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Attempt at Summarising Past Studies on Geographic Proximity

Abstract: The article is a review aiming to present the current research on the concept of geographic proximity and attempts to conceptualise it. The implementation of such a task required the identification of different ways of approaching the analysed issue, which was served by a systematic review of the literature, not performed on such a scale since the study of J. Knobon and L. Oerlemans (2006) (Micek, 2017). Proximity was captured in it using three types of logic: belonging, neighbourhood or similarity. Studies of proximity perceived as a value and trying to capture its intensity are rare. On the other hand, studies based on the proximity thresholds (most often expressed regarding physical distance) or affiliation to an administrative unit dominate. Meanwhile, proximity should be measured similarly as it is perceived and therefore using the logic of similarity. Therefore, there is a contradiction between the existing methods of measuring proximity and the essence of the concept itself. There is a need to capture proximity on a continuum that illustrates its intensity. The assessment of proximity, however, requires joint consideration of both objective and subjective measures, as well as the rejection of the thesis on the binary nature of the concept of proximity (Torre, Rallet, 2005).

Keywords: conceptualisation; distance; geographic proximity; neighbourhood; operationalisation; perception

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INTRODUCTION

In classic models explaining the distribution of services or industrial activities (by Christaller or Weber), the physical distance is an important determinant shaping spatial systems of the economy. Today, many authors emphasise the importance of a small geographic distance for facilitating the coordination of activities, especially innovative ones (Legendjik, Lorentzen, 2007), and for maintaining personal contacts (Weterings, Boschma, 2009). Along with the development of ICT and shortening travel time, the end of the 20th century brought a sharp depreciation of the importance of distance as a factor

affecting the behaviour of enterprises and organisations. The importance of proximity in the non-spatial dimension (social, institutional or organisational) to regional development, innovation, interactive learning and knowledge flows was emphasised (Boschma, 2005; Torre, Rallet, 2005; Grossetti, 2008; Huber, 2012). Regardless of the conditions, the above dimensions of proximity may be considered as complementary and even substitutive to geographic proximity (Agrawal, Cockburn, McHale, 2006; Aguiléra, Lethiais, Rallet, 2012). The tendency to undermine the importance of proximity in spatial terms was visible among Western European geographers, which led to the separation of the discipline from the sources of classical spatial economics. Thus, a research trend called the economics of proximity was born (Carrincazeaux, Lung, Vicente, 2008; Sokołowicz, 2013, 2015; Bouba-Olga, Carrincazeaux, Coris, Ferru, 2015). The best summary of the last dozen or so years of reflection on geographic proximity is the classic statement by R. Boschma (2005: 62) that “geographic proximity per se is neither a necessary nor sufficient condition for learning to take place”. Despite the agreement of Western European geographers about the limited role of proximity, the analysed concept itself is so fuzzy and ambiguous that it requires attempts to clarify it. It is also P. Śleszyński (2014) who indicates the definitional disorder concerning accessibility, mobility and proximity.

The article aims to present the current research on the concept of geographic proximity and attempt to conceptualise it. The implementation of such a task requires determining the differences between proximity and distance (Micek, 2017), which is difficult as often these concepts are identified with each other (most often in the operational dimension, not the definitional one). Therefore, the study also analyses the methods of operationalisation of geographic proximity. Presented review of literature is not limited to the latest studies but has also been referred to the classic literature of the subject, including previous reviews (Knoben, Oerlemans, 2006). The presented proximity and distance concepts include those by Polish and foreign authors. The basis for this concept presentation is a systematic review of 176 publications (Micek, 2017), of which 2/3 are articles published in journals indexed in the Web of Science database. The following discussion is based mainly on the evaluation of definitions and methods of measuring geographic proximity presented by English-speaking authors and the author’s own considerations in this regard. This article contributes to the organisation of terminology and methods for assessing the level of proximity based on different logics. The author points out the contradiction between the existing measurement methods and the essence of the notion of proximity itself.

CURRENT STUDIES ON GEOGRAPHIC PROXIMITY

In literature on economic geography, one can distinguish three most popular fields of studies on geographic proximity. The most common theme of analysis is the influence of various dimensions of proximity on innovation, not very fortunately expressed by employing indicators of patent activity (e.g. co-patenting or patent citation). Geographic proximity between enterprises and its impact on the financial conditions, knowledge flows or regional development are less often researched. Single papers deal with changes in the importance of geographic proximity in the era of virtual communication (Cairncross, 2001) and include attempts to verify the metaphor of the “end of geography” or “death of distance”.

The first papers that explicitly addressed the issue of geographic proximity appeared in the 1990s, especially after the publication of the special edition of the *Revue d'économie régionale et urbaine* (*Review of Regional and Urban Economics*) in 1993 (Bellet, Colletis, Lung, 1993). Since the mid-1990s, researchers started to emphasise that besides geographic determinants, social and institutional factors are also an essential component of proximity. Such reasoning gave rise to studies classified as the French School of Proximity (Rallet, Torre, 1999; Torre, Rallet, 2005; Torre, 2008), which introduced the notion of organised or organisational proximity, sometimes referred to as non-spatial proximity (Carrincazeaux, Lung, Vicente, 2008). At the same time, a thesis was developed about the need to include in the research the so-called temporary proximity occurring during various types of events, such as fairs, conferences, congresses, conventions etc. (Rallet, Torre, 1999). With time, more attention was paid to the different typologies of proximity, which resulted in the work of R. Boschma (2005) who distinguished its following dimensions: geographic, social, organisational, institutional, and cognitive. Some authors (Rodríguez-Pose, 2011) believe that inter-organisational proximity should be treated as a multidimensional variable. Nevertheless, R. Boschma (2005) argues that geographic dimension is different from the others and requires analytical isolation from the social, cognitive, organisational and institutional contexts. The work of R. Boschma (2005) gave rise to studies assessing the intensity of the impact of various proximity dimensions on the generation of innovations and knowledge interactions (Legendijk, Lorentzen, 2007; Balland, Vaan, Boschma, 2013). Recently, two review studies have been published; they collect the existing arrangements of the economics of proximity and indicate research challenges (Bouba-Olga, Carrincazeaux, Coris, Ferru, 2015; Balland, Boschma, Frenken, 2015).

In the analysed trend, the most common are single ties (so-called dyads) depicting relationships between people (e.g. inventors, see Agrawal, Cockburn, McHale, 2006; Breschi, Lissoni, 2009; ter Wal, 2013; Cassi, Plunket, 2015) or organisations (enterprises, science-research units – Giuliani, Bell, 2005; Boschma, ter Wal, 2007; Giuliani, 2007; Morrison, 2008; Balland, 2012, Broekel, Boschma, 2012). A serious, albeit widely used, simplification is the recognition of interpersonal or inter-organisational relationships as links between countries, regions, cities or metropolitan areas.

CONCEPTUALISATION OF THE NOTION OF PROXIMITY

In comparison to other dimensions, the concept of geographic proximity seems to be easy to understand and conceptualise. However, there is no distinct definition of geographic proximity (Eriksson, 2011), and few contemporary empirical studies include conceptualisation of this complex concept. Problems with operationalisation and conceptualisation of geographic proximity (Torre, Gilly, 2000) are accurately captured in the statement that *in fact, proximity is a notion that is poorly defined and even more poorly measured* (Aguilera, Lethiais, Rallet, 2015: 799).

An essential element influencing the assessment of geographic proximity is distance. Usually, it has four dimensions: physical, economic, temporal, and social (Chojnicki, 1966; Gatrell, 1983), which can be measured as, respectively: distance in the Euclidean space, the cost of transport or energy consumed in it, travel time, and distances in a social network. In research in the field of economic geography, it is often forgotten that the postulate of the symmetry of distance is often not met, and equivalence of

relations in both directions is often assumed. Some authors add to the aforementioned types of distances those related to subjective feelings, e.g. difficulty in covering the distance captured by the effort related to the lack of comfort during travel or the risk of an accident (Komornicki, Śleszyński, Rosik, Pomianowski, 2009). A. Gatrell (1983) believes that it is crucial how man perceives distance.

Based on the concept of distance, proximity is undoubtedly a property of the relationship. G. Micek's research (2017), conducted in enterprises of the IT services sector shows that the perceived geographic proximity is strongly associated with the physical and temporal distance. However, it cannot be equated with the former. While the assessment of the level of proximity in the case of small distances is quite apparent, in the case of a greater distance (in Polish conditions of 200–400 km), it is more difficult (Micek, 2017). Research by Z. Taylor (1999) on the relationship between distance and time of transfer for commuting to workplaces and services in rural areas showed that despite the real relationship, road and time distances might differ significantly depending on different infrastructural conditions.

In addition to other features (such as the direction, importance and frequency of relationships, the degree of its symmetry, etc.), inter-organisational proximity is a feature of the interaction between enterprises. It can be determined using measures of similarity or affiliation. Paraphrasing P. Klimas (2012), this similarity should be expressed in the degree of co-sharing space occupied by independent entities. This approach brings geographic proximity closer to the one presented by A. Gatrell (1983), which distinguished the distance perceived by a human being determined by the similarity of attributes (*attribute proximity*).

Geographic proximity is a complex construct (Torre, Rallet, 2005), whose personal dimension is partly due to objective values, especially distance. By analogy with the divisions of space, we can distinguish the following two critical approaches to geographic proximity (Boschma, 2005): objective and subjective (based on distance perception). The former type of proximity shows as a real construct, defined in a given coordinate system, in which the physical, economic or temporal distance can be measured. Physical proximity results from the spatial accessibility of places and involves covering space, regardless of the individual features of its user (i.e. time or financial resources held, Taylor, 1999; Komornicki, Śleszyński, Rosik, Pomianowski, 2009). Subjective proximity, on the other hand, results from the perception of the real space and distance existing in it. This perception may result from own experience of covering a given distance. Sometimes, however, this subjective evaluation results from verbal relations of other people, media coverage or the picture of the distance based on books or magazines etc. Proximity in the subjective approach is not limited to the individual component (Komornicki, Śleszyński, Rosik, Pomianowski, 2009) of transport accessibility, nor is it based on determining availability of a given place, but, in contrast to accessibility, it also includes a subjective assessment, often taking into account, for example, high values of infrastructure indicators or network congestion. Exceptions to proximity perception studies include the understanding of the concept of proximity carried out in more than 1,400 small and medium-sized enterprises in Brittany (Aguiléra, Lethiais, Rallet, 2015), in which three types of geographic proximity have been distinguished:

- real proximity identified with the metric distance,
- perceived proximity (assessment of the level of proximity performed by the actors),

- so-called active proximity (conducive to communication and cooperation between entities).
- G. Micek (2017) writes that operationally, geographic proximity is recognised in literature in three ways. First of all, proximity is usually treated as a property of relations between two companies or territorial units (Boschma, 2005; Balland, 2012). Within this perspective, there are three methods of measuring geographic proximity:
 - through a distance (physical, temporal or economic) between two actors or territorial units in which they operate,
 - by their co-occurrence in the same territorial unit,
 - in the notion of the neighbourhood of the administrative units in which these entities are located.

It can be assumed that the coexistence of entities in the same spatial unit is subject to the logic of belonging, while the measurement of physical distance or availability is part of the logic of similarity (Klimas, 2012). It seems, however, that in addition to the two aforementioned, there is a third, indirect, related, but distinct way of approaching proximity using the logic of neighbourhood.

For some authors, geographic proximity means the way in which distance is captured in the context of mobility (Torre, Gilly, 2000; Torre, Rallet, 2005; Haugen, 2012). Secondly, it is less frequent that proximity is treated as a company's property to other entities. In this approach, the notion of proximity is close to spatial (especially potential) accessibility and is sometimes perceived analytically using the potential or related method. Thirdly, least often, proximity is considered the property of a place (Capello, 2009). Such an incorrect, agglomeration-based and density-based approach is different from the previous two and simplifies the operationalisation of proximity too much. It is based on the assumption that the density of enterprises or employees reflects the mutual geographic proximity of economic entities in a given region (Gaczek, 2015). In this approach, proximity is treated as a measure of spatial concentration, not a relation between entities.

G. Micek (2017) shows that the analysed proximity dimension is most often referred to in the literature as "geographic", and in more than 1/4 of papers, erroneously, interchangeably as "geographic" and "spatial". Both G. Micek (2017), as well as J. Knoben and L. Oerlemans (2006) note that some studies even lack a description of what kind of proximity their authors write about, although the implication is geographic proximity. The term "spatial proximity" is less frequently used; it is most often used by German-speaking authors (Bathlet, Gluckler, 2003; Zeller, 2004), in most cases incorrectly as a synonym for geographic proximity. In Polish economic geography literature, the concept of spatial proximity is rarely used, with exceptions including studies of A. Tobolska (2017). According to G. Micek (2017), the term "geographic proximity" has a reasonably broad meaning and includes notions of spatial, territorial, local and physical proximities, though is not limited to them.

OPERATIONALISATION OF THE NOTION OF GEOGRAPHIC PROXIMITY

The biggest problem related to the use of geographic proximity is its too simplified measurement. In more than half of the publications in the field of economics of proximity analysed by G. Micek (2017), it boils down to using the most straightforward

measure, which is the physical distance between people or individuals. Frequent narrowing of proximity to physical distance is a considerable simplification. Physical distance (by some known as physical proximity – e.g. Kirat, Lung, 1999; Rallet, 2003) is not the best measure of geographic proximity, because it does not take into account the accessibility of places. A specific effort (time, cost or human) is needed to assess proximity, which must be put to cover the distance. The decisive factor here is the presence of physical, economic and social barriers. Physical distance is only one of the factors that influence the assessment of the degree of geographic proximity. Therefore, A. Healy and K. Morgan (2012) rightly distinguish geographic proximity from simple physical proximity.

Literature review (Micek, 2017) revealed that proximity is most often captured utilising physical distance, usually a simple Euclidean distance (*as the crow flies*), its reverse or logarithm (Laursen, Reichstein, Salter, 2011; Broekel, Boschma, 2012; ter Wal, 2014). In a similarly simplified approach, some use the Haversine formula, based on spherical cosine law (Hewitt-Dundas, 2013; Huang, Shen, Contractor, 2013). This approach reduces the measurement of geographic proximity to the spatial, physical distance because it does not take into account, for example, the use of the shortest (or average) distance in the road network. Geographic proximity cannot be reduced to a pure metric distance, which is a simplified, quantitative expression of the relationship between objects (Levy, Talbot, 2015). A small physical distance is only a signal that may or may not indicate potential geographic proximity.

It seems that the proximity measurement becomes even more simplified when the authors treat it as a binary feature. In this case, a zero-one matrix is used to indicate geographic proximity between entities – or lack thereof (farness). Moreover, in this situation, two values of geographic proximity are assumed: near and far. This view is aptly summarised by A. Torre and A. Rallet (2005: 49) who write: “It is binary: naturally, there exist infinite gradations (more or less far from, more or less close to), but the purpose of examining geographical proximity is to determine whether one is *far from* or *close to*”. This dichotomous approach reduces the consideration of proximity to the two ends of its continuum without considering its intensity at all. When using a binary approach, an absolute threshold value should be adopted, which should separate proximity and farness. It can be assumed that it depends on the type of business activity analysed, the size of enterprises, the origin of capital, but also on the size of sales markets, the location of suppliers, etc. The adopted proximity thresholds are therefore highly diversified. The lowest accepted values are 0.5 km and 5 km (Eriksson, 2011). The first is to determine the location within the same business park where qualified employees could change their workplace. It seems that for the majority of production activities, this distance should be increased, e.g. for the automotive or pharmaceutical industries, an adequate threshold should be a distance of 5 or 10 km (Abramovsky, Simpson, 2011; Schmitt, Biesbroeck, 2013). According to R. Eriksson (2011), a radius of 5 km is a distance at which individuals and enterprises interact with each other more efficiently, and circles of such radius contain many small and medium towns. Travels to such distances are usually not difficult (Eriksson, 2011), and contacts are more accessible than in the case of more considerable distances. The most commonly adopted physical proximity threshold is 50 km. According to R. Eriksson (2011) and A. Weterings and R. Boschma (2009), it would define the subregion of daily activity of entrepreneurs geometrically. E. Stam (2003) believes it reflects the reach of the supralocal

labour market. Larger distance thresholds are rarely accepted. In the case of analyses of critical connections between star scientists or inventors, the assumed distances are 100 km (Schiller, Revilla-Diez, 2012) or 200 km (Crescenzi, Nathan, Rodríguez-Pose, 2013). It is recognised that the earlier distance allows the car industry to perform more than one delivery during the day (Schmitt, van Biesbroeck, 2013). In the case of the above studies, their primary weakness is bringing the proximity thresholds closer to physical distance.

In few studies which use social research methods to assess the level of proximity, some ranges of physical distance are usually assumed. As W. Tobler (2004) writes, it is also possible to use ordinal variables to measure distance (for example, assume the following values: far, further, furthest, close, closer, closest). In the research of small and medium-sized enterprises in Brittany, A. Aguiléra, V. Lethiais, A. Rallet (2015) used the following distance classes: below 5 km (ultralocal scale), 5–50 km (local), 50–250 km (regional) and over 250 km (national, i.e. of France). This approach seems the most appropriate if it is impossible to include proximity on a continuum. According to the author, proximity is not of a step nature, as confirmed by J. Blažek, P. Žižalova, P. Rumpel, K. Skokan (2011) who write about the existence of a continuous spectrum of proximity degrees.

The presence of two actors in the same spatial unit is used less frequently than a distance as a measure of proximity (Balland, Vaan, Boschma, 2013; Godart, 2015). This approach is based on the application of the logic of belonging. The administrative unit is usually the region (hence sometimes the term regional proximity appears – Fritsch, Schilder, 2008), and somewhat less frequently the country (e.g. in the research of the satellite navigation systems sector – Balland, 2012). The coexistence is also explored in a spatially concentrated cluster (Aguiléra, Lethiais, Rallet, 2012), in the urban functional area (Levy, Talbot, 2015), the most frequently designated commuting area (Crescenzi, Nathan, Rodríguez-Pose, 2013), in the same city (e.g. in the case of knowledge-intensive services – Aslesen, Jakobsen, 2007, or system of fashion houses – Godart, 2015). In the intracity scale, geographic proximity is also measured using a similar postal code (Beugelsdijk, Cornet, 2002).

Literature inquiry on publications dealing with the issue of geographic proximity (Micek, 2017) reveals that in a relatively small number of publications its spatial scale is specified in detail. Most often it is a local scale, rarely – a regional scale. The logic of belonging to the same administrative or organisational unit is used to analyse proximity in almost half of the publications. When applying this logic, one should be aware of the threats it brings. Proximity interpreted in the context of sharing a given administrative unit is by nature an artificial measure. To avoid simplifications related to the unnatural course of administrative boundaries and with the diversified size of countries or regions, coexistence should be examined not so much within the same administrative unit but in spatial clusters of enterprises of a given sector or related sectors, which often go beyond administrative borders. Parallel conclusions can be drawn in the case of a similar measurement method based on the logic of neighbourhood. In studies which use the concept of proximity, neighbourhood is usually understood as sharing a common administrative border: national, regional (Quatraro, Usai, 2017) or urban areas (Levy, Talbot, 2015). Neighbourhood as an indirect indicator of proximity is relatively rarely used in analyses.

In the assessment of the level of proximity a significant number of authors (Torre, Gilly, 2000; Shearmur, 2011; Balland, 2012; Aguiléra, Lethiais, Rallet, 2012, 2015) postulates the use of spatial accessibility (in terms of time or economy, not potential availability) generally understood as the possibility of a relationship between at least two points (places) (Śleszyński, 2014). Indicators based on temporal availability are relative and to a much greater extent reflect the possibility of relationships rather than measures based on physical distance (Śleszyński, 2014). In principle, however, the availability measures are not used in proximity economy. Exceptions include M.-C. Béllis-Bergouignan, C. Carrincazeaux, M. Grossetti, (2004), in which proximity ends at the threshold of one hour drive. The necessity of using time-based measures stems from the results of some proximity studies. C. Mason and R. Harrison (2002), researching the market for high-risk funds in the UK, noted that many fund managers said they did not want to fly to a potential partner for more than two hours by plane. The use of the time distance is also associated with the adoption of a certain threshold. It seems that in the case of research on inter-organisational relations, it should describe the actors' ability to arrange personal meetings within one business day (Rallet, Torre, 1998; Moodysson, Jonsson, 2007). The economic distance measured by travel costs is used even more rarely than the time distance in studies of geographic proximity. It should be stated that in the case of large enterprises, the cost of travel itself or, more broadly, maintaining the relationship may not be a barrier to searching for knowledge in the network (Borgatti, Cross, 2003). Nevertheless, R. Capello (1999) emphasises the need to include in the definition of geographic proximity the possibility of maintaining personal contacts without deterring their costs.

If proximity is a construct influenced by different distances and their perception, then the method of its measurement should not be limited to one variable. Despite the complexity of the analysed concept, only 20% of the publications analysed by G. Micek (2017) (Knoben, 2011; Aguiléra, Lethiais, Rallet, 2012, 2015; Ellwanger, Boschma, 2015) use at least two ways of approaching this construct. Most often it is a combination of coexistence in various administrative units (from the commune to the region, Balland, 2012; Ellwanger, Boschma, 2015) and spatial accessibility and coexistence (Aguiléra, Lethiais, Rallet, 2012, 2015). Such a rare use of several different measures indicates the weakness of current research which uses the concept of geographic proximity.

SUMMARY – TERMINOLOGICAL AND OPERATIONAL ARRANGEMENTS

Paradoxically, geographic proximity is a complex concept. R. Levy and D. Talbot (2015) rightly believe that proximity is not an easy construct for quality measurement. It seems that it should be clear that the relationship between actors is not limited only to a physical distance (Rodríguez-Pose, 2011). Very often, however, the proximity measurement is limited to the physical distance, which results in identifying these two values. As shown earlier in current studies of geographic proximity, its subjective (perceptual) dimension is rarely pointed out (Carrincazeaux, Lung, Vicente, 2008). The assessment of the level of proximity depends not only on objective variables (e.g. distances) but also on the assessment of the possibility of moving between two points and its perception by entrepreneurs (Legendijk, Lorentzen, 2007). The objective dimension of proximity does not allow its overall assessment, as it often does not include mobility

and disregards the perception of distance. Not always a sizeable physical distance reflects farness (a low level of proximity), as demonstrated by G. Micek's (2017) research. A. Aguiléra, V. Lethiais, A. Rallet (2015) prove that distance perception from other partners assesses the proximity of the principal partner. According to the author, proximity as a relative and contextual construct is expressed precisely in the actors' perception of the distance separating the units in space (Torre, Rallet 2005; Carrincazeaux, Lung, Vicente, 2008; Micek, 2017). It is because people value objective distances: physical, temporal and economic. The perception of physical distance is less available than objective measurement, and it indeed depends on the characteristics of the person issuing the judgment. Different people perceive distance differently, and the way of perception is determined by the knowledge of both objects and the path between them, as well as experiences of covering the distance. Opinions about distance are acquired during covering it (Miller, Wentz, 2003) and during a conversation with other people.

There are, in fact, no absolute measures or thresholds of proximity and farness. The assessment of the level of proximity is contextual, as it depends, among other things, on personal experience of covering the distance. In current surveys of geographic proximity, its subjective dimension is rarely noticed. The assessment of the level of proximity, therefore, depends not only on objective variables (e.g. distances) but also on its perception by entrepreneurs.

Proximity is most often captured employing three types of logic: belonging (to the same administrative unit), neighbourhood, and similarity (approach with the help of distance). In comparison to previous studies, the article distinguishes the logic of neighbourhood, which is different from the logic of belonging.

In subjective terms, the assessment of the level of proximity is based on the logic of similarity, while the logic of belonging is more often used to measure proximity. Therefore, there is a contradiction between the existing methods of measurement and the very essence of the notion of proximity. Besides, if we rightly recognise that proximity can be measured on a continuum, its determination with a single distance threshold, as is usually the case in literature, becomes too simplistic.

Concerning the studies of A. Aguiléra, V. Lethiais, A. Rallet (2015) and G. Micek (2017), there are several ways of operationalising geographic proximity (Tab. 1):

- objective physical proximity (measured through physical distance, co-presence of entities in the same spatial unit, or neighbourhood of administrative units in which they are located),
- objective temporal proximity (temporal distance),
- objective economic proximity (economic distance),
- objective spatial availability resulting from the three above-mentioned,
- perceived proximity (assessment of the level of proximity made by enterprises based on the perception of the first three metrics of distance from the partner),
- active proximity is fostering communication between enterprises.

At present, in the economics of proximity, the measures of temporal distance are relatively rarely used to assess its level. Such indicators, however, to a much greater extent reflect the possibility of relationships rather than measures based on physical distance. Moreover, in the previous analyses, it was very rarely attempted to capture the perceived proximity. The optimal and possible measurement of proximity should be based on the combination of temporal distance and perception measures.

Tab. 1. Existing methods of conceptualisation and operationalisation of proximity

Manner of conceptualisation and operationalisation of proximity	Used logic	Frequency of use in publications on the economics of proximity	Level of suitability of the measure as an indicator of proximity*
Physical proximity	Similarity	Often	1
Coexistence of entities in the same spatial unit	Belonging	Often	1
Neighbourhood of administrative units	Neighbourhood	Rarely	1
Temporal proximity	Similarity	Rarely	2
Economic proximity	Similarity	Very rarely	2
Spatial availability	Similarity	Very rarely	2
Perceived proximity	Similarity	Very rarely	3
Proximity fostering communication	Similarity	Rarely	3

Note: * – level of suitability measured on a scale of 1–3, where 1 – low level, 2 – medium level, 3 – high level.

Source: own work

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