# The system of socio-spatial diversity monitoring in the city of Gdansk, Poland

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**Abstract:** This paper presents methods for the system of socio-spatial diversity monitoring in cities on the example of the a monitoring system for degraded and regenerated areas in the city of Gdansk. The main focus is on the use of spatial databases for the monitoring system and the possibilities of using its results for further work - especially spatial planning or scientific purposes. In the beginning, the author will discuss the conditions for the implementation of monitoring in Polish cities - the legal basis, data availability and institutional support for the spatial monitoring processes. Next, data sources and methods of the implementation of monitoring will be discussed, along with an indication of the most difficult obstacles and ways to overcome them. The next part will present the chances of using monitoring data both for the needs of spatial planning and for scientific purposes, for example in the characteristics of Gdansk residential areas and assessment of their level of social capital. The study aims to lead to a discussion on the willingness of municipal units to conduct effective spatial monitoring and the use of its results for real changes in the urban space.

**Keywords**: socio-spatial diversity, monitoring, regeneration processes, factorial ecology, sustainable development

## Introduction

From the very beginning of its existence, cities were places that gathered people with different social status. With the development of urban civilization, resulting in an increase in the number of inhabitants and their territory, the problem of the social diversity of cities has deepened considerably. Some scientists, however, believe that the main reason for this is the growing number of social characteristics that distinguish urban residents. Shevky and Bell (Shevky and Bell 1955, 3) regarded the city as *'a product of the complex whole of modern society; thus the social forms of urban life are to be understood within the context of the changing character of the larger containing society'*. Nevertheless, cities do display distinctive residential patterns and such areas may be termed morphological regions, neighbourhoods, urban social areas or urban regions, according to the type of approach and the semantic tastes of a researcher (Knox and Pinch 2000).

The paper presents the main conclusions from the implementation, conduct, and evaluation of the system of socio-spatial diversity monitoring on a micro scale in the example of city of Gdansk[1]. The focus is on the monitoring system for degraded and regenerated[2] areas which is a part of Gdansk Municipal Regeneration Program. The article also considers how monitoring can serve to improve the efficiency of the spatial planning system for long-term sustainable development.

First, there is a need to establish definition needed to the discussion. It is fundamental to present the idea and assumptions of factorial ecology, which is the theoretical basis for the creation of the socio-spatial diversity monitoring of Gdansk. As Michael Pacione explains (Pacione 2005, 371) '*factorial ecology offer a means of constructing urban social areas based on a mathematically rigorous procedure and using a larger set of diagnostic variables than the seven employed in classical social-area analysis*'. In addition to, and sometimes instead of, classic dimensions represented in Murdie's model (Murdie 1969) it is common for factor ecological analyses to identify other dimensions of residential differentiation (Knox and Pinch 2000). Social-area analysis based on factorial ecology has been used in many studies as a tool for constructing a social typology in the city, as well as a prelude to the ecological analysis of social characteristics such as crime, social activity or electoral behaviour. Moreover, as Paul Knox and Steven Pinch declared, factor analysis *'it is now generally the preferred approach for dealing with the complex question of measuring urban sociospatial differentiation'* (Know and Pinch 2000, 105).

**Institutional and legal framework of socio-spatial diversity monitoring in Poland**

At the outset, it is worth emphasizing that there are no legal provisions in Poland that contain a require of socio-spatial diversity monitoring in municipal spatial policy. The only legal requirement connected with the monitoring of urban space is contained in art. 32 of the Act of 27 March 2003 on Planning and Spatial: this regulation obliges the municipal offices to realize an analysis of changes in spatial development at least once during the term of office of municipal council, which is five years. The mentioned article does not indicate any detail or method of how to monitor these 'changes in spatial development' - in practice this unfortunately means that most of municipal offices do not conduct any spatial analysis, and only submit statistical data (such as the number of building permits, the number and the area of local spatial development plans or the area of transformed agricultural land).

Clearly this does not mean that spatial analysis is not carried out by Polish municipal offices at all. Mainly in larger (more than 200,000 inhabitants) Polish cities, usually the capitals of voivodships,

[1] Gdansk is the port city in northern Poland, a capital of Pomeranian voivodeship, with 466 631 registered inhabitants in the end of 2018 year.

[2] It is important to clarify the definition of the regeneration used in the paper, which comes from the Polish legislation (Act on regeneration, 2015). The regeneration process is defined as *'a process of counteracting crisis situation in the degraded areas, lead in complex approach due to integrated actions in favor of local community, space and economy, concentrated territorial, conducted by regeneration stakeholders, basing on local regeneration program*'.

there are special units within the municipal office, which are dealing with analysis, especially for the needs of spatial planning. Nevertheless, the issue of socio-spatial diversity analysis remains the domain of Polish universities. There are several well-known Polish geographers which are focusing on socio-spatial diversity like Grzegorz Węcławowicz (1988, 2007), Henryk Domanski (2004) or Stanislaw Liszewski (2009). Liszewski (Liszewski 2009) has been writing that in order to determine the socio-spatial structure of the city, it is necessary to look for regularity in the spatial distribution of social groups of its inhabitants and the connections that occur between them. Indication of where the social groups are located, the comparison of theirs living conditions and the consideration of why certain socio-spatial structures have been created in the city are according to Grzegorz Węcławowicz (Węcławowicz 1988) the main goals that should be accomplished by the study of the socio-spatial diversity.

However, what is worth emphasizing is that the monitoring system discussed in this paper was created in the municipal office, specifically in the Gdansk Development Agency, which is a municipal institution responsible for spatial planning. A direct cause to initiate the system of socio-spatial diversity monitoring in Gdansk was the Municipal Regeneration Program (MRP). It is a strategic document which includes diagnoses, plans and coordinates actions to achieve the expected changes after regeneration process. It is also used as an integrated regeneration project which is required for financial support for regeneration activities from EU Funds (Axis 6 of the European Social Fund and Axis 8 of the European Regional Development Fund) through Regional Operation Programs. Since 2015 the regeneration processes in Poland are being conducted out within the Act of on Regeneration, which enrolments obliges municipal offices to fulfil the guidelines set by the experts representing Marshals' Offices (polish provincial offices) during the preparation of the MRP. The Act on Regeneration also includes the obligation to rely on the analysis in the designation of regeneration areas and in their monitoring, which, combined with different regional guidelines, contributed to the creation of many various methods of spatial analyses concerning on changes in urban space, especially with differences on the scale of detail.

**A system of socio-spatial monitoring in Gdansk – study case**

As it was mentioned, the system of socio-spatial diversity monitoring in Gdansk was created for the Municipal Regeneration Program. Initially it was assumed that it will aims at assessing the degree of program implementation progress, identifying barriers, difficulties, but also new areas requiring support outside regeneration and degraded areas. After time, its scope expanded. It is worth mentioning that analyses for the needs of MRP are carried out in several areas using a variety of methods, and the monitoring is only the first step - the next are the survey of residents and the observation of the implementation of individual projects. However, this does not change the fact that in practice the monitoring system initiated for the needs of MRP became a full-fledged analysis of socio-spatial diversity in the city and a valuable material for many other studies and actions.

Gdansk monitoring system for the Municipal Regeneration Program distinguish oneself among other Polish cities systems, above all due to the exceptional scale of detail, reaching results aggregated separately for each hectare of the inhabited area of the city of Gdansk. The majority of Polish municipal offices carrying out spatial monitoring only to the level of settlement units or, in the case of larger cities, districts. In the case of the monitoring in Gdansk, every effort has been made to obtain as much detailed data as it is possible.

The distinguishing feature of Gdansk monitoring system is also its frequency. According to Gdansk MRP itself, the analysis will be realised in the cycles of at least 3 years - however, the success of the first socio-spatial diversity analysis has made the monitoring regularly carried out every year. Such a frequency of repeated analyses allows to observe even the smallest changes in the city social area. It also enable to look for a correlation between the analysis results and current local or global events more precisely, than it would be possible in the case of monitoring with three-year cycles.

The socio-spatial diversity monitoring covers whole area of the city of Gdansk. After considering the availability of spatial data and after selecting the indicators for analysis, it was decided that their results will be presented only for inhabited areas - this also means that the total area covered by monitoring changes every year (mainly because new residential buildings are created). However, this does not prevent the possibility of comparing the annual results, because the synthetic index is calculated individually for each hectare of the inhabited area in the city of Gdansk. The aggregation of data into one-hectare squares allows an easy comparison of selected areas according to the values of indicators, as well as it simplify the creation of a synthetic index summarizing the results of all components indicators used for the analysis. A comparison of the results of the analysis of the socio-spatial diversity for the selected area of Gdansk in two following years is presented in Figure 1.

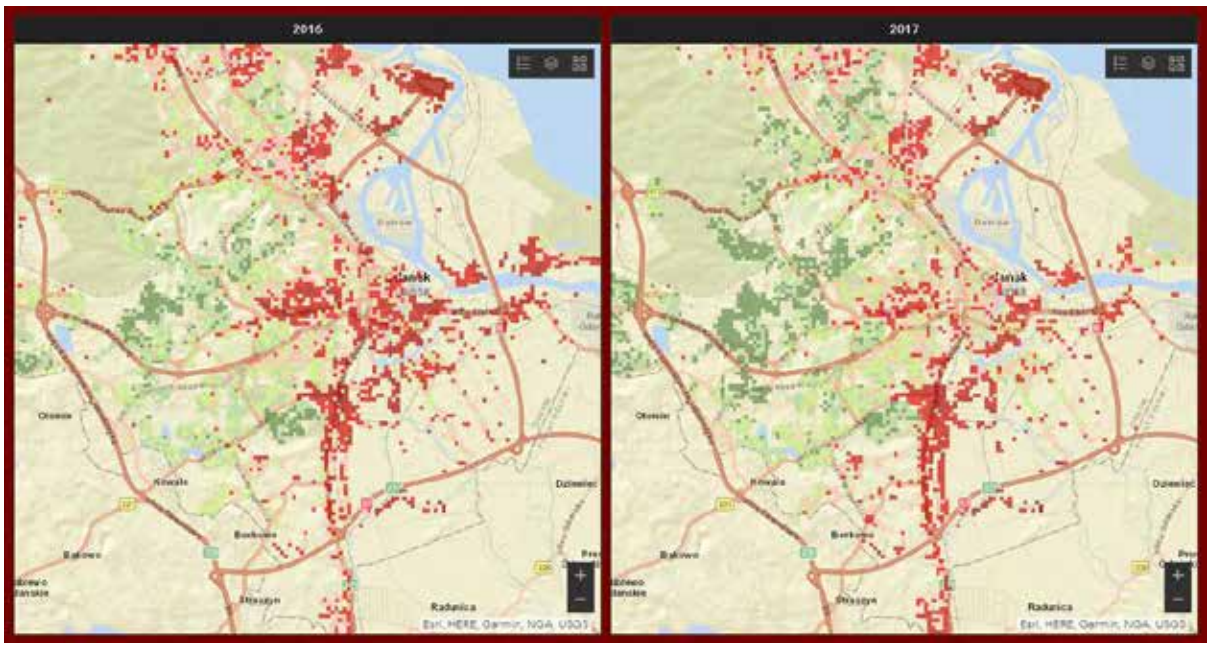


**Figure 1 The comparison of the results of syntetic index of the Gdansk MRP monitoring in 2016 (left) and 2017 (right). Source: Gdansk Development Agency (https://tiny.pl/twt1l, access: 05.05.19)**

As mentioned earlier, the system of socio-spatial diversity monitoring in Gdansk is based on the principles of factorial ecology. *'Factorial ecology employs the multivariate statistical technique of factor analysis in order to derive a smaller set of diagnostic factors from an initial larger set of variables measuring the social, economic and demographic characteristics of census tracts in a city'* (Pacione 2005, 371). The method of obtaining and processing data in accordance with the principles of factorial ecology is presented in Figure 1.

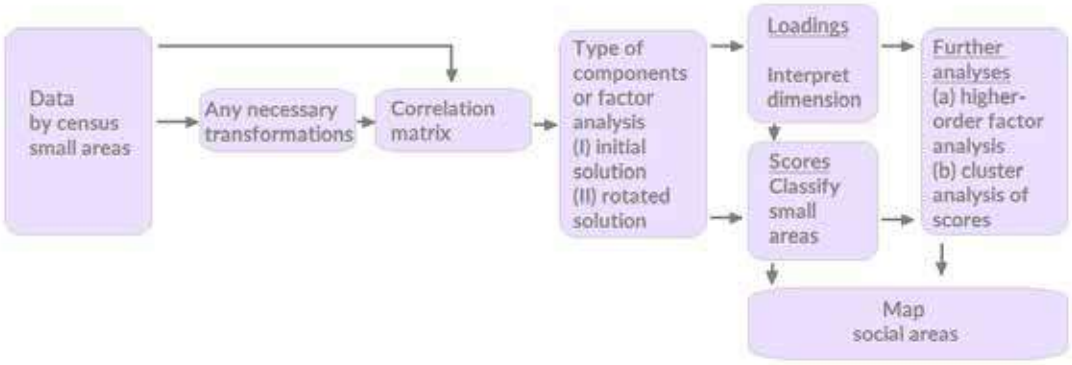


**Figure 2 The method of factorial ecology. Source: Own study based on Pacione 2005**

The system of socio-spatial diversity monitoring in Gdansk is based on synthetic indicators. The census data for synthetic indicators are always from the previous year of the analysis year. Additionally, for the base year for the whole monitoring system, the year 2016 was recognized. It will additionally refer to research in the following years. The selection and sourcing the appropriate census data was a key decision, but also the most time-consuming stage in the implementation of the monitoring.

In the first place, the choice of indicators was based on guidelines from national, provincial and local level documents. The main recommendations for the selection of indicators were:

- The guidelines of the Polish Ministry of Development;
- The guidelines of the Marshal's office (which is managing the disbursements of the funds from Regional Operational Programs and the EU),
- The indicators and goals adopted earlier in the diagnosis to and in the project of MRP for the city of Gdansk.

In this way, ten issues were selected - five social issues and five functional issues - for which appropriate (possible to be assigned to the location) indicators were sought. The socio-spatial diversity analysis is carried out in a set of permanently fixed 20 indicators for the social and functional domains. Table 1 presents the set of indicators with its sets.

**Table 1 Twenty indicators used in Gdansk socio-spatial diversity monitoring. Source: own study based on Turzynski et el 2016**

| | | | | | |
|---|---|---|---|---|---|
| SOCIAL DOMAIN | ***EDUCATION*** | ***SAFETY*** | ***SOCIAL CAPITAL*** | ***DEMOGRAPHY*** | ***POVERTY*** |
| | *the percentage of graduation* | *the crime rate* | *the voter turnout* | *the dynamics of population* | *the poverty rate indicator* |
| | *the exam results* | *the family violence rate* | *the civic budget turnout* | *The population aging* | *the rent debt rate* |
| FUNCTIONAL DOMAIN | ***ECONOMY*** | ***ENVIRONMENT*** | ***SOCIAL SERVICE*** | ***HOUSING*** | ***INFRASTRUCTURE*** |
| | *the level of unemployment* | *the noise exceeded* | *the availability of health services* | *the percentage of old buildings* | *the availability of sewerage systems* |
| | *the social entrepreneurship* | *the availability of green areas* | *the availability of public transport* | *the standard of living* | *The availability of water supply network* |

The data selected for the analysis were aggregated to the lowest possible level – the address points, which were the joining point for all data used in monitoring. In selected cases it was only possible to obtain data in area aggregation (school districts, electoral areas). In such cases, a value of indicator for an area was assigned to each address point in this area. For transforming census data into spatial data the geographic information systems (GIS) tools were used. GIS applications allows to process spatial information, edit data in maps, and present the results of all these operations (Maliene 2011).

Next, all the indicators were valorised. The appropriate classification of stimulants (indicators such as entrepreneurship or electoral turnout) and the destimulants (crime rate, poverty) was important for the proper synthesis of their results. The fundamental stage in creating the index of synthetic socio-spatial diversity was giving validity to individual component indicators. Giving appropriate weight to the indicators required extensive knowledge, discussion but also intuition. Synthetic indicators used in socio-spatial diversity monitoring presents values on a conventionally accepted scale, in percentage to the assumed reference value or in another way allowing for the interpretation of the state or trends. Individual geometric cartograms were created for all indicators used in the analysis. They are presented in a figure 3

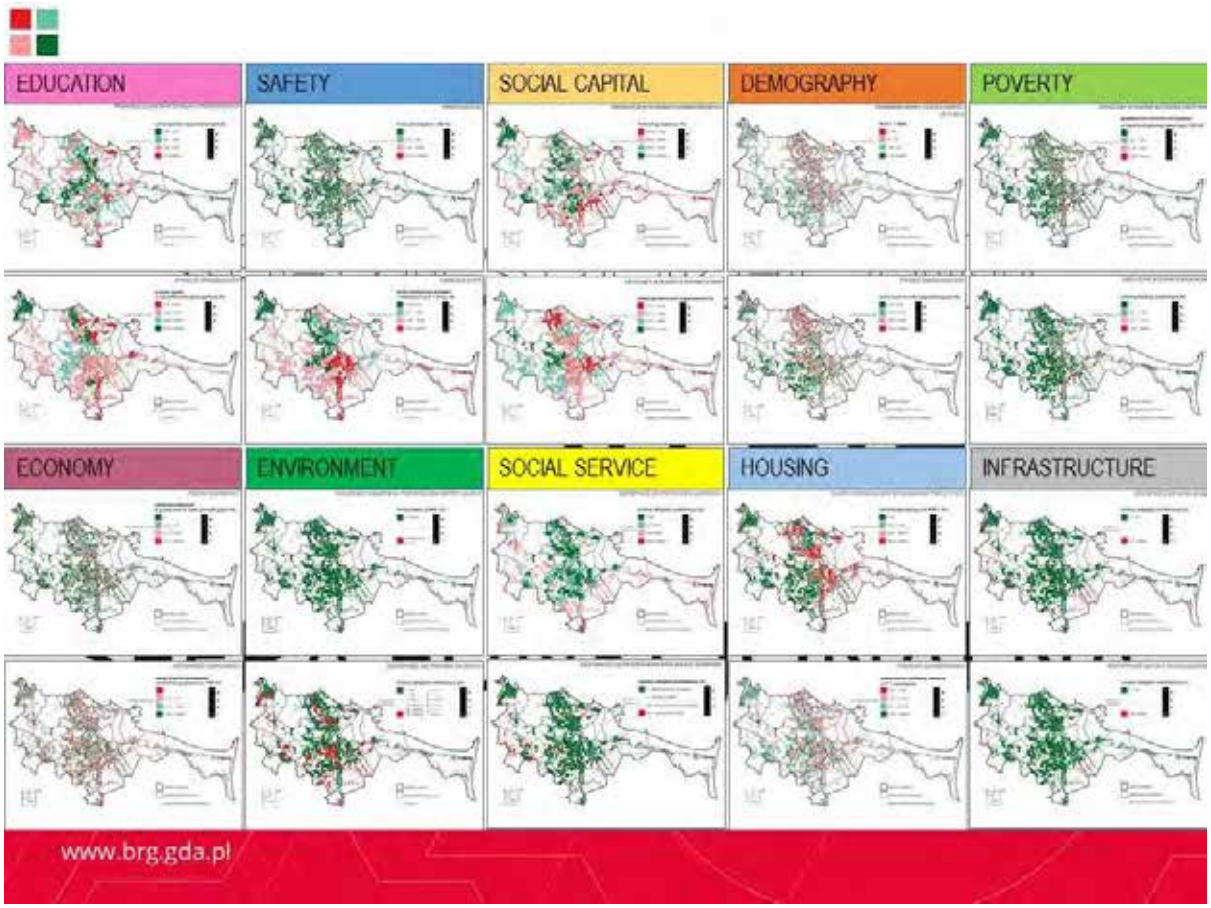


**Figure 3 A set of result maps of particular components of the socio-spatial diversity monitoring in the city of Gdansk for 2017. Source: Turzynski et al 2018**

Running a system of socio-spatial diversity monitoring in Gdansk has encountered many problems along the way. The greatest barrier was the availability of appropriate census data that could suitable represent this issue. It can be regarded as a success that twenty indicators have been selected and they are indicating various aspects of life of the inhabitants of Gdansk. However, the lack of availability of fundamental data usually used to determine social diversity, especially those relating to the sphere of social classes, has contributed to the disregard of this important aspect directly. Many of the census data are considered by the Polish law as sensitive data (such as, for example, wealth or income level) so that they are not available even for public or scientific institutions - even for the needs of research - all in the name of the protection of personal data. This does not mean the sphere of social classes has been completely ignored in the study. Using the data collected by municipal institutions (for example, the Municipal Social Aid Center) created indicators such as the synthetic poverty rate , housing standard or rent debt ratio in together allows to determine the generalized picture of social classes distribution in the city.

Another important barrier in initiating the monitoring system was the lack of regularity in statistical surveys conducted by the Polish Statistical Office (PSO). This office is responsible for such data as the size of households, the level of education or national and ethnicity affiliation of the population.

These data are collected through the National Census of Population and Housing[3] - a nationwide common survey program which consisted in involving census enumerators visiting all inhabited units and noting down information obtained directly from respondents on census forms. Last census took place in 2011, and there is no reason to believe that another will take place soon. The Polish Statistical Office justified the reason for this state that "such organization of the census turned out to be very expensive and laborious" (Polish Statistical Office 2014, 1). Therefore, despite the large potential usefulness of data collected by PSO in research on socio-spatial diversity, the irregularity of their collection excludes them for monitoring purposes.

Last but not least, the colossal problem in implementing the system of socio-spatial diversity monitoring turned out to be lack of awareness among employees of public units, which are collecting census data, on the meaning and rules of the spatial databases. Although the subject of GIS is not a novelty in Poland; despite the fact that the majority of universities conduct teaching courses in this field; even though GIS is becoming more and more popular in many spheres of public life, including marketing and advertising - despite all these premises, knowledge about the principles of data collection for future spatial database purposes is still underestimated. Unfortunately, even within one municipal office, the procedures of collecting registration data are varied, also in the case of the data attribute fundamental for monitoring method - the address, or more precisely the form of naming of address points. The problem exist because Polish streets are often called in honour of commonly respected people also known as patrons. Some institutions indicate names of such streets only with the last name of the honoured person, others use the last name with the surname, but there are also those which additionally add professional and military titles of the patron, such as a doctor, a colonel or a priest. Unification of the data record initially took a considerable amount of time. When data sets were collected again for the purpose of the next monitoring, a special application was created using SQL code, which automatically reduced various ways of saving addresses to one common form of address description through programmed name correlations.

The problems mentioned above are just some of the barriers faced by the authors of the Gdansk monitoring system of socio-spatial diversity. Among the others, one can mention the change in the method of classifying the source data about the civic budget (one of the indicators from the social capital sphere) or the change of the national education system (through the abolition of middle school) along with the change of school district's boundaries. Nevertheless, the results of monitoring are considered as a very useful imaging of the Gdansk urban space. These maps do both: confirmed the theories of social inequality between the upper and lower terrace of Gdansk (as the younger upper terrace has much better living conditions that the lower terrace) and also indicated new areas that are at risk of social degradation. Still, only long-term monitoring (at least five-year long) will allow for a meaningful analysis and then one can draw conclusions that will enable the elaboration of the necessary corrective actions.

[3] More information about the census is available on the Statisticts Poland website: www.stat.gov.pl/en/national-census/national-census-of-population-and-housing-2011/

**Future use of socio-spatial research results**

The system of the socio-spatial diversity monitoring was initiated in Gdansk only two years ago and has already gained recognition. The spatial analysis at the micro scale was appreciated by the regeneration committee (a council of residents, an advisory body in the processes of regeneration), experts from the Marshal's Office, spatial planners and officials working in the municipal office. The cartograms with partial results of the monitoring, which are made available in the form of an interactive maps, are particularly popular. The main recipients and their ways of using monitoring results for purposes other than MRP are presented on the figure 4.

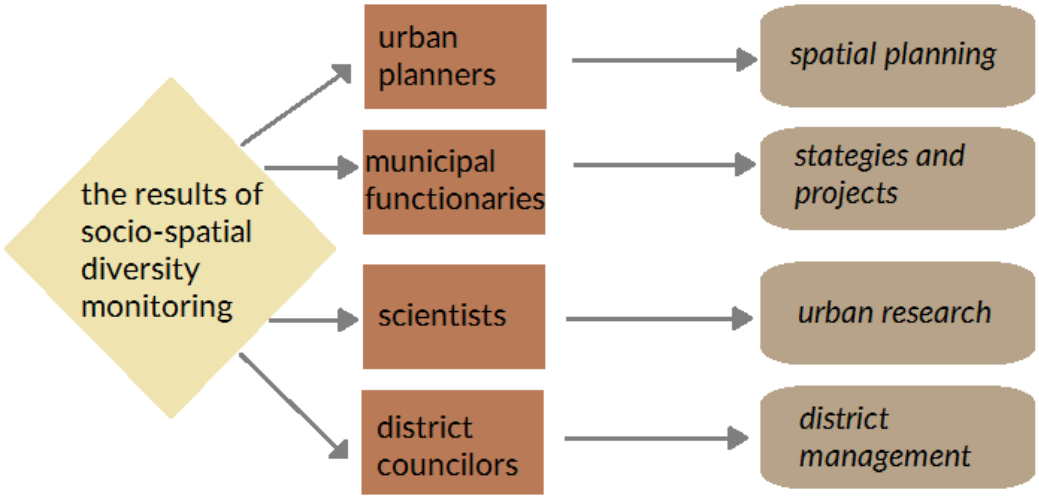


**Figure 4 Current wide use of the results of the monitoring. Source: own study**

The author of this article is also one of the authors of the described monitoring system. For a young scientist, whose research are concentrated around Gdansk neighbourhoods - their neibourhoodliness and their importance to the creation of social innovation - participation in the study of the distribution of socio-spatial diversity together with the subsequent consideration and analysis of the results had a significant scientific value. The work on the monitoring left a mark on many stages of the author's scientific work regarding the classification of the neighbourhood space of the city of Gdansk. Firstly, the synthetic collection of data on electoral districts or school districts allowed for these aspects to be taken into account in the delimitation of the borders of Gdansk neighbourhoods. Secondly the initial picture of social classes and the social capital level distribution in the city contributed to the assessment of the social cohesion of the neighbourhoods. The scientific application of Gdansk socio-spatial monitoring results may be significantly wider, which is why the Gdansk Development Agency makes them available online in the form of open data.

**Lesson learnt**

The publication of results of the system of socio-spatial diversity monitoring initiated discussions about the participation of the city's unit in research on the city space. So far, significant majority of spatial and social analyses (including those for the needs of development strategies) realised in Gdansk, as well as in other Polish cities, have been outsourced to expert companies, think-tanks or

universities. Currently, the possibilities offered by GIS tools allow for the more active participation of the municipal office itself in the analysis and research of the city space. This solution has many strengths - the office is the administrator of the necessary census data, well knows the needs and the purpose of the analysis and it has a broader knowledge about possible sources of deviations. In order to not be left behind by the developing research techniques, this approach requires constant dialogue with scientific units as the ones that lead the way in initiating and disseminating new research methods. The second necessary condition is also the requirement of continuous training of municipal office employees in the field of spatial databases and GIS itself, broadening knowledge about them and cultivating good practices.

Running a system of socio-spatial diversity monitoring in the city of Gdansk has shown that this topic is not yet properly installed in the realities of polish institutions. At the same time, the process of work on monitoring and the response to its publication showed how much research of this kind was needed. Analysis of socio-spatial diversity on a micro scale, in reference to each hectare of a residential area is consider an innovative solution on a national scale. Another novelty is the fact that the monitoring system has been developed and run fully by the municipal planning unit. This is the first step for greater involvement of GIS tools in municipal offices, but also, it's a sign of a greater openness to prototyping, testing new solutions and new methods in Polish administration.

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