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Whether we are still immature to assess the environmental KPIs!

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Abstract

This paper explores the relationship between company maturity level and environmental key performance indicator (KPI) assessment. A cross-sectional approach was taken to examine differences among low and high maturity organizations, measuring the level of environmental KPIs importance assessed by 51 project portfolio managers. The assessment has been prepared according to Regulation (EC) No 1221/2009 of the European Parliament and the Council 2009, and IPMA Delta model for maturity assessment (individual, project and organizational level assessment). Differences between environmental KPIs and individual, project and organizational maturity were observed. Data analysis was prepared using SPSS 20.0 software and Rapid Miner Studio 6.0. The initial step was related to the determination of the relationship between environmental KPIs areas (Material Efficiency, Energy Efficiency, Water Management, Waste Management, Biodiversity, Emissions into the air). K-means algorithm was performed in order to identify group characteristics. Man Whitney test was used for group comparison to determine environmental KPIs differences that are related to organizational, project and individual maturity level. The research findings are described by mean and standard deviation. Analyzing individual, organizational and project factors, influential maturity components were identified using linear regression analysis method. Project portfolio managers' demographics have taken into account in this analysis. The study showed a significant difference between high mature and low mature organizations in environmental KPIs assessment according to project and individual level, but there is no difference according to the organizational level. Theoretical and practical implications are discussed.

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Keywords: maturity, assessment, project portfolio managers, IPMA Delta model, environmental KPIs

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1. Introduction

Nowadays, majority of organizations are seeking to achieve sustainable development resepecting the "green approach", emhasizing eco-efficiency aspects and striving to achieve business maturity in orderd to improve processes. There are different models for project and organizational maturity assessment. Most of them have been inspired by the Capability Maturity Model development. Previous studies have shown that organizations with a higher level of maturity show a higher level of efficiency and effectiveness. Maturity Models provide a framework for project initiation, implementation and improvement. According to Backlund et al. (2014) the benefits of project management maturity assessment lie in setting direction, prioritizing action plans, and beginning cultural and organizational change rather than primarily identifying the current level at which an organization is performing. The maturity models show a structured set of elements that represent characteristics of effective processes. Currently on the market there are more than 30 models created by different organizations dealing with project management but also by the organization where the models are created as a result of process improvements. Some of maturity models which have been implemented and developed are: PRINCE 2 maturity model, P3M3, OPM3, IPMA Delta, CMMI, Mince 2, P2M, CMM, etc. Primarily, maturity models were first implemented in the software industry, and later wider application in other areas. Maturity itself is measured along three dimensions and includes knowledge (capability to carry out different tasks), attitudes (willingness to carry them out), and actions (actually doing them), and defines a set of levels or phases describing the hierarchically structured development of the observed object.

Performance measurement systems and indicators allow project managers to quantify the efficiency of resource usage and the effectiveness of the services provided (Vilanova et al., 2015). This process involves different kind of stakeholders and requires project manager technical competences in order to create sustainable proposal. Pintoet al. (2014) emphasize that human well-being strongly relies on the services provided by well-functioning ecosystems. System changes in the ecological functioning of any system can have influence on human welfare.On the other hand, energy efficiency is a main goal for energy policy and a key milestone for sustainable development (Pérez-Lombardet al., 2012). EU strategies and projects for eco management have long recognized the key role of recycling, concerning sustainable consumption and production. This resulted in a range of regulatory measures, among which the Waste Electrical and Electronic Equipment (WEEE) directive, which sets weight-based targets for recovery, preparation for reuse and recycling (Nelen et al., 2014). Based on the World Business Council for Sustainable Development definition of eco-efficiency, the eco-efficiency indicators include one economic indicator, and three generally applicable streamlined environmental indicators (raw material consumption, energy consumption, and CO_2 emission).

Three perspectives have been developed by International Project Management Association (IPMA) to assess organizational maturity: 1. Individual perspective ("ICB - IPMA Competence Baseline, Version 3.0" 2006), 2. Project perspective (using the European Foundation of Quality Management Excellence Model - EFQM model), 3. Organizational perspective (using "IPMA OCB - IPMA Organisational Competence Baseline - The standard for moving organizations forward" (2013) and verification through interviews with top management, middle management, and project managers). IPMA Delta model has competency based approach, rather than process and functional based approach. Therefore Aubry et al. (2007) emphasize that main project goal is to create value for the business, rather then to deliver projects on time, on budget and with quality specifications. According to this project success is measured by the business objectives, while the project management success is evaluated with traditional criteria.

It is a new research topic in project management, and there isn't any analysis of maturity that combines maturity levels and eco indicators. Therefore, the aim of this study is to investigate eco indicators analysis in organizations that have shown a higher degree of maturity comparing with those that have shown a lower level of maturity, analyzing individual, project and organizational characteristics according to IPMA Delta model.The initial hypothesis was based on the fact that companies with a higher maturity level (organizational, project and individual level) have positive influence on environmental KPIs analysis.

2. Theoretical background

2.1. Material efficiency

"Material efficiency is a description or metric which expresses the degree in which usage of raw materials, construction projects or physical processes are used or carried out in a manner which consumes, incorporates, or wastes less of a given material compared to previous measures”. For project managers and other stakeholders interested in the financial situation of the company, the material consumption is related with total operating costs. Internal observing of this consumption either according to outcome or according to the category of products enables examining of material efficiency and material flow costs. Also, material efficiency analyses recycled input materials that help to reduce the demand of new natural materials. Hanssen et al. (2003) suggest that the indicator system which is based on a representative sample of companies in economic important regions in Norway is considered as a eco-efficiency approach, with dimensions of packaging consumption for measuring material efficiency and waste minimization in national packaging sectors, and could be implemented on an European basis to perform the Packaging Directive, while Huysman et al. (2015) highlight framework that covers all different resource use-related aspects (simple accounting of resource extraction and use, assessment of environmental impact according to resource extraction and use, etc.). Valero et al. (2015) analyzed mineral resource efficiency through energy replacement costs instead of using mass terms and in accordance with previous analysis they developed new consumption index that could reduce the consumption of scarce materials with higher additional costs. Park & Behera (2014) proposed eco-efficiency indicator as an integral parameter for simultaneously quantifying the economic and environmental performance of industrial symbiosis networks. Linke et al. (2014) indicate that many efficiency indicators are bear upon the material volume processed, but since the volume is very small in closing operations, the material removal rarely is the best indicator.

2.2. Energy efficiency

Concerning the energy use, the main goal for energy efficiency is related with the amount of energy reduction required to provide products and services. There are different forms in energy efficiency. Energy may be purchased, mined, harvested, captured or brought within the organization by other processes. Renewable energy is obtained from natural processes that are continuously renewed. It includes electricity and heat generated from sun, wind, ocean, waterpower, biomass, geothermal resources, bio fuels and hydrogen obtained from renewable sources. Bor (2008) highlight two types of energy efficiency indicators:1) the economic-thermodynamic energy efficiency indicators (that use real GDP as the denominator); 2) the physical-thermodynamic energy efficiency indicators (that are based on the output volume index). Patterson (1996) reviews a large number of energy efficiency indicators that can be used at the policy level and point out that traditional thermodynamic indicators of energy efficiency were found to be of limited use. Wuet al. (2007) developed the utilization index of production capability and the variation index of energy utilization in order to describe the differences between energy efficiency indicators. Eichhammer & Mannsbart (1997) emphasize that changes in energy price levels, or energy and environmental policies, are key componentsfor the indicator analyses in the future. Song et al. (2013) suggest Hierarchical–Indicator Comparison method for industrial energy conservation programs in China, while Cicea et al. (2014) developed environmental efficiency index to asses environmental efficiency of investments in renewable energy.

2.3. Water Management

Concerning the water consumption, water resource management includes the activity of planning, developing, distributing and managing the optimum water resources usage. Information on water consumption in the organization can be obtained from different sources- the water meters, water bills, calculation derived from other information on water that are available or the organization's own estimates. Water productivity defined as the “ratio of the net benefits from crop, forestry, fishery, livestock, and mixed agricultural systems to the amount of water required to produce those benefits”, is one such indicator that has gained importance, particularly in R&D efforts in the developing world. Holistic water management should be an operational imperative in terms on cost savings (Gössling, 2015).

2.4. Waste management

Waste management is a set of activities that includes: 1) collection, transport, treatment and disposal of waste; 2) control, monitoring and regulation of the production, collection, transport, treatment and disposal of waste; 3) prevention of waste production through in-process modification, reuse and recycling. Puig et al. (2013) suggest Life

Cycle Assessment for environmental decision-support systems. Performance indicators are repeatedly used to estimate the environmental quality of waste systems, as well as to analyze and rank programs relative to each other in terms of environmental performance. Greene & Tonjes (2014) analyzed waste performance indicators and proposed model for waste system performance assessments. Attention is placed on how indicator selection affects comparisons between municipal waste management programs and subsequent system rankings. Plata-Díaz et al. (2014) analyzing the period between 2002–2010 conclude that economic and political factors impact in distinctive ways on the anticipation of waste management services. Permanent improvements are necessary in the process of effectiveness and productivity. From the financial point of view, reduction of waste and permanent improvements contributes to direct reduction of costs of materials and waste treatment. Waste information is necessary for appropriate management planning. Wilson et al.(2015) suggest integrated sustainable waste management in order to solve problems with lack of consistent data between cities.

2.5. Biodiversity

Biodiversity is widely recognized as a cornerstone of healthy ecosystems, and biodiversity approach is increasingly becoming one of the key milestones of environmental management. Biodiversity is the variety of different types of life found on earth. It is a measure of the mixture of organisms present in different ecosystems. This can refer to genetic difference, ecosystem difference, or species within an area, biome, or planet. The analysis includes the land usage by the organization. The certain risks are related with this kind of biodiversity: monitoring of its activities in protected areas and areas with high value of biodiversity outside protected areas. Decision on biodiversity aspects at international level must often be based on both ecological and socio-economic measures (Maxim, 2012). Many stakeholders' interests may be concerned by the decisions to be taken in the analysis. One of the main goals of the Common Agricultural Policy after 2013 is to avoid additional loss of agriculture-related biodiversity (Overmars et al., 2014). In 2002, world leaders made a commitment through the Convention on Biological Diversity, to achieve a significant reduction in the rate of biodiversity loss by 2010, and the same target was renewed for 2020 (Normander et al., 2012).

2.6. Emissions into the air

Emissions is the term used to describe the gases and particles which are put into the air or emitted by various sources, including at least emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, expressed in tonnes of CO_2 equivalent. According to Kyoto Protocol and Copenhagen Accord emissions of greenhouse gases are the main reason of climate changes. Lépicier et al. (2013) proposed emission-based indicator for the health impact of the air pollution caused by traffic. In order to assess human health impact Geelen et al. (2009) analyzed environmental pressure indicator, environmental quality indicator, and human health effect indicator. Many cities still exceed the European Union air quality maximum values, and one of the key benefits of air quality models lies in their ability to evaluate the impact of precursor emission reductions on air quality levels (Thunis & Clappier, 2014). Thunis et al. (2015) emphasize that chemistry-transport models are increasingly used in Europe for changes in pollution levels and air quality estimation.

3. Implementation of the study

This study has been prepared according to IPMA Delta model for maturity assessment and with Regulation (EC) No 1221/2009 of the European Parliament and the Council 2009.

3.1. Sample and procedure

Participants were 51 project portfolio managers in 51 companies in Serbia, involved in strategy implementation and environmental KPI analysis in their companies. The sample was composed of 45.1% from profit sector and 54.9% from public sector, then 35.3% were small and medium-sized enterprises, 25.5% were medium-sized enterprises, 39.2% were large-sized enterprises; and 31.4% of sample were organizations with less than 5 projects on a yearly basis, 27.5% were organizations that realize between 5-15 projects on a yearly basis, and 41.2% were organizations that realize more than 15 projects on a yearly basis.

Questionnaire (in online and regular paperback form) is used for gathering data about project portfolio managers and environmental KPIs appraisal in their companies. All variables are categorized according to four groups of factors: 1) individual level components - personal satisfaction and leadership styles' characteristics; 2) project level components – project, program and portfolio alignment characteristics; 3) organizational level components that are related with organizational commitment and communication 4) Environmental KPIs areas - material efficiency, energy efficiency, water management, waste management, biodiversity, emissions into the air.

3.2. Measures

Individual, project and organizational components, has been evaluatedon the Likert scale: "1 - very dissatisfied," "2 - dissatisfied "," 3 - moderately satisfied "," 4 - satisfied, "" 5 - very satisfied. The environmental KPIs assessment is consisted of the following solutions on the Likert scale: "1 - not used", "2 - low usage level", "3 - medium usage level", "4 - high usage level", "5 - very high usage level". Cronbach's alpha coefficient for environmental KPIs is 0.94, for individual level components is 0.8, for project level components is 0.79, and for organizational level components is 0.8, indicating a high degree of internal consistency.

Individual level. Individual level assessment includes following components: coordination competencies (Mean ± Std. Dev. =3.53±1.03), leading competencies (3.67±0.89), personal satisfaction (3.63±0.94) and personal development (3.88±0.95). Companies with a total individual level score over 15 were classified as "high individual mature" while those with a score 15 and lower were classified as "low individual mature".

Project level. Project level assessment includes following components: project deliverables (3.69±0.93), customer satisfaction (4.02±0.81), resource availability (3.33±0.93), resource adaptability (3.8±0.92), requirements & competences alignment (3.35±1.06), project task (3.61±0.92), project mutual tasks (3.53±0.88), portfolio dependent tasks (3.26±0.87), project selection criteria (3.43±1.04) and project strategic selection (3.96±0.96). Companies with a total project level score over 39 were classified as "high project mature", while those with a score 39 and lower were classified as "low project mature".

Organizational level. Organizational level assessment includes following components: organizational commitment (3.75±0.96), organizational learning (3.51±0.99), resource constraints & work organization alignment (3.18±0.95), resource productivity (3.71±0.86), reward for result (3.3±1.36), teamwork (3.67±0.97) and communication (3.69±0.91). Companies with a total organizational score over 27 were classified as "high organizational mature", while those with a score 27 and lower were classified as "low organizational mature".

Environmental KPIs. Environmental KPIs assessment includes following components: material efficiency (3.47±1.38), energy efficiency (3.45±1.4), water management (3.02±1.41), waste management (3.26±1.31), biodiversity (2.8±1.39) and emissions into the air (3.04±1.51).

3.3. Data analysis

Data analysis was prepared using SPSS 20.0 software and RapidMiner Studio 6.0. The initial step was related to the determination of the relationship between environmental KPIs areas (table 1). K-means algorithm was performed in order to identify group characteristics. Man Whitney test was used for group comparison to determine environmental KPIs differences that are related with organizational, project and individual maturity level.

3.4. Results and discussion

The research results show a high level of correlation between all environmental KPI areas. The highest degree of correlation has been expressed between material efficiency and energy efficiency, as well as in the water management and biodiversity field. On the other hand, the lower correlation is noticeable in the field of material efficiency and biodiversity, and betweeen water management and waste management, and waste management and biodiversity. It is evident that the biodiversity field has been perceived as a key driver of KPIs assessment in other environmental areas. Two types of clusters were identified, that describe two different groups of organizations: organizations with higher-level of environmental KPI assessment within clusters 1, and organizations with a lower level of environmental KPI assessment within the cluster 2 (figure 1).

Table 1. Clusters' characteristics for environmental KPIs and maturity components

Attribute		Cluster 1 (n=36)	Cluster 2 (n=15)
Enterprise type	Large	38.9%	40.0%
	Medium	27.8%	20.0%
	Small and micro	33.3%	40.0%
Num of projects	Num of projects = >15	41.7%	40.0%
	Num of projects = 5-15	25.0%	33.3%
	Num of projects = <5	33.3%	26.7%
Sector	Profit	50.0%	33.3%
	Public	50.0%	66.7%
Individual maturity	Low	55.6%	20.0%
	High	44.4%	80.0%
Project maturity	Low	55.6%	93.3%
	High	44.4%	6.7%
Organizational maturity	Low	33.3.6%	20.0%
	High	66.7%	80.0%

In cluster 1 organizations are equally distributed between profit and the public sector, while in cluster 2 public sector is dominant - 66.7% of cases (table 1). In cluster 1 uniform distribution is between organizations with higher and lower levels of individual maturity, while the cluster 2 has 80% of organizations with a higher level of individual maturity. A similar situation regarding to distribution in the cluster 1 is linked with the project maturity. On the other hand, cluster 2 consists of 93.3% of organizations with a lower level of project maturity. A higher level of organizational maturity is characteristic of cluster 1 in 66.7% of cases, and in 80% of cases is related with the cluster 2. Comparing organizations with higher and lower level of individual maturity, material efficiency and emissions into the air KPIs has been more evaluated within cluster 2. According to cluster analysis, it's noticeable that there is significantly difference between high mature and low mature organizations according to project maturity level in following areas: Material efficiency, Energy efficiency, Biodiversity, Emissions into the air. From the other hand there is no difference according to organizational maturity level between high mature and low mature organizations.

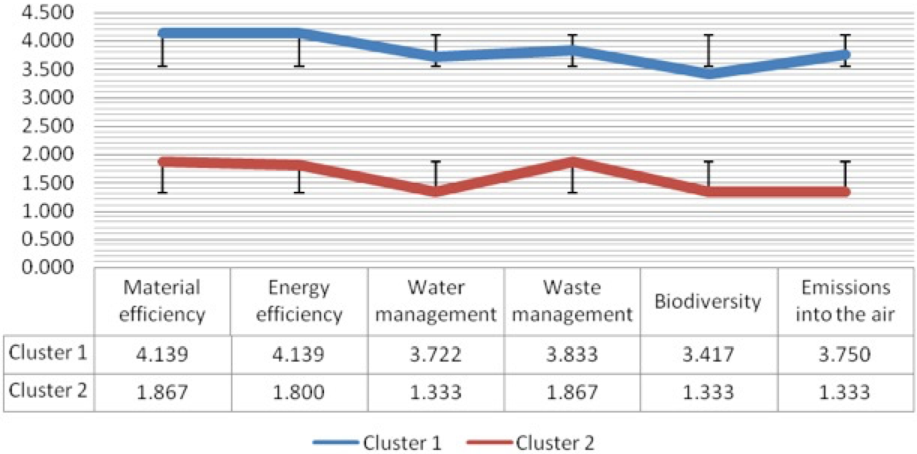

Fig. 1. Clusters' centroids for environmental KPIs

Regression analysis shows that there are no statistically significant predictors of material efficiency KPI definition in maturity components. Maturity components that are significant predictors of energy efficiency are personal satisfaction and resource availability. Project strategic selection is a significant predictor of water management KPI definition. Coordination competencies, personal satisfaction, personal development, resource adaptability, project selection criteria are significant predictors of waste management KPI definition. Personal satisfaction is a significant predictor of biodiversity and emissions into the air KPI definition. Biodiversity has the lowest average prediction, while material efficiency and energy efficiency have the highest average prediction, summing up all maturity components.

4. Conclusion

Numerous studies showed that organizations with higher level of maturity better perform processes and implement strategies. In the last decade environmental impact assessment has increasingly got importance and therefore organizations should improve processes and analyze their maturity. This study showed that mature organizations have a greater awareness of ecology and indicators associated with ecology. Also, individual and project aspects should be considered from organizational perspective in order to achieve business excellence.

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