

MEASUREMENT OF INTELLECTUAL CAPITAL OF LITHUANIAN CITIES BY A COMPOSITE INDEX

Rytis KRUŠINSKAS¹, Jurgita BRUNECKIENĖ²

¹*Department of Finance, Faculty of Economics and Business, Kaunas University of Technology, K. Donelaičio g. 73, Kaunas, Lithuania*

²*Department of Economics, Faculty of Economics and Business,*

Kaunas University of Technology, K. Donelaičio g. 73, Kaunas, Lithuania

E-mails: ¹rytis.krusinskas@ktu.lt (corresponding author); ²jurgita.bruneckiene@ktu.lt

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Abstract. The article comprises analysis of theoretical and practical aspects of measurement of the city's intellectual capital. This article includes analysis of the intellectual capital concept and possibilities of its application at the city level, generalization of the organization intellectual capital models and principles, which, considering the macro-level context and overview of tendencies of economic growth, are applied for measurement of intellectual capital of the city. The newly created city's intellectual capital balance index is presented. The empirical application of the method proved that it is an appropriate tool for the measurement of the city's intellectual capital within a country, which corresponds to the second level NUTS of the European Union. This article is one of the ambitions to promote the methodological background for urban governance and improvement of intellectual capital as well as competitiveness of Lithuanian cities. The city's intellectual capital balance index can be used as the tool for assessment of efficiency and timeliness of the urban and national development strategies, also as the tool for publicity for innovation, creativity and "smartness" of the city or the whole country.

Keywords: Intellectual capital, human capital, process capital, market capital, renewal capital, financial capital, city, composite index, Lithuania.

JEL Classification: O11, O38, R11.

Introduction

Particularly after the global economic crises of 2008–2010, Lithuanian cities, as those of many other countries, face major social – economic challenges, partially determined by reasons, which cannot be influenced by the city. There are many spheres, might be managed more effectively by employing intellectual capital of the city. Its involvement into the city development processes enhances the growth of industry and business competitiveness, improvement of the investment-related climate, establishment of high collective competences related to the city marketing, innovation, management and administration spheres. Knowledge cities, where intellectual capital is involved into solution of the city development problems, are the future of economy and precondition

of increase in the cities competitiveness. In such cities it is intellectual capital that is the generator of economic growth, whereas ideas are considered as endless recommendations on activities related to ongoing renewal and creation of wealth. Knowledge cities are characterized by accumulation of open-to-knowledge sectors, enterprises of innovative activities and learning as well as creative people. At the international level such cities have only several sectors of exceptional competence; however, they establish ambitious objectives to them, thus developing their knowledge-based strategies.

Beside involvement of the developed knowledge and intellectual capital into the city's development processes, successful competitiveness of the city at the local and international levels also requests permanent assessment of intellectual capital of the city. But, why is the measurement of urban (at the same time regional or national) intellectual capital so important? The answer to this question is related to the fact, that if the intellectual capital of the city cannot be measured, it cannot be improved. As the cities compete directly among other cities on regional, national and global level, the constant use of intellectual capital in the improvement of competitive advantage of the city will increase the productivity, visibility, popularity, attractiveness, quality of life etc. at the urban, regional and national levels. All this proves relevance and timeliness of the problems analyzed.

The research proved the lack of scientific works, which reveal particularities of the measurement of intellectual capital by a composite index and clear interpretations of the results. There is lack of researches, which shows the possibilities of application in the measurement of intellectual capital of the cities within a country, which correspond to the second level NUTS of the European Union. Hence, the city intellectual capital index, which is methodologically based and would enable practical measurement of intellectual capital of cities of the country, is still missing. Lack of means on complex measurement of intellectual capital is becoming one of the obstacles, which prevents from forming the effective strategies for the increase in cities competitiveness.

The aim of the article is to measure the city's intellectual capital by a composite index and identify the spheres and sectors of the city, where intellectual capital could be successfully employed for improvement the competitiveness and welfare of the city.

Methods of the research: systemic, comparative and logical scientific literature analysis; empirical research employing systemic analysis of external secondary data.

1. The concept of intellectual capital of the city

The concept of intellectual capital of the city is still in the stage of formation, as it exists just for a few decades; therefore it is attached to one of the most recent concepts from the perspective of both management and economic theories and approaches. The concept of intellectual capital is employed in analyses of various problems related to economy, management, law, politics, education and sociology, which determines abundance of different definitions on intellectual capital in scientific literature. The theory on intellectual capital considers analysis of intellectual capital-related problems at the

enterprise level, whereas at the urban, regional or national level this problem is not sufficiently analyzed.

The national intellectual capital is related and measured based on principles of intellectual capital of the organization, by adapting them to the macro-economic level. However, the current scientific and practical research is not sufficiently discussed by researchers; therefore, at the academic level the information on economic effects of intellectual capital and its involvement into the national and urban economic development processes is insufficient.

Some researchers' (Lerro, Schiuma 2008; Ginevičius, Korsakiene 2005; Cabrita, Vaz 2006; Alexander 2006; Bontis 2004, 2002; Choo, Bontis 2002) insight is based on presumption that intellectual capital is a strategic factor of economic development; although, it remains an object of scientific discussions. However, this does not at all imply denial of direct link between intellectual capital and economic development. It only emphasizes the relevance of analysis of intellectual capital and warns that its measurement is a complicated process, and the existing measurement methodologies might contain improvable issues.

Authors of this article (Krusinskas, Bruneckiene 2011) define intellectual capital of the city as the total intangible assets, existing in the city and making individuals, communities, enterprises and institutions of the city function, create, update ideas, processes or products by transferring them into results of sustainable development of the city, establishing possibilities for creating economic and social wealth as well as increasing the urban competitiveness and the quality of environment within the city now and in the future. The authors of the article specify the provided definition by the fact, the intellectual capital is a capital, which is used in the process of creation a value added and welfare of the city. The intellectual capital, which is in the city, but not used yet, is treated by the authors of the article as intellectual resources of the city. Authors of this article emphasize that they attach to intellectual capital all intangible assets existing within, not outside, the city; however, one way or another available to the city.

In research literature academic discussions prevail on components of intangible assets, which form intellectual capital. Different researchers provide different definitions: when defining intellectual capital, some authors enumerate all components constituting intellectual capital; whereas others introduce large-scale groups of components. The Scandinavia Navigator (Edvinsson 2002) model distinguished the following basic components of intellectual capital: human, process and customer capital; while the Intellectual capital index – human, infrastructure and relationship capital. When evaluating the EU intellectual capital, Andriessen and Stam (2005) distinguished human, structural and relational capital. Bontis (2004) has modified Edvinsson and Malone (1997) organization's intellectual capital framework into intellectual capital of nation's framework, and, when analyzing intellectual capital of the Arab region, assessed the financial, human, process, market and renewal capital. Analysis of research literature as well as the fact that the country consists of cities and peripheral regions allowed the authors of this article to presume that by the constituent components intellectual capital of the city can be compared to intellectual capital of the country. The authors of this article support the

structure of national capital introduced by Bontis (2004) and define intellectual capital of the city as consisting of human, financial, market, renewal and process.

Authors of this article emphasize that, with regard to the cities striving to become knowledge cities, it is not enough just to set up strategic guidelines. It is important to inventory and measure the current situation of the intellectual capital within the city and employ it for the promotion of the city's development and increasing its competitiveness. Research (Bruneckienė *et al.* 2010) revealed that if the intellectual capital of the city cannot be measured, it cannot be improved. The constant improvement of intellectual capital of the city will strengthen the city's position against other cities, especially knowledge cities, and create favourable conditions for the city's development and increase in its competitiveness, corresponding to modern changes of the market.

2. Methods of measurement of intellectual capital of cities

Intellectual capital itself, as a concept, is difficult to define, so its measurement in a simple way is also a difficult problem, because intellectual capital is allocated on various levels: national, regional, urban or organizational. In scientific literature (Luthy 1998; G. Roos, J. Roos 1997; Brooking 1996) intellectual capital-related problems are frequently analyzed at the organization level. At the city, regional or national level intellectual capital-related problems are seldom analyzed. This is conditioned by the lack of methodological background and principles for measurement, employment and involvement of the territorial intellectual capital into the decision making process. In many cases measurement of intellectual capital was referred to Edvinson and Malone (1997) model, based on measurement of intellectual capital at the organization level, arguing that transfer of measurement concepts from micro into macro level does not differ. Academic research of this problem was joined by international organizations, such as the United Nations (by measuring the Human Development Index), World Bank (by presenting Knowledge Assessment Methodology and Knowledge Assessment Index), European Commission (by presenting the Innovation union scoreboard), Organization for Economic Cooperation and Development (OECD). However, quite a different approach towards assessment of intellectual capital economic effect was presented by Pulic (2005), connecting intellectual capital with financial indicators of economic development and introducing the Value added intellectual coefficient (VAIC) index as output. In further works and studies Stahle, Bounfour (2008), Lin, Edvinson (2008), WEF (2007), P. Stahle, S. Stahle (2006) proved that factors enhancing the country's economic development (intellectual capital is recognized as one of them) are very much dependant on the GDP index and macroeconomic factors related to it. Therefore, the context on economic growth, within the measurement of intellectual capital, has to be revealed through respective analysis of the national, regional or urban statistics indicators.

Sweden was the first country, which attempted to measure its intellectual capital in 1996; later in 1999 Israel followed its example. Both countries applied the IC Navigator model. When assessing one region of Sweden – Skane, consisting of 33 municipalities, Christiansson, Rosengren (2004) created the IC of Municipality model, based on the

IC Navigator model, and distinguished 35 indicators. Viedma (2004), when assessing intellectual capital of the Spanish city Mataro, introduced the CICBS model (Cities' Intellectual Capital Benchmarking System), also based on the IC Navigator model, and distinguished 34 indicators. In 2004 the Norwegian region Larvik assessed and rated its intellectual capital from the perspectives of both its traditional elements (human, structural and communications capital) and culture, environment and nature. The conducted research allows maintaining that the intellectual capital measurement model is based on the IC Navigator model, whereas the number and variety of indicators employed for qualitative assessment of the problem analyzed, depend on availability of objective data.

Research shows (Bruneckienė *et al.* 2010; Snieska, Bruneckiene 2009) that for measurement of intangible concepts the index of often calculated in scientific literature. In scientific literature four basic indices for measurement of the national, regional and urban intellectual capital are employed. Bontis (2004) introduced the National Intellectual Capital Index (NICI), consisting of 24 indicators, which are grouped into 4 sub-indexes: the National human capital, National process capital, National market capital and National renewal capital. Pulic (2005) presented the Value Added Intellectual Coefficient (VAICE), which measures the efficiency of resources in corporations and regions in a financial value model. VAICE can be calculated for a company, regional and national economy. Another method is developed by Bounfour (2003), who divided the intellectual capital into four areas: structural capital, human capital, market capital and innovation capital. Bounfour's model of Intellectual Capital Dynamic Value Approach (IC-dVAL) measures intellectual capital in four interrelated dimensions: Resources as inputs; Processes; the Building of intangible assets (intellectual capital); Outputs. The author identified 21 indicators to describe the intellectual assets of a corporation. Also this methodology was used on the national and municipal level to evaluate the performance in European Union, Japan and the USA (Bounfour 2003). The Nordic region received the highest score and was assigned to regions, which manage their intellectual capital in the best way.

Research revealed that various intellectual capital benchmarks introduced by different scientists can be applied at organizational, urban, regional or national levels; the main challenge when applying the methods at different levels – availability of objective statistics data. Some indicators, available at the national level, are not calculated at regional or urban levels. Indicators, which can be taken derived from the enterprises' financial reports, are frequently not calculated at macro level.

While the academic understanding of the urban intellectual capital is still under formation, the components of urban intellectual capital are still being identified, levels of analysis of the urban intellectual capital are still being modeled in scientific literature, the intellectual capital of a city can be measured in different ways and different types of results can be achieved: indexes, efficiency ratio, balance sheet, etc. As every method has its advantages and disadvantages, many scientists seek to find reliable, methodologically justified, understandable, convenient to use, objective methods and adapt them to the specificity of particular cities, which allows to measure the existing cities intellectual

capital and practically use it in the development of intellectual capital of city, strategic planning and urban governance, which leads to urban, regional and national wealth.

Aiming to measure intellectual capital of the biggest Lithuanian cities, authors of this article introduce their own city intellectual capital balance index (CICBI).

3. Methodology of the city intellectual capital balance index

CICBI is based on the IC Navigator model. CICBI consists of five components: human capital, process capital, market capital, renewal capital and financial capital. It should be emphasized that CICBI is a static instrument for measuring the state of the current city intellectual capital. Components, consisting CICBI, differ from IC Navigator by excluding the time perspective. CICBI measures the existing current city intellectual capital, i.e. analysis the static view.

For measuring intellectual capital of Lithuanian cities by CICBI, 25 economic social indicators, grouped into five groups, were set up (see Table 1). Analysis of intellectual capital of Lithuanian cities was conducted by measuring intellectual capital of the biggest Lithuanian cities (Vilnius, Klaipeda, Kaunas) and the average national intellectual capital and it's changes in 2006–2010. The basic year in the measurement of intellectual capital – the year 2006, and data of other years is assessed against that year.

When calculating the basic index, all factor groups were assigned the same weight coefficient of 0.2 points. Weight coefficients of all indicators are measured depending on number of factors in each capital group by 0.04 or 0.05 points, indicators of the Human capital factors group are measured by 0.02857 points (0.2/7) and the Renewal capital factors group are measured by 0.0667 points (0.2/3) (one – by – 0.0067 points), as the indicator “Population internal and foreign net migration rate, per 1000 population” has a negative value. In CICBI calculations statistics data are rationed by applying the distance from minimal to maximal value method.

The main source of data used in the calculation appears to be the Department of Statistics of the Government of the Republic of Lithuania.

Department of Statistics has started to calculate some indicators on municipality level only since 2006. This determines the time period of the analysis of urban competitiveness in Lithuania. The possibilities of receiving the data on municipality level proves that the methodological background of intellectual capital improvement in Lithuania is not formulated yet and this concept should be given more attention from scientists.

4. Results of empirical application of CICBI to Lithuanian cities

The calculated results are presented in Table 2. The measurement results reflect the general tendency of the national intellectual capital development, also providing comparative information for the overview of the biggest cities intellectual capital and comparison with average values of the Lithuanian intellectual capital balance index.

Table 1. City’s intellectual capital index components

| Indicators of components | Weight coefficient |
|---|-----------------------|
| Financial Capital (FC) | 0.2 |
| GDP per capita | 0.05 |
| Part of GDP created by counties* | 0.05 |
| Revenues of the city. per 1 citizen | 0.05 |
| Average monthly gross earnings | 0.05 |
| Human Capital (HC) | 0.2 |
| Number of university students. per 1000 population** | 0.02857 |
| Number of college students. per 1000 population*** | 0.02857 |
| 16–74 years old persons using information technologies (daily during the last 3 months)* | 0.02857 |
| Average number of readers per one library | 0.02857 |
| Number of persons participating in art collectives per 1000 population | 0.02857 |
| Part of population (25–64 years old) with the highest education * | 0.02857 |
| Average life expectancy* | 0.02857 |
| Process Capital (PC) | 0.2 |
| Material investment per one citizen | 0.04 |
| Value added created by one industry employee | 0.04 |
| Part of operating small and medium size enterprises within activities of Information and communications | 0.04 |
| Households with the internet access | 0.04 |
| Area of newly constructed non-dwelling buildings. per 1000 population | 0.04 |
| Market Capital (MC) | 0.2 |
| Goods of Lithuanian origin from GDP | 0.05 |
| Registered unemployed and the working-age population ratio | 0.05 |
| Guests accommodated at accommodation institutions. per 1000 population | 0.05 |
| Direct foreign investment per 1 citizen | 0.05 |
| Renewal Capital (RC) | 0.2 |
| Number of operating economic subjects. per 1000 population | 0.06667 |
| Population internal and foreign net migration rate. per 1000 population | -0.06667 ¹ |
| Youth rate. Part of 15–24 year-old population | 0.06667 |
| Expenditure for R&D within the higher education and government sectors from GDP**** | 0.06667 |
| Employees involved in R&D in higher education and government sectors per 1000 population**** | 0.06667 |

Notes: * The data is provided by the county; ** The average of the biggest Lithuanian cities with universities is applied; *** The average of Lithuanian cities with colleges is applied; **** The average of the biggest Lithuanian cities is applied, as around 99 percent of employees of this sphere work in these cities.

¹ When calculating the renewal capital component value of Vilnius city, the only indicator of the indicators analyzed “Population internal and foreign net migration rate, per 1000 population” is positive, in comparison with indicators of Lithuania, Kaunas and Klaipeda. Considering this factor, the intellectual capital index component value, contrary to the rest cities and Lithuania, is positive; also, having measured the ratio with the index value of Lithuania of 2006 (which is considered basic), the weighted value 0.06667 of one indicator of the renewal capital indicators group is added, which compensates the negative value’s becoming positive.

Table 2. The general intellectual capital balance index

| | 2006 | 2007 | 2008 | 2009 | 2010 | Average |
|-----------|-------|-------|-------|-------|--------|---------|
| Lithuania | 1.000 | 1.092 | 1.129 | 1.065 | 0.221 | 0.901 |
| Vilnius | 1.928 | 2.156 | 2.298 | 2.215 | 1.507 | 2.021 |
| Kaunas | 1.064 | 1.142 | 1.047 | 0.974 | -0.035 | 0.838 |
| Klaipeda | 0.991 | 1.124 | 1.178 | 1.240 | 0.235 | 0.954 |

Consideration of the measurement results suggests that during the period of 2006–2010 the average index value of Kaunas, usually called the second biggest city by size, and was almost 2.4 times smaller than that of the country’s capital Vilnius. Besides, indexes of Kaunas city were also lagging behind the third biggest city by size Klaipeda (by separate years, higher index values were received only when assessing the period of 2006–2007), at the same time, however insignificantly, behind the calculated total national intellectual capital balance index (by separate years, higher index values were received only when assessing the period of 2006–2007). Prevalence of the country’s capital intellectual capital balance index against the rest cities analyzed and the total national average is obvious. This justifies the importance of Vilnius, as the country’s capital and regional centre, and exclusiveness of the city’s economic and social results with the whole country. These differences emerge when analysing changes within values of intellectual capital components during the analyzed period. Considering tendencies of financial capital indexes, Kaunas city insignificantly goes ahead of Klaipeda, due to the size of GDP part created in the county. Whereas the value of human capital is higher in Klaipeda city, as indicators on the number of colleges within the city, per 1000 population, as well as number of readers attending libraries are higher than respective indicators of Kaunas city. When measuring the Process capital component, measurement values are similar; however values of indicators on measuring the operating small and medium size enterprises within information technologies-related spheres are higher in Kaunas city; whereas during the period of 2006–2010 more non-dwelling areas buildings were constructed in Klaipeda. Considering the Market capital measurement values and results of its components, the cities of Klaipeda and Vilnius are obviously distinguished by the number of accommodated guests per 1000 population and indicators on direct foreign investment per one person of population. Analysis of the values of Renewal capital indicators suggest that, with respect to Kaunas and Klaipeda cities, the identified and negative weighted values are determined by the result of the population internal and international migration (Vilnius city has negative value of the factor only for 2010). In this respect of intellectual capital measurement the negative migration effect in Kaunas city is significantly bigger during the period of 2008–2010; however, the balance within the Renewal capital measurement in Kaunas is provided by higher indicators on R&D expenditure and employees working in R&D-related spheres.

The analysis revealed a major negative effect of the population internal and international migration indicator on the final result of the intellectual capital balance index (see Table 3). It should be marked that the Department of Statistics provides positive results on

Table 3. The total intellectual capital balance index after the elimination of migration

| | 2006 | 2007 | 2008 | 2009 | 2010 | Average |
|-----------|-------|-------|-------|-------|-------|---------|
| Lithuania | 1.000 | 1.095 | 1.165 | 1.209 | 1.268 | 1.147 |
| Vilnius | 1.672 | 1.875 | 2.008 | 2.018 | 2.028 | 1.920 |
| Kaunas | 1.178 | 1.287 | 1.345 | 1.360 | 1.475 | 1.329 |
| Klaipeda | 1.211 | 1.331 | 1.417 | 1.421 | 1.506 | 1.377 |

migration to the districts of some cities (which implies that citizens move from cities to live in suburban districts, however their working place remains in the same city); however, a precise identification of this group is rather complicated. Therefore, additional measurement of the cities intellectual capital is conducted by eliminating migration factor component values in calculation of the intellectual capital balance index.

Comparison of the intellectual capital balance index results including and excluding the migration indicator component proves Kaunas city gaining advantage against the average data of Lithuania, also a decrease in prevalence of the Vilnius city intellectual capital balance index.

The calculated Pearson correlation coefficients for each group of intellectual capital balance indicators and for the summing balance index value, with respect to separate cities and the whole country (see Table 4), prove inter-relationship between indexes values and effect on the summing index indicator. In Table 4 moderate, average and strong correlation coefficients values are marked with a different color.

Table 4. Correlation between values of different index groups and the total index values

| | FC | HC | PC | MC | RC | RC, migration excluded |
|-----------|--------|--------|-------|--------|-------|------------------------|
| Lithuania | -0.140 | -0.420 | 0.559 | -0.881 | 0.985 | 0.649 |
| Vilnius | 0.402 | -0.077 | 0.721 | -0.522 | 0.915 | 0.818 |
| Kaunas | -0.280 | -0.665 | 0.128 | -0.911 | 0.994 | 0.173 |
| Klaipeda | -0.297 | 0.038 | 0.504 | -0.738 | 0.980 | 0.864 |

The effect of the Kaunas city renewal capital (whose measurement includes values of migration indicators) on the total intellectual capital value is the biggest, in comparison with other cities. Also a significant distinguished negative correlation of the balance index with market capital is observed, which implies while the market capital indicators values were decreasing, the total index value was compensated by effects of other indicators values. Whereas in the case of Vilnius city, both financial and human capital values as well as values of their measurement indicators have weak correlation with the index values. Finally, correlation results for Market and Renewal Capital indicators with total index values, show high interdependence in all cities analyzed.

The results of this measurement reveal spheres of major effect within measurement of intellectual capital; also they allow the cities to focus on the most vulnerable and relevant directions of intellectual capital development both at urban and national level.

The conducted analysis allowed authors of this article to distinguish major reasons for an unequal development of Lithuanian cities with regard to intellectual capital; the reasons should be taken into account by economists, politicians, urban strategic planning specialists and interested persons:

- Differences in migration rate between cities of the country;
- Disproportional creation of GDP in industrial enterprises at the national level;
- Disproportional development of new technologies-related activities and businesses in the country;
- Disproportional construction of the non-dwelling area buildings, accommodated for the development of commercial activities;
- Differences within the in-coming tourism;
- Disproportional attraction of direct foreign investments among cities;
- Disproportional performance of R&D activities, involvement of highly qualified specialists into these activities, investment into this sphere.

Conclusions

Cities intellectual capital is directly related to the competitiveness and welfare of the city. The employment of cities intellectual capital to the process of the urban functions creates preconditions and accelerates for the cities becoming the cities of knowledge. The definitions of intellectual capital, presented in the scientific literature are mostly connected with organizations. The identification of the specific of urban function and adaptation those to the definition of intellectual capital at micro level allow to formulate the definition of cities intellectual capital.

There are plenty of methods and models of intellectual capital at micro level. The lack of analysis in scientific literature does not allow identifying, which intellectual capital measurement model is the best, when transferring from intellectual capital measurement from micro to macro level. It is essential to correct the existing models by taking into consideration the specificity of the object assessed and data availability at the national, regional and urban levels.

Intellectual capital can be described by various factors, expressed by quantitative and qualitative indicators. This justifies impact of the factor selection technique on the intellectual capital measurement results as well as the necessity of an explicit and methodologically based background of measurement.

When measuring intellectual capital of the city, it is recommendable to analyze the following groups of factors – human, process, market, renewing and physical capital. Involvement of the financial capital component into the city's intellectual capital measurement process is based on the fact that beside economic functions, the city involves functions of social, environmental, engineering development and other spheres, which require financial capacities of the city.

The suggested method CICBI can be considered as a valuable source of information for both parties interested in the city development and the city administration authorities, when forming efficient strategies for balanced development from the national perspective and ensuring the increase in the city competitiveness.

The suggested method CICBI is assigned to static, not to dynamic, methods. Measurement of the city's intellectual capital status quo may allow to presume directions of the urban and national economic social development in the future; thus, significantly contributing to both the strategic knowledge economy management process and insights on the future urban and national development.

The results obtained by CICBI and interpretations performed on their basis are mostly dependable on reliability of the initial information source data.

The empirical application of CICBI proved the method applicability with respect to other Lithuanian cities. Transfer of this method into analysis of another selected object of the country can be limited due to the lack of information and nonconformity of indicators.

The establishment of the factors weight coefficients when measuring both the total intellectual capital of the cities and the city's single components, effects the measurement result; therefore, a comprehensive analysis of relationship between these components could improve their measurement and avoid speculative interpretation of results. Involvement of the expert measurement into the urban intellectual capital assessment process could ensure achievement of more objective results.

This index could also be applied as the tool for assessment of efficiency and timeliness of the urban and national development strategies, also as the tool for publicity for innovation, creativity and “smartness” of the city or the whole country.

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Rytis KRUŠINSKAS. Prof. Dr of Social Sciences (Management and Administration), Head of Department of Finance in Kaunas University of Technology, Faculty of Economics and Business. Research interests are in the areas of financial management, economic and social effectiveness measurement, cost – benefit analysis, strategic financial management decisions, financial planning and modeling.

Jurgita BRUNECKIENĖ. Assoc. Prof. Dr of Social Sciences (Economics), Lecturer in Kaunas University of Technology, Faculty of Economics and Business, Department of Economics. Research interests are in the areas of regional and urban development, regional and urban competitiveness and its measurement, intellectual capital of the city, measurement by index.