish resources plus closer link to available resources, Energy efficiency index, Species and habitat or ecosystem diversity area of key ecosystems. All the presented indicators could be divided in two major groups: natural resources

and pollution. Notably, despite the fact that the considered classification presents 10 facets, it looks sufficiently comprehensive. It is a specific feature that more attention is paid to air quality than to other environmental spheres, such as water and land (coasts, rivers, seas, soil are not being considered). The *Organization for Economic Co-operation and Development' (OECD)* classification is suitable for analytical purposes when only basic indicators are being considered. On the other hand, conciseness of this classification in some cases may be seen as an advantage.

SIBIS (Statistical Indicators Benchmarking the Information Society) is a project in the "Information Society Programme" of the European Commission which was running from January 2001 to September 2003. SIBIS has taken up the challenge of developing innovative information society indicators and to enable the benchmarking of the progress in the EU Member States. SIBIS indicators are social. Each group of indicators has its facets or "sub-domains". *Telecommunications & Access* group has 7 sub-domains: Technology, infrastructure, Access – choice, Use, Access – quality, Access – cost and Market, reflected by 38 indicators related to Internet, cable TV, mobile telephones and other technologies. *The Internet for R&D* group has three sub-domains: Infrastructure, Research processes, R&D collaboration. 21 indicators are included into the group. They express the Internet importance to research and development: E-mail communication for R&D purposes, Effects of computer skills on R&D, etc. *Trust and Security* group has only one sub-domain – Trust and security – and 25 indicators. These indicators are related to computer crimes, security spending, and security controls. *Education* group does not have sub-domains, but it has 4 parts: A – Policy and strategy; B – Economy & infrastructure; C – Use and access; D – Competencies. There are 49 indicators in education group. They are related to ICT implementation at school, the Internet use and access, specialist ICT teachers, expenditure on ICT, etc. *Work, employment and skills* indicators embrace into thematic domain sub-domains, indicators. Every given Work, employment and skills indicator also has sub-indicators. E.g. *Labour productivity* indicator of Output of employment sub-domain has 2 sub-indicators: Labour productivity (statistic) and Labour productivity growth, etc. The sixth group of SIBIS indicators is *Social inclusion*. This group is divided into three parts:
1. Identifying the vulnerable change.

2. Access to ICTs and accessibility.
3. Rationale for participation in the IS.

This group is represented by 55 indicators. The seventh group is *E-commerce*. It has three groups: E-commerce readiness, E-commerce intensity and E-commerce impact. The eighth group is *E-government*. These indicators aim at measuring the use of government service online, the use of the Internet and its access from home, consider the level of sophistication of specific online services. The last group of SIBIS indicators is H*ealth*. These indicators are divided into 2 groups: System quality and System usage. System quality has six sub-domains: Background of system developers, Purpose of the application, Content of the application, Confidentiality procedures, Design of the website, Evaluation of the website. System usage group has three sub-domains: Barriers to system usage, Patients and public usage of E-health systems, Practitioners usage of E-health systems. SIBIS indicators are specialized. They all are related to ICT, information system, so they can be used just in a specific way. They are considered as being sufficiently comprehensive.

4. Conclusions

The concept of Sustainable development on the institutional level was introduced in 1980. The key role of evaluating the countries' progress towards sustainability plays the sustainability indicators. The system of indicators is required for the estimation and later provision of policy recommendations. Trials to define the system of indicators illustrate the complicity of the task itself, no single definition could be accepted as accomplished. The international organizations have introduced the systems of indicators composed for Sustainable development measurement and management purposes. Despite general agreement on the main aspects of Sustainable development (economic, social and environmental), the main international organizations use rather differing systems of indicators. In the paper institutional approaches towards Sustainable Development were considered, the systems of indicators juxtaposed. It appeared that each classification emphasizes different Sustainable development facets and is differently composed. It was observed that the systems of indicators are not stable and are being changed. The systems of institutional indicators, as a rule, do not pay attention to overlapping and interdependence of some indicators (Tvaronavičienė, Grybaitė 2007; Tvaronavičius, Tvaronavičienė 2008; Tvaronavičienė, Tvaronavičius 2006; Tvaronavičienė, Korsakienė 2007, Tvaronavičienė *et. al.* 2009). On the contrary, the impression is that the increase in a number of facets embraced serves as an ultimate goal, while the issues related to any kind of analysis of provided information are not taken into account. Applicability of any system of currently available institutional indicators is seen as the urge towards further accomplishments. As scientific practice witness (Tvaronavičienė *et al.* 2008, *Tvaronavičienė et al.* 2009)), any task-oriented analysis requires a short-list of indicators otherwise comparisons of the countries and sustainable development management process are hardly feasible.

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