REAL ESTATE MANAGEMENT
Spatial analysis supported by GIS tools

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INTRODUCTION

This book presents current research of selected problems in the field of real estate management understood both in the narrower and broader sense. Particular attention was paid to the spatial property market analysis and decision-making processes in this field supported by the use of some Geografic Information Systems tools.

Modern real estate management is proactive, comprehensive and strategic, extending far beyond short-term aims of the property owner or investor. It involves perception of real estate in long term, throughout its life cycle on a background of a complex and constantly changing market. In this context, proper methodological evaluation of development potential of regional real estate markets and assessment of their structural similarity become an important matter both from theoretical and practical point of view. Obtained results of presented spatial analysis enable more rational decisions and actions by managers, investors, financiers, urban planners, local politicians, public administration and other entities interested in developing real estate markets. The models may become a valuable contribution to implement innovative GIS solutions in real estate management and spatial planning.

The next important issue are analysis of the processes related to real estate management in the areas of historic importance. Performance of many activities on real properties located at these areas is strongly restricted by a number of legal regulation whose aim is to protect historical buildings and monuments. This issue was shown in details on the example of an Old Town area in Krakow inscribed on the UNESCO World Heritage List.

This book aims at the closer discussion about the application needs and usefulness of GIS tools for spatial visualization, analysis and interpretation of phenomena that occur in management of urban areas, in particular on the real estate markets and in their environment.

I wish You a fruitful reading.

Scientific Editor
Andrzej Muczyński
1. REAL ESTATE MANAGEMENT IN THEORY AND PRACTICE–A CASE STUDY OF POLAND

The political, social and economic changes that have taken place in Poland since the 1990s, and in particular the introduction of free market principles into the sphere of real estate management, autonomy of local governments as well as the restructuring and privatisation of public property, have created new quality conditions and requirements in real estate management. All of these changes have been formally recognised by The Real Estate Management Act, which lays the foundation for the new system of real estate management. The system facilitates a significant diversification of the services provided and the transfer of their execution to private real estate managers, who run real estate management businesses. The training of top-quality professional managers capable of providing a full range of professional services in real estate management calls for personal development with regard to specialist knowledge and for a comprehensive study into the theoretical side of management sciences. This chapter aims to present the theory and practice of the system of property management in Poland. The initial part contains a synthetic characterisation of the paradigm of management science, including exploration of the essence of management processes. From there, links between the general theory of management and property management are examined as well as the underlying causes of problems encountered when adapting the general theory to the actual conditions of real estate management. The subsequent part of the paper focuses on characteristics of key elements in the property management system (i.e. the subject and the object of management) and on their mutual relations. The study is placed in the context of the binding legal regulations and the authors' professional experience.

1.1. Management theory as a discipline of science vs real estate management

The science of management emerged during the industrial revolution in response to the demand for rational, empirically verifiable concepts, principles and methods for managing business activities. The essence of management theory, as any other discipline of science, may be defined by determining (1) the subject of its study, comprising the scope of reality that each discipline takes into account, (2) the point of view from which the specific reality is being examined, as well as (3) the purpose and (4) the methods used in the study (ZIELENIENIEWSKI, 1974).

The subject examined by the theory of management encompasses: co-ordinated activities, particularly such as organisations consisting of human and other resources; processes of forming those organisations; their functioning and development; and, most importantly, their management. The subject includes mostly enterprises, organisations and institutions in the public sector (e.g. in education), as well as economy on the local, regional, and central levels, and even the state as a form of social organisation. Theoretically, an organisation is perceived as an open social and technical system (people and objects), interacting with the environment (the exchange of matter, energy, and information) and aiming to achieve specified goals and operating on the basis of the specific type of internal organisation (KOZUCH, 1999). The internal complexity of the subject matter plus a wide range of external factors requires an interdisciplinary approach to the management theory. The exploratory aspect of the theory is the efficiency with which the organisation functions as a whole and as separate subsystems of which it is built. Organisations are the subject
studied by numerous disciplines of science (sociology, economy, ecology, etc.), yet none of them aims at diagnosing, explaining and predicting the existing regularities and tendencies for a change in management. What has to be emphasised is that the discipline in question is not concerned with the study of basic processes taking place in the real sphere of an organisation, which is usually the focus of interest of natural, social, technical or even economic sciences. What is the main focus of management theory is the information and decision-making processes. These processes include extracting information (both from the inside and outside of the organisation), transferring the information through information channels and processing the information in order to be able to make internal decisions regarding the choice of goals, methods of achieving them (activity patterns), activity structures as well as the methods and procedures designed to incite activity. Additionally, the range of processes also includes comparing the progress and outcomes of an activity to predefined patterns (KRYŻANOWSKI, 1994).

When considering research methods, the science of management may be said to be characterised by methodological pluralism. On the one hand, this results from the multi-aspect nature of the subject matter. On the other hand, it stems from the fact that this discipline of science is constantly being developed, while all the original methodologies are usually invented at an advanced stage of studies (KOŻUCH, 1999). Hence, management theory is dominated by research methods adopted from such disciplines as social sciences, mathematics, information technology, cybernetics, system engineering and legal sciences. The original methods within the theory include: verbal description methods, research concepts, problem and thesis formulation methods and methods used to explain phenomena, processes and occurrences.

The institutional integration and official recognition of the science of management as an independent discipline of science did not happen in Poland until 1974. Organisation and management are now registered in the State Registry of Sciences, under the rank of discipline, in three domains: Arts, Legal and Social Sciences (1), Economic Sciences (2) and Technical Sciences (3). This categorisation confirms the interdisciplinary nature of Management Studies, which is justified by the fact that relations between psychosocial, economic and technical aspects of functioning and development of organisations cannot be considered separately. Historically, this is the result of the theory being developed from several sources (three principal approaches: classical, psycho-sociological, and systematic, divided into a number of directions and schools of management). This complexity certainly does not promote integration processes within the discipline nor does it help to eliminate its major flaws, which are (KRYŻANOWSKI, 1994): terminological inconsistencies, methodological imperfections, general disorder in the theoretical heritage and excessive preference of narrowly defined research approaches (general disinterest in the systematic approach).

1.2. The concept and essence of management

Management may be defined as the entire body of activities and decisions whose aim is to achieve the intended state of affairs. What various definitions of management have in common is the co-ordination in the use of human, financial, property, and informational resources for the purpose of achieving goals efficiently. This coordination consists in pursuing an external balance, i.e. the balance between the object being managed and the unstable and changeable environment surrounding it, as well as an internal balance
between all sorts of resources being used (KOŹMIŃSKI AND PIOTROWSKI, 2002). Generally, it may be assumed that management is the science and the art of effective functioning, which takes into account the principles of rational economics. Management is a broader term than direction, which is concerned with making people behave in the way that complies with the goals of the director. Management, in turn, consists in the conscious and rational shaping of relations between all the accessible elements of an organisation. Another attribute of management is that the manager holds the status of the ruler (or disposer) of the resources, which enables the organisation to survive and develop. The essence of management may be characterised in terms of structure and function. Structurally, the process comprises three interrelated elements, i.e. the object being managed (the manager and the managed), the subject of management (e.g. an organisation or a real estate property) and the decision-information feedback, which constitute the essence of all management activities. Functionally, the management process consists of the description of its progress by means of a sequence of four typical functions of management: planning and decision-making, organising, directing and controlling (KNOOTZ AND WEIRICH, 1990).

In view of the general theory of management, the essence of property management may be defined as a dynamic process in which the managing subject influences the object being managed, covering the entire sequence of the four basic functions of management - planning, organising, directing (people) and controlling; the process consists in constant coordination and integration of the resources related to the real estate (human, material, financial and informational) in order to efficiently achieve the conscious goals and expectations of the real estate owners; the set sequence and the mutual relations between each function of management regard both the current and the long-term activity of the property manager (MUCZYŃSKI, 2000).

1.3. Evolution of the real estate management issues - an overview of approaches and concepts

Despite the long tradition of management theory, the theory of real estate management has a much shorter history than the management of production processes. For a long time, immovable properties were in fact treated as objects that allowed production, storage, sale or consumption of accounted objects (apartments). During that time, management of real estate was limited to passive performance of daily activities related to collecting rents, covering operational costs, maintaining the physical object, as well as supervising the contractual requirements and laws in the use phase of real estate (narrow approach). The modern theory of real estate management began to develop when it was observed that a real property was an example of capital goods whose market value depended on the quality of management, which could enhance the value of a household, thus affecting its earnings or the owner’s income either from the collection of a rent or by realizing a capital gain (e.g. THORNCROFT, 1965; DOWNS, 1981; SCARRETT, 1983). This modern, broader approach to the real estate management is proactive, comprehensive and strategic, reaching far beyond short-term tasks. It involves the perception of real estate (or groups of such assets) in the long term, throughout its life cycle and against the background of a complex and constantly changing market environment (e.g. DUBBEN AND SAYCE, 1991; ALEXANDER AND MÜHLEBACH, 1993; DE CARLO, 1997; RUTKAUSKAS AND BRUKSTAITIENĖ, 1997; DASSO AND RING, 1998; KYLE AND BAIRD, 1999; DEAKIN, 1999; PLAT, 2001; SCHULTE AND SCHÄFERS, 2005; THEN, 2005; KÄMPF-
In this approach, it is often emphasized the market value of the property should be preserved or increased using a wide range of competences and responsibilities of the real estate manager, which requires an appropriate education and ethics system.

The evolution of this broader approach, having adopted general business theories (e.g. ANSOFF, 1984; AAKER, 1988; KOTLER, 1997), has led to the formation of three organisational levels of real estate management (Miles et al., 1996). The first level includes a real estate portfolio management – REPM (portfolio investment policy, performance-analysis portfolio, investment scheme), the second one is the real estate asset management – REAM (estate policy, performance analysis of estates, marketing policy, relation management, organization and outsourcing), and the third one deals with the property management PrM ('daily' administrative, technical and commercial/promotional management).

REPM encompasses the strategic management of a group (portfolio) of properties to achieve value and benefit overall that derived from management of individual assets (e.g. DUBBEN AND SAYCE, 1991; MICHAUD, 1998; VARCOE, 2000). It is defined as a complex, continuous and systematic process of analysis, planning, management and control of real estate portfolios designed to increase the transparency for the property owner (or investor) to strike a balance between income and the risks of real estate investment and management decisions related to the property portfolio. Based on the portfolio theory of capital markets (MARKOWITZ, 1991) investment organizations can create a multi-asset portfolio covering many different asset classes, as well as a single asset portfolio in which to deal with only the resources of real estate assets (BONE-WINKEL, 2000).

On the second level, REAM is interpreted differently, depending on the context of management and consequent strategic objectives for assets. Overall, as a decision making-process about acquiring, holding and disposing of real property (KAGANOVA AND NAYYAR-STONE, 2000), REAM includes considerations of the maintenance of physical, operational and financial integrity of assets in order to achieve the ultimate goal of both the owner and investment. In the area of real estate investment management (REIM) managing of real estate assets is to maximize their financial value (Veale, 1989), which allows one to optimize returns on investments by considering various combinations of risk, return and liquidity (SOENS AND BROWN, 1994; FRENCH AND FISHER, 2007). However, in corporate real estate management (CREM), when a company owns and uses real estate for its non-real estate business, the main goal is to maximize a corporate value or profits. CREM includes activities to ensure that the land and building asset base of an organisation is optimally structured in the best corporate interest of the organisation concerned. This type of REAM should be integrated with corporate strategy, bringing benefits for the organisation's operations and improving competitiveness of the company's core business (e.g. ZECKHAUSER AND SILVERMAN, 1983; VEALE, 1989; AVIS ET AL., 1989; 2000; ROULAC, 2001; THEN, 2005). The goals of public real estate asset management (PREM) are distributed different than in the private sector, because there social benefits are emphasised and effective implementation by the real property of public tasks and functions. Additionally PREM focuses on supplying the right quantity of property for public goods and services, supporting local economic development and obtaining revenues from alternative sources (e.g. KAGANOVA AND NAYYAR-STONE, 2000; EVERS ET AL., 2002; SCHULTE AND SCHÄFERS 2005). There are many interesting studies aimed at improving the efficiency of the public sector by applying some methods, models or procedures developed in the private sector for the public real estate asset management, especially in the field of strategic housing management (e.g. SIMONS, 1993; DEAKIN, 1999;
In conclusion, it should be emphasized that by developing management strategies for objects (or their stocks), REAM fulfills the explanatory and connective role between the first (REPM) and third (PrM) organisational level of real estate management.

Property management (PrM), in the present approach, involves effective implementation of strategies optimal for the owner in the dimension of the managed object. It includes many day-to-day activities (administrative, financial, technical, organizational, promotional, etc.) on an operational level. The property manager’s purpose is to ensure that these activities bring optimal financial benefits for the owner, are efficiently realized and that the real estate meets the requirements of customers and staff (e.g. Dubben and Sayce, 1991; Soens and Brown, 1994; Rondeau et al., 2006; Frensch and Fisher, 2007). In larger commercial or institutional properties, where the management of buildings is more complex, the above tasks have evolved into a specific area of activity referred to as facilities management (FM). The European Committee for Standardization defines FM as: \textit{the integration of processes within an organization to maintain and develop the agreed services which support and improve the effective-ness of its primary activities}. It consists of four constituent parts, such as space management, technical management, administrative management and management of other services (Zavadskas et al., 2002). Thus, in this type of real estates, the terms of PrM and FM have many similarities, but it seems that the PrM is more focused on core processes from the owner’s perspective related to optimizing financial performance and managing the value of the investment property (accounting and financial management, leasing, marketing, insurance and management, etc.). The FM is more targeted on secondary processes related to ensuring optimal use and functionality of the developed environment by integrating people, place, processes and technology. The role of the FM is both to coordinate as well as to supervise safe, secure, and environmentally sound operations and maintenance of these assets in a cost effective manner (care for the air conditioning, electric power, plumbing and lighting systems; cleaning, decoration, security, etc.). It is aimed at creating an optimum working environment for staff and long-term preservation of the asset value.

1.4. Relationship between theory and practice of real estate management in Poland

The current relations between the classical theory of management and organisation, and the theory and practice of real estate management (still in early stages of development) are not too close. In order to train professional real estate managers, it is necessary to bridge the gap and adapt elements of the general theory of management to the requirements of the real estate management. The key reason is that modern real estate management should be treated as a domain within the general theory of management. This would require real estate, i.e. the object being managed, to be seen as an open social and technical system corresponding to a simplified model of an organisation.

On the one hand, the lack of closer relations between both sciences results from the short period of development of theory and practice of real estate management and limited experience in this field; on the other hand, it is due to the mentioned inconsistencies in the theory of organisational management. Hence, imperfections of the general theory of management (as a discipline in the stage of forming) manifest themselves in the area of real
estate to a greater extent. Consequently, the theory of real estate management does not have its own research methodology, and its problems are perceived unilaterally and in isolation from many other specialist standpoints. What remains to be developed is an interdisciplinary approach to research, which would perceive multi-faceted problems of real estate management as a holistic entity, deeply rooted in the arts and in the legal, social, economic and technical sciences. In this context, it may be claimed that real estate management is a discipline in the stage of recognition (incubation). What needs to be emphasised is that the first impulses to form this discipline of science and practice appeared as a result of social, economic and legal changes in the area of real estate rather than a result of the systematisation, development or integration of management science.

1.5. Property management system and its characteristics

A property management system may be characterised by defining its basic concepts and determining its elements with all the relations between them. The key legal act that constitutes the property management system in Poland is the Real Estate Management Act of August 21, 1997. According to this act, property management consists in making all decisions and taking all steps necessary to maintain the real estate in the proper condition in compliance with its purpose, as well as making justifiable investments in that real estate. The above legal definition implies a wide scope of problems related to property management. It covers both the traditional (passive) activity of the manager, i.e. administration, exploitation servicing and maintenance of buildings and equipment in proper technical condition, and the dynamic activity, which consists of analysing, planning and efficient execution of investment, renovation, and modernisation processes of the real estate. The latter, then, generates utility and market value appreciation of the real estate. Property management is a process orientated towards achieving a number of various (technical, economic, social and environmental) goals pursued by the owners, which should constantly adjust the object being managed to the changeable market, social, and economic environment.

In the existing legal conditions, property management is a professional activity pursued by private property managers or by entrepreneurs who employ such managers. Property management as a professional activity is seen as such: when it is run permanently (1), in return for a fee (2), for the benefit of other persons (3) and when the object being managed (real estate and the rights and duties related to it) is not owned by the manager (4). If one or more of the above conditions is not observed, the management activity may no longer be treated as a professional activity. This is mainly to make the distinction between the professional activity and the management exercised by the owner of the real estate. The owner has the right of choice. He may manage the property personally; by his organs or employees (in the case of state treasury or local government owned real estate), or he may delegate management activities to professional managers. Additionally, since the act does not define the activity directly, it may be claimed that management activities need not be limited to real estate only, but may include the owner’s entire property related to the real estate (i.e. all sorts of the owner’s rights and duties, including non-material rights).

1.6. Real estate and its resources as the object of management

The objects of management are all types of real estate separately or in groups (resources). They may be classified as objects (according to their spatial range), as subjects (according
to the owner), or according to their function attributed in the spatial management plan or according to their actual function. The object-based division of real estate comprises land, buildings and housing facilities.

*Land real estate* includes parts of land area (land along with their components) which constitute a separate property. The discrimination of such a type of real estate is based on two criteria: the physical separation and legal separation of property. Spatial boundaries (horizontal range) of land real estate are marked by lines visible on the surface, determined by a geodesist and accessible in the land and building registry. It should be noted that according to the Polish civic law system, property extends over a land both on and under the surface within borders determined by its social and economic purpose. In view of the above, land real estate is a three dimensional concept. The vertical range of land real estate property is changeable, as it is determined by the purpose of the land as specified in the spatial management plan. Moreover, the range is further limited by specific regulations in the spheres of water management, geology, mining and aviation. Land real estate comprises: buildings and other facilities permanently connected with the land, as well as trees and other plants from the moment of planting or seeding.

A *real estate building* is a building that is permanently connected with the land, if, according to special regulations, it constitutes a property that is separate from the land. That is the case when the building may not be separated from the land without damaging its construction. A real estate building consists of the right to perpetual use of the land, which is the right that is connected with the ownership of the building property. A real estate building is in most cases separated when the land with the building is passed over for hereditary use, or when the hereditary user has built a building on the site passed over to him for hereditary use.

*Real estate housing* is a housing facility with a separate ownership (premises) – independent both architectonically (a room or a set of rooms separated with permanent walls) and functionally (a housing facility with additional rooms serving to satisfy housing and other needs). Currently, the object of separate ownership may be a facility serving the purpose of activities, such as production, provision of services, trading, garage, etc. The components of real estate housing are the included rooms, such as a basement, attic, or a warehouse, even if they do not adhere to the housing facility itself. The separate ownership rights include participation in the ownership of the shared parts of the building or in the shared hereditary use of the real estate land.

From the point of view of a manager, shared real estate represents a particular kind of real estate, which may be found on real estate belonging to housing communities. Shared real estate is defined as the part of a building and a facility that serves all the users rather than the owners exclusively. In view of the above, everything in the building that does not serve the owners exclusively is shared real estate. Shared real estate includes such elements as foundations, construction walls, roofs, chimneys, shared lofts, staircases, corridors, as well as additional rooms i.e. basements, unless they are integral components of the separated housing facilities. Shared real estate components may also include bathrooms, showers, other sanitary facilities, and even garages, unless they serve exclusively the owners of separate estates. However, what is never part of shared real estates are any non-separated facilities, unless they serve the owners of separate estates exclusively.

The object division includes real estates as part of the property that belongs to a community, administrative district, province or private persons. A significant share of the public property has been converted into real estate resources, described as state treasury, community, district and province autonomous resources respectively. The process of
management of these resources is governed by particularly strict legal regulations related to the requirement of holding a valid professional licence by the manager and to the obligation to abide to the Public Commissioning Act during the procedure of employing professionals to manage such real estate. The functional division in this management system assigns the greatest significance to real estates designed to serve the housing sector (property of housing communities, co-operatives, municipalities, and the state treasury), commerce (offices, shops, hotels, services, warehouses and stores), institutions as well as multi-purpose real estates.

1.7. Property manager as the subject of management

The property manager is defined as a physical person who holds an appropriate professional licence issued by the Ministry of Infrastructure and Development. The Act states that management services may be pursued by any entrepreneur as long as the actual management activities are carried out by licensed real estate managers. The managers operate on the basis of a real estate management contract signed with the owner, housing community and any other person or organisation that holds the title to the property. All rights and responsibilities of real estate managers are determined by The Real Estate Management Act, regulations in separate acts and by the contract mentioned above. Hence, the basic responsibilities of real estate managers may be divided into professional, statutory and contractual responsibilities.

The manager's professional responsibilities are laid out in The Real Estate Management Act. Managers who pursue their professional activities are expected to observe the principles of law, professional standards as well as the principles of professional conduct, and execute management activities with the utmost care, adequately to their professional character. The manager is additionally obliged to protect the interest of the persons for whom the management is being executed, and to continuously develop own qualifications. The responsibilities enumerated above illustrate the unilateral responsibilities of the property manager in relation to the body issuing professional licences. It is the Ministry of Infrastructure and Development, and never the owner of the real estate, who shall judge whether or not the manager's responsibilities have been observed. The manager who fails to observe responsibilities is liable to be held professionally responsible, which may entail disciplinary restrictions ranging from a formal reprimand to the withdrawal of the professional licence with the right to apply for a renewed licence after three years.

The manager's statutory responsibilities are laid out in such acts as The Civil Law, The Construction Law, The Accountancy Act, The Spatial Management Act, The Environment Protection Act, The Taxes and Local Fees Act, The Cleanliness Maintenance Act, etc. In this respect, the manager is held accountable by the owner, and by other organs appointed for that purpose (e.g. building inspection, fire department, environment protection). The statutory responsibilities include also those that the Civil Law imposes on managers who act without a contract with the owner. The manager’s contractual responsibilities, in turn, are determined by the management contract signed between the manager and the owner of real estate. The management contract is a contract of careful activity, which may resemble a commissioning contract. By signing the contract, the manager accepts from the owner the agreed range of responsibilities which the owner has acquired along with the title to the property. In practice, the manager assumes the entire set of activities under ordinary management, as well as a number of activities exceeding those of ordinary management activities. The latter encompass activities connected with renovation and modernisation. What needs to be emphasised is that
the contract determines mutual relations between the manager and the owner. The contract is the principal source of both the rights and responsibilities of the manager in relation to the owner and vice versa. The contract is signed as a result of negotiations, and therefore it fully captures the essence of legal relations shaped in the conditions of free market economy. The manager should not undertake to manage a real estate without previously signing the contract, because it has a priority before the letter of law, unless the regulation is binding and unreserved. The contract should thoroughly determine mutual rights and responsibilities of the manager and the owner of the real estate; hence it must be in the written form, otherwise being invalid. What should be noted is that a manager who does not observe these responsibilities, apart from professional responsibility, may be held responsible with regard to the civil, criminal, and misdemeanour laws.

The key rights of the property manager are the following: the right to represent the owner of the real estate, the right to make independent decisions within ordinary management and the right to the reward for his services. The contract between the manager and the owner may either expand or limit the scope of those rights, or set new rights, such as the right to use the real estate being managed.

1.8. Conclusions

1. The theory of management is undoubtedly a multi-disciplinary sphere of research. It is justified by the inseparable nature of relations between the psychosocial, economic, and technical aspects of functioning and development of organisations. Despite the formal separation of management science, in Poland this discipline is still in an early stage of development, which is characterised by the lack of organisation of the theoretical heritage, methodological imperfections and an excessive preference to adopt certain research approaches. It seems, however, that with respect to the independence, perception and application of this science, greater attention should be paid to the inter- rather than multi-disciplinary approach. However, the interdisciplinary attitude is not easy to achieve due to the “rigid” division of sciences into disciplines, the limited nature of individual competencies and conservative application of procedures and research methods.

2. Management is a science and art of taking effective actions (or causing actions) with the inclusion of principles of rational economics. The essence of the management process is the co-ordination of the use of all resources at hand in order to achieve goals, while its content is the information and decision feedback. Real estate management may be described as the science and art of taking purposeful steps through the appropriate influence of management on people, objects (technical resources), financial and informational resources connected with the object being managed as a system.

3. Weakly developed connections between the general theory of management and the theory and practice of property management are due to inconsistencies of management as a science (currently in the stage of ordering and forming a contemporary paradigm) and a certain novelty of the problems of real estate management, which in Poland stems from the legal regulations and the economic situation rather than scientific research.

4. The current system of real estate management is a professional area of activity pursued by licensed property managers as freelancers. The main goal of the licensing system in this area is to protect the public interest, hence the absolute indispensability of possessing such licences by managers pursuing their professional activity in real estates within the public
real estate resources. An additional guarantee that real estate management in this sphere is rational lies in the requirement to observe public commissioning regulations.

5. The development of the property management system is connected with the formation of the professional environment composed of associations and federations, with the training of candidates to the profession and with the development of qualifications of practising managers, as well as with developing professional standards, including the principles of professional ethics. The targeted direction of development is probably an appointment of a professional self-governing body, which will result in further autonomy of real estate managers and will contribute to a higher ranking of this profession in the society.
2. DEVELOPMENT POTENTIAL EVALUATION OF REGIONAL REAL ESTATE MARKETS USING GIS TOOLS

In spite of the globalisation and continuing integration of local markets into one global goods, services and capital market (economic globalisation), no spatially uniform socio-economic development accompanied by the development of local real estate markets is observed. National markets differ both by the resources of existing real estates and by their size and quality. The said differentiation is influenced by the degree of investment in technical infrastructure as well as the local investment potential. This potential includes the following resources: real estate, available financial means (financial capital) as well as the knowledge or skills that support the market activities of the entities (human capital). The flow of capital into local markets is uneven, as certain locations are preferred, in particular if they are connected with development projects. This phenomenon refers both to financial and human capital, whose inflow may stimulate the real estate market but may also lead to the occurrence of disadvantageous phenomena.

Excessive share of foreign speculative capital such as investment funds may cause the local market to collapse when investors want to discount the real estate profits in a short-term perspective or if they are forced to compensate for losses on investments realised on other markets. Similarly, excessive inflow (or outflow) to or from the local market will be first of all reflected in the supply and demand on the housing market and, eventually, also on the other, non-residential sectors of the real estate market. Differences in the potential of local markets are the reason for the transfer of capital and people to markets with better development opportunities. The bigger the developmental differences, the more energy is required to eliminate the disproportions. When the market reaches the state of equilibrium in its spatial aspect, the dynamics of developmental processes decreases and the development potential falls to minimum values.

The subject of the present study is the potential of the European real estate market in the continuing economic recession period (Report on the situation on the real estate market... 2013). The analysed objects are countries that have been described by a set of attributes characterising the potential of the discussed market. Data has been obtained from the public statistical resource Eurostat. The aim of the study is to determine which of analysed countries have the highest potential in the recession period and to classify them. The study was conducted basing on object classification methods, preceded by the determination of the synthetic measure of development. Markets with a high position in the ranking are less attractive for investors, because they have lower investment potential than markets characterised by lower values of the determined synthetic measure of development. The tests were conducted with use of statistical tools and statistic calculation packages. Empirical analysis was preceded by a review of source materials and of local and international literature. The applied tools and the obtained results facilitate the process of selecting countries for further analyses for investors and enable decision-makers to look for reasons of a weaker ranking position of the given country.

2.1. Development potential of regional real estate markets

The development of the real estate market is closely linked to social and economic development. It causes socio-economic phenomena, but it may also be their result (FORYŚ 2011, p. 42-57). Thus, development cannot be a static phenomenon. Its pace depends both on the strength and the direction of influences of external forces that constitute the legal, institu-
tional, economic and social elements of the environment of the real estate market (BRYX 2006, p. 88). The development pace of this market changes in time and it is spatially differentiated, like the factors determining the discussed phenomenon. Development may be understood as a process that moves in a specific, pre-determined direction. This enables the identification of subsequent development stages and the evaluation of changes that occur on the market as well as the comparison of such changes with established development patterns. However, young systems (markets, economies) are more prone to development processes, while as they mature, the dynamics of these processes tend to slow down. Oskar Lange demonstrated that a very young system is resistant only to small disorders, while as it matures, it grows more resistant to bigger ones (LANGE 1962). This means that emerging real estate markets have a higher development potential than stable markets with a long-term history. However, the latter are less sensitive to interference from the environment of the real estate market, particularly the economic environment. As the experience of the global economic recession that started in the USA in 2008 show, the real estate market, and thus its development, is closely connected to the economic development. The proper functioning of the real estate market also depends on the efficient operation of institutional and legal infrastructure, in particular on the transparency of the principles of operating on a specific local market. Well-designed spatial policy of the government, stimulating road construction and civil engineering investments allows for the creation of new investment areas and for increasing the value of real estate located in their proximity. Thus, investors are encouraged to invest free funds in local real estate which in turn fosters the development of the local real estate market.

Therefore, the development of the real estate market means qualitative and quantitative changes in the real estate sector, identified by the number of transactions closed on the market, capital flowing through that market per one inhabitant and the organisation of processes on the real estate market. Developed markets are markets that have large resources of real estate that may be subject to market turnover, efficient mechanisms regulating the transfer of real estate ownership titles and the accessibility of capital enabling trade. This means that the development of this market is determined by changes in the use of real estate and spatial shifts of people and capital (FISHER 1992, FORYŚ 2011). Human flow means demographic changes, i.e. changes in the age structure, the structure of households, internal and external migrations. This is also the transfer of labour and households, which entails the shift of needs on the real estate market and increased trade in real estate.

As it was mentioned before, the discussed changes are spatially differentiated. Spatial data processing methods may support the identification of such changes in space and the search for mutual interconnections.

### 2.2. GIS in the spatial analysis of the development potential of regional real estate markets

In GIS (Geographical Information Systems) are used to describe, explain and forecast the spatial distribution of geographical phenomena. They are currently considered as an IT (software) and science sector with an elaborated methodology of solving research problems. GIS should be understood as a proven method of spatial data processing that provides tools for spatial analysis (LONGLEY, GOODCHILD, MARGUIRE, RHIND, 2008).

The ways of using GIS techniques have been changing since the 1960s. Initially, they were understood as specialist software, but then they evolved through concepts connected with IT systems to a notion referring to the sectors of science, economics and administration.
Nowadays GIS is used as an IT tool supporting the operation of businesses, institutions and individuals in their daily lives. The practical applications of GIS technology are vast and interdisciplinary. GIS is used in an infinite number of areas of life – in geographic information portals, car, air and sea navigation. This technology is applied in areas closely connected with real estate management, such as cadastre, in the process of direct subsidies for agriculture, in flood protection, crisis management, and the management of special areas (National Forests, conservation areas). GIS is used in public statistics as a tool that supports business management (logistics, monitoring of vehicles and individuals).

A separate, constantly developing sector where GIS techniques are applied is the real estate market (GOTLIB, IWANIAK, OLSZEWSKI, 2007). Activities related to real estate management are a perfect setting for the application of GIS analysis. Depending on the type of operations, the following processes may be improved by means of the application of GIS technology:

- Real estate valuation (in particular mass valuation);
- finding real estate offered for sale;
- identification of real estate with respect to its availability and existing technical infrastructure;
- decision making in the process of selecting a real estate to be purchased.

These solutions may be used by any entity operating on the widely understood real estate market. These entities may include property valuators, bank analysts, real estate brokers and potential customers, including buyers, sellers, lessors and tenants. Depending on the type of demand for spatial information reported by specific groups of customers, these systems use various types of spatial information. In this context, the basic group of data will contain:

- The land registry system – as a nationwide, uniform, regularly updated set of information about land, buildings and premises, their owners and other natural persons or legal entities that manage such land, buildings or premises (Geodesic and Cartographic Law);
- Systems collecting data about local spatial development plans and spatial development conditions and directions studies of communes – as data that inform about the management possibilities of a given area;
- The System of Geodesic Records of Public Utilities (GESUT), Land Databases (BDOT500), State Border Register [PRG] and others – as information systems providing uniform collection, updating and disclosing of information about public utility networks and spatial location of spatial elements for the whole territory of the country (Geodesic and Cartographic Law);
- Topographic databases, including sozological studies – as studies that present the state of the natural environment, the causes and effects of changes occurring in the environment and the ways of protecting its natural values;
- Studies published by the Central Statistical Office (GUS) connected with the real estate market;
- Data from the Land and Mortgage Registers, as data about real estate owners.

The objective of geoinformational systems is to solve problems connected with spatial phenomena (LONGLEY, GOODCHILD, MARGUIRE, RHIND, 2008). They allow for a rational management of resources according to adopted criteria. The use of GIS systems enables the detection of the spatial distribution of attributes and the recognition of correlations or the lack thereof between areas as well as the determination of unique properties of the given area. These systems make it easier to discover the processes that are active in the natural envi-
environment and to develop environment management strategies. In this context, five main functions of GIS may be distinguished:
- Developing maps;
- Cartometrical measurements;
- Monitoring;
- Modelling;
- Management.

The use of information contained in various records enables to determine the attractiveness of a given area for selected criteria. This influences the duration of analyses and related decisions connected with the selection of the location for new manufacturing facilities, which determines the access to labour markets, outlet markets, accessibility of transport or the location of new office buildings connected with the communication accessibility for customers, prestige of the location, the exposure of the new investment and long-term risk analysis in the process of granting bank loans, or finally, with the determination of potential development directions of the given areas, which involves a series of activities related to the creation of communal strategies or spatial development (Table 1). The application of GIS technology allows partial automation, i.e. supporting decision-making processes in the common taxation process. This enables the creation of real estate price maps for selected areas of the agglomeration, but also supporting maps containing additional informational layers, such as maps of land and water conditions, maps showing adjacent annoyance-causing facilities lowering the real estate value or maps of environmentally valuable lands. More complex spatial research, used, among others, for the analysis of the real estate market components with use of GIS technology includes e.g. the analyses of changes in land cover at various time intervals. Such studies are typically based on satellite images in various spectrum ranges (OSTAPOWICZ 2012). The results of such analyses are applied in large-scale studies whose aims include the determination of changes in forest surface area, analysis of the health condition of the environment of a given area, analysis of land formation structure, finding dangerous places such as landfills or wastewater discharge points (OSTAPOWICZ 2012).

2.3. Linear arrangement method in the evaluation of the development potential of regions

The development of the local real estate market depends on the socio-economic situation in the given region (SUAREZ 2009). Good economic condition fosters new investments, and an efficient system of financing the construction sector along with high remunerations that confirm the credit ability of real estate purchasers generate demand for new apartments, undeveloped land and other non-residential property. The development of the construction sector is often seen as a driving force for other sectors of the economy (BALL, LIZIERI, MAC-GREGOR, 1998).

An interesting problem for the local real estate market analyst is the spatial classification of such markets (BERTG, BURNS, KLAASSEN, 1987). Which of the local real estate markets has the highest development potential? This may be tested with use of the taxonomic methods (FORYŚ 2009; GATNAR, WALESIAK, 2004; NOWAK 1990; ZELIAŞ 2000), supported by GIS tools in the interpretational and graphic aspects.
**Table 1.** Sample application of GIS technology in spatial studies for the purposes of real estate management

<table>
<thead>
<tr>
<th>Category</th>
<th>Cataloguing applications</th>
<th>Analytical applications</th>
<th>Implementation-related applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic development</td>
<td>Investment location, logistic requirements for the location</td>
<td>Availability of resources for future suppliers.</td>
<td>Supply sources.</td>
</tr>
<tr>
<td>Communal services</td>
<td>Transport planning, location of landfills and wastewater discharge points.</td>
<td>Location of conflict places and potential development opportunities.</td>
<td>Identification of development areas, infrastructure density and communication accessibility.</td>
</tr>
<tr>
<td>Housing management</td>
<td>Age of buildings, technical condition, ownership types, resident's age structure.</td>
<td>Spatial analysis of the market for service purposes, based on the analysis of residents' affluence.</td>
<td>Financial analysis of space revitalisation, location of services.</td>
</tr>
<tr>
<td>Local planning</td>
<td>Identification of flood areas, land usage, green areas, leisure paths.</td>
<td>Analysis of availability of leisure locations, influence of spatial planning on the life of inhabitants.</td>
<td>Location of new objects (housing, industrial areas) basing on demographical and environmental analyses.</td>
</tr>
<tr>
<td>Other</td>
<td>Cataloguing of roads, green areas, location of public utility objects.</td>
<td>Spatial changes in population (deaths, migration, births), analysis of revenues of local authorities, adjusting services to demand...</td>
<td>Influence of the changes in usage on the level of revenues of local authorities, location of infrastructure, and influence of new public utility objects on the improvement of inhabitants' life.</td>
</tr>
</tbody>
</table>

Source: FORYS AND KEMPA based on (LONGLEY, GOODCHILD, MARGUIRE, RHIND, 2008).
Such analysis enables to determine the best local markets from the point of view of the development potential of the given area.

One of the arguments for the use of an analysis of multiple variables and objects is the spatial differentiation of markets resulting from the regional differentiation of the factors determining their development. Multi-dimensional methods of analysis of the structure of a set of observations include discrimination and classification methods. The proposed classification methods may include the linear arrangement methods, which allow to rank the objects from the best one to the worst one according to the analysed criterion, and additionally to determine classes corresponding to the levels of the arrangement criterion, to which specific objects will be assigned. Linear arrangement methods enable to take into account a set of multiple variables at the same time, but first of all they allow for the comparison of the (regional) spatial structures. The regional differentiation that determines further development capacity, direction and strength, changes with time. Comparative analysis consists in the selection of an appropriate method of dividing the set into distinct and nonempty groups of units that are similar with respect to the subject of the analysis. The process of separating homogeneous groups is based on methods that use the values of a synthetic attribute. Synthetic (taxonomic) measures of development are the most important among classification methods, in particular if the subject of the analysis is the development level of a phenomenon, described by a set of numerous attributes, which may be replaced with one variable – a synthetic variable. Synthetic measure of development (SMD) is a function that aggregates partial information contained in specific variables. SMD is determined for each analysed object, provided that the assumptions of linear arrangement are met:

- The subject of analysis is a non-empty and finite set of objects and a finite set of variables substantively linked to the analysis, presented, at least, on the ordinal scale and comparable as a result of normalisation;
- There is an existing synthetic criterion for ordering the objects, which is not subject to direct measurement, and the ordering relation is a relation of most of the values of this measure.

The basis for the analysis is a two-dimensional observation matrix (Hellwig 1981, Zeliaś 2000):

\[
X = [x_{ij}] \quad i=1,...,n, j=1,...,m
\]

where \( n \) and \( m \) refer, respectively, to the number of objects and number of variables.

In the adopted analysis, Matrix X refers to a specific moment. The number of the adopted variables results, on the one hand, from the necessity to analyse the problem synthetically and on the other hand from the available statistical information (Zeliaś 1985). These are the most commonly used parameters that describe the real estate market and its environment.

The pre-defined set of diagnostic variables is subject to selection according to their substantive and formal properties and informational value. The substantive and formal aspects of the selection of variables should include the criteria of universality, measurability, availability, efficiency and data quality. Another important criterion is also the interpretability, i.e. high substantive value of a variable and the possibility to determine its influence on the analysed phenomenon precisely (stimulants, de-stimulants and nominates).
The verification of a set of potential variables also includes the statistical evaluation of their discrimination capacity, i.e. the variability of attributes in the analysed objects. For this purpose, the classic variation coefficient should be determined as a product of the standard deviation and the arithmetic average of the analysed variable. The subsequent stage consists in the elimination of the variables for which the value of the variation coefficient does not exceed 10%, which leaves a set of variables measurable on the ratio scale.

On the following stage, variables are divided into groups based on content. The prerequisites for the proposed division are of a procedural and research nature, and the analysis of too many variables at the same time hinders the interpretation of the analysed phenomenon. Pearson linear correlation coefficients are calculated for the determined groups of variables, eliminating variables that are too strongly correlated and thus duplicate information. As a result, a final set of diagnostic variables is obtained, which enables the determination of a synthetic measure of development for each analysed object.

The next step is the uniformization of the nature of variables (the postulate of uniform preference of variables), which consists in transforming destimulants into stimulants. For the purposes of the study, the authors adopted a ratio formula for the transformation of destimulants into stimulants (the reciprocal of the variable value), and negative values of stimulants were transformed into positive values, at the same time transforming them into destimulants (ZELIAŚ 2000).

As the attributes \((x_{ij})\) adopted for further calculations must also meet the comparability condition, whose aim is to deprive the variables of titres and to uniformise the orders of magnitude of measurement results, they were transformed to comparability by normalisation transformation, pursuant to the formula (TARCZYŃSKI 1996):

\[
x'_{ij} = \frac{x_{ij} - \overline{x}_j}{s_j}
\]

where:
- \(s_j\) - standard deviation of the \(j\)th variable,
- \(\overline{x}_j\) - average of the \(j\)th variable.

Methods of linear arrangement of a set of objects (including taxonomic methods) require to establish a weight system, unless the variables are considered equally important with respect to the objective of the analysis. Variable values may be aggregated basing on model or non-model formulas, and their application is limited by the scale of measurement of variables. Non-model formulas consist in averaging the normalised values of the diagnostic variables, while model formulas assume the creation of a taxonomic development model, which is an object characterised by certain optimal properties expressed by appropriately determined functions of value of specific diagnostic attributes.

Model methods are based on the assumed existence of a model object, with respect to which taxonomic distances are determined of the remaining analysed objects \(q_i = d(x_i, x_0)\). The determined distances allow to order the objects from the most developed one (located closest to the model) to the least developed one (located furthest from the model). The distance between the given object from the development model (as a value of the synthetic measure) is most commonly based on the Minkowski metrics, where the Euclidean distance is a special case:
\[ q_i = \left[ \frac{1}{m} \sum_{j=1}^{m} \left( x_{ij}' - x_{0j} \right) \right]^{\frac{1}{2}} \quad \text{for } i = 1, 2, \ldots, n \]

where:

- \( x_{ij}' \) - normalised values of the \( j \)th diagnostic variable for the \( i \)th object.

The obtained values of the synthetic variable \( q_i \) are then transformed, resulting in obtaining the synthetic measure of development \( (q'_i) \) for the \( i \)th object:

\[ SMR_i = \frac{q_i}{\|Q\|}, \quad \text{for } i = 1, 2, \ldots, n \]

where the adopted norm of the synthetic variable is usually the statistic maximum value. In practice, the values \( 1-q'_i \) are determined, which leads to a change in variable preference (in the case of stimulants higher values demonstrate the higher level of the analysed phenomenon).

The last step of the analysis may consist in grouping the objects into \( k \)-classes characterised by a similar structure, where the determined values of the synthetic variable are adopted as the classification criterion. The number of classes is determined arbitrarily, or with use of other available grouping methods. Subject literature proposes the division into four classes with use of the arithmetic average or arithmetic average and standard deviation (in justified cases also position variables may be used). For the changeable model it is possible to apply the division into four groups according to the formula:

\[
G1: z_i \in \left( \overline{z} + S_z; \max_1 \{z_i\} \right), G2: z_i \in \left( \overline{z}; \overline{z} + S_z \right) \\
G3: z_i \in \left( \overline{z} - S_z; \overline{z} \right), G4: z_i \in \left( \min_1 \{z_i\}; \overline{z} - S_z \right)
\]

where:

- \( z_i \) - synthetic variable,
- \( \overline{z} \) - arithmetic mean of the synthetic variable,
- \( S_z \) - standard deviation of the synthetic variable.

The interpretation of the obtained values of specific synthetic measures of development as well as the values of diagnostic attributes is improved if GIS IT tools are used for their spatial analysis. This enables to notice the spatial co-occurrence of specific analysed diagnostic attributes and the SMD coefficient itself.

2.4. Results of empirical tests

2.4.1. Analysis of the variables adopted for tests

Initially, for the purposes of the conducted tests, a wide range of variables of both economic and social nature, directly influencing the potential of the real estate market, was adopted (ŻELIAŚ 1985). European states (21 objects) for which a full catalogue of variables considered important in the aspect of the test subject was available for 2013 were adopted as test units (Fig 1).
Due to the subject of the tests, variables from the real estate market environment and those concerning the real estate market itself or its selected segments were taken into account as diagnostic attributes. The data originated from the statistical data resource Eurostat and from research by entities specialising in the analyses of the real estate market. Unfortunately, in the latter case the possibilities to use the test results were limited due to the narrow spatial scope of selectively conducted analyses (Fig. 2). However, the results of such tests allowed us to interpret the obtained outcomes in more depth.
As a result, the selected variables were grouped in three thematic areas:
- demographic and sociological data;
- data directly connected with the real estate market;
- data constituting evidence of the economic condition of the country.

In the first group seven variables were initially proposed, characterising those demographic factors that have the strongest influence on the phenomena occurring on the real estate market:

- X1 – median age of population,
- X2 – proportion of population aged 65 and over (%),
- X3 – population density (inhabitants per km²),
- X4 – crude birth rate (per 1 000 inhabitants),
- X5 – marriages (per 1 000 persons),
- X6 – divorces (per 1 000 persons),
- X7 – crude rate of net migration plus adjustment (per 1 000 inhabitants).

In the analysed countries, the highest median age of population in 2013 was found in Germany (45.3 years) and the lowest in Cyprus (36.2 years), while the average for 28 EU Member States at that time was 41.9 years. The ageing of the German society is also confirmed by the proportion of population aged 65 or over, which accounts for 20.7% of the total population (Fig. 3). The lowest proportion of population in this age group is found in Slovakia, where they account for 13.1 of the total population of the country. The older the population, the higher the demand for specific public utility real estate, such as nursing homes or healthcare facilities and lower demand for housing in the quantitative aspect.

The spatial analysis of the variable presented in Fig. 3 enables to determine that the society in the analysed European countries is growing old. The highest proportion of population aged 65 or over is noted both in "old" EU Member States – Germany, Austria, Portugal, Sweden and Finland and in post-communist countries – Lithuania, Latvia, Bulgaria and Croatia. The lowest proportion of elderly people is found in Poland and the Czech Republic.
The highest population density among the analysed countries is found in the UK (229.4 inhabitants/km² surface area) and the lowest in Finland (17.8 inhabitants/km² surface area), while the average for EU Member States is 116.3 inhabitants/km². High population density is strongly correlated with the intensity of development and high prices of investment land for development. High population density usually also means high demand for housing, commercial, service and office property. Similarly, high positive net migration rate refers to those markets to which more people immigrate than leave (Fig. 4). The highest values of this indicator are noted in Sweden (6.9), Austria (6.5), while negative values were found in Cyprus (-14) and Latvia (-7.1).
The highest migration rate is found in Central and Northern European countries, while the lowest occurs in countries located on the border between Eastern and Western areas of the EU – Spain, Portugal as well as Lithuania and Latvia. Basing on the criterion of coefficient of variation exceeding 10%, variable X1 was rejected. On the other hand, Pearson linear correlation coefficients showing a lack of strong correlation between the remaining variables were an argument for leaving those variables for further analysis (Table 2).
Table 2. Table of correlations between variations in the demographic data group

<table>
<thead>
<tr>
<th></th>
<th>X2</th>
<th>X3</th>
<th>X4</th>
<th>X5</th>
<th>X6</th>
<th>X7</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X3</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X4</td>
<td>0.20</td>
<td>0.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X5</td>
<td>0.29</td>
<td>0.31</td>
<td>0.18</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X6</td>
<td>0.21</td>
<td>0.08</td>
<td>0.15</td>
<td>0.46</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>X7</td>
<td>0.40</td>
<td>0.26</td>
<td>0.11</td>
<td>0.03</td>
<td>0.26</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Source: FORYŚ AND KEMPA

Variables (X2–X7) left for further analysis were not characterised by a high correlation coefficient. The strongest negative correlation (−0.31) exists between variables (X3, X5), i.e. population density and the number of marriages per 1000 inhabitants, while the strongest positive correlation (0.40) is found between variables (X2, X7), i.e. the proportion of population aged 65 or over and net migration rate, as well as between variables (X5, X6), i.e. the number of marriages and divorces per 1000 inhabitants (correlation coefficient 0.46). Variables X2, X6 and X7 were considered destimulants, negatively influencing the development of the real estate market.

In the second group, a set of available and comparable variables directly linked to the real estate market were proposed for analysis:

- X8 – house price index (2010 = 100),
- X9 – building permits - number of dwellings - residential buildings, except residences for communities (%),
- X10 – building permits – m² of useful floor area - residential buildings, except residences for communities (%),
- X11 – distribution of population by dwelling type – detached house (%),
- X12 – distribution of population by dwelling type – semi-detached house (%),
- X13 – distribution of population by dwelling type – flat (%),
- X14 – distribution of population by dwelling type – others (%),
- X15 – distribution of population by dwelling type – flat in a building with ten or more dwellings (%),
- X16 – distribution of population by dwelling type – flat in a building with less than ten dwellings (%),
- X17 – distribution of population by dwelling type – house (%),
- X18 – dwelling owner, with mortgage or loan (%),
- X19 – dwelling owner, no outstanding mortgage or housing loan (%),
- X20 – dwelling tenant, rent at market price (%),
- X21 – dwelling tenant, rent at reduced price or free (%),
- X22 – dwelling owner (%),
- X23 – dwelling tenant (%).

Among the selected variables, available in the public statistical databases, a majority of the compared data refer to the residential market. Analysing the housing price indices one might notice that the highest increase in this index in comparison to the year 2010 occurred in Latvia (127.56) and Austria (122.82), while the decrease in the value of this index was the lowest in Spain (70.75) and Croatia (77.39). The mere values of these indices may not be a reliable comparative attribute, due to the differences in the methodology of calculating
such indices in various countries but mainly due to the data taken into account for the purposes of such calculations (primary market, secondary market, data sources etc.). The number of commenced new investments or building permits obtained for such investments is a measure of the activity on the real estate market. In 2013, the highest increase in the building permits per the amount of dwellings that were to be constructed in comparison to the preceding year (2012 = 100) occurred in Latvia, Lithuania and Germany, whereas the lowest – in Cyprus (Fig. 5).

Fig. 5. Building permits – number of dwellings – residential buildings, except residences for communities (%). Source: FORYŚ AND KEMPA based on Eurostat

The most building permits were issued in the central part of the analysed area, whereas the lowest proportion of building permits were issued in Hungary, Spain and Portugal. The
The cartogram (Fig 6) matches the previous cartogram (Fig 5). The largest usable area of the building permits is found in the central part of the analysed area, while the lowest proportion of building permits were issued in Hungary, Spain, Portugal and Croatia. The affluence of real estate owners on the given local market is manifested, among others, in the ownership structure of dwellings and the structure of leased dwellings as well as the sources for financing the purchase of such dwellings. The highest proportion of owned flats
is found in Slovakia (90.5%) and Romania (95.6%), although in both cases this situation results from ownership transformations that took place as part of the economic and social transformations. In these countries the proportion of dwellings encumbered with mortgages or loans is low. A high proportion of owned flats are also noted in Croatia (85.8%). The spatial structure of flat ownership and lease has been illustrated in the figures below (Fig. 7 and Fig. 8).

Property ownership as a form of title to real property is the most common in "new" EU Member States and in Spain. The lowest proportion of individuals who have ownership title to real property can be found in Germany, Austria, the UK and France.
Lease is most popular in the Central and Northern part of the analysed area and in Portugal, whereas it is the least common in Latvia, Slovakia, Hungary and Bulgaria. As in the case of the first group of variables, Pearson linear correlation coefficients were determined for the second group, allowing us to eliminate variables that are strongly correlated (Table 3).
Table 3. Table of correlations between variations in the second group – real estate market

<table>
<thead>
<tr>
<th></th>
<th>X8</th>
<th>X9</th>
<th>X10</th>
<th>X11</th>
<th>X12</th>
<th>X13</th>
<th>X14</th>
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<th>X19</th>
<th>X20</th>
<th>X21</th>
<th>X22</th>
<th>X23</th>
</tr>
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<tbody>
<tr>
<td>X8</td>
<td>1,00</td>
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<td>0,88</td>
<td>0,30</td>
<td>-1,00</td>
<td>1,00</td>
</tr>
</tbody>
</table>

Source: FORYŚ and KEMP A

After the elimination of correlated variables, seven final variables remained in the second group, all of which were stimulants: X10, X13, X14, X17, X21, X22 and X23.

There are several reasons why the initial number of variables in the third group was not as large: the lack of complete time series in the analysed period, incomparability of data, and finally, lack of strong intra-group correlation and low variability. The following were adopted for analysis:

- X24 – GDP per capita in PPS (Index EU28 = 100),
- X25 – real GDP growth rate – volume (% change on previous year),
- X26 – long term government bond yields are calculated as monthly averages (2014Q1),
- X27 – intention to buy a car within the next 12 months,
- X28 – volume index of production construction (% change compared to same period in previous year),
- X29 – volume index of production construction – buildings (% change compared to same period in previous year),
- X30 – volume index of production construction – civil engineering works (% change compared to same period in previous year).

The highest value of GDP per capita in 2013, measured as index with respect to the EU for 28 states was obtained in Austria (127) and Sweden (127), whereas the lowest, below EU average was found in Bulgaria (45) and Romania (55). High GDP value proves a high level of economic development and thus high demands in all segments of the real estate sector. It also means a good condition of households and business entities, which are able to make long-term investment decisions on the real estate market. The condition of households may also manifest itself in the increased consumption of durables, such as e.g. the purchase of a new car, and in the case of enterprises in the investments in owned fixed assets or the purchase of new real property. The value of the volume of building production in the first
quarter of 2014 in all analysed countries was only slightly higher than in the same period of the preceding year. The highest increase was noted in Latvia (34.1%) and Lithuania (22.5%), while the highest fall was noted in Cyprus (–13.2). Most of the analysed countries noted a slight growth in production volume (Fig. 9).

![Volume index of production buildings - Percentage change compared to same period in previous year](image)

**Fig. 9.** Volume index of production construction (% change compared to same period in previous year). *Source: FORYS AND KEMPA based on Eurostat*

The analysed attribute is distributed unevenly. The highest values are noted in the Central and Western parts of the EU (apart from Portugal), whereas the lowest negative values are observed in Portugal, Croatia and Denmark.

On the other hand, a significant increase was noted with respect to the production of civil engineering works (Fig. 10), particularly in such countries as Lithuania (56.6%), Slovenia (52.9%) or Hungary (37.2%). These works are typically road works, bridges and other civil engineering objects, which contribute to the improvement of the technical infrastructure of the real estate market and, as a consequence, attract investors who realise other, commercial construction projects, to the local markets.
The highest dynamics of changes in the analysed attribute occurs in the central part of Europe and Bulgaria, while the lowest dynamics is noted in Portugal, Denmark and the Netherlands.

The analysis of linear correlation between variables within the group (Table 4) shows a strong positive correlation between the variables X29 and X25 and X28, i.e. between real GDP growth rate and building production index. The strongest negative correlation exists between variables X24 and X26, i.e. between GDP with respect to EU average and long term government bond yields.
Table 4. Table of correlations between variations in the third data group – economic variables

<table>
<thead>
<tr>
<th></th>
<th>X24</th>
<th>X25</th>
<th>X26</th>
<th>X27</th>
<th>X28</th>
<th>X29</th>
<th>X30</th>
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<td>0,32</td>
<td>1,00</td>
</tr>
</tbody>
</table>

Source: FORYS AND KEMPA

After the elimination of correlated variables, five final variables remained in the third group, all of which were stimulants: X24, X25, X27, X28 and X30. The final set of variables obtained in all three groups of factors influencing the development of the real estate market enables to start the determination of synthetic measures of development, after the transformation of destimulants into stimulants and normalisation of the variables.

2.4.2. Grouping national real estate markets according to SMD

Basing on the adopted final set of variables determined pursuant to Section 2.4, the authors started the procedure of determining the SMD value in compliance with the procedure described in section 2.3 and the ranking of the markets in specific countries that were subject to the analysis. The highest SMD value was obtained for the UK (0,215), which places this country in the last position of the development potential ranking. Markets characterised by a high value of this indicator are well-developed markets, so their development potential is already low in comparison to developing markets (Table 5).

Table 5. Ranking of EU Member States according to the Synthetic Measure of Development (SMD)

<table>
<thead>
<tr>
<th>Object</th>
<th>State</th>
<th>Value</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
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<td>11</td>
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<tr>
<td>O2</td>
<td>Bulgaria</td>
<td>0,119</td>
<td>6</td>
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<tr>
<td>O3</td>
<td>Czech Republic</td>
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</tr>
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<td>O4</td>
<td>Denmark</td>
<td>0,185</td>
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<tr>
<td>O5</td>
<td>Germany</td>
<td>0,139</td>
<td>7</td>
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<tr>
<td>O6</td>
<td>Spain</td>
<td>0,049</td>
<td>2</td>
</tr>
<tr>
<td>O7</td>
<td>France</td>
<td>0,141</td>
<td>9</td>
</tr>
<tr>
<td>O8</td>
<td>Croatia</td>
<td>0,081</td>
<td>3</td>
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<tr>
<td>O9</td>
<td>Cyprus</td>
<td>0,099</td>
<td>5</td>
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<tr>
<td>O10</td>
<td>Latvia</td>
<td>0,162</td>
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<tr>
<td>O11</td>
<td>Lithuania</td>
<td>0,149</td>
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</tr>
<tr>
<td>O12</td>
<td>Hungary</td>
<td>0,097</td>
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<tr>
<td>O13</td>
<td>Austria</td>
<td>0,156</td>
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<td>Poland</td>
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<tr>
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<td>Portugal</td>
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<td>O16</td>
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<td>Slovenia</td>
<td>0,191</td>
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<tr>
<td>O21</td>
<td>United Kingdom</td>
<td>0,215</td>
<td>21</td>
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</tbody>
</table>

Source: FORYS AND KEMPA
Similarly, such countries as Poland, Slovenia or the Czech Republic are already saturated markets in the aspect of development potential, which however does not mean that the investment needs on these real estate markets are fulfilled. However, the environment of these real estate markets does not foster dynamic development in the analysed period. Countries characterised by a high level of the real estate market development, and thus by a limited development potential, are in the lowest positions of the ranking. On the other hand, countries characterised by a low SMD index in the analysed period have a high development potential of the real estate market.

The main representatives of this group are Portugal, Spain and Croatia. These three countries constitute group IV, characterised by the highest development potential of the real estate market with respect to the analysed variables (Table 6), i.e. by the lowest values of the SMD indicator.

Table 6. Ranking of EU Member States according to the value of Synthetic Measure of Development (SMD)

<table>
<thead>
<tr>
<th>Object</th>
<th>Country:</th>
<th>Group</th>
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<tbody>
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<tr>
<td>O6</td>
<td>Spain</td>
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<tr>
<td>O8</td>
<td>Croatia</td>
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<tr>
<td>O12</td>
<td>Hungary</td>
<td></td>
</tr>
<tr>
<td>O9</td>
<td>Cyprus</td>
<td>III</td>
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<tr>
<td>O2</td>
<td>Bulgaria</td>
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<tr>
<td>O5</td>
<td>Germany</td>
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<tr>
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<td>Sweden</td>
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<tr>
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<td>France</td>
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<tr>
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<td>O1</td>
<td>Belgium</td>
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<tr>
<td>O11</td>
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</tr>
<tr>
<td>O21</td>
<td>United Kingdom</td>
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</tbody>
</table>

Source: Foryś and Kempa

Group III, determined by the mean minus standard deviation as lower limit and the average of the obtained SMDs as the upper limit, contains Hungary, Cyprus and Bulgaria. These countries are characterised by high values of beneficial demographic indicators and positive attributes of the real estate market, in particular with respect to their location in the mild Mediterranean climate zone. Group II is the largest, consisting of countries characterised by SMD values above average.
2.5. Conclusions

Analyses of the real estate market are usually based on the influence of specific, isolated factors on the variables characterising the development level of such market. The evaluation of similarity between the development of regional markets (objects) complements such analyses and shows the spatial differentiation of development levels by ordering objects from the best to the worst one, while grouping illustrates the similarities between these markets in the aspect of the adopted classification criterion. The obtained results enable to determine the areas that are characterised by the highest development potential and thus are an investment niche for real estate market investors.

The proposal to apply synthetic measures of development (SMD) is worth considering as it is a simple measure as far as calculations are concerned and it is applied mainly for the linear ordering of multidimensional objects. The possibility to apply it to socio-economic phenomena that cannot be measured directly is one of its particularly important applications.

The factors that influenced the quality and number of analysed objects included the limited amount of data available in Eurostat as well as the manner of determination of specific values, particularly in the group of economic variables.

The application of GIS tools facilitates analysis and enables to interpret the spatial distributions of the analysed properties in a fast and precise way. However, the application of these tools for comparative purposes requires some practice and the obtained results always have to be subjected to individual assessment of correctness of the applied criteria for the division into classes, graphic visualisation and verification of source data.

The discussed topic is an attempt at demonstrating the usefulness of GIS tools for simple spatial interpretation of phenomena that occur on the real estate market and in its environment. Combined with linear ordering methods, they also provide a tool for establishing ratings of the analysed markets based on multidimensional criteria and making decisions based on such ratings.
3. REAL ESTATE MANAGEMENT PROCESSES IN THE AREA INSCRIBED ON THE UNESCO WORLD CULTURAL HERITAGE LIST ON THE EXAMPLE OF THE CITY OF KRAKOW

There are a number of legal regulations whose aim is to protect historical buildings. These laws have a significant impact on the real estate management. Restricting the possibility of extension of the existing structures, introducing specific orders and bans, or the obligation to obtain the consent of conservation authorities, all contribute to the reduction in investment processes carried out in the center of historic towns.

Krakow enjoys the largest in Poland resource of the objects entered in the register of monuments (JANCZYKOWSKI, 2007). In December 2013, the register contained 73 churches and monasteries, 8 synagogues, 4 cemeteries, 7 urban systems, 34 military monuments (medieval and from the times of the Austrian Krakow Fortress), more than 1,000 buildings and several monuments have other functions, e.g. city parks and gardens. In the municipal record of historical monuments for the city of Krakow, there are over 6,300 monuments listed (BIP). The unique cultural value of this area has been recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) by inscribing it on the UNESCO World Heritage List. Krakow is a city where there is a real problem of reconciliation between the protection of monuments and the rapid development of urban structures. It is essential to limit the interference in the historic center of the Old Town.

This study aims to show the influence of the existing legislation to protect historical buildings on the real estate management processes.

3.1. The historic center of Krakow on UNESCO’s World Heritage List

One of the greatest distinctions for historical buildings is to be entered on the World Heritage List of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Old Town with the Wawel Castle, Kazimierz and Stradom had this honor as one of the first 12 sites in the world in September 1978. The conservation area is 149.65 hectares and its boundaries have been presented in Figure 11.

The Old Town, which serves as the historic center of Krakow, also acts as the city center with various functions: administrative, commercial, service, residential, scientific, cultural and tourist ones. It houses seats of numerous institutions, which are important for the rank of the city, such as universities, museums, churches, municipal administration offices, banks. The basic shape of the spatial structure of the Old Town of Krakow was given by the incorporation charter in 1257 according to the Magdeburg law, when the market and the surrounding blocks were set out, including earlier irregular layout elements into the system. At the beginning of the fourteenth century, the neighboring village of Okół became a part of Krakow, and the enlarged city was surrounded by the walls, which established the area of Krakow for several more centuries (MYDEL, 1979). City fortifications were demolished in the early nineteenth century, and in this place a green belt – Planty Gardens were created, leaving the northern section of the walls with St. Florian's Gate and the Barbican (OSTROWSKI, 1992). The dominant elements of the spatial structure of the Old Town are the Wawel Castle and the Main Market Square. The development of the Wawel Hill lasted several centuries and it resulted in the creation of outstanding works of architecture, such as the Gothic cathedral, built in the fourteenth century, the place of coronation of the Polish kings, as well as the royal castle. The role of the Wawel Castle as the seat of the Polish rulers ended with the transfer of the royal court to Warsaw in 1609, but the Wawel Hill still...
played a special role as the necropolis of the Polish kings, and later also of great poets and national heroes. Over the centuries, the Market Square was both the commercial economic and administrative center, as well as the setting of political events, which were the most important for the history of the city and the country. The Market Square buildings were erected between the thirteenth and the eighteenth centuries (Figure 12).

Fig. 11. The boundaries of the city of Krakow, the UNESCO World Heritage Site. Source: UNESCO

The nineteenth century brought the actions aimed to order the development which, unfortunately, led to the demolition of many valuable structures, such as the Weigh House and the Town Hall. The spatial structure of the Old Town is still preserved today – dominated by the historical quarter development of a compact character (REVITALIZATION, 2008).

Fig. 12. Photographs of the Wawel Hill and the Market Square with the Cloth Hall. Source: BATURO, 2010
Stradom became part of the town of Kazimierz at the time of its incorporation charter, but it was not included within its city walls. It was the most important suburb of Kazimierz, linking it with Krakow. Vast areas of the western part of Stradom were occupied by Bernardine monastery complexes.

Kazimierz is a district of rich cultural traditions and significance to the city, both due to its history and location between the Old Town and the Vistula River. Despite its location in the city center, this place is an enclave of a specific character. Kazimierz, founded by the incorporation charter in 1335, until the year 1792 existed as an independent town. In the fifteenth century, the Jews living in Krakow were relocated to Kazimierz and settled in the part of the town separated by the walls, which initiated the process of formation of a culturally unified Jewish Quarter, initially centered around the so-called Old Synagogue in the area of Szeroka street (Purchla, 1996). Kazimierz became an important center of the Jewish culture in Poland and abroad. Until today, it has retained the charter urban layout with the market.

3.2. Spatial planning in Poland

Spatial planning and land use are key aspects in the context of the proper development of our surroundings. In accordance with the current regulations [the Act, 2003], spatial planning and land use in Poland is performed at three levels: the national, provincial and municipal ones.

Spatial planning at the central level involves the preparation of the spatial development concept of the country, defining conditions, objectives and directions of sustainable development of the state, as well as the actions which are necessary to achieve it. At the provincial level, the main purpose of spatial planning is the preparation of a development plan. The most significant and the most detailed spatial planning, however, is done at the municipal level. This task can be accomplished by:
- the study of land use conditions and directions,
- the local land use plan.

As stated by (BIEDA et al., 2012): “The study is an internal act binding the municipal authority in conducting further planning activities in order to prepare and adopt a local development plan”. The study is prepared for the whole municipality. It should contain the essential elements of the spatial policy for a particular area.

The most important document for the planning processes in the municipality is the local development plan, which is the act of the local law. The plan is based on the provisions of the study and it is adopted by the municipal council on the basis of the draft plan. The primary objective of the local development plan is to determine land use and the manner of land management. Therefore, it can be concluded that the local plan is a tool for running spatial policy adopted in the study of land use conditions and directions (BIEDA et al., 2012). The preparation of the local land use plan is not mandatory for the whole territory of the municipality. In the absence of the local land use plan, spatial policy is carried out through the issuance of a planning permission. Local plans set out the specific changes that are to take place in space, they introduce bans and orders. They play a key role in the protection of historical monuments as well.

3.3. Archival development plans

In the planning office of the city of Krakow, archival land use plans from 1939, 1967, 1977, 1988, 1993 and 1994 were saved. Their fragments covering the area listed as a UNESCO
World Heritage Site have been presented in Figure 13.

Protection of historical monuments of Krakow has always been one of the fundamental objectives of the local development plans. The plan of 1967, due to the “extraordinary cultural and historical value of the city” introduces the provisions protecting historical monuments. They say that “investment plans within the historical complexes and structures require to be respected in terms of their character and to obtain a consent of the Municipal Conservator of Monuments” Similar provisions were included in the development plan of 1977.

**Fig. 13.** Fragments of land use plans for the area of the Old Town. Source: BIP (Public Information Bulletin)
The first planning document with a rank of the local law, adopted after inscribing the Historical Center of Krakow on the UNESCO World Heritage List, is the plan of 1988. The set out goals for Krakow development by the year 2000 include the “protection of cultural values inherent in the substance of the city and its compositional structure through:
- maintaining, emphasizing and harmonious complement of the urban structure and spatial composition of the city,
- maintaining and emphasizing historical spatial structures,
- maintaining in good technical condition the historical building substance,
- preservation and emphasizing of movable monuments,
- maintaining the climate and the mood of the city by taking into account the factors of continuity and tradition of the place in the transformation process”.

The plan also points to the need of improving the spatial order by, among others, the protection of historically developed parts of the city. The protection zone for the panorama of the Old Town was also determined, according to which there is a limitation regarding the size of the designed buildings “which are the foreground for the historic silhouette of the Old Town viewed from some vantage points located on its periphery” to 4 stories. Protection of the development is carried out through non-demolition of the existing buildings and restrictions on the implementation of new ones, except as set out in the conservation studies. In this plan, prepared 10 years after entering the center of Krakow on the UNESCO List, there is no reference to the World Heritage List. The plan of 1994 specifies the concept of the “protection zone for exceptional cultural values”, whose aim was to preserve the unique cultural values of urban, suburban, rural, residential spaces, religious places, fortifications, cemeteries, preserved in the structure and substance, but once again, there is no reference to the Historical Center of Krakow, inscribed on the UNESCO List.

The presented local development plan of 1994 was the last planning document developed for the entire administrative area of the city of Krakow. On 1 January 2003, all local development plans adopted before 1 January 1995, lost their validity. As a consequence, 98% of the total area of the city remained without spatial regulation concerning the use and principles of management (BIP). The Old Town area functioned for eight years without the valid local development plan. For the district of Kazimierz and Stradom these studies still have not been adopted.

3.4. **Forms of the protection of historical monuments**

The rules for the protection of historical monuments and ways of their conservation in Poland are regulated by the Law on the protection and conservation of historical monuments (ACT, 2003b). It defines the historical monument as “real estate or movable property, parts or complexes thereof, which are the work of man or of his activity and which are a testimony of a bygone era or an event, whose preservation is in the public interest due to their historical, artistic or scientific value”. There are four forms of the protection of historical monuments:
- entry in the register of monuments;
- recognition as a monument of history;
- establishment of a cultural park;
- settlements regarding protection in the local development plan or in other documents prepared in the absence of a plan.

As it was already mentioned, in Krakow there are over 6,000 monuments. Relevant information is contained in the municipal record of monuments, run by the head of a
commune, mayor or president of a city, in the form of a collection of address cards of immovable monuments in the municipality. The record of historical monuments itself is not a form of protection, though (BOŃSKI, 2011). Only entering the object in the register gives the conservation authorities the power of interference with respect to a given real property. When the decision on entering in the register of monuments becomes final, the following activities require the consent of the provincial conservator of monuments: performing construction works in the monument, conservation and restoration works, installing technical equipment and advertising on the monument, carrying out physical subdivision of real property, as well as taking actions that could lead to damage to the substance or changing the appearance of such a monument.

In Figure 14, buildings located in the Old Town and entered in the register of monuments have been marked in dark gray. Objects belonging to the record of monuments have been marked in light gray. Due to the immense historical value of the area, most of the buildings are protected by the entry in the register of monuments. The register of monuments also contains the urban layout of the city of Krakow within the Planty Gardens (the Decision of 1933) and the urban layout of the old town of Kazimierz with Stradom (1934). In 1994, the President of the Republic of Poland, by ordinance (ORDINANCE, 1994), established the historic city of Krakow to be the monument of history. The purpose of its protection is: “preservation of the authenticity of the historical urban and architectural system of Krakow due to its unique, universal historic and artistic values, as well as its intangible assets, which was shaped over a thousand years of history, and which is one of the leading arts and cultural complexes in Europe” (ORDINANCE, 1994).
Fig. 14. Buildings in the Old Town entered in the register of monuments and listed in the record of monuments.  
*Source: BIP (Public Information Bulletin)*
The Appendix to the Ordinance contains a map of the boundaries of the historical complex, presented in Figure 15. The boundaries of Krakow’s monument of history cover a larger area than the one listed as the UNESCO World Heritage Site. Unfortunately, in accordance with the applicable provisions, granting the status of a historical monument is primarily a prestigious event (KLIMCZAK, 2011), and is the only deviation from the rule of equivalence of monuments, under the Act on the protection and conservation of historical monuments (SZMYGIN, 2011). He points out that the recognition of an object as a monument of history does not change anything in the manner of management of historical buildings, does not impose upon, or relieve administrators from, any obligations, does not increase the regime of historic substance protection, nor is it formally associated with obtaining financing for this object made easier. Nor does the Act set any new tasks or gives additional powers to the conservation authorities, other than those that they have with respect to any other immovable historical monument.

Fig. 15. The boundaries of the historic city of Krakow, declared as the monument of history. Source: ORDINANCE, 1994

The situation is different in the case of establishing a cultural park - the third form of protection of historical monuments. The cultural park, which is designed to protect the cultural landscape and to preserve scenically outstanding areas with immovable monuments characteristic for the local building and settlement tradition, may genuinely affect the conservation of historical buildings. According to (ACT, 2003b), the resolution which creates a cultural park should include its name, boundaries, manner of protection, as well as bans and restrictions on:

- performing construction works as well as industrial, agricultural, farming, trade or service activities;
- changing the manner of use of immovable monuments;
- placing boards, inscriptions, advertising, or other signs not related to the protection
of the cultural park, with the exception of road signs and signs for the protection of public order and safety,
- storage of waste.

The head of a commune, the mayor or the president of a city, in consultation with the provincial conservation officer, prepares a plan to protect the cultural park, which is then approved by the municipal council. Additionally, in order to carry out tasks related to the protection of the cultural park, the municipal council may create an organizational unit to manage the park. The most important aspect of the creation of a cultural park in terms of real estate management is to impose upon the municipality an obligation to prepare a local development plan for the area of the park. In 2010, by means of a resolution (RESOLUTION, 2010), the Council of the City of Krakow established a cultural park called the Old Town Cultural Park. Its purpose is to protect the cultural landscape, the historical monuments and the historical urban layout of the Old Town and the Plany Gardens, together with the Wawel Hill and its surroundings, which is the area inscribed on the UNESCO World Cultural and Natural Heritage List, and in the register of monuments. Pursuant to this resolution, bans and restrictions resulting from the previously mentioned provisions of the Act were introduced. The provisions of the resolution are in force since 7 December 2011.

The cultural park boundaries run along the following streets: Straszewskiego, Podwale, Dunajewskiego, Basztowa, Westerplatte, Św. Gertrudy, Bernardyńska, a fragment of the Vistula Boulevard to Podzamcze street connecting with Straszewskiego street, and they have been illustrated in Figure 16.

![Fig. 16. Boundaries of the Old Town Cultural Park. Source: RESOLUTION, 2010](image-url)
It is surprising that, despite a direct reference in the text of the resolution to the Krakow area which was entered on the UNESCO World Heritage List, the cultural park has only covered the Old Town. Not including Kazimierz and Stradom to the cultural park, may have a negative impact on the protection of historical buildings located in those areas.

Limitations affecting the real estate management in the Old Town Cultural Park will result from the local development plan, the preparation of which was made obligatory under the resolution (RESOLUTION, 2010), and from the restrictions and bans on performing construction works, resulting directly from the provisions of the resolution. Restrictions on construction works may relate to:

- with respect to the front buildings, ban on performing construction works leading to changes in elevation design, including changes to the shape of the roof and ridge height, allowing the changes resulting from the historical conditions and local land use plan,
- ban on the construction, outward extension and upward extension of outbuildings with the height higher than the ridge of the front building on the given property, allowing the changes resulting from the historical conditions and local development plan,
- all construction works on the facades of the buildings, including changes in the color of the facade, require maintaining its original form. Where historical research or conservation works allow to specify the former color of the facade, it is required to restore the original color scheme,
- ban on demolition of the historical building entered in the record of monuments only, subject to the separate provisions, and the possibility of reconstructing such a structure, taking into account conservation guidelines resulting from historical conditions, subject to compliance with the settlements of a local development plan,
- order to preserve historical window frames, shop windows, entrance gates. If there is a need to replace these items, including gutters, there is a ban on using plastic elements and obligation to reinstate the traditional forms and to use traditional materials.

These restrictions may significantly affect the number of the performed surveying works, related both to real estate subdivision and preparation of maps for design purposes.

Another important event affecting the protection of cultural heritage was the decision to establish a buffer zone in the city center, which was taken at the international UNESCO committee meeting in Brazil (July 25 - August 3, 2010). The establishment of the protection zone allowing for a more effective protection of the panorama of the Old Town was the UNESCO's requirement for the site. Such principles for the protection of the world heritage have been introduced, among others, under the influence of the events in Cologne (Germany), where on the other side of the river Rhine skyscrapers were built, disfiguring the view of the historical cathedral. A comprehensive approach to the protection of monuments should include not only individual objects, but also the entire urban layouts and views. The mere existence of a buffer zone does not bring new legal solutions, as it was explained by HAJOK (2010). However, it creates the basis for including the stipulations regarding the protection of historical monuments in the planning documents for the city of Krakow. The existence of such a zone must be demonstrated in a study of land use conditions and directions and also included in local plans. In the absence of such studies, a possible consequence is the removal from the List of World Heritage Sites.

The buffer zone has been designated within the historical boundaries of the Fortress
core and it comprises a system of concentric rings with a grid of radiating streets and a part of historical structures of Krakow (cities, suburbs, and jurydykas – settlements independent of municipal laws), together with the nineteenth- and early twentieth-century complexes of high compositional values and with distinct stylish features, representing historicism, Art Nouveau and Modernism (BIP). Figure 17 illustrates these boundaries, marked in black.

The creation of a buffer zone has been reflected in the current study of land use conditions and directions for the City of Krakow. The STUDY (2014) identifies the following lines of management for the UNESCO World Heritage Site:

- Consistent application of conservation guidelines, particularly in the area entered on the UNESCO World Heritage List.
- Strengthening spatial planning instruments in the area entered on the UNESCO World Heritage List (e.g. by adopting local plans).
- Taking into account the importance of conservation and protection of monuments, e.g. in cultural development strategy.
- Taking into account the issues of conservation and protection of monuments in the system of City spatial and urban planning - designating conservation areas with various protection regimes.

Fig. 17. The boundaries of the buffer zone for the area of the Historical Center of Krakow, a UNESCO World Heritage Site. Source: UNESCO
The main protection objective is entering the objects located within the buffer zone into the register of monuments. The areas within the buffer zone are also to be covered by local development plans. The objectives and principles for preparing these plans include:

- protection of the existing urban structures and building complexes with clearly stylish features,
- allowing for new investments to complete the preserved old urban fabric without creating spatial dominant features,
- determining the dimensions of the new investments based on the performed view analysis, also taking into account the foreground and background of the view, due to the potential impact of new investments on a silhouette of the City,
- special protection of the following views: the Wawel Hill Complex, Skałka, the Town Hall tower, the churches and church towers of the Old Town, Stradom and Kazimierz views from the banks of the Vistula river, the Kotlarski bridge, starting from the Norbertine monastery,
- shaping public spaces based on high aesthetic standards; this applies also to equipping the space with landscape architecture and visual information media.

Basing on the conducted analysis, it can be concluded that from a legal point of view, there are three aspects which are essential regarding the protection of monuments:

- entry into the register of monuments - it gives a possibility to interfere in the works carried out in the monument, the conservator’s permission will be required for construction works or real estate subdivisions;
- establishing a cultural park - introduction by resolution of specific bans and restrictions, as well as ways to protect cultural heritage;
- preparation of the local development plan - the fourth form of the protection of historical monuments, allowing for a full and comprehensive management of a given space and its protection.

For the area inscribed on the UNESCO World Heritage List it seems necessary to prepare the local development plan, allowing for proper management of this unique urban layout and full protection of the historical buildings and structures.

### 3.5. Local land use plan for the area inscribed on the UNESCO World Heritage List

Further to the change in the legal regulations in 2003, only 1.5% of the Krakow area had local development plans. It would seem that the City Center, as Krakow’s most prominent sight and the area of a unique historical value, will be one of the first areas for which the plan will be prepared. Planning works for the Old Town area began in 2006. However, the local development plan did not enter into force until April 2011. Provisions of the resolution on establishing the cultural park, imposing an obligation to prepare the plan, may have influenced the acceleration of its introduction. Figure 18 illustrates the status of the local plans covering the central area of the City of Krakow in 2011 and 2014. The areas with the existing local development plans have been marked in dark gray, and the areas for which the development plans are under preparation have been marked with light gray or in hatch. Once again, the subdivision of the area entered on the UNESCO World Heritage List into the Old Town and the districts of Stradom and Kazimierz is clearly visible. For the Old Town, the plan has already been adopted, for the other two districts, in 2014, the preparation of the plan has only started. It may take a few years before its entry into force. The valid plan for the Old Town covers an area within the 1st administrative district (the Planty Gardens) and the Wawel Hill, its surroundings and the associated part of the left bank of the Vistula.
The aim of the local land use plan is (LDP, 2011):
- protection of cultural values, landscape and historic urban system of the Old Town with the Wawel Hill,
- establishing the principles for conservation and shaping of the development,
- ensuring an attractive diversity of uses for the areas covered by the plan, with a preference for housing and services,
- determining terms and conditions for the development and use of public spaces,
- establishing the rules for the infrastructure and communication system, subordinate to the historical layout of the streets and squares and prioritizing pedestrian traffic.

The first goal, which was included in the plan, is protecting a part of the area entered on the UNESCO World Heritage List. This demonstrates a large emphasis on the protection of monuments in spatial planning. An equally important issue is an indication that any regulations regarding communication in this area should be performed without damage to...
the historical urban layout of Krakow. In order to protect the cultural heritage and monuments, including archaeological sites and historical urban layout of the “Old Town” and the Planty Gardens, together with the Wawel Hill and its surroundings, which are the UNESCO World Cultural and Natural Heritage Site (1978), elements protected by the law in accordance with the requirements of separate provisions as well as elements protected by the local plan have been described in great detail.

The local land use plan repeatedly mentions the protection of historical monuments and provides detailed instructions for its implementation. It can therefore be concluded that, compared to the previously existing plans, it contains a broad spectrum of forms of protection of historical monuments, including the UNESCO Site. Among the principles regarding the protection and shaping of spatial order, as well as the principles of building development, there are regulations which can significantly affect the real estate management. This includes the obligation to protect the historical urban layout, where the main actions are protecting through conservation and restoration activities (there is no possibility of extension or reconstruction), a ban on the construction of underground car parks, or significant limitations regarding the works which are possible to be performed.

3.6. Real estate management in the Krakow city center

Real estate management is a tool for shaping the space in accordance with the settlements set out in the local development plans and planning permissions. It is a process involving a number of principles and activities of legal and surveying character, in order to ensure appropriate real estate management (HANUS, HYCNER, 2007). The concept of real estate management comprises numerous processes. Its basic tasks include (ACT, 1997):

- management of real estate owned by the State Treasury and by local government units,
- real estate subdivision,
- real estate consolidation,
- real estate pre-emption,
- expropriation and restitution of expropriated property,
- share of the costs of technical infrastructure utilities,
- property valuation
- professional activity involving real estate management.

The most popular legal and surveying process of real estate management is real estate subdivision. The real estate subdivision is often performed during investment process. It allows to adjust the shape and size of plots to the planned development. Subdivision of real property can be carried out if it is consistent with the settlements of the local development plan, or in the case of its absence, if it is not contrary to the separate provisions or if it is in compliance with the planning permission.

Regarding the real estate listed in the register of historical monuments, it is necessary to obtain a permission of the provincial conservator of monuments (ACT, 2003b). According to JAWORSKI (2013), the provincial conservator has the statutory authority to make the assessment of permissibility of real estate subdivision. It does not appear, however, that the real estate subdivision itself may have an impact on the historic values of the real property entered in the register of historical monuments. This subdivision, however, results in parceling out of separate plots of land which can be transferred as a separate property, and then separate real estates will be created. JAWORSKI (2013) adds:
“Proprietary fragmentation of a real estate may, however, affect the preservation of a uniform shape of the existing real estate entered in the register of monuments by distribution of statutory duties in this respect, as defined in (ACT, 2003b), upon all the owners of new real estates separated from the existing historical real estate. The requirement to obtain the permission of the provincial conservator of monuments shall therefore serve to restrict the fragmentation of historical real properties”.

To summarize the above discussion, it can be concluded that the settlements of the local development plan and the permission for real estate subdivision issued by the provincial conservator of monuments have a direct impact on the historical real estate subdivision. The subdivision may also be indirectly affected by other forms of protection of historical real properties affecting the number of investments, which translates into a number of subdivisions performed. Figure 19 below presents the timeline of major events that affect the protection of historical monuments and real estate management.

**Fig. 19.** The events affecting the protection of historical monuments in Krakow. *Source: BIEDA AND PęSKA*

It may be noticed that the solutions with the greatest legal force occurred in recent years, when the cultural park was established and the local development plan was prepared for the area of the Old Town.

In order to examine the impact of these events on the real estate management, a quantitative analysis of the real estate subdivision procedures carried out in the years 2008-2012 was performed. The object of the study were 39 cadastral districts located in the center of the City of Krakow. Figure 20 illustrates a division into cadastral districts against the orthophotomap background.
The analyzed cadastral districts were included in three cadastral units: City Center, Krowodrza and Podgórze. In order to mark on the drawings which cadastral district belonged to which cadastral unit, the district number had the suffix added, which was the first letter of the name of the given cadastral unit (Fig. 11 and Fig. 12). Cadastral district S1 is part of the UNESCO World Heritage Site, covering the area of the market square and the Wawel Hill. Stradom and Kazimierz are created by the cadastral districts identified as S3, S11, S12, S13, S14, S15 and S26.

Figure 21 shows the cartogram illustrating the number of the completed real estate subdivisions in individual years. In 2008, within the very center of Krakow, the number of subdivisions performed was significantly lower than in the peripheral areas of the study area. In most cadastral districts of the Old Town the number of subdivisions was fewer than 2. In 2009, a significant increase in the studied phenomenon is noticeable within the S1
district, covering the area of the market square and the Wawel Hill. The years 2010 and 2011 resulted in a slight decrease in the number of performed subdivisions, however, within the S1 it still remained at a level higher than in neighboring cadastral districts. A large interest in subdivisions in this particular district should not be surprising due to the high value of the real estate there and the location in the most prestigious area of Krakow. After the adoption of the local development plan in 2011, the number of subdivisions within the S1 district decreased.
There is a noticeable tendency of a far greater number of subdivisions performed in the areas outside the UNESCO World Heritage Site. The cadastral districts located farther from the center are characterized by a smaller number of historical monuments. In order to perform subdivision in this area it is not necessary to obtain a permission of the provincial conservator of monuments, which simplifies and accelerates the whole process. The cadastral districts characterized by a greater number of subdivisions made, have no applicable local development plans. It can therefore be concluded that the existing mechanisms, i.e. conservation protection in the form of the register of monuments, the establishment of the cultural park and, consequently, the adoption of the local development plan, are a consistent and effective method for the protection of the Historical Center of Krakow, inscribed as the UNESCO Site. This protection is manifested in fewer real estate subdivisions, as compared with the neighboring districts, which should be understood as taking care of the existing historical Urban Layout of the Old Town.

**Fig. 21.** The number of real estate subdivisions for individual cadastral districts in the years 2008-2012. *Source: BIEDA AND PĘSKA*

**Fig. 22.** The number of real estate subdivisions carried out for individual districts in the years 2008-2012. *Source: BIEDA AND PĘSKA*
The cartodiagram (Fig. 22) shows a downward trend for the cadastral district S1 in terms of the number of real estate subdivisions. For other districts of the City Center, this number is constant and is at the level of 0 to 2 subdivisions performed annually. Peripheral areas have a much higher number of recorded subdivisions, with a slowly increasing number of subdivisions performed, in particular, within the cadastral districts located in the south.

Real estate management is implemented through construction processes. In order to examine the impact of the inclusion of a given area as the UNESCO World Heritage Site on these processes, a number of maps for design purposes in the city center were analyzed. A map for design purposes is essential for the preparation of a construction project, and thus it commences the construction process. Figure 23 illustrates the number of maps prepared in respective cadastral districts during the study period. In subsequent years, there is a constant, high number of maps prepared for design purposes for the UNESCO Site. In contrast to the proceedings relating to real estate subdivision, which generally has a negative impact on the protection of historical monuments, a multitude of design documentation may indicate an attempt to maintain the monuments in the best possible condition. As stipulated in the resolution on the cultural park (RESOLUTION, 2010) and in the local development plan (LDP, 2011), significant restrictions on the extension in the Old Town area were introduced. It should therefore be concluded that the documentation was prepared to obtain a permission for conservation or restoration works in the existing buildings. Cadastral districts, located within the so-called 2nd administrative district of Old Town, are characterized by a much smaller number of maps for design purposes. This is because in these areas there are historical monuments which are not of as high ranking as those located within the S1 district, so there is no need to perform extensive conservation works there. At the same time, these are areas with strongly shaped urban form, which makes it impossible to carry out significant changes, or to implement new investments, which results in lower interest from investors, and thus fewer maps.
In the cadastral districts located on the edge of the study area, the number of maps is high and remains relatively constant. This demonstrates a continuous interest of investors in the areas located within walking distance from the city center. These are areas which are characterized by a less dense development than the very center of Krakow. New structures are being built here, new investments are being carried out. Figure 24 presents a cartodiagram illustrating trends in the changing number of maps for design purposes in individual cadastral districts.
In the district which is the cultural park and which is covered by the local development plan, the largest number of maps for design purposes was prepared before the adoption of these documents. In 2008, there were 80 maps for the S1 district, while in 2009 there were 51. This might reflect a reduction in the number of construction processes, which could adversely affect the structure of the Historical Center of Krakow. In the years 2010-2012, the number of prepared maps remained constant and fluctuated around 40 per year.

In total, the greatest number of maps were prepared for Krowodrza and Podgórze. It may be noted, however, that although more real estate subdivisions were performed in Podgórze, more maps for design purposes were prepared in Krowodrza. This follows from the relations between real estate management and construction processes. Real estate subdivisions are often activities preceding construction processes. In the study period, Krowodrza cadastral unit was already after the changes related to the structure of real properties, which was followed by a process of intensive construction development. Based on the high number of real estate subdivisions performed in the final years of the study period in Podgórze, it can be predicted that in the next few years there will be an increased demand for documentation for design purposes.

**Fig. 24.** The number of maps for design purposes for individual cadastral districts in the years 2008-2012. *Source: Bieda and Peska*
3.7. Conclusions

Protection of cultural heritage is an important task of spatial planning. In Krakow, the beginning of the twentieth century saw the first efforts to preserve historical monuments. The inclusion of new objects in the register of monuments, as well as records of protecting outstanding cultural and historic values of the city in the subsequent local development plans were the beginning of the formation of legal regulations for the protection of historical monuments. The most important event was the inclusion of the Historic Center of Krakow as the UNESCO World Heritage Site in 1978. This fact formally confirmed the worldwide unique cultural value of the City of Krakow. The area inscribed on the UNESCO List comprised the Old Town, including the Wawel Hill, the districts of Stradom and Kazimierz.

Poland has four forms of protection of historical monuments. The first one is the record of monuments comprising the majority of buildings located in the Historic Center of Krakow. The urban layout of the city of Krakow within the boundaries of the Planty Gardens (the decision of 1933), as well as the urban layout of the town of Kazimierz with Stradom (1934) were also included in this record due to their unique nature. Another way to preserve exceptional objects is recognizing them as monuments of history. The title was awarded to Krakow in 1994, recognizing Krakow as one of the leading arts and cultural complexes in Europe. The Old Town Cultural Park was established in Krakow in 2010, as one of the strongest forms of protection of its monuments. This resolution introduced specific regulations concerning the reconstruction of buildings, as well as bans and orders related to the process of shaping space. In the same year, a buffer zone for the UNESCO site was created, allowing for more effective protection of the Old Town panorama. The last form of protection is to implement a local development plan, which was executed in Krakow in 2011. The plan largely refers to the Krakow Historic Center, a UNESCO World Heritage Site, however, it does not cover the entire area. Stradom and Kazimierz districts still remain without a local development plan till this day.

The center of Krakow inscribed as the UNESCO World Heritage Site, and consequently, this area becoming subject to a number of legal regulations, had a significant impact on the real estate management in this area. Activities, such as real estate subdivision, require a compliance with the settlements of the local development plan, as well as obtaining a permission of conservation authorities. These restrictions affected the number of real estate subdivisions performed, as in the historic center of the city their number was significantly smaller than in the cadastral districts located outside the center. The reduction in the number of subdivisions, after the local development plan has entered into force, is particularly noticeable. It can therefore be concluded that the existing legal regulations promote the conservation of monuments, by reducing the fragmentation of the plots.

The existing provisions of law strictly determine the permissible extension or reconstruction of a given object, and therefore the construction process, starting with the preparation of maps for design purposes, should not be combined with the activities interfering with the historical structure of the city. The number of prepared maps for design purposes in recent years proves a great and constant interest in the conservation works performed in this UNESCO World Heritage Site.
4. SPATIAL DECISION SUPPORT SYSTEMS (SDSS) ON REAL ESTATE MARKET

Decision Support Systems (DSS) become more and more popular in many fields of science as well as in a variety of branches of economy. Such tools can be useful in optimizing various processes. So far they are used in many companies in private sector. This fact seems to be related with higher potential in private sector to apply innovative solutions. Development of DSS led to creation of SDSS which includes two- or even three-dimensional features of analyzed objects. Implementation of SDSS in the processes on real estate market (e.g. selecting optimal location) could efficiently help in making smart decisions.

In current research the authors tested utility of CommunityViz (one of SDSS) to analyze suitability of different properties according to decisions which are usually made in real estate management. The CommunityViz is one of GIS software. It is an extension of ArcGIS which is one of the most popular programs of that type. The study presents a connection between the program and real estate market which might become a valuable contribution to implement innovative GIS solutions in spatial planning and real estate management.

4.1. Spatial Decision Support Systems - areas of application and components

In more complex world we have to face more complex problems. For many years construction of those problems became more complicated both because of the factors which have an influence on our case as well as the variety options of possible solutions. The challenge of optimizing so many smaller elements led to closing them in mathematical formulas and calculating them. With the IT revolution those problems could be calculated also by machines. Computers gave also a new framework which allowed people to create tools, programs and applications to support decision making process. Nowadays they are widely used by the millions of users across the globe. They are called Decision Support Systems (DSS). There are various types of DSS in many fields of science (DE MEYER ET AL. 2013) as well as in different branches of economy (KISILEVICH ET AL. 2013). Research conducted in last years proved that they are developed usually in the fields which are domain of a private sector. This phenomenon seems to be correlated with higher potential in applying innovations in private sector rather than in public services and administration.

Improving DSS faced the problem of taking into consideration a third dimension. Some problems cannot be properly solved without analysis of spatial distribution of some objects. Additional information, like topology, area, distance, neighborhood, proximity, overlapping, buffering, etc., allow to analyze all elements which have to be presented on a map. Furthermore, the possibility of presenting all calculated results on a map helps the users to interpret the optimal solution. All those DSS which include two- or three-dimensional information established new group of Spatial Decision Support Systems (SDSS).

According to responsibility for spatial investments in most of economies SDSS are created from the point of view of public administration (ONG AND LEE 1996, WANG 2005). Local government as bureaucracy can be viewed as a group of policies. All those policies govern the activities of citizens. They can support calculating costs of technical and social infrastructure, evaluate management process of common goods, transportation problems, etc. (ARENZTE AND TIMMERMANS 2000, RAY 2007, COUTINHO-RODRIGUES ET AL. 2011, SANTOS ET AL. 2011, VERSTEGEN ET AL. 2012, GORSEVSKI ET AL. 2013, KIM ET AL. 2014). But still it is possible to find some solutions prepared also for commercial development area (KIM AND LEE...
The goal of implementing all those systems is to improve operational effectiveness and efficiency of plans, development programs and strategies.

A very important feature of SDSS is their simplicity. It is crucial in the matter of formulas which are used to calculate, the interface for a user who very often is not a specialist in programming, the intuitive visualization of results and the number of steps to follow. Building systems which do not meet those conditions may occur by not using them at all; as a result they are useless. Dutch experiences show that these obstacles are often the reasons for not using the SDSS (URAN AND JANSSEN 2003). They examined five different tools for coastal zone and water management. The results show that SDSS provide limited or no support for analyses and evaluation. One of the main obstacle is no or poor support for spatial evaluation, That is why the crucial point is to find a flexible software which would be users’ friendly.

According to the theory DSS have to deal with three basic elements: user, system and analyst. All new solutions that researchers develop right now are based on understanding the dynamics of DSS evolution at those elements. The adaptive development of DSS is based on loops between those aspects, cause each of them have an influence on the other. In the relation User-System user have to learn the framework to understand the method of computing the results. However, the user can have an impact on personalized use. The software of the system can be modified according to the user’s needs. In the relation User-Analyst occurs middle-out design which is based on prototype. Creating a model, conducting research, testing and building the final product – all of those steps have a background in working on a prototype. The user creates analysis according to his/her concept. The relationship is shown in the feedback. It is possible to implement all facilities which are necessary for a user. The last relation System-Analyst is based on evolution. Softwares and frameworks are constantly improved which allows to define new analysis. Sometimes they are based on similar calculations but they are less time-consuming which makes them quicker and finally more friendly for user as well as computers. From the other point of view the need of new analysis makes a pressure on evolution of system functions. Lack of tools or processes to implement calculations constantly gives the new challenges in systems improvement (ARNOTT 1998, CRANE 2005). All those mechanisms refer also to SDSS.

4.2. The use of decision support systems on real estate market

It was highlighted some years ago that there is a need to improve the communication between participants on real estate market. The Information and Communication Technologies (ICT) were used occasionally by big enterprises as well as by small firms. Already, one decade ago one of the most popular DSS were affordable ICT and universal Internet linkages that allow to get worldwide data about costs. But still there was a need to develop new solutions which could not only simply present quantified data about real estate cycles but also include spatial time-scope factors (KUMMEROW AND LUN 2005). However, the methodological framework for DSS for real estate market were known much earlier there was still lack of practical applications. Knowledge background described factors of that specific industry, designed goals and necessary functions to solve the problems of acquisition, improvement and divestment of real estate asset (TRIPPI 1989). The 21. century gave us many practical solutions in this field. At first DSS were used in monitoring and control of situation in real estate market. They helped in assessing trends in macro scale (Huang 2006). Naturally, the next step was to support general investment decisions (GIUDICE 2009). However,
research in that field proved that such a way of describing the topic is too wide. That opened further specializations for DSS on real estate market. One of possible feasibilities in narrowed range was to analyze the risk. In this specific topic we have to face the problem of very high level of uncertainty. That is why DSS in risk analysis should be based on smoothly progressive calculations rather than on sharp interpretation, like binary assessment (0 or 1). Because of that mechanisms became being based on fuzziness. Fuzzy real option seemed to be very efficient in evaluation of real estate projects (MAO AND Wu 2011).

Another use of DSS in real estate problems was examined in last years. Systems were used to solve the problems of different spatial structures. The cases were focused on land fragmentation, land consolidation and land reallocation. In that research geographic information systems (GIS) were integrated with artificial intelligence, genetic algorithms and multi-criteria decision methods (UYAN ET AL. 2013, DEMETRIOU 2014). In most of cases DSS are used to solve the problems with economical background, like prices or taxes. Studies about real estate behavior in response to tax vagaries proved that decreasing house prices do not influence in fall in property tax receipts (COZMEI ET AL. 2014). Such a knowledge is crucial for local government to create sustainable and solid perspectives for further development. Some research helps to understand better impact of spatial distribution of different elements on real estate value (ZOPPI ET AL. 2015). Such elements could be based on zoning plans, accessibility to open-spaces and leisure areas, density of housing area or distance of each apartment from the shoreline (Fig. 25).

Fig. 25. Real estate value factors. Source: Zoppi et al. 2015
Another feature taken into consideration in constructing decision support model was public transport. Further analysis allows to calibrate an impact of public transportation on property values by hedonic method (WANG ET. AL. 2015). Using DSS leads to better understanding of mechanisms on real estate market. Nowadays it becomes more and more popular to involve best practices and techniques as applications of corporate social responsibility. Opening DSS to different participants on real estate market could be assessed as such a social responsibility action by the real estate brokers (SARDINHA ET AL. 2011). It seems to be very helpful to find open databases, describe users’ needs and create simple and understandable model to involve DSS in improving transactions on real estate market.

4.3. Research and results

The goal of current research was to create a suitability model for a district of the city of Wroclaw. The case study was the Sepolno district. The concept of this neighborhood was based on garden-city and it was developed between 1919 and 1935. Data source was the Topographical Database (TBD) stored by Lower Silesian Marshall’s Office. The suitability model contains seven different categories of elements which can be helpful to choose the optimal location for the citizens. These categories of objects are: education, sport & recreation, green areas, public transport, churches, health care and shops & services. For each factor distance between those spatial elements and dwelling unit was calculated. All those factors are identified as stimulants. That is why shorter distance (higher score) is represented in green color and longer distance (lower score) is represented in red color (Fig. 26). To present each factor in uniform way they were marked violet.

The suitability model prepared in current research contains all stimulants described above and allows to calculate mean value of all those factors. There are six basic steps in the model, showed in the model (Fig. 27). First group is simple data from TBD represented on the diagram as sprockets. They are linked with other elements by yellow arrows which show that these are static connections. Under simple data there are dynamic attributes marked with blizzards. Dynamic attributes are calculated every time the user defines relocation of any element. Their spatial distribution can be modified which allows to include additional objects, e.g. new development planned in the neighborhood. The third group of elements in the diagram are weights shown as bulbs with question marks. Formulas applied in the model enable to add different weight for each element as assumption. That is why the computed results can be personalized according to needs of a user. The fourth group are indicators (circles with green triangles) which calculate proportional weights for each stimulant. The fifth element is a hub of all calculations marked also with a symbol of dynamic element – blizzard. Raw Suitability Score takes into consideration values from those both branches. Dynamic attributes with the distances to specific objects together with their proportional weights allow to create a ranking of points of all residential buildings. The most suitable object gets 100 points and the less suitable one gets 0 points. The rest of the objects are assessed proportionally to their basic values in ranking. The normalization process was added to make the results more visible for users in case the basic values are to similar. However, it has to be underlined that because of normalization process residential dwelling units with 0 points cannot be defined as not suitable at all. It means that from all of objects it is the less suitable according to defined factors’ weights.
The suitability model prepared in current research was used during consultations with three different surveyed subjects. Each of them had to define personalized weights for analyzed seven elements. The weights can be set in the range from 0 to 10. By defining those values every person created his own scenario. Each scenario present different demographical group to show variety needs of possible customers on the real estate market.
Fig. 27. Structure of suitability model. Source: KAZAK AND SZEWRAŃSKI
4.3.1. **Scenario 1**

The first surveyed person is a single, aged 24. He studies at a university outside this neighborhood. He does not have a car so his basic needs in transportation are provided by public transport. Weights of factors defined by the polled are presented in the table (Table 7). Automatically the model calculated relations between different residential dwelling units and present them on the map (Fig. 28).

**Table 7. Weight of factors defined in scenario 1**

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>0</td>
</tr>
<tr>
<td>Sport &amp; recreation</td>
<td>5</td>
</tr>
<tr>
<td>Green area</td>
<td>7</td>
</tr>
<tr>
<td>Public transport</td>
<td>10</td>
</tr>
<tr>
<td>Churches</td>
<td>2</td>
</tr>
<tr>
<td>Health care</td>
<td>2</td>
</tr>
<tr>
<td>Shops &amp; service</td>
<td>6</td>
</tr>
</tbody>
</table>

*Source: KAZAK AND SZEWRAŃSKI*

According to those weights calculations in the suitability model showed that the most suitable part of this district for the person is located in the northern part. The less suitable are the houses located in the central part of the neighborhood.
4.3.2. Scenario 2
The second surveyed subject is a married couple aged 34 and 37. Both of them work outside the neighborhood. However, one of them has a full-time job and goes there by car while the second person has a part-time job and uses public transport. They have three children. Two of them go to kindergarten and one goes to primary school. Weights of factors defined by them are presented in the table (Table 8). The results for houses suitability calculations are presented on the map (Fig. 29).

Table 8. Weight of factors defined in scenario 2

<table>
<thead>
<tr>
<th>FACOTRS</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>10</td>
</tr>
<tr>
<td>Sport &amp; recreation</td>
<td>6</td>
</tr>
<tr>
<td>Green area</td>
<td>5</td>
</tr>
<tr>
<td>Public transport</td>
<td>2</td>
</tr>
<tr>
<td>Churches</td>
<td>6</td>
</tr>
<tr>
<td>Health care</td>
<td>4</td>
</tr>
<tr>
<td>Shops &amp; service</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: KAZAK AND SZEWRAŃSKI*

The analysis showed that the most suitable part of this district for this couple is located in central and northern part. The less suitable are dwelling units located in the south-eastern part of the neighborhood.
4.3.3. **Scenario 3**
The third polled person is a retired 73 years old lady. She does not have a car. Despite being retired she is active. Bigger part of the year she goes by bus to cultivate a community garden. At least once a day she goes for a walk in the neighborhood. Weights of elements defined by her are presented in the table (Table 9). The results for suitability calculations of residential buildings are presented on the map (Fig. 30).

**Table 9. Weight of factors defined in scenario 3**

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>0</td>
</tr>
<tr>
<td>Sport &amp; recreation</td>
<td>0</td>
</tr>
<tr>
<td>Green area</td>
<td>6</td>
</tr>
<tr>
<td>Public transport</td>
<td>8</td>
</tr>
<tr>
<td>Churches</td>
<td>9</td>
</tr>
<tr>
<td>Health care</td>
<td>7</td>
</tr>
<tr>
<td>Shops &amp; service</td>
<td>5</td>
</tr>
</tbody>
</table>

*Source: KAZAK AND SZEWRAŃSKI*

The calculations showed that the most suitable houses in this area for this person are located in the eastern part. The less suitable are residences located in the western part of the neighborhood.
4.4. Conclusions

Making decisions about choosing one object from thousands of them is a difficult issue for human perception. Renting a flat or buying a house are relatively unique situations for an ordinary person. It is estimated that in Poland average citizens changes their home every 15 years while in US it is at the level of 5 years. That proves that people are not used to comparing many real estates. Moreover, very often their decisions are based on emotions rather than on facts. It is not bad according to features like the esthetic aspects, atmosphere of the neighborhood, etc. But it may be seen as a problem when it comes to pressure that is made on the potential buyer. Usually it is a time pressure which comes from the fact that the real estate enjoys a considerable interest. Such conditions are not optimal to make so important and expensive decisions as buying a flat or a house. That is why it seems to be very important to support this process with new solutions developed in recent years. Already, people used to work and analyze many spatial information with a use of GIS, even if they did not notice that. Nowadays many citizens of EU changed traditional mobile phones to multi-functional devices like smartphones. Most of applications for smartphones use spatial data collected both in static (addresses of shops, offices, etc.) and dynamic way (location of a bus or other user). Year by year, people are more fluent in using spatial information and it is easier for them to interpret maps and spatial analysis. That fact is promising and allows to assume that implementation of spatial decision support system on real estate market is possible and such tool could be used before deciding about transactions.

The model created in SDSS in current research for Sepolno district in the city of Wroclaw proved that according to accessible data it is possible to use such a system in Poland. Changes which were made in recent years according to implementation of INSPIRE directive made databases more open which allows to use new solutions in decision making process. In the case of Sepolno the scenarios showed that the most suitable place to live for a young person (after university studies) is the northern part of the neighborhood. The most optimal location for a couple in their mid-thirties with children is the central part of Sepolno. According to priorities defined by a retired lady the best location would be in the eastern part of the study area. It has to be highlighted that the system creates a ranking which is standardized. That is why it can not be assumed that residential dwelling units with fewer points are not suitable at all. It can be only said that according to defined weights of analyzed factors some houses are more or less suitable than the others. We could get different results with different ranges of spatial data. Bigger area used in case study could show us which districts in general are more optimal according to our needs. Results got from smaller case study area have to be interpret in slightly different way. In case we want to move into a specific part of the city each building would be relatively better from the others.

More complex world has to face the problem of redundancy of data. Nowadays we are in the era of big and available databases, data-mining analysis and numerous branches of economy which need clear answers for their questions. Those trends create new fields for practical applications of existing tools as well as development of new solutions. SDSS used in current research enabled to create a model to support probable decision making process on real estate market. The results of this research proved the simplicity of users’ interface as well as intuitive presentation of the calculations. Those features give the possibility of development of simple interactive applications which could work on different IT devices. However, it is clear that current issue may not be so popular to be used by everyone. However, user’s friendly interface, simple calculations and existing applications on
regular devices could result in popularization of that tool for potential buyers or real estate brokers. The question for further research is the possibility of combining presented mechanism of dwelling units assessment with real offers on a market. That could effectively support the decision making process on real estate market. Current research is the contribution for further discussion in that topic.
5. SPATIAL ANALYSIS OF REAL ESTATE MARKET STRUCTURAL SIMILARITIES ON THE EXAMPLE OF POLISH CITIES CASE STUDY

Real estate markets play an increasingly important role in highly developed and developing countries. The real estate market development, its condition and potential depends on many social, economic or spatial factors etc. Investors no longer regard real estate markets as sources of safe and passive capital income. Rapid economic growth and the search for new investment opportunities have turned the real estate market into a highly competitive arena where various players carry out diverse investment strategies. The growing significance of the real estate market prompts investors to search for factors and variables which support cohesive analyses of real estate markets and market comparisons based on diverse criteria.

Although recent year have witnessed the growing popularity of various support systems, comprehensive and effective information systems that facilitate real estate management and analyses continue to be in short supply. The above results from the specific character of real estate management operations which involve complex procedures and decisions, as well as the unique character of real estate data. Those factors prevent smooth flow of information which is required for the implementation of rational decisions and actions in business, investment, financial and promotional projects. This study presents a methodology for developing real estate market structural similarities with the use of spatial analysis. The elaboration uses the utilities of rough set theory assumption and GIS tools. The main aim of this chapter is to create solutions for the development of decision support subsystem in the real estate market.

5.1. Similarities of real property markets as a research problem

The need to have a place to live is one of the basic human needs. Man experiences many varied needs related primarily to aspects of existence and activity, which include inborn needs (basic ones) and acquired needs (higher needs) (Smyczek, Sowa 2005). Satisfying these needs takes place according to a natural sequence. Satisfaction of needs may be put in order, according to Maslow's theory, in line with importance criteria (Kotler and Oth, 1993):

- Physiological needs (hunger, thirst, shelter, sleep);
- Safety needs (safety, care, order, stability);
- Social needs (feeling of affiliation and love);
- Need of recognition and respect (prestige, accomplishments, social position);
- Self-fulfilment needs (spiritual life, putting ideas into practice).

According to such ranking, the need of shelter is on the first and foremost place. At the same time, it is necessary to emphasize that broad and varied needs which may be fulfilled by real property, remain in inseparable relation to expectations and needs determined with respect to the space surrounding us. Real property is a part of the system that, in general, can be called a real property market. The necessity of determining structural and spatial similarities of real property markets results from various needs related to the sphere of becoming acquainted with and analysing market mechanisms. They refer to the needs resulting from the legal aspect related to evaluation of real property, the scientific and cognitive aspect related to establishment of theories and premises for determining similarities, the consulting aspect with respect to performance of various types of calculations and analyses related to location of an investment, and also to the context of analysis of economic,
social and environmental risks. This gives rise to a broad scope of utility of analyses of this type, related to manners and procedures of designating similarities of real property markets and real properties as such.

The study of Bełej and Kulesza (2013) contains a discussion devoted to this subject matter; it was indicated there that determination of similarities of markets of local real properties may rely on identification of their diagnostic features and, subsequently, on ascertaining the degree of compliance among such features. For example, it is possible to assume a set of attributes characterizing the demand for real property (including demographic data, level of unemployment, level of profitability, birth rate, etc.) or existing supply (including area of market, share of urbanized areas, number of developer investments, etc.). At the same time, the authors show that the degree of integration of individual regional markets changes only slightly in the course of time. Therefore, it is possible to put forward a thesis on dependence of local real property markets, portrayed as a system of interconnected vessels (Bełej and Kulesza, 2014).

Housing markets have multiple interactions with the rest of the economy. The drivers of house prices include income, the housing stock, demography, credit availability, interest rates. That’s why the housing market is defined as one where housing services are allocated by the mechanism of supply and demand (Bełej and Cellmer, 2007).

Similarity of real property markets may therefore be defined as a similarity expressed with the use of specific features, which are mutually comparable, preferably in a longer time period. The real property market is influenced by various types of phenomena, factors and situations which may be, in general, assigned to the following criteria: economic, social, political, technical, spatial and behavioural. However, when performing an analysis of markets with the use of quantity methods, we encounter problems related to the manner of expressing and coding, in a numeric manner, of certain variables along with their homogeneity and availability. Selection and adjustment of the analytical method to the specific nature of phenomenon subject to analysis also poses a significant problem.

The study includes a methodology for determining similarities of residential property markets, taking into account the premises of decision making theories, including their structure and impact of endogenous and exogenous factors. The study was prepared as a result of implementation of research project No. UMO-2014/13/B/HS4/00171 financed from the funds of the National Science Centre.

5.2. Material and methods

Determination of similarities between real property markets was prepared in the form of a procedure aimed at obtaining a significant element supporting decision making on the market (Figure 31). Decision making process relies on analysis of available information for a given problem and, in effect, selection of a specific direction for further activities. The efficiency of decision making is mainly influenced by collection and access to proper quantity and quality of information regarding endogenous and exogenous factors of the object of analyses and use of tools supporting the decision making process, dedicated specially to the analysed phenomenon.

The presented methodology was prepared in the form of modules of a system supporting the decision making process. The objective of decision theory (Stoner and Wankel, 1994) is provision of accurate information, on which decisions can be based. For this purpose, mathematical and statistical methods are used in order to forecast changes in the en-
environment, to conduct multi-variant analyses of various activities and to subsequently evaluate them.

As a rule, we are dealing with absence of complete information, especially in the context of real property management and real property market; decisions are made in conditions of significant insecurity. Therefore, it is important that the entire decision-making process is conducted in a manner decreasing the degree of insecurity and the risk of potential losses. This may be achieved by increased access to information and simulation of various decision-making variants (RENIGIER, 2013). In the analytical part of the study, similarities of markets were made with the use of methods based on the rough set theory and GIS tools within forming a part of the ArcGis programme. Selection of the method based on the rough set theory is dictated by its possibilities, which takes into account the specific nature of information referring to the real property market. This theory is used to examine imprecision, generality and insecurity in the process of data analysis (PAWLAK, 1982, 1991), occurring commonly on the real property market.

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**Fig. 31** Model of decision-making support system concern real estate markets similarities

*Source: RENIGIER-BIZOZOR AND BIZOZOR*
The proposed method constitutes a good theoretical basis for solving problems related to intelligent decision-making systems. It focuses on providing databases with indispensable formulas, rules and information. Rough sets are used as a methodology in the process of discovering knowledge in databases, which is usually an iterative and interactive process (with numerous decisions undertaken by the user [Soldacki, 2001; Muraszkiwicz, 2004], forming a specific platform for efficient conclusions [Deja, 2000; Komorowski i in., 1999; Mrózek and Płonka, 1999; Polkowski and Skowron, 1998a; Polkowski i Skowron 1998b; Pawlak, 1997; Słowiński, 1992; Renigier-Biłożor 2005 and 2007, d’Amato 2004 and 2006]).


5.3. Results and discussion

The presented Figure 31 assumes initial definition of the objective of analyses, along with spatial and structural range of study. With respect to the real property market, it is necessary to determine the segment and its type, narrowing down the area of analysis to the utility function of the type of real property, for the purpose of making the scope of data, as well as classification categories, uniform. Within the scope of the study, analysis of similarities of real property markets with residential function in province cities was performed, along with classification taking into account utility typology, including spatial scope. The objective of the scope determined in this manner is specification of structural and spatial similarity of markets, taking into account all regions in Poland assuming that province cities constitute the most important space of impact onto other regions and the best point of reference – representation of their region, also on account of more complete access to data. The subsequent module (II) assumes preparation of a database, taking into account quality and quantity classification of analysed real property markets. With this objective in mind, a set of factors and information impacting diversification of real property markets was analysed. When performing analysis of literature items, including Irwin et al. (1993), Jaffee and Sirmans (1989), Bryx and Matkowski (2001), Ball and Wood (1999), Case (2000, Forys (2012), along with own studies of authors Renigier-Biłożor et al. (2014), a general outline of factors and information reflecting the condition of the real property market (Table 10) was made. Division of information in module II is supposed to take into account macro-, meso- and micro-scale of economy, along with a division into endo- and exogenous factors.

The range of factors was divided into four sub-categories: technical and spatial, social, economic, political and behavioural. These are the most common factors which directly or indirectly impact the residential real property market. Another step was verification of availability and uniformity of data in available information sources. The next module in the presented decision making layout assumes collection of a database and its preparation in the form of a decision-making table. The study contains 30 attributes, which are going to be used for classification of similarities of real property markets.
### Table 10. Information base of the residential real estate market

<table>
<thead>
<tr>
<th>Technical and spatial factors</th>
<th>Social factors</th>
<th>Economic factors</th>
<th>Political and behavioral factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new dwellings</td>
<td>Unemployment rate</td>
<td>Price of real estate</td>
<td>Market trends</td>
</tr>
<tr>
<td>Supply of real estate</td>
<td>Net migration</td>
<td>Real estate mainte-</td>
<td>Settlement traditions</td>
</tr>
<tr>
<td>Spatial reach of market</td>
<td>Population on a given market</td>
<td>nance costs</td>
<td></td>
</tr>
<tr>
<td>Planning reports, e.g.</td>
<td>Population growth</td>
<td>Average salary</td>
<td>Prestige associated with home</td>
</tr>
<tr>
<td>availability of local zoning</td>
<td>Fulfillment of basic needs, including home ownership</td>
<td>Mortgage availability</td>
<td>ownership</td>
</tr>
<tr>
<td>plans</td>
<td>Programs that stimulate demand for real estate, e.g. subsidized housing, subsidies for residential renewable energy</td>
<td>Development prospects and new investments</td>
<td>Individual motivations driving market demand</td>
</tr>
<tr>
<td>Attractive location, e.g.</td>
<td>Public utilities: universities, hospitals, public administration, etc.</td>
<td>Purchasing power on the real estate market</td>
<td>Satisfaction with local government</td>
</tr>
<tr>
<td>proximity of forests, parks, water bodies</td>
<td>Number of real estate agencies and construction firms</td>
<td>Mortgage availability</td>
<td>Local government's support for new investments and projects</td>
</tr>
<tr>
<td>Arduous neighborhood: major roads, railway lines, industrial plants, etc.</td>
<td>Job market and job creation</td>
<td>Price of fuel (affects urban sprawl)</td>
<td>Global economic outlook (credit ratings, demand for high-risk investments)</td>
</tr>
<tr>
<td>Availability of vacant land</td>
<td>Internal and external market communication</td>
<td>Real estate revenues in the municipal budget</td>
<td>The ratings and classifications of urban space, eg.</td>
</tr>
<tr>
<td>Land use structure</td>
<td>Other...</td>
<td>Ratio of average replacement value of 1m² to average market value of 1m²</td>
<td>The quality of life, creditworthiness</td>
</tr>
<tr>
<td>Access to real estate –</td>
<td></td>
<td>Prices of construction materials</td>
<td>City's significance in the region</td>
</tr>
<tr>
<td>condition of roads, airports, railway lines, planned construction projects, e.g. ring roads.</td>
<td></td>
<td>Prices of energy carriers, including electricity, gas, coal, etc.</td>
<td>Public mood</td>
</tr>
<tr>
<td>The technical state of the property.</td>
<td></td>
<td>Local authorities' revenues and spending on housing policy</td>
<td>Other....</td>
</tr>
<tr>
<td>Condition of real estate.</td>
<td></td>
<td>Real estate tax and fees</td>
<td></td>
</tr>
<tr>
<td>Comparison of new and old property. Comparison of property on the primary and secondary real estate market.</td>
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**Source:** Renigier-Bilozor and Bilozor on the basis of Renigier-Bilozor and Oth. (2014)

In the study, data for 16 province cities was taken into account of 2012 and prepared in the form of a decision-making table (Table 11 and 12). Data was divided into two groups of information, which characterize and influence the residential property markets, i.e. social and economic (exogenous) (Table 11) and market (endogenous) (Table 12 a and b). Information was prepared in the form of indices and constitutes a sample proposal for a set of data indispensable for use within the scope of description of residential investment market. Such data is of informative nature and is “open”, which means that its selection depends on the type and the segment of the market, as well as the economic situation.
### Table 11. Economic indicators

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<th>City</th>
<th>area in ha</th>
<th>number of residents</th>
<th>rating of Fitchrating agency</th>
<th>quality of life</th>
<th>number of deaths (older than 50)</th>
<th>age structure of potential clients (25-45 population group vs. total population in a given area)</th>
<th>number of new registered businesses per 1000 residents</th>
<th>population density per m²</th>
<th>average salary on the local market</th>
<th>local government’s spending on promotion</th>
<th>unem employment rate</th>
<th>number of marriages</th>
<th>number of divorces</th>
<th>net migration rate</th>
<th>population growth</th>
<th>local government’s spending per 1 resident in recent years</th>
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Source: RENIGIER-BIŁOZOR and BIŁOZOR based on Central Statistical Office, National Bank of Poland, SARFIN, AMRON.
### Table 12a. Economic indicators

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<tr>
<th>City</th>
<th>local government’s spending on housing policy in zł</th>
<th>total number of issued construction permits</th>
<th>number of issued construction permits</th>
<th>number of property offers per 1000 residents</th>
<th>number of property transactions per 1000 residents</th>
<th>changes in local property prices</th>
<th>ratio of replacement value per 1 m² of property</th>
<th>average time on the market in months</th>
<th>number of property offers</th>
<th>number of real estate agents on the local market</th>
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<th>availability of mortgages in terms of m²</th>
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*Source: RENIGIER-BILOZOR and BILOZOR* based on Central Statistical Office, National Bank of Poland, SARFIN, AMRON.
Table 12b. Market indicators

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<th>value of property transaction per 1 resident on the local market</th>
<th>affordability of rental housing in m²</th>
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<th>existing residential area per 1 resident</th>
<th>number of residents per 1 existing apartment</th>
<th>number of new apartments per 1000 residents</th>
<th>the average quoted price on the local real estate market</th>
<th>the average transaction price on the local real estate market</th>
<th>number of property offers</th>
<th>rental price of housing per m² in zł</th>
<th>land covered by zoning plans in ha</th>
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</table>

Source: RENIGIER-BILOZOR AND BILOZOR based on Central Statistical Office, National Bank of Poland, SARFIN, AMRON.
The above-listed factors constitute indispensable information which presents the present-day reality on the real property market, whose scope may be arbitrarily extended or narrowed down, depending on the size of the market subject to analysis (e.g. large, small), type and segment of the real property market and objective of analysis. The presented information constitutes a certain database, but it often does not constitute factors which can be easily quantified and accepted for analyses as a database subject to analytical modelling. Data pertaining to social and economic information which influences the real property market was used for analysis, along with a set of data strictly portraying the residential property market. An assumption was also adopted that economic factors constitute exogenous information having direct impact on the market, whereas market factors constitute endogenous information directly related to the object of analyses.

Another step was making the initial data uniform and adjusting it to the object of analyses. With this purpose in mind, unification of “raw” data was performed, referring to a given area of local market, by transforming it into indices expressed in the form of units per inhabitants, units of space, average pay of local inhabitant or average price of real property. Transformed data is presented in Tables 13 and 14a, b.
Table 13. Unified economic indicators

<table>
<thead>
<tr>
<th>City</th>
<th>local government's spending per 1 resident in recent years</th>
<th>difference between the national average salary and the average salary on the local market</th>
<th>local government's spending on promotion</th>
<th>population density per m²</th>
<th>rating of Fitchr agency</th>
<th>number of marriages per 1000 residents</th>
<th>number of deaths (older than 50) per 1000 residents</th>
<th>number of divorces per 1000 residents</th>
<th>net migration rate per 1000 residents</th>
<th>population growth per 1000 residents</th>
<th>age structure of potential clients (25-45 population group vs. total population in a given area) per 1000 res.</th>
<th>unemployment rate</th>
<th>quality of life</th>
<th>number of new registered businesses per 100 residents</th>
</tr>
</thead>
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<td>0,75</td>
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<td>312,70</td>
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<td>382,00</td>
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<td>35,00</td>
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Source: Reniger-Bilozor AND Bilozor
### Table 14a. Unified market indicators

<table>
<thead>
<tr>
<th>City</th>
<th>average purchasing power in comparison with the national average</th>
<th>local government’s spending on housing policy per capita in zł</th>
<th>total number of issued construction permits per 1000 residents</th>
<th>number of issued construction permits per 1000 residents</th>
<th>number of property offers per 1000 residents</th>
<th>number of property transactions per 1000 residents</th>
<th>purchasing power on the local housing market</th>
<th>changes in local property prices</th>
<th>ratio of replacement value of 1 m² of property and the average transaction price on the local real estate market</th>
<th>ratio of replacement value per 1 m² of property to the average price quoted on the local real estate market</th>
<th>average time on the market in months</th>
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*Source: Reniger-Biłozer and Biłozer*
### Table 14b. Unified market indicators

<table>
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<tr>
<th>City</th>
<th>number of real estate agents on the local market per 1000 residents</th>
<th>number of developers on the local market per 1000 m² area</th>
<th>availability of mortgages in terms of m² per 1000 residents</th>
<th>value of property transaction per 1 resident on the local market</th>
<th>affordability of rental housing in m² per 1000 residents</th>
<th>difference between the average prices of new and second-hand property per 1 resident</th>
<th>existing residential area per 1 existing apartment</th>
<th>number of residents per 1 existing apartment</th>
<th>number of new apartments per 1000 residents</th>
<th>percent of land covered by zoning</th>
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Source: RENIGIER-BILOZOR AND BILOZOR
The following analytical procedure based on the rough set theory was used:

- Development of a decision table – determination of the attributes domains
  Determination of decision rules – Every object \( u \in U \) in decision table \( TD = (U,C,(d),V,f) \) can be written in the form of a conditional segment (if... then...), and it can be regarded as a decision rule. In decision table \( TD \), the decision rule comprises functions \( g : C \cup D \rightarrow V \) if \( x \in U \) provides for \( g = f_x \). The restriction of \( g \) to \( C \) (\( g |C \)) and \( g \) to \( D \) (\( g |D \)) is referred to as the conditions and decisions of decision rule \( g \), respectively.

- A "valued tolerance relation" (Stefanowski and Tsoukias 2000) is applied to conditional attributes, and the following matrix is created:

\[
R_j(x,y) = \frac{\max\{0,\min(c_j(x),c_j(y))\} + k - \max(c_j(x),c_j(y))}{k}
\]

(1)

where: \( R_j(x,y) \) - relationship between two sets with membership function [0,1] 
\( c_j(x),c_j(y) \) - variable of the analyzed real estate market 
\( k \) - coefficient adopted as standard deviation for a given real estate market attribute,

- the results produced by the valued tolerance relation matrix of conditional attributes were summed up, and the sum matrix (table 15 and 16) was determined based on the below formula:

\[
R(x,p) = \max\left\{ \sum_{j=1}^{n} R_j(x,p) \right\}
\]

(2)

- Preliminary degrees of indiscernibility were determined at a given level of similarity for sets in decision subgroups based on the following equation:

\[
IND_{TD}(B,d) = \{(x,y) \in U \times U : (x,y) \in IND_{SI}(B) \lor f(x,d) = f(y,d)\}
\]

(3)

On this stage, modification of original assumptions of the rough set theory was performed, due to significant variety of the object of analyses. In effect, classes of indiscernibility were determined, taking into account four levels of similarity: I – minimum (0-25%), II – average (26%-50%), III – average high (51%-75%), IV – very high (76%-100%).

Subsequently, on the basis of the above-listed results of similarity, a spatial structure of real property market was developed, similar with respect to the economic and social situation (so-called exogenous) and market situation (so-called endogenous). For this purpose, Gis tools and maps of similarities with the use of cartographic methods were used (Fig.32). It is necessary to emphasize that this is an analysis relying on determination of rough similarity (fuzzy similarity), so called bi-polar similarity. This means that results of analysis of similarity level of a specific object do not have to be analogous and do not show any feedback. For example, the Gdańsk market may be most similar, in its structure, to the Kraków market, but the Kraków market does not have to show greatest similarity to the Gdańsk market, etc.
Table 15. Unified market indicators

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Source: Reniger-Biłozor and Biłozor
## Table 16. Sum matrix for market indicators

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</tbody>
</table>

*Source: Reniger-Bilozor and Bilozor*
| Gdańsk  |   |   | IV | IV | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Olsztyn | II | II | IV | IV | II | II | II | II | III | II | II | II | II | II | II | II | II | II | II | II | II | II | II | III | II | II |
| Szczecin| I | I | II | II | II | II | IV | IV | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I |
| Bydgoszcz| II | II | III | II | II | II | IV | IV | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Białystok| II | II | III | II | II | II | IV | IV | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Poznań  | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Warszawa| II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Łódź     | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Wrocław | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Lublin   | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Kraków  | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Rzeszów | II | II | III | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Zielona Góra | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Kielce   | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Katowice | II | II | I | I | I | I | I | I | IV | IV | I | I | II | II | II | II | II | II | II | II | II | II | II | II | II | II |
| Opole    | II | II | III | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II | II |

**Table 17.** Results of real estate markets similarities  
*Source: Reniger-Biľozor and Biľozor*
For the purpose of verifying and determining the scope of similarity of the real property market space, analysis was performed with the use of GIS tools (ArcGIS programme); analysis of diagram maps was also used. Analysis was performed with division into economic and social zone and market zone, in order to determine existence or lack of correlation between these two analysed zones of functioning of selected cities. On the basis of spatial analysis, a similarity matrix was developed (Table 17). The marks in the table comply with the symbols on the map.

**Fig. 32** Maps of similarities for economic and market situation of the cities

**Gdańsk**

![Map of Gdańsk](image1)

**Olsztyn**

![Map of Olsztyn](image2)
Zielona Góra

Kielce

Katowice
According to the conducted analyses, there is a discrepancy between the economic and the market zone in individual major cities in Poland. This is interesting due to the fact that majority of scientific studies and common sense suggest close correlation and relation between strictly economic data and market factors. At the same time, it is clear that the majority of similar markets are on the level of 25-50%. According to the conducted analysis, Gdańsk shows greatest economic similarity on the level of 25-50% to such cities as: Olsztyn, Szczecin, Białystok, Poznań, Warszawa, Wrocław, Lublin, Kraków, Zielona Góra, Kielce, Katowice, Opole.

5.4. Conclusions

The concept of similarity among real property markets derives from a problem which has been of interest to analysts searching for similar real properties. It is known from theory and practice that two identical real properties do not exist – even more two real property markets. The problem that appears here consists in finding the manner of comparing similarities of real property markets, as well as the degree of the level on which two facilities are considered similar. Analyses related to real property market are the object of complex studies resulting mainly from their huge internal heterogeneity, locality and problems with access to reliable and uniform information.
The real estate market is a very complex system which often results in the low efficiency and practical verifiability of analysis results, including popularly applied statistical tools. The starting point for improving effectiveness and efficiency of valuating real estate on the real estate market is the application of appropriate research methods and procedures which take into consideration the distinctiveness of the market. Valuation should also not be generalized to suit all markets, including the capital market. Many determinants contribute to the distinctiveness of this market which is influenced by, among others, the following factors:

- significant variations in the quantity of available information, subject to the type of the analyzed market (region),
- complex methods of data description (differences in the scale of attribute description) – the same attribute can be described in a variety of ways using different evaluation scales,
- significant differences between real estates (no two real estates are identical),
- various criteria for using real estate (every real estate can be used and managed in a variety of ways),
- lack of comprehensive information (due to the lack of homogenous systems for gathering real estate data which results in limited and incomplete knowledge about real estate and market prices),
- inaccurate and "fuzzy" character of real estate data (caused by stochastic factors which reflect random processes that escape the generally acknowledged cause-and-effect market relationship),
- absence of homogenous functional dependencies between real estate attributes, decision-making strategies represented by the value, function and method of real estate management.

According to the conducted analyses, studying the similarity of real property markets is needed and prognosticates well with respect to theory and practice. In particular, determination of the degree of similarity along with separation of similar areas may have significance for determining the degree and the possibility of changing the direction and the development potential of real property markets. This also enables initial selection of real property markets e.g. for evaluation of unique real properties.
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