A Review on the Use of Performance Indicators in the Public Sector

Danijela Markić

University of Zagreb, Faculty of Organization and Informatics, Pavlinska 2, Varaždin, Croatia

***Abstract* – When set in strategic context and developed according to valuable criteria, performance indicators can be a powerful tool for different purposes in the public sector. Since their use in public services is evidently increasing, this review paper presents needed synthesis of important facts and findings about performance indicators: their advantages and shortcomings, characteristics, types and purposes, important criteria for their selection, data sources for indicators and data collection and processing procedures. Also, an overview of open questions in data collection and processing is introduced.**

***Keywords* – Performance indicators, public services, performance data management system, data sources.**

1. Introduction

Researchers studying the behavior of public sector organizations stress two important features of the public sector in comparison with the private sector: bureaucrats often serve multiple masters and they are expected to achieve multiple goals (tasks) [1]–[3]. Also, there is no profit maximizing focus, little potential for income generation and no bottom line against which performance can ultimately be measured [2]. Describing these characteristics in next chapters, this paper gives an overview of performance indicators use in the public sector and present questions for further research.

Organizational performance, both in private and public sector, is a complex and important multidimensional construct; performance measures (indicators) compare the value of the organization's output using the productive input assets (individuals and tangible and intangible assets) with the value that the asset owners expect to receive [4]. Nowadays, performance measurement (PM), that is process of defining, monitoring and using objective indicators of organizations and programs on a regular basis, is of vital concern to managers in the public sector [5].

PM may be implemented at various levels (for a single unit or overall organization) and with different purposes (to improve overall performance, foster or generate pseudo-competition, improve accountability, allocate resources, etc.) [1]. The PM information may be kept internal to organization (as a management tool) or made public (and linked to explicit or implicit incentive scheme); in an explicit scheme financial reward is given to the individual, group or whole organization while under implicit scheme the organization gets the financial reward as a result of the others to the PM (for example, by getting more contracts) [1].

Since the first increased interest for PM in public sector in the late 1980s, several changes in the form and use of PM have occurred: from collection of data on a narrow range of performance dimensions towards development of specialized indicator packages [1], [6], from informal performance assessments based on peer review or sample-based inspection towards increased reliance on published performance league tables based on indicators [1], [6], [7], from input-based funding to output-/performance- based funding [1], [8] and other.

1.1. Performance measurement system

Performance measurement systems are management systems that track selected performance measures at regular time intervals with aim to assess performance and enhance organizational decision-making, performance and accountability [5]. As presented in Figure 1, including the general management function, performance measurement system consists of three components: data collection and processing, analysis and action. Responsibility of management function is to clarify and communicate the strategic framework and to orient performance measures toward that framework. Data collecting and processing are often the most time consuming and expensive part since data are usually input by decentralized organizational units in different locations which later must be gathered and stored in common databases. In analysis component indicators are converted into useful information in a way that they are compared with something (over time, against goals and targets, across units, with external entities etc). Finally, the results must be used to inform decision-making regarding strategy, program, service delivery, ongoing operations, resource acquisition and allocation and other purposes. Also, the performance data can be used to refine performance indicators and decide if and when comprehensive program evaluations should be undertaken.

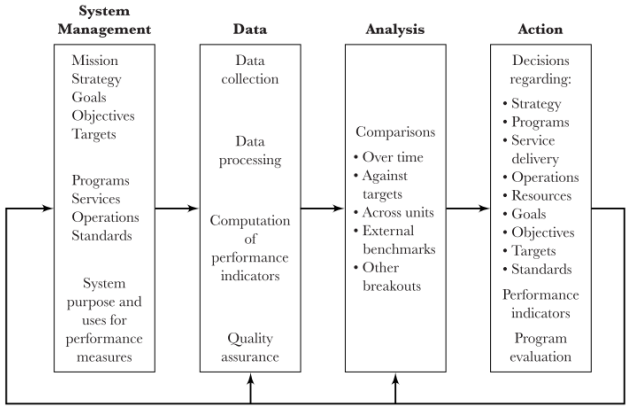

Figure 1.Performance management system [5].

1.2. Performance indicators

Group of authors in [8] define performance indicators (PIs) as measures which give information and statistics context, allow comparisons between fields, over time and with commonly accepted standards and provide information about the degree to which objectives are being met. PIs should be measurable and clearly defined in the same way over a number of years in order to perform comparisons [9]. They are described by their function (what they measure), the means of obtaining it (formula and needed data), their quality (the extent to which they can be used over time) and the limits on their use (what they do not measure or measure poorly) [10]. It is relevant to ensure that PIs do not provide a partial and thus potentially misleading picture of quality or effectiveness [11]. Prerequisite for PIs' usefulness is clear definition of purpose and objectives of service which is evaluated.

Good indicators share two characteristics: first, they are well-founded in theory, having explanation for the assumption that they correctly represent a given feature of reality and second, they are robust against limitations in the underlying data [1], [3]. After adding a few more important characteristics, quality indicators should be: cost-effective, timely, reliable, valid and specific [10], [11].

Also, the most illuminating or key performance indicators are those that carry the central motifs of the institutional story [6] and reflect the critical success factors of an organization [12]. The test of usefulness of performance indicators is that over time they facilitate actual improvement in organization or program performance [5]. In general, PIs can be categorized as quantitative and qualitative [8], [10]:

Quantitative indicators:

- input indicators – reflect the human, financial and physical resources involved in supporting institutional programs, activities and services;
- output indicators – reflect the quantity of products or services generated;
- impact indicators – reflect final and long-term impact of a project or program.

Qualitative indicators:

- outcome indicators – refer to the direct, short-term effects on beneficiaries; reflect the quality of program, activity or service;
- process indicators – include the means used to deliver programs, activities or services;
- impact indicators – describe less tangible progress toward the achievement of the strategic objective.

Advantages
- PIs reflect the strengths, weaknesses and effectiveness of institutions [6]; - PIs help in institution's self-understanding, the establishment of its objectives and priorities and the evaluation of its work [5], [6], [12], [13]; - PIs help in managing programs and operations more effectively [5]; - PIs can be used to communicate the results produced by the organization (helping in marketing activities) [5], [13], [14]; here PIs may reflect current favorable performance [13]; - PIs support budget requests to funding organizations (to attract investment) and help in performance-based allocation of resources [5], [13], [14]; - PIs provide information for (comparative) judgements and decision-making [5], [11], [13], [14]; - PIs help to shape critical questions for exploration of an issue [6]; - PIs offer experts additional information and counterbalance peer review's shortcomings [15]; - PIs reveal changes in an institution's identity over time (trendlines) [6], [14]; here are important changes in the structure of income and expense (fund-raising performance);
Disadvantages and limitations
- the ability of PIs to reflect objective reality may be limited [11], [13]; - PIs are not useful when they are devoid of context [5]; - often information is produced merely because the data happen to be available [11]; - technical (establishing link between inputs and outputs) and political (stakeholders have different priorities and give different weights to each measure) problems of PIs usage [13], [14]; - there is room for manipulation by selection, weighting and aggregating PIs [11], [13], [15]; unnecessary burden for stakeholders during introduction of public service reforms [16]; data collection and processing may require too much time, money and effort; there are significant direct costs [5], [13]; - PIs do not provide a clear indication of cause and effect or of the extent to which a program or agency might be responsible for producing the results observed [5]; - inappropriate PIs can lead to goal displacement and behavior that detracts from rather than enhances performance [5];

Table 1.Advantages and disadvantages/limitations of PIs' usage

Despite numerous advantages of performance indicators there are also negative situations which can occur when dealing with these measures. The pros and cons list of performance indicators is presented in Table 1.

Disadvantages of PIs' use may be minimized by a number of strategies which involve caution in making simple comparisons between alternative providers of public services [13], use of series of PIs instead of relying on single PI [7], [12], combination of PIs with transparent peer review [7], use of only feasible indicators (or a large number of proxy PIs) instead of theoretical indicators [10] and other.

2. Use of performance indicators in the public sector

Interest in performance measurement has been enlarged in public sector organizations as a result of increased demands for accountability on the part of governing bodies, the media, and the public in general, and a growing commitment on the part of managers and agencies to focus on results and strengthen performance [5]. Thus, many stakeholders have an interest in the use of performance indicators, including legislative bodies, different agencies, managers and employees, customers and constituents, professional and funding organizations and citizens in general [5], [14], [17].

When set in strategic context and developed according to valuable criteria, indicators can be a powerful tool for different purposes in the public sector:

- managing and improving performance [5], [7];
- monitoring, policy determination, target-setting, evaluating and reforming [11];
- comparative benchmarking [5];
- more informed strategic decision-making and decision-taking [5], [11];
- project, program and environment management [17];
- strategic planning and management (achievement of strategic priorities of development) [5], [11], [16];
- allocating resources and performance-/result-/output-based budgeting [5], [7], [11];
- quality improvement [5];
- performance contracting [5];
- reporting (about progress and accomplishment of predetermined objectives) [16]
- communication with the public [5];
- effectiveness evaluation of public service delivery [16];
- rewarding success (employee incentive systems) and taking corrective actions to avoid replicating failure [5].

Also, each performance indicator is employed in some form of performance management model. Performance models utilize a range of indicators for different purposes and with different underlying assumptions [8]. Different performance models can be described under five broad types:

- accreditation – favors input and process indicators;
- quality audit – favors input, process and outcome indicators;
- performance-/output-based funding – favors input, output, outcome and process indicators;
- performance reporting – favors input and output indicators;
- surveys and tests – favor outputs and outcome (rarely input) indicators.

Performance indicators, employed in different models and systems, are used in the following public services: education, health care and government, described in the following subchapters respectively.

2.1. Education

The origin of PIs in education can be traced back to the requirement of accountability of education providers to different stakeholders [12], [13]. Strategic decision making for universities is particularly challenging because of different stakeholders involved (of faculty, personnel, boards of directors, local and national governments, students, parents, former students, and others) [6].

According to Wu in [12], educational PIs have dual purpose: first, they predict the outcomes of educational operations and second, they describe important characteristics of educational system. Also, their purpose can be described as summative and formative [14]. In summative case, the evaluation based on PIs can help an applicant choose an educational institution to apply to, inform prospective employee, inform the allocation of resources to institutions by financing agencies, or inform the licensing or accreditation of a degree of an institution. Formative purposes may include: helping to communicate to all members of educational institution the importance of good organizational performance and its contribution to the desired direction, motivating members to reach institution's targets or promoting continuous improvement and accountability to all stakeholders.

Nowadays, PIs are used in education for:

- measuring student learning outcomes [11], [18], [19];
- widening participation (the recruitment of students who otherwise would not enter education) and implementing fair access (ensuring that students from disadvantaged backgrounds

have a fair chance to gain admission to the more selective institutions) [13], [18], [19];
- developing performance-based league tables and rankings of educational institutions [20]–[23];
- performance monitoring and evaluation of educational institutions and their activities (teaching, research, knowledge transfer) [24]–[27];
- performance-based budgeting, funding and reporting [18], [19], [25].

2.2. Health care

Public health policies aim at maintaining and improving the health of citizens so they also have to be based on relevant data and PIs concerning health status, health care resources and utilization, expenditure on health, health care financing, lifestyle and health habits, living and working conditions, demographic and socio-cultural factors [28]. As in other public services, selecting appropriate PIs allows health care system professionals to transform crude information into a form that is more suited for decision making [29]. Also, health care research performance is increasingly assessed through research PIs with the aim of accurately quantifying the performance of health care individuals and institutions to cultivate an environment which improves the quality of patient care [30].

2.3. Government

Due to increased demands to hold governmental departments and agencies accountable to legislatures and the public in terms what they spend and the results they produce, most agencies are pressured to engage in strategic planning, goal setting, budgeting and performance measurement on a very systematic basis.

PIs in government support improved communication within and across branches of government, advance discussion about the results of activities and services and help in making budgeting decisions [31]. Governmental agencies at all levels use PIs for assessing their performance and the effectiveness of newer social programs [5]. For example, PIs (especially outcome indicators) are used in laws and programs that prepare youth, unskilled adults and disadvantaged people for entry into the labor force [1]. Local governments use PIs to measure effectiveness in attaining strategic (primary and intermediate) goals, to allow performance-based budgeting and to benchmark their performance against each other in selected program areas [5].

Today, effective operation of information and communication technologies (ICT) is mission critical for governments because there are few if any programs or services that can operate without constant support of ICT [17]. It is possible to define PIs that provide insights into ICT performance at the levels of: planning and investment, project management, ICT operations (daily monitoring) and enterprise ICT management.

3. Performance indicators selection and data collection

Public services produce outputs in order to achieve outcomes and finally to have an impact on society. That implies when choosing objectives and indicators, decisions should be guided by the desired impact. However, there is no fixed method of converting the desired impact into objectives, indicators or targets [10].

3.1. Selection of performance indicators

In practice, it seems that the main criterion used for the selection of PIs is availability of the required data (the data can be collected with an acceptable level of effort) [10]. Using only available/feasible PIs allows targets to be set but will not always precisely describe the related objective. So there is a number of other criteria that can help in the selection of PIs [11], [21]:
- relevance – the relative importance of PI according to stakeholders' perspectives;
- validity – the PI measures what it claims to measure;
- reliability – the PI is measured on the same way regardless of who collects the data or when;
- comparability – the PI allows comparison from one situation to another.

Selecting indicators is a process that consists of three stages [10]: 1) the first stage is analytical and results in the identification of the challenges which ask for special attention and should be monitored; 2) the second stage is more pragmatical where PIs are identified and linked to the challenges from first stage; 3) the third stage standardizes the presentation of selected PIs in a form of documentation (information) sheet.

3.2. Documentation sheet

Documentation sheets contain definitions, calculations, interpretations, availability info, quality and other metadata for PIs [28]. Metadata are used to facilitate exchange, reporting and dissemination of data about PIs. For example, metadata are: PI name, PI definition, source of the data, data type, frequency of collecting and processing the data, users of the data (level of aggregation), levels of thresholds and target, possible actions if a threshold is reached, person responsible, time zone (past/current/future),

method of measurement, unit of measure, unit multiplier etc. [29], [32].

3.3. Performance data management system

Performance measurement systems and related PIs are worthwhile only if they are designed appropriately to serve a particular purpose and if they are actually used by its users, and this will happen only if the users have faith in the reliability of the data. Data collection procedures must be clearly defined and performed, also, the data must be correct and unbiased otherwise the resulting performance data will be distorted and misleading.

System in charge for data collection and manipulation is performance data management system (PDMS); it consists of hardware and software parts that provide links between databases and an interface to allow easy access and reporting from the databases [5].

Characteristics of good PDMS [5]:

- safe, effective, and accessible data entry (minimization of data entry errors);
- integration with other data collection systems within the organization;
- cost-effectiveness;
- availability of multiple reporting formats, depending on the request of the user;
- integration with Web-based applications to allow for various options in the dissemination of data.

3.4. Data sources

The data for performance management systems come from a wide variety of sources, described as multilevel and multifaceted. Multilevel means that data can be collected from multiple levels of a system (user, unit, institution, regional, national, international) while multifaceted represents data collecting from agency records, program operating data, existing management information systems, direct observation, self-reports, tests, clinical examinations, population census, various types of surveys, and other special measurement tools [5], [11], [21], [33]. Also, data collection methods vary dependent upon whether the data to be collected are quantitative or qualitative [17].

PIs data from sources can be collected in three ways:

I. When the data needed for PIs already reside in established data files maintained for other purposes, the data collection procedures involve "extracting" the required data elements from these existing databases [5]. So, the data are result of business processes performance, coming from organizational transaction processing system. This is usually accomplished by programming computer software to export and import specific data elements from one or several databases to another.
II. The second case is collecting original data specifically for the purposes of performance management. This way requires using standard, adapted or new instruments for data collection, developing protocols for administering tests, examinations or surveys to ensure the validity and reliability of data and also making decisions about sampling strategies [5]. Finally, the data are stored in a database for performance management purposes.
III. Usually, important PIs reflect performance over time, describing if performance has been improving, deteriorating, or static, achieving predetermined objectives and targets [5]. So, data for these PIs are archived and often accumulated data in organization's databases and other files which facilitate the analysis of comparisons and trends back over time.

With regard to all three ways of data collection above, data users need to be concerned with quality assurance [23]. There needs to be provision for some kind of spot checking or systematic data audit to ensure the integrity of the data being collected [5]. Also, responsibilities for use of performance data and deadlines for data entry, processing and distribution must be clarified.

Concerning the availability of data at national level, in general there are three types of situations [3]:

- data are centrally collected by national statistical services;
- there are some centralized data but not from statistical services (annual or conference reports);
- data should be collected from individual organizations (this is the most problematic case since harmonization of the data is usually quite difficult).

4. Conclusion and implications for future research

In this paper, the current state of the art regarding the use of PIs in the public sectorhas been presented. To take advantages of their use, managers and other decision-makers should be acquainted with situations when PIs should be used and when not, when they facilitate the work and when they impose unnecessary burden, when they offer stakeholders additional information or when they lead to goal displacement and behavior that detracts from rather than enhances performance.

Despite there is no fixed method of converting the desired impact into objectives and indicators, a number of valuable criteria can help in the selection

of PIs. In practice, it seems that the main criterion used is availability of the required data [10] so issues of data quality, integrity and accessibility are of special interest here to solve problems like breaks in time series for aggregates, inconsistencies between data from different sources, variability in the precise meaning of variables [3], [34].

Further, when dealing with data availability and comparability of performance data from different data sources, there are two main groups of problems: differences in the organization and governance structure of systems and heterogeneity of the individual organizations [3]. In the first case, according to the structure of different (e.g. national) systems, different data are available [23]. In the second case, problems are located at the level of individual organization and deal with its ontology and data classification as objects of analysis.

One of the solutions for data availability and comparability is establishing the likely annual timetable for data collection and reconciliation that will include factors like: assurance on continuity of baseline data supply, annual cycle, variation in data structure, year-to-year variations in data compilation, structure, aggregation and content, data conventions, etc. Such central database can be held by one central organization where different institutions have access and validate the correct assignment of records or performance data can be supplied by institutionsby themselves [35]. Also, methodologies to treat data from non-statistical sources should be developed here [3].

Since performance-relevant data is stored in various databases and documents of numerous institutions, research centers and international organizations and each of these entities uses its own system to determine the quality of stored data, standard methodology for data quality control would ease the task of sharing data(bases) between these institutions and increase the reliability of the available data sets. The process of reaching an international agreement on standardization is quite long and complex. Consequently, one of the most important issues refers to the establishment of more systematic procedures for data collection and validation. Here standardized data and metadata exchange models can be of great help.

Finally, performance data and evaluation results usually have a retroactive character, while they could have more of a preliminary and concurrent character, allowing for a better link between planning and controlling [14]. Hence, a real challenge is to promote use of performance indicators as an integrated management tool in strategic and operational decisions of institutions.

References

[1]. C. Propper and D. Wilson, "The Use and Usefulness of Performance Measures in the Public Sector," *Oxford Rev. Econ. Policy*, vol. 19, no. 2, pp. 250–267, (2003).

[2]. T. Boland and A. Fowler, "A systems perspective of performance management in public sector organisations," *Int. J. Public Sect. Manag.*, vol. 13, no. 5, pp. 417–446, (2000).

[3]. A. Bonaccorsi, C. Daraio, B. Lepori, and S. Slipersæter, "Indicators on individual higher education institutions: addressing data problems and comparability issues," *Res. Eval.*, vol. 16, no. 2, pp. 66–78, (2007).

[4]. J. B. Barney, *Gaining and Sustaining Competitive Advantage*. New York: Addison-Wesley Publishing, (1997).

[5]. T. H. Poister, *Measuring Performance in Public and Nonprofit Organizations*, 1st ed. San Francisco: Jossey-Bass, p. 316, (2003).

[6]. R. L. Morrill, "The Use of Indicators in the Strategic Management of Universities," *OECD High. Educ. Manag.*, vol. 12, no. 1, (2000).

[7]. H. F. Moed, "The future of research evaluation rests with an intelligent combination of advanced metrics and transparent peer review," *Sci. Public Policy*, vol. 34, no. 8, pp. 575–583, (2007).

[8]. D. Chalmers, "Defining quality indicators in the context of quality models," (2008).

[9]. A. Whittington-Jones, "The Development and Implementation of a Performance Management System: A Case Study," MSc thesis, Rhodes University, (2005).

[10]. P. Delorme and O. Chatelain, "Policy Steering - The Role and Use of Performance Measurement Indicators," *Aid Deliv. Methods Program.*, no. February, (2011).

[11]. K. Rowe, "Analysing and Reporting Performance Indicator Data: Caress' the data and user beware!," *ACER*, (2004). [Online]. Available: http://research.acer.edu.au/learning_processes/13.

[12]. C.-S. Wu and R. J.-C. Cheng, "A study on Key Performance Indicators (KPIs) for Basic Education in Taiwan," in *International Conference: Innovative Research in a Changing and Challenging World*, , no. December, (2012).

[13]. G. Pugh, G. Coates, and N. Adnett, "Performance Indicators and Widening Participation in UK Higher Education," *High. Educ. Q.*, vol. 59, no. 1, pp. 19–39, (2005).

[14]. C. S. Sarrico, M. J. Rosa, P. N. Teixeira, and M. F. Cardoso, "Assessing Quality and Evaluating Performance in Higher Education: Worlds Apart or Complementary Views?," *Minerva*, vol. 48, no. 1, pp. 35–54, (2010).

[15]. L. Butler, "Assessing university research: a plea for a balanced approach," *Sci. Public Policy*, vol. 34, no. 8, pp. 565–574, (2007).

[16]. D. Jurlina Alibegović and L. Blažević, "Pokazatelji uspješnosti i upravljanje lokalnim razvojem: primjer Fonda za obnovu i razvoj grada Vukovara," *Ekon. Pregl.*, vol. 61, no. 11, pp. 631–665, (2010).

[17]. "Performance Indicator Resource Catalogue," *Australian Government Information Management Office, Department of Finance and Administration*, (2006).

[18]. "An Indicator Framework for Higher Education Performance Funding," *Department of Education, Employment and Workplace Relations*, (2009). [Online]. Available: http://www.deewr.gov.au/HigherEducation/Documents/HIEDPerformanceFunding.pdf. [Accessed: 12-Sep-2012].

[19]. "Education at a Glance 2012: OECD Indicators," (2012). [Online]. Available: http://www.oecd.org/edu/highereducationandadultlearning/48631582.pdf. [Accessed: 05-Sep-2013].

[20]. S. Marginson, "Global University Rankings: Implications in general and for Australia," *J. High. Educ. Policy Manag.*, vol. 29, no. 2, pp. 131–142, (2007).

[21]. F. van Vught and F. Ziegele, Eds., *U-Multirank: Design and Testing the Feasibility of a Multidimensional Global University Ranking - Final Report*, no. June. Consortium for Higher Education and Research Performance Assessment, (2011).

[22]. R. Proulx, "Higher Education Ranking and Leagues Tables: Lessons Learned from Benchmarking," *High. Educ. Eur.*, vol. 32, no. 1, pp. 71–82, (2007).

[23]. A. Rauhvargers, *Global university rankings and their impact*. European University Association, (2011).

[24]. A. García-Aracil and D. Palomares-Montero, "Examining benchmark indicator systems for the evaluation of higher education institutions," *High. Educ.*, vol. 60, no. 2, pp. 217–234, (2009).

[25]. J. C. Shin, "Impacts of performance-based accountability on institutional performance in the U.S.," *High. Educ.*, vol. 60, no. 1, pp. 47–68, Nov. (2009).

[26]. U. Schmoch, T. Schubert, D. Jansen, R. Heidler, and R. von Görtz, "How to use indicators to measure scientific performance: a balanced approach," *Res. Eval.*, vol. 19, no. 1, pp. 2–18, (2010).

[27]. D. Palomares-Montero and A. Garcia-Aracil, "What are the key indicators for evaluating the activities of universities?," *Res. Eval.*, vol. 20, no. 5, pp. 353–363, (2011).

[28] K. Kilpeläinen and A. Aromaa, *European Health Indicators: Development and Initial Implementation: Final Report of the ECHIM Project*. Helsinki: National Public Health Institute, (2008).

[29]. T. Lippeveld, Rainer Sauerborn, and C. Bodart, Eds., *Design and implementation of health information systems*. Geneva: World Health Organization, (2000).

[30]. V. M. Patel, H. Ashrafian, K. Ahmed, S. Arora, S. Jiwan, J. K. Nicholson, A. Darzi, and T. Athanasiou, "How has healthcare research performance been assessed?: a systematic review," *J. R. Soc. Med.*, vol. 104, no. 6, pp. 251–61, (2011).

[31]. J. Melkers and K. Willoughby, "Models of Performance-Measurement Use in Local Governments: Understanding Budgeting, Communication, and Lasting Effects," *Public Adm. Rev.*, vol. 65, no. 2, pp. 180–190, (2005).

[32]. D. Parmenter, *Key performance indicators (KPI): developing, implementing, and using winning KPIs*, 2nd ed. John Wiley & Sons, Inc., (2010).

[33]. A. Usher and M. Savino, "A Global Survey of University Ranking and League Tables," *High. Educ. Eur.*, vol. 32, no. 1, pp. 5–15, (2007).

[34]. F. A. van Vught and D. F. Westerheijden, "Multidimensional ranking: a new transparency tool for higher education and research," *High. Educ. Manag. Policy*, vol. 22, no. 3, pp. 31–56, (2010).

[35]. "The use of bibliometrics to measure research quality in UK higher education institutions," *Evidence Ltd, Universities UK*, (2007). [Online]. Available: The use of bibliometrics to measure research quality in UK higher education institutions. [Accessed: 03-Jul-2012].

Corresponding author: Danijela Markić
Institution: University of Zagreb, Faculty of Organization *and Informatics, Croatia*
E-mail: danijela.markic@foi.hr