Benchmarking as a telecommunications policy tool – benefits from using composite indices

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***Abstract* — This paper is about potentials of benchmarking as a support tool for policy-making in telecommunications. The purpose of research was to examine what benefits can telecommunications authorities gain from cross country performance evaluation based on ICT composite indicators (indices). Issues in constructing indices are analyzed in order to give recommendations for benchmarking process and policy theoretical framework reconciliation.**

***Key words* — benchmarking, telecommunications policy, composite indices.**

I. Introduction

THE dynamics of the telecommunications sector requires constant measuring, survey, analysis and comparison of the relevant performance features as a way to set the starting point in the adoption and implementation of the appropriate development strategy. At the same time, it is vital to create a concrete methodological procedure that will enable continual monitoring and also act as the sustainable source of guidelines for the definition, implementation and post-implemental corrections of adequate telecommunications policy. Benchmarking has achieved a major importance as a support tool for policy-making. As a common tool for strategic planning benchmarking found it's way for becoming widely used methodology for improving performance both on micro (operators or services) and macro level (for cross country performance evaluation). [1]–[3]. One of biggest fields of implementation is tracking progress towards information society [EU projects SIBIS (2001-2003) and BISER, (2002-2004)]. In first phase of WSIS benchmarking has been identified as a methodology for monitoring information society at global level (Geneva Plan of Action, ITU, 2003).

The main idea of benchmarking is simple, compare yourself with others, find the best practice and use it as a goalpost (benchmark) for your development strategy. But as it is well known what cannot be measured cannot be tracked and be manageable.

Where there are no quantitative targets defined by policy-makers, the role of benchmarking is much fuzzier. [1, p.2] In [4, p.347], authors pointed out that benchmarking must be used with caution, and its design as a tool of analysis must be thoughtfully considered in order to achieve accurate and meaningful indicators.

There are many existing indicators sets in telecommunications recommended for cross country ranking and therefore suitable for benchmarking. Main focus of our research is question should national policy creators consider benchmarking based on existing composite indices or create its own. In next paragraph we give overview of existing indicators and indices. After, we analyze issues in constructing composite index and give recommendations for their development and further research.

II. Indicators Selection – Key of Effective Benchmarking

There are two main sources of indicators in telecommunications defined be ITU. First one is addressing *Key indicators for analyzing telecommunications/ICT sector* (defined within *The Indicators Handbook* published in April 2007). The Handbook identifies and defines a range of key indicators for analyzing the telecommunication/ICT sector. It contains about 41 core indicator within 12 categories. The second source is *The Partnership on Measuring ICT for Development's Core ICT Indicators* and provides definitions, model questions and methodological notes to measure the Information Society. It contains list of core indicators divided into four categories (infrastructure and access, access and use by households and individuals, use by business, ICT sector and trade in ICT goods). Every domain of indicators listed above contains indicators making basic core and extended core and one reference indicator within second category. Core-indicators can be named as fundamental indicators, and they are traditionally supply side indictors (telephone, mobile, computer, broadband penetration, etc). The biggest advantage of core indicators is that they are available and therefore can be used for international comparability. But core indicators are not enough for cross country performance evaluation as a support for policy making. It is important that indicators cover both supply (service penetration) and demand side (ex. how much of the incomes goes to communications). Recent studies (since convergence of telecommunications become intensive)

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show that demand-side indicators gained more importance. Evidence can be seen from EU projects like already mentioned SIBIS and BISER but also from *The UNDERSTAND* project (2005), Eurobarometer survey, 2005/06). Developing countries could face lack of data regarding these indicators since they rely on specialized surveys and are more expensive to collect and analyze. Other issue on indicators in general is about Quantitative and Qualitative Indicators in Telecommunication/ICT. Deregulation process is one of circumstances that give more importance to qualitative indicators. Qualitative indicators are required to measure the various stages of sector reforms. Validity of these indicators can be influenced by experts or users opinions and sometimes hard to take into calculations. In terms of policy making these indicators are important since interviews, focus groups and case studies can be used to collect qualitative information that provide support to quantitative measures that often fail to show the reason why some data does not fit well to what is being observed in the field. Qualitative indicators are common when monitoring telecommunications regulation performance, but in analyses, they are used transformed into quantitative values. [5], [6] Gathering information about defined indicators, available data and existing studies on access, use and impact of telecommunications is starting point in selecting benchmarking indicators but it doesn't make "first phase completed". The following step is to make ICT indicators selection. Policy makers can either adopt existing set of indicators for benchmarking or create a list that suites best the defined policy targets.

Need for statistical tool that will allow countries to benchmark their electronic communications globally and regionally was recognized by ITU. In its 2002 *World Telecommunications Development Report* ITU concludes that "it is only by making international comparisons that it is possible to show which policies have been more successful than others…For this reason, an approach based on comparative rankings may be more meaningful than one that uses absolute growth rates". With the revolutionary spread of ICTs during the past two decades, and the resulting impact on societies and economies, international calls for monitoring and benchmarking have increased. At the same time, since the turn of the century the availability of Internet-related data globally has increased, making it feasible to construct a composite index that combines several indicators into one single statistical value and compare it over a number of years. [7, p.9] ITU in its 2009 *Report on Measuring the Information Society* emphasized that the sub-indices on which the composite index is based, and countries ranked further provide policy makers with the opportunity to identify strengths and weaknesses and to adopt and develop policies accordingly. ITU's work on composite indices began in 2002. Beside ITU indices, there are many others developed within deferent projects, surveys and research programs.

III. Composite indices and benchmarking

Index or composite indicator presents a group of indicators aggregated into single value [8]. There can be more then one level of indicators aggregation. In that case a first level are indicators aggregated into composite indicators called sub-indices, and as a result of sub-indices aggregation (second level) we have composite indicator that in fact is composite index.

The idea of a composite cluster of associated technologies along with selection of these technologies and the indicators measuring, was introduces by Press who pointed out that with a complex concept such as the Internet, "an index may be more robust than a [*single*] indicator in measuring a qualitative concept" [9, p. 5]. In 2002, ITU published its first composite index, the "Mobile/Internet index" (ITU, 2002), which measured the relative levels of mobile and Internet developments in a total of 177 economies. The idea of creating categories consisting of indicators sets and then combining them into a single view was also, among first, presented in SIBIS (*Statistical Indicators Benchmarking the Information Society*) project. At beginning of SIBIS in January 2001, three domains were identified: access, use and impact of telecommunications, with every domain consisting of indicators divided into sub categories. Since the project obtained two very large surveys (General Population Survey and Decision Making Survey) one of conclusions was that large amount of indicators (today SIBIS indicators Handbook consists of 84 indicators) cannot be in its original form used for benchmarking and performance evaluation [10]. That is when compound and snapshot indicators were presented. ITU also continued with "index idea", in response to the WSIS Geneva Plan of Action call for an ICT Development Index. Selhofer and Husing (2002) presented The Digital Divide Index in order to measure social inequalities in the adoption of ICT. In 2003, ITU developed the "Digital Access Index (DAI) in order to measure the overall ability of individuals in a country to access and use ICTs. It was thus built around five categories: infrastructure, affordability, knowledge, quality and actual usage of ICTs. Philipa et all (2003), under the guidance of UNCTAD secretariat reviewed and evaluated existing work to measure ICT development from different sources, (UNDP, UNIDO, OECD and ITU) and formulated a view to measuring ICT development. In this report ICT Diffusion Index was presented as a simple arithmetic average of scores on the quantitative Connectivity and Access indices, and with Qualitative variables for policy indicators presented separately. The framework was used to benchmark and analyze the diffusion of ICT capabilities across 160–200 countries for 1995–2001 period. In 2005, DAI was merged with another index, the Orbicom "Infostate Index" to create the "ICT Opportunity Index (ICT-OI)". The ICT-OI was particularly designed to monitor the global digital divide and to track country progress over time and between countries of similar income levels. [7] Also in 2005, ITU developed "Digital Opportunity Index (DOI)" with main objective to measure the potential of countries to benefit from access to ICT. The DOI was based on three main categories: opportunity, infrastructure and utilization. One of biggest advantages of DOI is its

simplicity that gives countries an opportunity to track progress in field of information society. But DOI was also criticized. James in his paper points out that "the index lacks an analytical foundation and is found to suffer from cumulative biases of different kinds…These and other problems all suggest that one should be cautious in drawing policy conclusions from the DOI, as it currently stands" [14, p.46]. In 2007, ITU represented by Mahan and Jensen engaged in a process to examine the feasibility, and make concrete proposals, for the construction of a single index. As presented in *2007 World Information Society Report* (WISR), there was a correlation coefficient between two indices (DOI and ITU-OI) of 0.94, with only minor variations in country rankings. Therefore, merging the two indices and creating a single ITU ICT index was consider. A major difference between the two indices concerns the methodology, whereby the ICT-OI uses a reference country and year, which allows individual countries to track real progress on the index score, whereas the DOI uses a simpler methodology, with no normalization of the data (all indicators are expressed as a percentage), and which compares countries' index values and ranking across different years [7, p.10]. The new index proposed as a result of noted framework was called ICT Development Index – IDI (name also proposed by Geneva WSIS Plan of Action). It combines characteristics of DOI (indicators related to households and broadband and its simplicity) and ICT-OI (skills indicators, normalization and digital divide methodology). In [13] authors pointed out, two main areas of consideration in creating a single ICT index (beside indicators selection) are the question of sub-indices as well as normalization, weighting and aggregation methods applied.

IV. Building an Index – Building a Policy Tool

Combining multiple indicators into a single value provides a holistic picture on the state of ICT development within a country. Once a composite index is established its own structure represents policy domains. As seen in DOI, opportunity, infrastructure and usage are sub indices that can be taken as policy areas. The same is in IDI, with sub indices access, use and skills. Through benchmarking a country (policy creators) can determine who is "best in class" (so called benchmark) and determine how national ICT sector stands relative to benchmark. By decomposing the Index a country can get better picture of what areas of development need enforcement. Tracking rank changes through time enables tracking progress towards policy targets. It allows policy makers to put their countries' achievements into context, by benchmarking them to other countries at similar income levels, or with similar geographic, social or regional characteristics. Through this, Governments can set realistic targets and track and evaluate developments over time. In general indices do not provide comprehensive picture of a country but they allow for benchmarking of weaknesses and strengths of countries with those of similar social and economic settings. Beside the "easiest" way of tracking country rankings through analyzing existing indices values (DOI, ICT-OI, IDI), policy creators can chose to define its own benchmarking process and reference index as support tool for policy making. In that case the starting point is ICT identifying national ICT policy targets and defining indicators that help them measure these goals from the outset. The process for developing indictors should be consultative (brainstorming, multi-stakeholder discussions and decision making surveys). For an example, for priorities of ICT sectors in western Balkan countries, we can take following areas that underpin the development of indicators: Infrastructure development; Access, Affordability and Availability of ICTs; Policy and regulatory frameworks; Promotion of socio-economic applications of ICTs (e-health, e-education, e-commerce, e-learning, etc).

The next step is to assign indicators to each area of priority defined with caution that indicators should be: reasonable in a sense that they should make it easier for collection of appropriate data (supported by a body of empirical research); sustainable (maintain same definition and sense overtime); simple enough to be used by decision makers and experts. Indicators could be assigned from ITU lists of core indicators and based on existing case studies experiences. We propose ITU list of indicators in order to ensure availability of reliable data. Also for further analyses (sensitivity and robustness for example) time series are needed. Indicators can then be classified into categories according to defined policy areas. These categories are future sub indices (single composite indicators). Since the list of indicators can be long and complex it is recommended to perform analysis for reducing multidimensional data sets to lower dimensions. The purpose is to find and exclude indicators highly correlated in order to avoid double counting. Most common tools are PCA (used for IDI), Factor and Cluster analyses. After indicators selection and categorization, next step is normalization. Indicators should be normalized to render variables comparable. When selecting normalization method one must be aware that different methods will produce different results for composite indicators [15, p.83]. The methods can go from simple equations to statistical or multivariate analyses tools. DOI is an example of "normalization avoidance" since all indicators are expressed as percentage of defined target value. Variety of methods can be seen in *Handbook on Constructing Composite Indicators* [15]. One approach to data normalization is assigning scores to data values prior to defined scale and values assigned to each score. There are several considerations in this issue. Minimal and maximal score can refer to minimum and maximum of indicator values, or they can be defined prior to quantitative policy targets, (defined goalposts as in DAI, EU average or maximum for Balkan countries, or ideal situation with having all services on 100% penetration with free off charge as in DOI). This approach is similar to one called distance to referent country. For our exercise we used normalization based on scores with assigning 1 for lowest indicator value and 5 to EU average. The main advantage of this method is its simplicity and the independence to outliers. Disadvantages appear in tracking country's performance across years since perhaps

a country improves from one year to the next, yet its ranking deteriorates as other countries improve faster. The type of normalization most commonly used is Standardization (or z-scores) [15].

Once normalization is completed, next step is weighting and aggregation. These procedures are highly correlated with theoretical framework. As in normalization weighting can also go from simply assigning equal weights (as seen in DAI, and HDI) to all indicators to different methods application (DEA, AHP, CA). Expert's opinion is one of often used methods for weighting indicators. In [16] authors pointed out that "One of the main disadvantages of this (expert's opinion) method is that modelers may not have access to the experts….if the number of the experts is less than 30 the outcome of a composite index and ranking countries in a benchmarking exercise is not robust." Here we can point out that there can be more levels of weighting and aggregation if we firstly created sub indices form selected indicators and afterwards an index based on sub-indices aggregation. Aggregation is a final step in index constructing since it calculates a final single value of all indicators included. Aggregation methods go from arithmetic or geometric mean to using multi-criteria analyses. Different aggregation methods can be used for creating sub indices and composite index. In Table I one simplified method of weighting and aggregation is presented (example is given for fixed telephony).

TABLE 1: INDEX CONSTRUCTION – AN EXAMPLE

	T sub-index			**R sub-index**					**Index**
	P	D	T	CS	CPS	RIO	RUO	US	
CR	5	5	2.63	0	1	1	1	1	2.07
MN	4	5	3.13	0	0	1	1	1	1.87
TU	3	5	3.25	0	0	1	1	0.8	1.73
RO	3	4	2.63	1	0	1	1	1	1.72
MK	3	5	2.63	0	0	1	1	1	1.69
BA	3	4	2.63	0	0	1	1	0.9	1.56
BG	4	1	2.38	0.5	0.5	1	1	1	1.46
SR	4	3	3.75	0	0	0	0	0	1.25
AL	1	5	2.5	0	0	0	0	0.6	1.08

Average score for three indicators (fixed penetration - F, digitalization - D, and Tariffs - T) is used to create T-sub index. Indicators are weighted equally and sub indices are weighted as 0.7 for T and 0.3 for R sub index. This is because infrastructure and access represent area with direct and stronger [15] influence on country's ICT performance while institutional impact is indirect and hard for quantitative measurement. Overall aggregation is calculated as an average score. All data refer to 2005. [16] Correlation coefficient between the result index and DOI is 0.70, with only minor variations in country rankings (with regards that it is a small data sample).

V. CONCLUSION

Policy areas for developing countries (for example Balkan countries) can differ from the one given globally (within WSIS or by ITU, OECD) by its priority or socio-economic environment for adoption. Our opinion is that countries still experiencing sector reform should consider inclusion of regulatory indicators into benchmarking process along with Infrastructure&Access, Usage and Skills indicators. This institutional component should be built into an originally created index for benchmarking process. Research must be carried out through carefully developed theoretical framework and set of simulation models in order to determine right methods for each step in index and sub indices construction.

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