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The concept of geographical space

Abstract

In the process of shaping the geography as a science there appeared two research trends. One of them is reflected in ongoing scientific specialization and isolation of new disciplines, while the other is characterized by making attempts to synthesize the results achieved by the specialized disciplines. Against this background, this paper is trying to find a frame to synthesize the phenomena through the relations between the natural, socio-economic and cultural elements of geographical space. More and more precise study of the processes of the geographical space is necessary to understand and make rational decisions concerning the transformation of spatial systems.

Key words: cultural space; geographical space; natural space; socio-economic space

The ongoing development of science strives to study its subject more and more precisely. This manifests itself in undertaking new, narrower and more deeply recognised research issues. Learning more and more detailed characteristics of the structure, functioning and development of the analyzed phenomena leads to progressive narrowing of the subject and the need to develop new, often more precise analytical methods. This allows for the progressive specialization and the emergence of new sciences, which develop within the structures of more general, traditional science disciplines. In this process we often see overlapping of research areas as well as addressing specific problems from the position of various scientific disciplines¹. In addition, much work is undertaken to synthesise the results of specialized disciplines, which enables us to gain knowledge on their functioning as well as changes of a larger and more complex whole².

The process of progressive specialization in science research also refers to geography. Within its structure a number of disciplines, which undertake specific

¹ An example of this can be the isolation of more specific scientific disciplines in the fields of biology, physics or chemistry, which then show some tendencies for partial integration of the subject of research, e.g. in the field of biophysics or biochemistry. In these new fields, new discoveries are made that allow for better understanding the object of research.

² In medicine there are many sciences and specialties studying the functioning and health of individual organs. It often happens that the medicine applied to remove the disease of one organ leads to negative effects in other organs. In this situation, there is a need for an overall analysis, which is to answer the question of how by healing one organ not to evoke the deterioration of the others.

research and draw from their new research methodologies, have been identified (Maik, Rembowska, Suliborski, 2005, 2006, 2007). The following considerations will give an insight into the functioning and changes of geographical space, allowing for the synthesis of research results of the specialised geographical disciplines. The proposed concept should be regarded as an attempt to seek a pattern of conducting research. It will allow for a holistic approach to processes of change taking place in the structure of geographical space. Developing a new concept of synthetic approach to the results of the various geographical disciplines is of significant cognitive importance, for because of this we can accurately know the relations between the individual elements of geographical space. This creates the right conditions for making certain decisions related to changes in the natural environment influenced by human activities, as well as for stimulating economic growth, and raising the level and quality of living conditions and of culture.

An important role in the functioning and transformation of geographical space is played by natural conditions that enable the formation of socio-economic and cultural processes in accordance with the rules of economic development and as a result of deliberate actions on the basis of socio-economic policy. This is particularly important during the development of information society, which is increasingly knowledge-based. Synthetic approaches to transition processes in shaping the structure of geographical space is undertaken by both geographical (incl. Dobrowolska 1962, 1978; Kuciński 1990; Lisowski 1999, 2003; Liszewski, Łoboda, Maik 2008) and economic sciences (e.g. Domański 1982, 1992, 2010; Kudłacz, Wrona 2010). These considerations also relate to the author's earlier work in which this issue has been considered in terms of both geographical and economic research (Zioło 1996, 1999, 2003).

The issue of geographical space was addressed by other authors, who consider it from different points of view. This is shown by works many authors including Bittner & Frank, (1999), Chojnicki (1989), Gattrel (1983), Harvey (1991), Jones (2009), Mark, Frank (1996), Massey (1999, 2001), Meentemeyer (1989), Nunes (1991), Peuquet (1988) and Withers (2009).

Basic directions of geographical research

In the development of geography as a science, as it is in the case of other scientific disciplines, the trend towards more and more precise knowledge of the complexity of the natural, social, economic, cultural and political reality is going to continue. This is accomplished by studying new, more specific problems and research objectives, developing and applying new and more precise methods for measuring the potential, and identifying internal relations between the leading elements of the structure. Consequently, these trends, as in other sciences, have led to progressive specialization and isolation of new geographical disciplines. This process refers to the famous thesis that learning more and more new content influences blowing up

old forms and leads to the formation of new patterns of research. In connection with this idea two main directions of research have developed in geography.

The first one seeks to find new, more specific research problems, leading to narrower and narrower scientific specialization that allow for more precise knowledge of new developments. As a result, many new sciences that deal with the individual elements of the natural, social, economic, cultural and other environments have been identified and isolated in geography³.

The second line of research seeks to build syntheses of partial results delivered by not only the specialist geographical sciences but also by economic, social, historical, cultural, technical and other related sciences, the research achievements of which are shaping the geographical space of the world. The synthesis that is being built cannot be simply the sum of the individual research disciplines, but it must take into account the quality and seriousness of substantive as well as methodological and functional linkages between them. This requires an attempt to build and improve coherent research concepts that apply the synthetic approach to transition processes of the geographical space as a whole and of different scales of spatial systems such as groups of countries, individual countries, regions, local systems, or other areas, delimited by the object and purpose of the study⁴.

In building syntheses related to the development of certain phenomena occurring in geographical space, the main trends include those leading towards a possible precision in (Domański, 1982, 1992; Chojnicki, 1991; Liszewski, Łoboda, Maik, 2008; Ziolo, 2009):

- understanding and explaining the undergoing processes,
- identifying future trends of changes,
- identifying opportunities to control them in relation to the assumed objectives and directions of development that can be implemented in existing or changing conditions.

In studying the functioning and development of geographical space we observe a partial takeover of research issues, traditionally regarded as geographical, by social, economic and technical sciences. To a large extent this is due to the fact that these fields were unoccupied and unused by geography. This was partly due to some conservatism and lack of courage to seek new research problems. Additionally,

³ In the field of geography, there are also some centrifugal forces manifested, for example, in attempts to create separate societies, and the artificial extension of the research field of geography of the Institutes of Geography adding a new determinants, such as 'and spatial management' or 'and spatial planning', forgetting that these research problems should be developed within geography, assuming that the newly discovered contents and application needs require the creation of new models and research methods.

⁴ Such attitude is represented by, *i.a.*, Bański, 2005; Falkowski, 2009; Gorzelak, 1995; Korcelli, Degórski, Drzazga, Komornicki, Markowski, Szlachta, Węclawowicz, Zaleski, Zaucha, 2010; Kudełko, 2007; Parysek, 2004; Rydz, 2006; Węclawowicz, Bański, Degórski, Komornicki, Korcelli, Śleszyński, 2006.

a lot of work undertaken by geographers was treated as non-geographical⁵. Thus, geographical sciences are relatively less prone to look for research issues in other disciplines, such as those related to spatial differentiation of capital, revenues, budgets, or crisis phenomena.

Depending on their location in the geographical space, different-scale spatial systems are often characterised by different conditions as well as trends and the level of social, economic, cultural and political relationships⁶. Therefore, it seems that geographers must boldly enter the fields of other sciences, with a view to study comprehensively and solve specific problems – already encountered or just emerging – in spatial systems, which often differ in terms of natural, social, economic, cultural, or political aspects. In every spatial system the focus is put on various processes, studied by different scientific disciplines (such as geography, economics, history and social and technical sciences) which do not, however, give the overall synthetic approach. This convention requires expanding and deepening of synthesized geographical research, improving and adapting new research methods and meeting new targets of not only cognitive but also applied character. In recent years there has been an increased social need for a comprehensive analysis of various processes of change of spatial systems of diverse scale, such as the formation of the European space diversity, and spatial diversity of individual countries, regions and local systems⁷. As diagnostic work, they should serve by marking out the objectives and building a strategy for the rational development. There is therefore a need for continued discussion on the ordering of the existing and proposed new research approaches in the field of geography, especially referring to synthesizing the results of studies obtained by the more specialized scientific disciplines⁸. It seems that in

⁵ A good example here was criticism of undertaking commuting issues in the Department of Economic Geography of the Pedagogical University in Cracow by Prof. Maria Dobrowolska at the end of the 1950s, as it was considered a sociological rather than geographical subject. Only after several years did this problem widespread in many national and international geographic centers (incl. Herma, 1966, Lijewski, 1967).

⁶ The expression of this can be poverty of relatively rich countries in Africa. Despite significant mineral resources they remain at a low level of development, although their leaders are often well educated at European or American universities. The main obstacle in this respect are defined resources of spiritual culture resulting from the traditions that are maintained by the already educated elite.

⁷ It seems that a certain conservative attitude of the representatives of geographical sciences contributed to the emergence of, for example, spatial economy, which, in principle, was undertaken by geographers who did not find their place in the institutional structure of geographical sciences. In co-operation with representatives of economic sciences, the good resulting from the “annuity of space” was discovered and thus a new discipline was created. Ecology developed in a similar way. It was established on the basis of natural sciences in connection with representatives of technical and economic sciences. What should be emphasized here is the work on the place of Poland within the European space (e.g. Kukliński, 1995, 1997).

⁸ An interesting attempt in this regard was the concept of alternative development of economic geography by R. Domański (1982), who to some extent ordered the research

the near future other sciences, through more precise methods, may still take over the current research areas of geographical sciences, expanding their interest by the element of space, and subordinating them to the objectives of management.

Concept of functioning of geographical space

In studying the rules of functioning and transformation processes of geographical space, there is a need to try and build model approaches that will allow to define a hierarchy of its structural elements and to test the relations between them. In line with previous works of the author it must be assumed that geographical space is a dynamic whole that includes a variety of elements which satisfy the specified functions and interact with each other.

We assume that the knowledge on the quality and intensity of interrelations between the structural elements of geographical space, in addition to the cognitive values, also provides important evidence for taking rational decisions on its restructuring. What is essential in this respect is the analysis of the functioning of modern structures, the process of its formation in a given period of time, the prediction of further directions of change, their evaluation in light of the objectives of development and creation of appropriate instruments of control, with reference to the circumstances and the resources available (Ziolo, 2009).

This discussion will be limited to the analysis of the functioning and transformation of geographical space, which take place as a result of changes in terms of quality and size of potential of individual components, as well as changes of their functions and the intensity of relations between them (Ziolo, 1996, 1999, 2003, 2001).

The structure of the functioning and development of geographical space is characterized by three basic categories of space, namely:

- natural (physical-geographical) space,
- socio-economic space,
- cultural space.

It is assumed that the basic elements of the physical-geographical (natural) space structure include: geological substrate, climatic conditions, water conditions, relief, soil, flora and fauna. In the structure of the socio-economic space the essential elements include: spatial structure of agriculture, spatial structure of industry, transportation network, services and institutions, demographic structure, settlement pattern and the capital and financial resources of businesses and citizens. In the structure of the cultural space there are: material and spiritual resources of culture (including religious and philosophical ones), the level of education of the population, aspirations of the society, intellectual resources and, within their structure, human capital, social capital as well as political, social and cultural awareness.

activity and gave the basis for analysing the processes of change (Ziolo, 2009), but little of it has been used in the field of geography.

The individual elements of geographical space are not isolated units, various relations between them occur in the process of their functioning and development. The first group consists of internal relations within the structures that occur over the delimited categories of space (natural, socio-economic, cultural). Their structural elements are characterized by diverse quality and potential. They function under the influence of certain regularity essential for individual items.

1. Functioning of the natural space is presented in Table 1. The processes that shape its elements are illustrated by relations along the table's diagonal. For instance, the processes taking place in the structure of the geological substratum (X_1), are represented by relations $[x_{11}]$; those in the structure of climatic conditions (X_2) by relations $[x_{22}]$; similarly, those in the vegetal structure (X_6) by relations $[x_{66}]$.

Tab. 1. Relations between elements of natural space

Elements of natural space		X_1	X_2	X_3	X_4	X_5	X_6	X_7
Geology	X_1	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}
Climate	X_2	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}
Water	X_3	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}
Relief	X_4	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}
Soils	X_5	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}
Vegetation	X_6	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}
Animals	X_7	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}

Source: own compilation

In the structure of natural space the individual elements are not isolated but exist as a result of certain active and passive relations occurring between the individual elements.

- a) Active relations are illustrated by the table's horizontal lines, which show the influence of a given element on other elements. For example, the influence of the geological substratum (X_1) on relief (X_4) is presented by the relation $[x_{14}]$, and on soil conditions (X_5) by the relation $[x_{15}]$. Similarly, the influence of water conditions (X_3) on other elements of the natural space (X_1, \dots, X_7), are represented in the lines from $[x_{31}]$ to $[x_{37}]$, and the influence of vegetation (X_6) on other elements by the line of the relations $[x_{61}], \dots, [x_{67}]$.
- b) The columns of the table represent passive relations of a given element of the natural environment in relation to other elements. For instance, climatic conditions (X_2) are influenced by other elements as illustrated by the column of relations $[x_{12}], \dots, [x_{72}]$, while the influence exerted over fauna is represented by the relations columns from $[x_{17}], \dots, [x_{67}]$.

As a result of the foregoing considerations, it can be assumed that in the process of functioning of natural space, a fundamental role is played by potential and quality

of individual elements (X_1, \dots, X_7), as well as active and passive relations between them, as shown in (Table 3):

$$[x_{ij}^x] \quad (i = j = 1, \dots, 7)$$

2) Similarly, the relations between the elements of the socio-economic space (Y_1, \dots, Y_8) can be presented, such as the relations:

- in spatial structure of agriculture (Y_1) as represented by relations $[y_{11}]$,
- in spatial structure of industry (Y_2) as relations $[y_{22}]$,
- and in the structure of settlement network (Y_7) by relations $[y_{77}]$.

There are also active and passive relations that occur between different elements of socio-economic space, for example:

- influence of industry (Y_2) on capital and financial resources (Y_8) is presented by the relation $[y_{28}]$,
- influence of communications network (Y_5) on other elements of the socio-economic space are represented by relations $[y_{51}], \dots, [y_{58}]$,
- and the influence of the individual elements on the services (Y_3) is illustrated by the relations column $[y_{13}], \dots, [y_{83}]$.

In the process of functioning of socio-economic space, thus, the elements of diverse quality and potential (Y_1, \dots, Y_8) take part as both active and passive relations between them (Tab. 3):

$$[y_{ij}^y] \quad (i = j = 1, \dots, 8)$$

3) Also in the cultural space there exist inner relations between the individual elements (Z_1, \dots, Z_8), such as the relations:

- in terms of spiritual culture $[z_{22}]$,
- in the structure of intellectual resources $[z_{55}]$,
- or cultural awareness $[z_{88}]$.

The influence of, for instance, the education level (Z_4) on other elements of the cultural space is represented by the relations lines $[z_{41}], \dots, [z_{48}]$ and the influence of the cultural elements (z_8) on other elements by the relations $[z_{81}], \dots, [z_{87}]$.

The columns, however, represent the influence exerted on a given element of cultural space by the other elements, such as social aspirations (Z_3) under the influence of other elements $[z_{13}], \dots, [z_{83}]$.

Thus it can also be accepted that individual structural elements of various quality and potential (Z_1, \dots, Z_8) take part in the process of functioning of the cultural space, as do relations between them (Tab. 3):

$$[z_{ij}^z] \quad (i = j = 1, \dots, 8)$$

The second group consists of matrices defining the relations between different categories of geographical space. The relations between elements of natural space

and the elements of socio-economic space are presented in Table 2, which reflects the functional interrelation between their structural elements.

Tab. 2. Relations between elements of socio-economic space and elements of natural space

Elements of space		Structure of farming	Structure of industry	Services	Institutions	Transport and communication	Demo-graphy	Settlement pattern	Capital resources
		Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	Y ₇	Y ₈
Geology	X ₁	X ₁₁ ^y	X ₁₂ ^y	X ₁₃ ^y	X ₁₄ ^y	X ₁₅ ^y	X ₁₆ ^y	X ₁₇ ^y	X ₁₈ ^y
Climate	X ₂	X ₂₁ ^y	X ₂₂ ^y	X ₂₃ ^y	X ₂₄ ^y	X ₂₅ ^y	X ₂₆ ^y	X ₂₇ ^y	X ₂₈ ^y
Water	X ₃	X ₃₁ ^y	X ₃₂ ^y	X ₃₃ ^y	X ₃₄ ^y	X ₃₅ ^y	X ₃₆ ^y	X ₃₇ ^y	X ₃₈ ^y
Relief	X ₄	X ₄₁ ^y	X ₄₂ ^y	X ₄₃ ^y	X ₄₄ ^y	X ₄₅ ^y	X ₄₆ ^y	X ₄₇ ^y	X ₄₈ ^y
Soils	X ₅	X ₅₁ ^y	X ₅₂ ^y	X ₅₃ ^y	X ₅₄ ^y	X ₅₅ ^y	X ₅₆ ^y	X ₅₇ ^y	X ₅₈ ^y
Vegetation	X ₆	X ₆₁ ^y	X ₆₂ ^y	X ₆₃ ^y	X ₆₄ ^y	X ₆₅ ^y	X ₆₆ ^y	X ₆₇ ^y	X ₆₈ ^y
Animals	X ₇	X ₇₁ ^y	X ₇₂ ^y	X ₇₃ ^y	X ₇₄ ^y	X ₇₅ ^y	X ₇₆ ^y	X ₇₇ ^y	X ₇₈ ^y

Source: own compilation

For instance, the influence of water conditions (X₃) on the structure of agriculture (Y₁) is illustrated by the relation [x₃₁^y], and their influence over the other elements of socio-economic space (Y₁, ..., Y₈) by relations [x₃₂^y], ..., [x₃₈^y]. Similarly, the influence of relief (X₄) on other elements of socio-economic space (Y₁, ..., Y₈) is illustrated by relations [x₄₁^y], ..., [x₄₈^y], and the influence of vegetation (X₆) on the socio-economic elements (Y₁, ..., Y₈) by relations [x₆₁^y], ..., [x₆₈^y]. Passive relations are represented in columns; for example, the influence exerted on the transportation network (Y₅) by individual elements of natural space (X₁, ..., X₇) is shown in the relations column [x₁₅^y], ..., [x₇₅^y]. The relations between elements of natural space (X_i) and the elements of socio-economic space (Y) are described by (Tab. 3):

$$[x_{ij}^y] \quad (i = 1, \dots, 7); (j = 1, \dots, 8).$$

A synthetic model of functioning of the geographic space is illustrated in Table 3. It shows the active and passive relations that occur between the distinguished categories of geographical space. Active relations determine the effect of a given element on other elements:

- the influence of natural elements on socio-economic space are represented by the relations [x_{ij}^y], and on cultural space by [x_{ij}^z],

- the influence of socio-economic space on the natural space are described by the relations $[y_{ij}^x]$, and on the cultural space by $[y_{ij}^z]$,
- the influence of the elements of the cultural space on the natural space are illustrated by the relation $[z_{ij}^x]$, and on the elements of the socio-economic space by the relations $[z_{ij}^y]$.

Tab. 3. Geographical space model

Elements of geographical space			Geographical space			
			Natural space	Socio-economic space	Cultural space	
			X_1, \dots, X_7	Y_1, \dots, Y_8	Z_1, \dots, Z_8	
Geographical space	Natural space	Geology	X_1	X_{ij}^x	X_{ij}^y	X_{ij}^z
		Climate	X_2			
		Water	X_3			
		Relief	X_4			
		Soils	X_5			
		Vegetation	X_6			
		Animals	X_7			
	Socio-economic space	Structure of farming	Y_1	Y_{ij}^x	Y_{ij}^y	Y_{ij}^z
		Structure of industry	Y_2			
		Services	Y_3			
		Institutions	Y_4			
		Transport and communication	Y_5			
		Demography	Y_6			
		Settlement pattern	Y_7			
		Capital resources	Y_8			
	Cultural space	Material culture	Z_1	Z_{ij}^x	Z_{ij}^y	Z_{ij}^z
		Spiritual culture	Z_2			
		Aspirations of the society	Z_3			
		Education	Z_4			
		Intellectual resources	Z_5			
		Social awareness	Z_6			
		Political awareness	Z_7			
		Cultural awareness	Z_8			

Source: Ziolo 1976, 1999

Passive relations represent the impact of other space on a given space:

- the natural space under the influence of socio-economic space is represented by the relation $[y_{ij}^x]$, and under the influence of cultural space by $[z_{ij}^x]$,
- the socio-economic space under the influence of the natural space is represented by the relation $[x_{ij}^y]$, and under the influence of the cultural space by $[z_{ij}^y]$,

– the cultural space under the influence of the natural space is represented by the relation $[x^z_{ij}]$, and under the influence of the socio-economic space by $[y^z_{ij}]$.

All the above means that the relations $[x^y_{ij}]$ and $[y^x_{ij}]$ are not equal. The relations $[x^y_{ij}]$ represent the influence of the elements of natural environment (X_i) on the elements of the socio-economic space (Y_j), while relations $[y^x_{ij}]$ represent the influence of the elements of socio-economic space (Y_j) on the elements of natural space (X_i).

Moreover, the presented model of geographical space indicates that between the various structural elements of individual spaces there are certain active and passive relations. For instance, in the geological substratum (X_1) there are certain inner processes $[x^x_{ii}]$ taking place, and its role in the structure of the geographical space should be considered from the position of the active relation, namely to what extent it influences the other elements of the natural space $[x^x_{12}]$, ..., $[x^x_{17}]$, the elements of the socio-economic space $[x^y_{11}]$, ..., $[x^y_{18}]$, and the elements of the cultural space $[x^z_{11}]$, ..., $[x^z_{18}]$, and the other way around, i.e. to what extent the geological structure is under the influence of the other elements of the natural space $[x^x_{21}]$, ..., $[x^x_{71}]$, the elements of the socio-economic space $[y^x_{11}]$, ..., $[y^x_{71}]$ and the cultural elements $[z^x_{11}]$, ..., $[z^x_{81}]$. A similar convention should be used to analyze the functions of the individual elements (natural, socio-economic, cultural) in the geographical space.

The delimited elements of the geographical space (X_i , Y_j , Z_k) make specific aggregates which include a large number of more specific features. For example, within the demographic relations (Y_6) we can delimit various population structures, e.g. by sex, age, education, births, deaths, influx or outflow of population. Similarly, the education level (Z_4) includes people with or without certificates from primary, vocational, secondary or higher educational institutions. Therefore, depending on the research or application purpose different kinds of disaggregation can be made, highlighting interesting, more specific variables. In these works we should seek to determine the relations between the more detailed features and other elements of geographical space. In previous research projects and specialist literature, not all relations have been fully understood. Therefore, the proposed model may also contribute to opening new research areas and filling gaps for a more detailed study of the processes of the geographical space functioning.

Transformation of geographical space

Functioning usually refers to a short period of time in which no significant changes take place in the quality and potential of the structural elements and the relations between them. In the long term, however, quality and potential of the individual elements of the geographical space and the intensity of relations between them undergo changes. This is due to changes in circumstances and factors shaping the behavior of the individual structural elements and the relations between them. Consequently, this affects the processes of change in the geographical space, which

can manifest themselves in the processes of growth, stagnation or recession. At a certain time, a variety of factors influencing the behavior of individual components and intensity of relations between them:

- may have disappeared and in the coming years will no longer play any role,
- may have a tendency to lose significance,
- may keep their current position in geographical space in terms of capacity and developed relationships,
- may increase their importance,
- there may also be new factors appearing, previously unknown, that affect the potential for more dynamic development of certain elements, and the emergence of new relations between them.

As a result of the specific operation of various factors, individual elements of geographical space:

- may reduce their potential and importance in the structure of geographical space,
- may maintain their relevance at the same level,
- may increase their importance and play an increasingly important role⁹.

As a consequence, five types of behavior of the elements in the processes of changes may be delimited, namely: those which have disappeared as well as those disappearing, stagnating, developing and emerging. The relations between them may behave similarly. At this stage of study there are sometimes difficulties in measuring the value of the potential of individual elements as well as in presenting the qualitative features metrically. However, before the target idea of measuring all the qualitative elements is fulfilled, their role in the geographical space through adopting conventional scales of values can be defined.

In the process of changes of geographical space taking place in a specific time interval there also occurs a change in the value of the potential of individual elements and the relations between them. In the analyzed time intervals (t_1) and (t_2) the potential of a given element of space changes, e.g. in the structure of natural space a change in water conditions (X_3) is represented by:

$$X_3^{t2} - X_3^{t1} = \Delta X_3^{t2-t1}$$

⁹ For example, mineral resources may be subject to exhaustion, or they may be on decline in market demand; in the settlement network towns could lose or regain their city rights, be characterised by stagnation or growth, but also new towns may appear; in the spatial structure of industry companies can be liquidated, may limit their production and seek to liquidate, they can stagnate, exhibit developmental trends but there also may appear new businesses referring to the progress of civilisation, which will take over the function of boosting factors and influence the social and economic growth; the society can also work towards improving their political consciousness, it may not show political interest, or reduce it significantly. Many empirical examples in this area were provided by the research conducted in the former Department of Economic Geography of the former Pedagogical University in Cracow, conducted by the team of Prof. Dr. Maria Dobrowolska (e.g. Dobrowolska, 1962 1978; Rajman, 1969; Ziolo, 1978)

In the structure of the socio-economic space a change in financial resources of businesses and population (Y_8), is illustrated by:

$$Y_8^{t2} - Y_8^{t1} = \Delta Y_8^{t2-t1},$$

while inner changes of the relations taking place in the values of financial resources of businesses and population is represented by:

$$[y_{88}^{yt2}] - [y_{88}^{yt1}] = [\Delta y_{88}^{yt2-t1}]$$

The changes which take place in all the relations are presented in Table 3. For instance, the changes in intensity of the relation between the elements of natural space [x_{ij}^x] are illustrated by:

$$\begin{bmatrix} x_{11}^{xt2}, x_{12}^{xt2}, \dots, x_{17}^{xt2} \\ x_{21}^{xt2}, x_{22}^{xt2}, \dots, x_{27}^{xt2} \\ \dots\dots\dots \\ x_{71}^{xt2}, x_{72}^{xt2}, \dots, x_{77}^{xt2} \end{bmatrix} - \begin{bmatrix} x_{11}^{xt1}, x_{12}^{xt1}, \dots, x_{17}^{xt1} \\ x_{21}^{xt1}, x_{22}^{xt1}, \dots, x_{27}^{xt1} \\ \dots\dots\dots \\ x_{n1}^{xt1}, x_{n2}^{xt1}, \dots, x_{77}^{xt1} \end{bmatrix} = \begin{bmatrix} x_{11}^{xt2-t1}, x_{12}^{xt2-t1}, \dots, x_{17}^{xt2-t1} \\ x_{21}^{xt2-t1}, x_{22}^{xt2-t1}, \dots, x_{27}^{xt2-t1} \\ \dots\dots\dots \\ x_{n1}^{xt2-t1}, x_{7n2}^{xt2-t1}, \dots, x_{77}^{xt2-t1} \end{bmatrix} = [x_{ij}^{xt2-t1}]$$

that is:

$$[x_{ij}^{xt2}] - [x_{ij}^{xt1}] = [\Delta x_{ij}^{xt2-t1}] \quad (i = j = 1, 2, \dots, n)$$

A synthetic approach to the change of relations between the elements of geographical space in two time intervals is illustrated by Table 4. For example, changes in relations between elements of the socio-economic space is illustrated by:

$$[\Delta y_{ij}^{yt2-t1}],$$

the changes in the impact of the components of the cultural space on the elements of the natural space (e.g. due to the increased environmental awareness) are represented by:

$$[\Delta z_{ij}^{zt2-t1}],$$

while changes in health impact are represented by:

$$[\Delta x_{ij}^{zt2-t1}]$$

Tab. 4. Changes in relations between elements of geographical space

Elements of geographical space				Geographical space		
				Natural space	Socio-economic space	Cultural space
				X_1, \dots, X_7	Y_1, \dots, Y_8	Z_1, \dots, Z_8
Geographical space	Natural space	Geology	X_1	ΔX_{ij}^{x12-11}	ΔX_{ij}^{y12-11}	ΔX_{ij}^{z12-11}
		Climate	X_2			
		Water	X_3			
		Relief	X_4			
		Soils	X_5			
		Vegetation	X_6			
		Animals	X_7			
	Socio-economic space	Structure of farming	Y_1	ΔY_{ij}^{y12-11}	ΔY_{ij}^{y12-11}	ΔY_{ij}^{z12-11}
		Structure of industry	Y_2			
		Services	Y_3			
		Institutions	Y_4			
		Transport and communication	Y_5			
		Demography	Y_6			
		Settlement pattern	Y_7			
		Capital resources	Y_8			
	Cultural space	Material culture	Z_1	ΔZ_{ij}^{z12-11}	ΔZ_{ij}^{z12-11}	ΔZ_{ij}^{z12-11}
		Spiritual culture	Z_2			
		Aspirations of the society	Z_3			
		Education	Z_4			
		Intellectual resources	Z_5			
		Social awareness	Z_6			
		Political awareness	Z_7			
		Cultural awareness	Z_8			

Source: own compilation

The outlined relations between individual elements are realised in different areas of geographical space to a different extent. As a result of varying potential and quality of individual structural elements and the relations between them, in the geographic space there are relatively similar spatial configurations (e.g. regions). Due to that, the proposed concept allows to identify the similarities and differences between them, which creates certain conditions for the application of actions to achieve the developmental goals.

Concluding remarks

In the light of these considerations it must be assumed that geographical space is a complex system of natural, socio-economic and cultural components. They show a great qualitative, potential and functional diversity, as well as diversity in terms of active and passive relations occurring between them. The proposed concept allows for:

- identifying new fields of research on functional relations existing between the various elements of geographical space; pointing out the ways to build a synthesis of the results of research conducted by various geographical sciences; and emphasizing the unity of geography as a science;
- systematizing the diagnostic work on the area of natural, socio-economic and cultural relationships, and changes between them in the processes of transformation which are of major significance both as fundamental studies as well as application work for determining the projected trends of change of developmental conditions, setting objectives and directions of change;
- identifying changes in the potential and functions of individual elements and the relations between them, taking place as a result of natural processes and management methods used by humans in the geographical space;
- determining places and changes in the behaviour of a given element in the geographical space, by analysing its potential and the active and passive relations occurring with the individual elements of the natural, socio-economic and cultural space;
- adopting any hierarchical level of a group of elements for analytical works and determining their place in geographical space;
- giving the possibility of a comprehensive examination of research issues with taking into account the analysis of quantitative and qualitative variability and the relations between the delimited structural units.

This approach can also be a way of selecting variables relating to a specific level of generality. It also indicates the necessity of examining the interesting elements (research problems) along with the changing relations occurring within a given space (natural, socio-economic, cultural) as well as changing relations occurring between individual elements of different spaces.

The proposed model seems to be a good research model for the implementation of diagnosis, which should be the foundation for building the strategy of socio-economic

and cultural development, and for the analysis of changes in natural, socio-economic and cultural conditions in regional systems. This is particularly important in transition economies, intensifying processes of European integration and globalisation, and the ever-increasing rate of the development of civilisation, which seek to shape the knowledge economy and balance the spatial developmental processes.

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