



## DETERMINING GEOGRAPHICAL INEQUALITIES OF INFORMATION ACCESSIBILITY AND USAGE: THE CASE OF HUNGARY

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### Abstract

In the era of information and communication technologies it is necessary to clarify what motives are in the background of geographical disparities. The paper firstly sets up a theoretical framework that depending on the phase of technological innovation adaptation, main features of inequalities have different basic characteristics. By the multivariable analysis of information accessibility differences in the Hungarian microregions, basically the physical infrastructural constraints of the information society and economy are determined. Secondly, since an increasing number of people have become able to access the new information channels by today, the factor of accessibility could now be treated as a secondary problem. In contrast with accessibility differences the inequalities of usage come into the forefront of the analyses. Finally, the last section reveals that instead of usage volume differences the inequalities in the quality of information usage should be taken into consideration, when dealing with the newest geographical inequalities of the information age.

**Keywords:** *information society, regional inequalities, ICT, GIS, Hungary, EUROGEO 2013*

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### 1. INTRODUCTION – THE CHANGING NATURE OF ICT INEQUALITIES

Nowadays, alongside with traditional factors of inequalities some new ones seem to emerge, which have thorough effects also on geographical disparities. In connection with the currently very popular phase of information society there are more and more practical experiences confirming that processes affecting regional differences are showing also new characteristics. For example, by the appearance of the new innovations of information and communication technologies (ICTs) a transformation process has begun, which has changed our opinion on the advantages and disadvantages of geographical position, location, distance or other geographical factors. In information inequalities besides economic and social factors thus an increasing role is believed to be played by geography as well. Since recognising the growing importance of the notion of information society, modern geography has certainly the task to discover and evaluate the main characteristics of changes induced by the information age. Actually there is an increasing demand on clarifying what reasons are in the background of disparities. The explanation of the function of geography in information inequalities by the

clarification of accessibility disparities and user differences could serve the better understanding of recent days' altering processes.

When speaking about linking traditions with future an obvious question arises within the circles of geographers: does future or recent geographical inequalities have the same basic characteristics, or new inequalities are different from traditional ones? In the context of information society this research question could be further specified: does the geography of the information age really differ from geographies of previous times, or it has significant ties with traditional geographical concepts and research results? These questions practically reflect on the fact that we may look upon geographical problems a different way time by time. This time our eyes are focusing on geographical inequalities, while trying to determine what spatial characteristics are typical in information accessibility and usage differences.

Theoretically, among factors of geographical inequalities three basic types can be identified (Jakobi, 2004). The first covers traditional factors, which had same effects on geographical inequalities in the past as they will probably have in the future. The second group contains transformed factors, which were on the scene in the past, too, but have a different kind of influence on inequalities at present. Finally, the third type is about new factors, which either did not exist formerly or did not have any influence on the spatial inequalities, but exert a strong geographical impact nowadays. According to these groupings, at first sight the modern age factors of information society should be considered as new inequality effects, since main innovations of ICT appeared only in the last couple of decades, or are appearing recently, and typically new type of geographical disparities (e.g. virtual space inequalities or the digital divide [Mossberger et al. 2003]) is related to it.

Information society as a distinctly new socioeconomic concept, motivation factor and value system burst upon the scene, though not without preliminaries, in the last few decades; it is a consequence of the social evolution caused by accelerated technological development. The commercial opening of the Internet at the beginning of the '90s brought really important changes into the previously almost closed world of the Web. The new innovation was spreading at an unprecedented rate, and has required a completely new way of thinking, which proved to be an extremely useful instrument and also created new opportunities. Although computers and mobile phones were in use much earlier and information and knowledge have always been important, the substantial change was due to all these elements being associated with the main production factors (besides labour force and capital), thus gaining much more importance than simple tools.

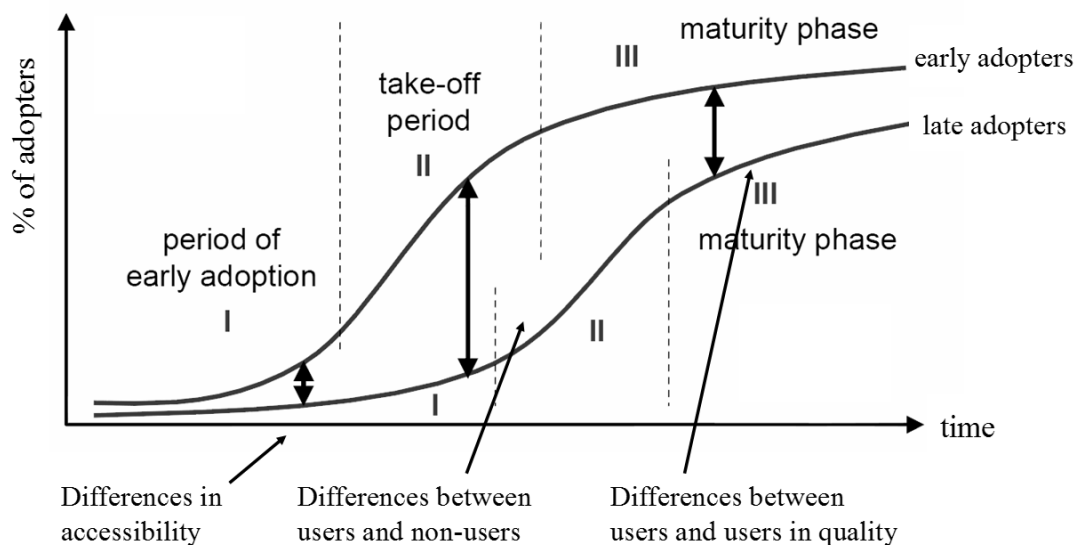
In truth the term "information society" has been used by researchers since the 1960s (Umesao, 1963; Porat, 1977) and has appeared from utopian to matter-of-fact scientific approaches in many contexts. It has had the highest occurrence among the keywords of publications in the last couple of decades (Masuda, 1988; Fichman, 1992; Castells, 1998; Trujillo, 2001; van Dijk, 2005). The research of ICT-based inequalities despite the novelty of this term is already not unknown in circles of international researchers. Basic works of Castells (1996, 1997, 1998), Norris (2001) or van Dijk (2005) formulated many concepts on inequalities of the information society. Also regional aspects of this topic became widely analysed (Goddard et al. 1985; Odendaal, 2003), however it has still a lot of questions to be answered, especially in relation with cyberspace inequalities and those effects on traditional geographical features. Joining to this, actually, it seems to be a re-emerging question, whether ICT-based inequalities are typically new ones, or they are just reshaping existing differences.

Digital divide or the digital gaps are the expressions of the researchers of information society on describing how specific the inequalities are in this environment. In the background of ICT-based differences there are (also) general social distinctions, namely income, education, gender or age differences of the population (Servon, 2002), which are basically

traditional inequality factors even in the information age. We should note that digital divide cumulatively foster existing social inequalities, therefore in that sense the factors of information inequalities may be considered also as traditional, or at least transforming ones, although ICT still have in majority new type of differentiating effects. All in all, if we go into details, we might discover that there are traditional, altering and new inequality motives within the topic of information age disparities, too.

To prove this concept, first of all the changing nature of ICT-based inequalities should be understood. Models, which try to explain and quantify inequalities of information accessibility and usage, evaluate the factors of early and late phases of technological development differently. Professionals explain the altering role of the influencing effects of factors related to inequalities of information society typically by the assistance of diffusion models (e.g. Hüsing et. al, 2001; OECD, 2001), primarily starting from that inequalities are basically determined by the adaptation level of ICT.

Social and spatial diffusion in time is characterised by a logistic curve, which shows a time-lagged shape depending on the development level of the analysed target group (Figure 1.). As a result of later adaptation certain social groups (for example peripheral regions) are becoming relatively lagged behind, which can be realised in social and spatial inequalities. In phases of the adaptation process different types of inequalities can be discovered. In early adaptation phase, when only few applies ICT, differences can be seen in accessibility, in the phase of diffusion the differences are present between users and non-users, while in the phase of saturation differences in quality can be emphasised. As a result, ICT-based inequalities can more or less be measured by the society's adaptation level.



**Figure 1.** Diffusion model of ICT innovations in the group of early and late adopters (Source: compile of the author based on Hüsing et al. 2001)

The theory that ICT-related inequalities have different contents depending on the phase of ICT adaptation were further detailed for example in social (Galács and Molnár, 2003) or in methodological contexts (Dolničar, 2008). Additionally, the above mentioned model is suitable to explain the changing nature of the ICT-related geographical inequalities as well, if regional adaptation level of ICT innovations were taken into account. In this modified model the first order geographical inequalities appear in connection with infrastructural differences in the traditional and “physically existing” space, which can also be named as the external

space of the information society and economy. This phase of regional inequalities is basically characterised by differences of accessibility to physical infrastructure. Typically the unequally built-up environment of information and communication infrastructure is among the most important measurable factors.

The second phase of ICT-related geographical inequalities has fewer relations with external space; rather it is dependant on internal space inequalities those are disparities of social origin. In this phase accessibility is still an important factor in disparities, however, with decreasing significance, while usage inequalities are gaining notable importance.

In the third phase the main accessibility disparities are disappearing or dissolving and the usage differences remain as inequality motives, however, this time only the quality differences are counting. Technically this phase is the most difficult to measure, since there are only few regional datasets about the quality of ICT usage, however, some experiments already successfully managed to collect data on this topic. Recently, when increasing amount of data are generated willingly or unwillingly during information interactions, also new sources appear which indirectly may serve as quality indicators of information usage.

**Table 1.** Different phases of ICT-based regional inequalities

<b>Main character of regional inequalities</b>	<b>Main regional inequality dimensions</b>	<b>Main type of regional inequality factors</b>	<b>Typical phase of appearance in diffusion theories</b>
External inequalities	Regional inequalities of accessibility to physical infrastructure	Traditional	Early
Internal inequalities	Regional inequalities of social origin in accessibility and usage	Transforming	Take-off
Quality-based inequalities	Regional inequalities in the quality of usage	New	Mature

If we look on recent days' ICT-related regional inequality processes, we might discover that some of the above mentioned dimensions of disparities are rather "old" ones, while others are substantially new. This coincides with our three basic types of inequality factors, since factors, which appear in the early phase of ICT inequalities slowly become traditional ones (by forming the stable background of infrastructure inequalities). The early appearing disparities at last could have a decaying importance. At the same time in the take-off period of ICT diffusion the typical inequality factors obtain a transforming character. Nowadays several factors could be found, which already appeared a couple of years or decades ago, but have somewhat altering significance currently.

In the last, mature phase of ICT diffusion the adaptation level differences are decreasing, while completely new inequality features are appearing. Recently the newest inequalities can possibly be connected to some previously unknown dimensions (that are typically related to quality differences). All in all, the regional disparities of the information age can be characterised by both traditional, transforming and new factors of inequalities currently, which could be observed by the evaluation of accessibility and usage parameters.

## **2. INEQUALITIES OF INFORMATION ACCESSIBILITY**

### **2.1 Has geography got any role in inequalities when internet is “everywhere”?**

It seems to be obvious that information accessibility has an increasing importance in modern age inequalities (see e.g. Kim and Kim, 2001), however, this topic is many times explained as an aspatial theme, since internet and other cyber-technologies are available theoretically everywhere in the globalised world (Grieg, 2002). On the other hand, there are significant contributions to the concept that the possibilities of information accessibility induce definite differences among locations (Alonso-Villar and Chamorro-Rivas, 2001). Accordingly, the statements should be clarified and the questions have to be answered: why spatiality should be stressfully emphasized in connection with information accessibility? Why is it important to deal with spatial questions in a world, where information – that are the key factors of social and economic development – are available theoretically everywhere?

To be precise, we only think that information is freely accessible for everyone and at all places of the globe. It was many times proved that the role of geographical space could be considered as a borderless and friction free world (Ohmae, 1990; Lewis, 1998) only if we look on the topic as a utopian thing. We could only theoretically state that ensured by new information and communication technologies the everyday troubles originated from spatiality could disappear, namely the ardently wished dream, the overcoming on space may become reality. Empiric results on the other hand still confirm that geography matters today as well (Morgan, 2001; de Blij, 2007). This concept realised that previous geographical principles are also standing their ground in recent new environment. It is important that possibilities of information communication network connections and infrastructural grounds of bandwidth, which determine the speed of communication connections, are still unequally distributed in space. This new form of communication is dependent on real world's spatial bounds, on geographical position of access points, materiality of cables, as well as on other infrastructural, social and economic influences outside the world of wires. We should note that no bit can proceed via the Net without passing through kilometres of wires and optical fibres or tons of computer hardware tools, which are all in physical space indeed, and are forming the physical frames of information accessibility.

### **2.2 Geographical patterns of information accessibility differences**

Since there are infrastructural bounds of the chance of getting information, and the pattern of the built-up infrastructure is not equalized spatially, the inequalities should have geographical consequences as well. Telecommunication channels, cable networks of information transference are representing the specific at the same time significantly important material fundamentals of the communication infrastructure that is forming the technical system of conditions of the information society. Actually the most important “public utility” of the information society, the cable system of information transmission plays the main role in the infrastructure-centred version of the external space of the information economy and society.

Concerning regional differences, the level of built up infrastructure as well as distance from access points of networks is assumed to be more unfavourable in geographically peripheral places. Accessibility is though a central category of the geography of information society. It worsens the chance of peripheries since the deployment of technical systems as the “soul” of network society is defined by market regularities of economy, hence infrastructure differentiates society and space also on its own. Centre-periphery relations live further in

urban-rural differences, additionally inequalities are defined along city-hierarchy as a result of that nodes of information and communication networks are to be found basically in urban spaces, and the density of connecting services and activities is also the highest at these locations.

To test this assumption, empirical statistical experiments should be carried out by collecting regionally detailed data on information accessibility. As a starting point we analysed the existing methodology to find the best measures of regional inequalities. Although there are many internationally well known attempts to measure ICT-based regional inequalities or at least the level of information society development (see e.g. ITU, 2012), the formulated methods can not be implemented one in one for all kind of regional analysis. The major problem is that international indices take into account variables, which are possible to be collected on country levels, but are rarely available for smaller regional units.

The lack of territorially detailed data (basically due to the lack of small scale data collection) resulted that a large number of indicators should be left out from analysis, or alternative solutions should be found. Also due to the novelty of factors, regionalists often struggle with data problems, and can therefore make only general models and measurement experiments of their own; no wide-spread consensual measure or methodology has yet evolved. On regional differences in the development of the information society there are some notable early research experiments in Hungary, which also reflects the new character of this topic (Nagy, 2002).

Since the term of accessibility is a complex one, no simple indicator can be found to characterise it; therefore multi-variable methods have had to be elaborated. To quantify disparities of information accessibility already many experiments were carried out (Corrocher and Ordanini, 2002), mostly dealing with complex sets of indicators, featuring infrastructural and social causes of information accessibility. Typical complex analyses apply indicators that were formerly also important in affecting inequality processes, and on the other hand new indicators that have recently become indispensable. For example, the calculations and the methodology of World Times and International Data Corporation (2001) use 23 different indicators in its complex index. Among the indicators we find those representing the phases of invention, innovation, diffusion and adaptation of the innovation chain.

Another widely spread methodology is represented by the International Telecommunication Union's Digital Access Index (DAI), which applies the direct indicators of accessible infrastructure and costs, as well as the indirect indicators of social adaptation. Accordingly, based upon international examples, our calculation – represented in the followings – tried to find the best selection of variables in relation with regional scale information accessibility.

In order to represent the ICT-infrastructure based regional disparities within Hungary, microregional (LAU-1) level data were collected for 174 spatial units. The first dataset was formulated by ICT-infrastructure related indicators, which represent the accessibility of information. Data were provided by the Hungarian Central Statistical Office and by surveys of GKIE.NET (an ICT research company in Hungary). The dataset was created for 2010 depending on data availability. The final dataset comprehends the following indicators:

- Number of personal computers in households per 1000 people (Source: GKIE.NET)
- Number of mobile phone subscriptions per 1000 people (Source: GKIE.NET)
- Number of telephone main lines and ISDN lines per 1000 people (Source: HCSO)
- Number of cable TV subscriptions per 1000 people (Source: HCSO)

The complex index of information accessibility was created by the application of the well known simple Bennett methodology (Bennett 1954). Data were represented as percent of the maximum value and averaged by small regions with the following simple formula (1):

$$I_j = \frac{\sum_{i=1}^N \left( \frac{x_{ij}}{x_{i \max}} \cdot 100 \right)}{N} \quad (1)$$

where  $I_j$  is the complex index of information accessibility in region  $j$ ,  $x_{ij}$  is the value of indicator  $i$  in region  $j$ ,  $x_{i \max}$  is the maximum value of indicator  $i$  in the dataset, and  $N$  is the number of indicators. Values of the estimation range from 0 (the worst) to 100 (the best).

Figure 2. represents unweighted results of Hungary's regional structure of information accessibility. The map shows the definite difference observed by city-hierarchy, which is reflected by the above average attendance of urban areas. Meanwhile another significant feature is the lagging of the eastern part of the country. Regional differences between eastern and western parts of the country, particularly the lagging of the eastern Great-Plains regions is remarkable. At the same time maximum values of the index are located mostly in the agglomeration of Budapest, in metropolitan regions (Győr, Debrecen, Szeged), as well as in some adjacent zones in Central-Transdanubia and Northwest-Hungary, whilst the minimum values of the index can be connected mostly to small regions of East- and Northeast-Hungary. Though it is also observable that geographical location (the possible east-west dichotomy of the country) and information accessibility performance is not deterministically related. There are well performing microregions in the East, as well as less accessible microregions in the West, which suggest a stochastic relation of geography and accessibility.

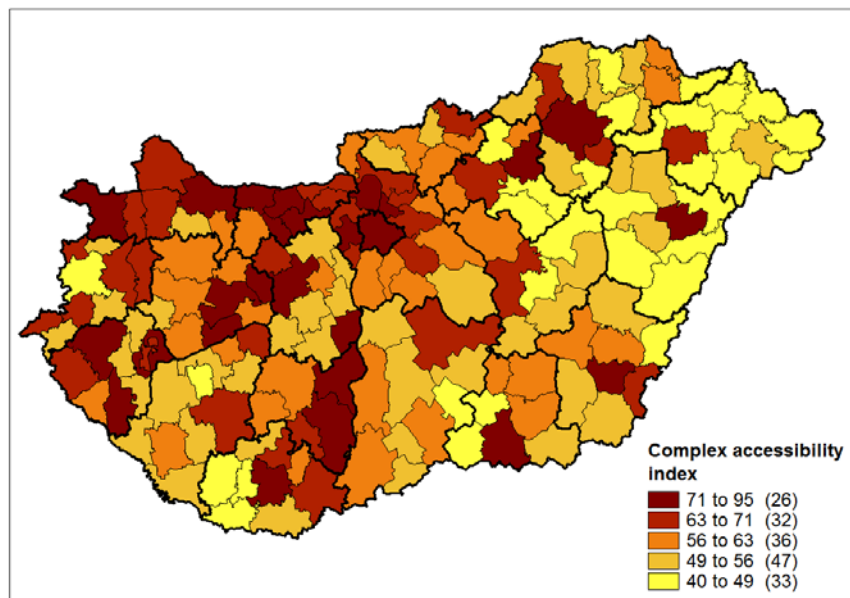
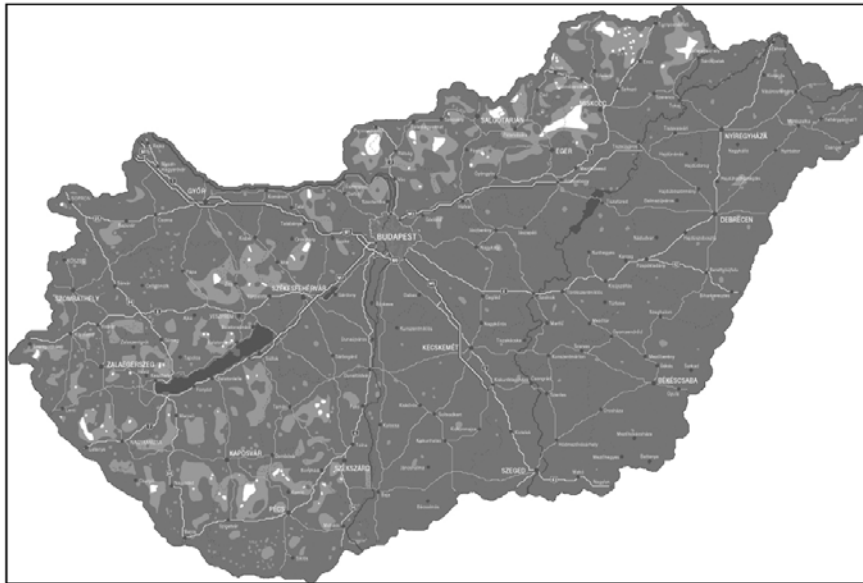


Figure 2. Complex information accessibility index of microregions in Hungary (2010)



**Figure 3.** The accessibility of mobile phone networks in Hungary: signal strength map of mobile communication (based on data of [www.t-mobile.hu](http://www.t-mobile.hu))

The result map mirrors the unequal chance of getting information in different regions of Hungary, although there are some other geographical factors of accessibility, which should be taken into account, too. Besides statistically measurable data also geography-related disparity motives of infrastructure availability could be found in the background. We should be aware that physical geography also determines the possibility of accessing telecommunication channels. There are bounds and barriers of “overall information accessibility” due to constraints of geographical environment, in which for example the relief or the artificial environment could also play an important role (but basically on micro scales, and with minor influences)(Figure 3.). This confirms again that geography still matters in the information world.

### 3. INEQUALITIES OF INFORMATION USAGE

Geography is important in the information age not only because that material infrastructure of information and communication technologies is unequally distributed in space, but also because there are social intentions to “traditionally” use space even though cyber-technologies make it possible to communicate from any distance or independently from spatial constraints. Since the depth of communication interactions is becoming more and more important, it is not only enough to access information channels, additionally the mode and location of information usage gets an increasing attention.

While technological innovations are continuously diffusing in time, the role of primer ICT background differences in regional inequalities is beginning to decline, since following the typical logistic curve of ICT diffusion. It results that from first order geographical disparities of direct infrastructure accessibility we are stepping towards the increasing importance of second order usage disparities with the revaluation of social, economic and other soft components instead of hard physical factors. Since infrastructure development policies (basically in developed countries) have recognized the necessity of ICT development, growing number of people have become able to access the new information channels, resulting that accessibility could now be treated sometimes as a background problem and

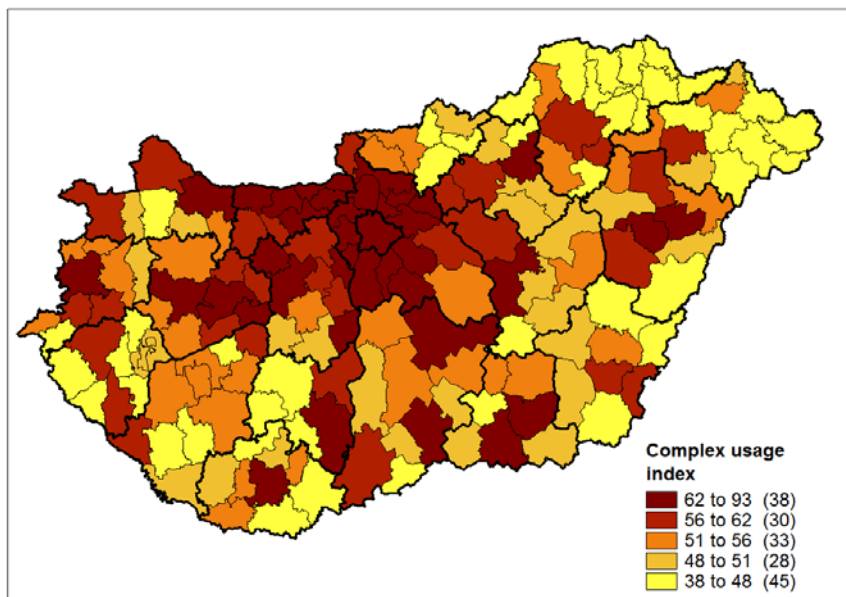


other secondary topics happen to outcrop. In contrast with accessibility differences, recently a new type of disparity emerges: the differences between users in the frequency and way of usage.

This can also be proved by empirical experiments, therefore further statistical data were collected on the level of Hungarian microregions. This time the created dataset was focusing on indicators, which could better reflect usage habits of local people, companies and institutions. Data were provided by surveys of GKIE.NET (an ICT research company in Hungary). The final dataset for measuring usage disparities comprehends the following indicators:

- Average level of e-administration (Source: calculations based on GKIE.NET)
- Number of internet users per 1000 people (Source: GKIE.NET)
- Share of companies with websites (Source: GKIE.NET)
- Number of internet subscriptions per 1000 people (Source: GKIE.NET)

By applying the previously mentioned Bennett's methodology this time the unweighted complex regional indices for information usage were determined for each microregion. The outcomes of the calculations (Figure 4.) reflect somewhat similar, but also different spatial structure related to the accessibility map. This time the map shows sharper centre-periphery differences, with best results in the agglomeration zone around Budapest, and observably low values in areas relatively far from the capital. Again, only some urban microregions have better than average indices. The best results could be found in microregions of Central-Transdanubia and in Central-Hungary, while the lowest ones are observable in south-western, eastern and north-eastern areas. Time and again the relation between geographical location and information usage performance is basically stochastic with some exceptions as well.

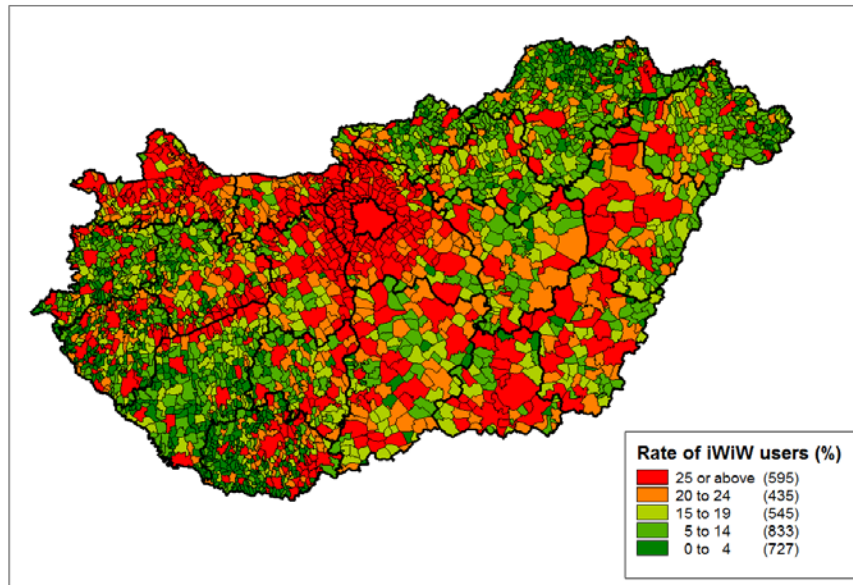


**Figure 4.** Complex information usage index of microregions in Hungary (2010)

The relatively large concentration of the better usage indices in the central part of the country on Figure 4. assumes that distance factors are present in the background of information usage results. This was also confirmed in an other examination, where distance and size effects were tested in regional disparities of using online social network connections (Lengyel and Jakobi, 2012).

Accordingly, if we look on the map, which represents the share of population, who were registered at the largest Hungarian online social network site, it can be observed, that central

parts of Hungary, as well as urban zones have usually better, while peripheral and rural areas with smaller settlement size have typically worse user rates (Figure 5). The map was created by using data of iWiW (International Who Is Who), which is a leading online social network provider in Hungary with more than 4 million users. The outcomes of the research certify again that certain components of geography matter in information age inequalities.



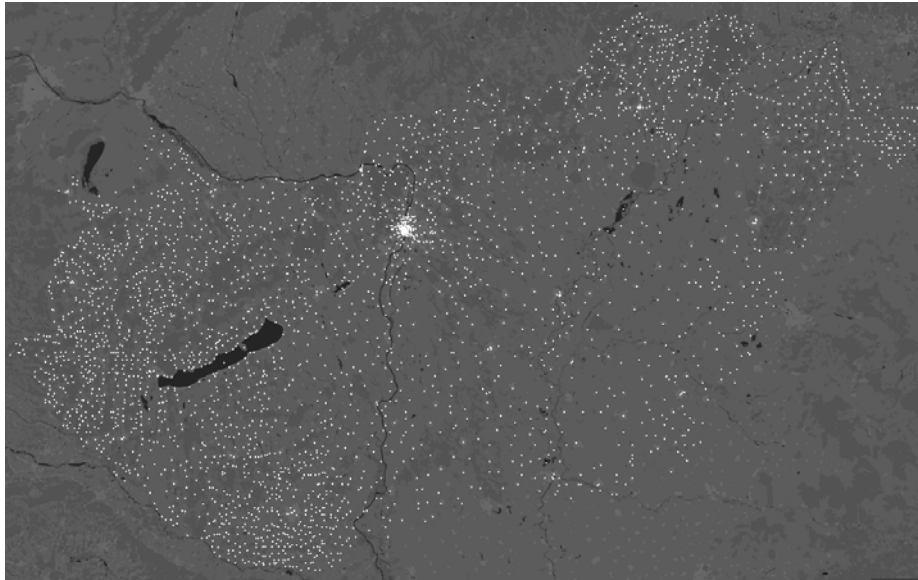
**Figure 5.** The rate of online social network (iWiW) users from total population in the settlements of Hungary (2008)

#### 4. DISPARITIES OF SPATIAL INFORMATION USAGE – AN EXAMPLE ON QUALITY DIFFERENCES

According to theories about the changing nature of ICT-based inequalities the newest features in connection with regional disparities of information society development should be related to quality issues. By now we have exceeded the initial take-off phase in many respects. The concept emphasises that recently the vast majority of the population has the chance to access information, and also many of them have devices to use new technologies (a lot of people have internet or mobile phone subscriptions), however, only few applies the newest achievements or only few participates the information society actively. In this new type of disparity the quality and not just the quantity counts, which can be possibly observed for example through the usage inequalities of a specific information resource, the spatial information. Spatial (or geographical) information can be considered as qualitatively higher level of information that is also indicated by the ever wider diffusion of applications supporting spatial information usage.

Although spatial information usage is essentially device-independent, yet it is worth to put special emphasis on application possibilities of smartphones. Namely these devices made it possible to easily access spatially sensitive data for those, who had previously not so much ambitions about it. The number of smartphone users recently shows especially dynamic growth worldwide, just like in Hungary. In 2011 statistics reported 15-24% of penetration within the whole population of Hungary (Pintér, 2011), while in 2012 one third (or others assume even higher proportion) of the users have smartphones. Smartphones provide active spatial data usage possibilities through the built in GPS devices, bringing the advantages of

GPS technology closer to everyday users. It should be also mentioned in connection with telecommunication trends that the market of separated GPS receivers is shrinking, while the mobile software market (the market of GPS-related smartphone applications) is still expanding. According to Hungarian surveys 22% of the mobile devices have already GPS inside, and more than half of the users reckon the usage of smartphone for positioning as possible in the near future. The survey also reflected on the market potential of location based applications, since almost half of the respondents would pay more or less in order to avail themselves of such services.



**Figure 6.** Geographical density of geotagged Wikipedia information in Hungary, 2013  
(Source: <http://wikiproject.oii.ox.ac.uk>)

Territorial level of spatial information usage beyond the direct observation of the diffusion of GPS-enabled devices and other GIS applications can be experimentally determined or at least approximated by other direct or indirect instruments. The frequency of occurrence and the usage of spatial information can be indicated for example by the diffusion level of geocoded information. There are several websites, where published information are provided with clearly defined location parameters (geocodes), resulting that up-to-now spatially independent information also gained spatial attributes. In an HTML environment geocoded information can be placed in the source of website by geotags. By collecting and mapping geotagged data it becomes possible to determine areas, where users publish spatial information more frequently.

Geotagged spatial information can particularly mirror the inequalities of spatial information usage in case of multi-user-edited open websites (such as Twitter or Wikipedia)(see e.g. Graham and Zook 2011). Figure 6. shows the spatial density of geocoded Wikipedia information that can be located within Hungary (due to lack of data the example shows only English and French language results in Hungary). The geographical pattern naturally does not depict the real traffic density, only the relative density of information with spatial content is reflected. The map for the Hungarian results shows again a relative concentration near and inside Budapest but also the wide dispersion of geotags around the country can be noticed.

## 5. CONCLUSION

By understanding that information age inequalities have both older and newer motives, a complex group of factors can be made up in order to get a whole picture on recent days' ICT-related regional inequality processes. Nowadays, both accessibility, usage volume and usage quality disparities are existing, which all should be taken into account in regional information society analysis.

Additionally, geographers have a further task to provide necessary information on understanding current processes of the world. It seems to be needful to shift emphasis on spatial information quality analysis both statistically and empirically, since spatial information is one of the fastest emerging and one of the newest special type of information, which could induce or perhaps reduce differences between groups of people. There are already several examinations, which reflect that geographical information gained new and dynamic possibilities to reach people by map-crowdsourcing, public participatory GIS or volunteered geographic information solutions (see Gryl, 2012), which all give chance to increase the reputation of spatial information and hereby geography.

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