# CURRENT PROBLEMS OF VALUATION
# AND REAL ESTATE MANAGEMENT BY VALUE

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**2014, Zagreb, Croatia**

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# INTRODUCTION

Real estate management consists in making decisions and performing actions to maintain a real estate property in an unimpaired condition according to its designation and at reasonable investment in this real property. These activities cover diverse aspects of real estate acquisition and use and are oriented, among others, towards increasing the capital of real estate owners. Value-based management is both a management philosophy and a practice requiring full coordination of all actions carried out in this complex process. It should be noted that a special role is played in the process by real estate appraisal, whose methodology has a centuries-old history. It is rooted in discussions devoted to the category of value and the principles of its measurement. It turns out that historically-formed appraisal methodologies do not stand the test of time. They undergo continuous evolution, with the trends of changes of both an exogenous and endogenous character. Moreover, there are many unsolved problems related to real estate value determination, which can be an inspiration for both theoreticians and practitioners to seek new solutions, taking into account both proper market imitation and the requirements of real estate owners and users.

The appropriate real estate property appraisal method is selected by a real estate appraiser, taking into account, among others, the purpose of the appraisal, the type, function and location of the real estate property, its condition and the available market information. The profit method is used in many cases for real estate appraisal, especially for untypical real estate properties, which are rarely the object of transactions in the market. To illustrate the problems which occur during the application of this method, the study presents two examples of appraisals, which concern a gas station and a real estate property developed with a building in which a hotel and a restaurant operate.

The process of value-based real estate management should take into account the specificity of the real estate property related to its function, its utility or intangible values. The thesis can be proposed that efficient real estate property management, especially for a historic real estate property, requires the knowledge of the market value expressed as a value range. This requires the indication of such a method for historic real estate value determination which takes into account both the strengths and weaknesses resulting from the possession and use of this specific national treasure because it is economically necessary today to treat a historic building also as an object of investment and a business venture. This approach will help to save cultural and historical values and may allow a satisfactory rate of return on the capital invested to be obtained by the investor. The theoretical analyses presented in this study were verified based on a palace and castle complex currently in use and under development. The residual method was first applied to determine the value and a sensitivity analysis of the development project was then performed. At the same time, the advantages and threats were indicated which could result from the application of the residual method and sensitivity analysis, both for the determined real estate property value and for financially efficient real estate property management based on the determined value.

Appraisal of the market value of commercial real-estates is most commonly performed based on the relation between the income obtained from the real estate and its market value. Building a model which includes the largest possible amount of factors affecting the real estate value is a difficult and very complex task. The final verification of the statistical model does not take place at the time of its development or testing but as a result of the comparison of the prognoses' results with actual transactions made after the implementation of the model.

The most difficult moment in the creation of a model is to establish the number of significant independent variables that are being used. An insufficient number of variables makes an adequate description of the occurrence impossible, whereas an excessive number of variables decreases the credibility of the model and makes it "too sensitive".

In this study, the "dominant variable" is defined and its impact on the local commercial real estate market is shown. The study also has a practical dimension, since the results of the research apply to the deliberations concerning the "Recommendation J" and may also provide a

comprehensive source of information for the local authorities and national government by showing the results of planning decisions in a simple and clear manner.

Real estate value determination requires the acquisition of a proper store of information, including spatial and market information. Because of the intensive real estate market development in Poland, the issue has emerged of the availability of this information and software which allows its proper processing. Information systems intended for real estate appraisers, realtors, real estate managers or banks are currently functioning. With the development of this software, GIS functionality has become a part of this system. Spatial information systems allow many advanced spatial analyses to be performed, which are necessary, among others, in the real estate value determination process. This study presents and compares the functionality of selected existing spatial information systems. Their basic functions and the preferences of their users are presented as an analysis result, which can contribute to further development of systems supporting both real estate appraisal and management.

The real estate market is extremely complex, which makes it difficult to develop an objective method of price and value modeling or evaluation of the effect of individual attributes on their formation. Statistical methods and models allowing the analysis of regularities concerning relationships in time and space can be extremely useful in this case. One of the methods, which may find broad application for real estate market analysis, is discriminatory analysis, which enables the selection of attributes for market division into relatively homogeneous groups. The experimental application of discriminatory and classification methods which is presented in this paper allows, among others, the verification of the correct selection of a real estate using a database of real estate properties similar to the one being appraised. The advantage of the method is the possibility of verification and classification, at the selected probability level, of every real estate property into a precisely-defined group.

Contemporary problems of appraisal and value-based real estate management should be considered in a broad international context, especially in today's world, in which the mobility of entities and capital is less and less limited by political, economic or administrative barriers.

**Editor**
**Radosław Cellmer**

# 1. VALUATION AND MANAGEMENT OF REAL ESTATE IN INTERNATIONAL CONTEXT

## 1.1. New trends in real estate valuation.  International perspective

The valuation methodology has a history which is centuries long. It is rooted in discussions devoted to the category of value and principles of its measurement. Even A. Smith, in the "The Wealth of Nations", when describing how market operated, showed that markets could not operate effectively without accurate valuation. The lack of a credibly determined value of real estate makes it impossible to develop mortgage loans, blocking access of capital to the real estate market (MILLER, MARKOSYAN 2003). The literature on the subject reveals how the concept of valuation was born over the centuries (cf. i.a. MILLER, MARKOSYAN 2003, KUCHARSKA-STASIAK 2006).

The "economic core" was subjected to the influence of local solutions, which constituted the result of the merging of theory and practice of valuation. Undoubtedly, the local customs, including social, cultural and psychological constraints, had a significant impact on the final shape of valuation. The varied transparency of this market, manifested in the deficit of information in many of its type and space elements has significant influence on the local valuation methodologies. In consequence, a mosaic of diverse domestic valuation methodologies was created. Comparing domestic methodologies, one may observe shared features, but also ones which make them very different. The source of common features are the economic valuation framework and the radiation of the three valuation concepts distinctly formed in the world (three valuation schools) on solutions adopted in other countries: the American, the British, and the German school. The source of differences are most certainly the different institutional market framework, including both the legal framework (different forms of possession, different tax systems), economic standards (different cycles of the economy), social (diversified level of satisfaction of basic needs in the area of real estate), as well as conventions according to which the society is organised (e.g. duration of and method of concluding tenancy agreements[1]). The shape of the valuation methodology is particularly affected by the availability of data from the real estate market. The historically formed valuation methodologies, however, cannot survive the test of time. They have evolved and they continue to do so.

**Motivation to undertake the deliberations**

The valuation concept strongly evolved: from informal oral traditions, passed on among those who dealt with determining the value, to more formal practice, then to the written word and establishment of professional associations, professional training, and finally – valuation of real estate becoming a formal scientific discipline (Vandell  2007).

It seems that in modern times two main sources of change of the valuation concept may be distinguished, constituting at the same time the manifestation of the emerging tendencies in the real estate valuation:

- changes of exogenous nature, caused by the influence of institutions which shape the valuation area, such as: International Valuation Standards Council  and TEGoVa, responsible for the shape of the real estate valuation. These organisations have been striving for over thirty years to develop common valuation principles[2]. These efforts have not been successful. The organisations abandoned the standardisation of the code of conduct and valuation methodology, leaving the definition standards and standards of the document from the

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[1]  The conclusion of the lease agreement or the tenancy agreement with the rent review clause is characteristic for British conditions. It is the custom in the British market to determine at the time of conclusion of the agreement the rates of rent which in the second half of the agreement are determined at a higher level ("rents always up" rule).

[2] Under the International and European Valuation Standards, four groups of standards could be distinguished: valuer's conduct standards), including the standard determining the cod of professional ethics, valuation process standards definitional standards) and a standard devoted to valuation methodology (technical standards). Standards issued until 2005 resembled a mix of standards and an academic textbook. Cf. Ch. Thorn. 2007. Valuation Standards and the New Red Book. The Valuation Journal 2007, no 2(3).

valuation process as the area of operation. However, even in the area of definition standards, the interpretation of the market value category has not been made uniform (GRZESIK, ŻRÓBEK 2012),

- changes of endogenous nature, including:
  - influence of valuation theoreticians originating mainly from the academic circles, improving the valuation approaches, methods and techniques,
  - influence of economy and behavioural finance on the perception of the valuation methodology – the group of valuation methodologists has been joined by psychologists, economists and behavioural financiers, trying to answer a question whether the fully formed valuation model, the so-called normative model, matches the reality. This is because it has been noted that valuation practitioners did not respect this model. An attempt has been made at answering a question in what direction should this model therefore evolve.

The emerging tendencies are of significant theoretical but also practical dimension. In the face of the occurring changes, a question therefore arises about the future shape of valuation.

**Purpose of development and research methods applied**

The purpose of the paper is the attempt to capture changes taking place in the valuation methodology: changes referred to here as exogenous changes, as well as changes of endogenous nature, taking place in the valuation methodology under the influence of valuation theoreticians and valuation practitioners. Endogenous changes are caused mainly by the appearance of new financial products as well as inclusion of behavioural elements in order to explain the impact of behaviour of property valuers on their resolving of problems in the valuation process. Against the background of the ongoing changes, an attempt will be made at discussing the future of valuation.

In the paper, the method of analysis of the literature on the subject will be used. In order to reveal the need to include behavioural aspects in the valuation of real property, results of a questionnaire survey among property valuers will be cited. The analysis of the literature on the subject and the research conducted will constitute the basis for defining directions of evolution of the valuation model.

### 1.1.1. Historically formed valuation concepts

**Diverse valuation basis**

The foundations of the currently dominating valuation concept were laid in the USA. The literature on the subject distinguishes four fundamental stages in the development of real property valuation as an academic discipline (MILLER, MARKOSYAN 2003):

- the period of three approaches, falling on the years 1900-1940, during which the valuation concept was based on relatively simple calculations. During this period, first academic curricula on real estate valuation were published, and they influenced the emergence of the valuation concept in other countries. At that time, first valuation manuals were written, and the real estate valuation was accepted as an academic specialty in the USA. The notion of best (optimum) use appeared in the interpretation of the market value. The clash of views concerning, among other things, the deriving of F capitalisation rates. F. Babcock, the author of the first American publication on valuation was the supporter of the breakdown of the capitalisation rate into the part referring to income from land and the part referring to income from buildings[3]. This concept has been rejected by methodologists.

  Many representatives of this period emphasised that the income approach should be preferred in valuation, and that the selection of the approach is determined by the objective of the valuation and the availability of market data. The leading representatives of this period

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[3] This concept is in force in the German school to this day.

believed that it was inappropriate to apply three approaches to determine the value of the given property without taking account of its features and availability of market data.

- the period of theory improvement, lasting from 1950 to mid-1960s, when the basic definitions were improved, as were the valuation methods. The concept of value as the most probable price was developed, which means, firstly, that in the valuation process the property valuer predicted the price at which the property could be sold, secondly that all predictions had an element of uncertainty. Capitalisation rates were distinguished for stable and growing income. One of the representatives of this period, R. Ratcliff, explained why it was inappropriate to divide the capitalisation rate into the rate connected with income from land and the rate connected with income from buildings – the capitalisation rate reflects risk for the entire investment, and it is identical for the entire property. That is why net income generated by the real estate should be capitalised with one rate of return. In the 1960s, together with the development of the investment portfolio theory and observance of values of a property as a component of this portfolio, arguments have been put forward for accepting the fact that rates of return in the real estate market remain directly connected with rates of return in the capital market.
- the period of new methods and techniques, from mid 1960s to the beginning of the 1980s. During this period, the discounted income technique was promoted, the concept of simple capitalisation was rejected, the capitalisation theory was improved, and the electronic calculators were more and more widely in use. The most probable use was proposed as the replacement for the optimum use.
- the period starting in the second half of 1980s and lasting until today. This is the period of computers and the Internet, facilitating communications and access to market data, as well as development of automated valuation models (MILLER, MARKOSYAN 2003). It was noticed that these methods will play an important role in valuations in the residential property market.

The United Kingdom and Germany are strong centres where the valuation thought developed. In consequence, considerably different trends in real estate valuation clash on the international scene, and among them the influence of three schools may be clearly noticed: the American school, the British school and the German school[4]. The comparison of valuation principles adopted in individual countries rarely constitutes the subject of scientific investigations. It seems to stem from the fact that these comparisons require thorough knowledge of assumptions made, interpretations, and thus also the knowledge of the market functioning culture, including the principles of tenancy and lease, tax regulations, or area measurement principles. However, the globalisation of markets forced such research (NOVELLI, PROCTER 1992; VOGEL 1994).

**Comparison of three valuation concepts**

The common feature of the three trends in valuation was the reference to three approaches: comparative approach, income approach, and cost approach[5]. The use of these approaches requires the adoption of various assumptions, depending on the purpose of the valuation: market data when the objective of the valuation is the objectivisation of behaviours of the market participants, data originating from the owner, where the purpose is to search for an individual value referred to as the investment value. In valuation methodologies – besides common features – significant differences exist. It is worth pointing out several differences existing in the valuation methodology in classic assumptions of those schools[6]. One of the differences is the number of approaches used in the valuation of the given real estate. In the American school each valuation required the application of three approaches simultaneously, in the German school – two, and in the British school – one approach.

The schools analysed attach different meanings to various approaches in the process of determination of value. In the United Kingdom, the cost approach is applied to the valuation of

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[4] We may talk about a school where its valuation concept is adopted as a good model in other states.
[5] The British do not use the term approach but valuation methodology.
[6] The comparison of the valuation schools by a persons from outside the areas analysed is extremely difficult, that is why the catalogue of differences presented is an original one.

real estate which rarely constitutes the subject of trading in the market and for which no market value may be established. In the USA, this approach has a supportive role, and in German – it is a priority one.

The schools also differ by the sources of origin of valuation data and their disclosure in the valuation document. In the American school and in the British school the sources of data are similar. These are market evidence but also results of informal research. Both schools believe that each datum from the market, justified appropriately, may accepted as a market datum. The notion of market data is broader than the notion of market evidence. In Germany, on the basis of data or market evidence gathered from notarised deeds, the data are published in an aggregated form. The differences exist in the method of disclosing data in valuation documents. In the American school, property valuers fully disclose details of sale of comparable real estate, adopted for valuation of the given property. In the British school, the valuers do not disclose data because details in real estate transactions do not constitute public property in the United Kingdom. In Germany, the details of individual transactions are covered by the Information Protection Act, property valuers only provide aggregate data.

It is worth noting the different interpretation of market value. Despite certain differences in nomenclature, the interpretation in the United Kingdom and in the USA was deemed the same (NOVELLI, PROCTER 1992). However, in the German methodology the function of the market value is played by the so-called current market value (Verkehrswert), calculated as the average price, which significantly changes the concept of value the purpose of which is the objectivisation of the market. The characteristic feature of German methodology is seeking long-term value, reflecting long-term market tendencies, both in the construction market and in the real estate market (Beleihungswert).

An important feature of the American school is searching for value with the assumption of the optimal use (highest and best use). This principle, introduced into the valuation methodology already in 1903, is well understood and accepted in the American market. In the United Kingdom, mainly two types of value have been recommended: free market value with the existing use, and the free market value with an alternative use[7]. The first type of value is applied in the case of valuation of real estate as assets, the second one allows for alternative uses and possibility of redevelopment, with the assumption of compliance with law with regard to spatial planning. In the United Kingdom, in the interpretation of market value, a significant role is played by the "hope value" principle which allows the estimation of market value without meeting the conditions of compliance with the local area development plan.

Differences in the valuation methodology become apparent in individual schools, in particular in the methodology of the income approach. This constitutes the consequence of adoption of different principles of reproducing changes taking place in the market. The American school, in which an assumption on the volatility of the market is always adopted, should be considered the most market-oriented school. This is why property valuers in the United States rarely reach for the simple capitalisation technique, universally applying the discounted income technique. The variable income is adopted not just during the period of forecast, when extrapolating the previous trends they assume also its variability after the forecast period, which is reflected in the method of determining the residual value[8]. The source of variable income is not just the property itself but also changes taking place in the market. In the British school, the market constitutes the background, its volatility does not affect the amount of income, but the risk of generating the income in the future, adopted at the market level on the valuation date. In the German school, market is static. In the valuation methodology, only the simple capitalisation technique is adopted, whereas there is no discounted income technique. This technique is used at the stage of evaluation of the economic effectiveness of the

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[7] 9 types of value functioned in the United Kingdom. Cf. The Mallinson Report, Key Findings, RICS, April 1995. Supplement: Commercial Property Valuations.

[8] In the American school, there calculation of the residual value is conducted in two stages. In order to reflect the volatility of the market, property valuers adopt different levels of the discount rate and the capitalisation rate. In the British school it is assumed that after the forecast period income has stabilised at a level of income from the previous year, which means that the capitalisation rate and the discount rate are equal. Cf. N.Novelli and A.Prokter, Real Estate Valuation..., op. cit.. 251.

investment in the real estate. The difference in the application of the income approach in the German School is apparent particularly at the stage of determining the income generated by the property – it is broken down into income allocated to land and to the building. Only income allocated to the building is subject to capitalisation. its value is increased by the value of land. The subject of the valuation in this school is not so much the right to generate income from the real estate, but the economic sustainability of generating this income, which is manifested in the capitalisation of the income for the assumed further economic use period. In the American and in the British school, the rights to generate income are the subject of valuation in the American school and the British school. In the valuation of ownership, this right is unlimited by time.

The difference between valuation methodologies is also apparent at the stage of application of the comparative approach and the cost approach. In the American school, in the comparative approach, 3 to 5 similar properties which have recently been the subject of a transaction in the given market, are adopted, in the British school it is a rule that only one, most similar property which has recently been sold, constitutes the basis for comparisons. In the German school, several properties constitute the basis for comparisons. In this school, similar as in the income approach, the value of land and the value of developments are separated. The application of the cost approach leads to the determination of the market value in the American school and in the German school, in the "old" British school it lead to the determination of the replacement value.

These diverse valuation concepts have been adopted as good models for the development of national valuation principles in other states. For example, British valuation principles, published in the form of RICS standards (Red Book), have been approved by the Commonwealth countries, and can still be seen in former colonies, such as e.g. Hong Kong, Singapore, India, Australia, New Zealand. The valuation principles in force in the USA have been adopted for example in Canada[9] and in Japan. Many countries have showed interest in the German concept of long-term value (bank-mortgage value), understood as the technique of risk analysis by the creditor.

Several valuation schools functioning in practice resulted in different assumptions being made, which led to reaching varied levels of property value. Valuation documents were incomprehensible for a buyer coming from a state with different valuation principles. On the other hand, it turned out that standards, even such model ones as the "Red Book", published by RICS, may turn out to be inappropriate for users in other states even on the same continent. The cultural differences, differences in national legal regulations, the level of economic development and the level of real estate market development, as well as in the access to market data constitute the source of problems. It is not surprising that aspirations for standardising the valuation principles of international reach.

### 1.1.2. Property valuation change tendencies

**Changes of exogenous nature – aspiration for standardising the valuation methodology**
The maturation phase of valuation – according to VANDELL (2007) – has been characterized by integration occurring both across applications, geographic and societal boundaries, associated with the integration going on within the world order itself, with economic, political, technological, and legal dimensions. At the same time, the rate at which this integration is proceeding is becoming increasingly rapid, driven by the forces of globalization and technological and institutional advancement (VANDELL 2007). The requirement for this integration is standardisation of principles of valuation not only at the continent level but on the world scale.

The previous approach to valuation has been referred to as the "mom and pop" balkanized approach (VANDELL 2007). The effect of the aspiration for standardising valuation principles at the level of one continent was the publication of the European Valuation Standards, referred to as the "Blue Book" by TEGoVA in 1981. However, it turned out very quickly that standards allowing for the needs and requirements of countries from different continents were needed,

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[9] Canada initially copied the British valuation concept, however it gave in to the American concept, cf. Vandell, 2007

developed in such a way that they could constitute a reference point for users all over the world (EDGE 2001). The first International Valuation Standards, prepared by the International Asset Valuation Standard Committee (TIAVSC), were published in 1985. They were supposed to facilitate cross-border transactions and contributed to increased activity of international real estate markets by promoting the reliability of valuations performed for the purpose of securing debt claims, to transfer ownership and for decisions in tax matters (MILLIGRIM 2001). By assumption, those standards were to affect the shape of regional and national standards. Their purpose was for common valuation principles to be adopted and promoted. It was apparent in the aspirations of both organisations:  the International Asset Valuation Standard Committee (IVSC, as the successor of TIAVSC) and TEGoVA within the area of adoption of the same definitions and interpretations of value, agreeing principles and procedures for carrying out valuations. By assumption, these standards did not contain the full discussion of all knowledge about valuation approaches and practice but only valuation methodology framework. This is because it was believed that the interpretation of the use of the valuation methodology should be the literature on the subject, as well as specialist training courses conducted as part of life-long learning (MSW 2007).

Undoubtedly, the aspirations for standardizing the valuation principles have escalated together with the progressing globalisation, accompanied by the increase in the foreign investors' share in domestic real estate markets and development of global real estate advisory firms. The achievement of this goal required presentation of valuation methodology framework, but first and foremost definitions and interpretations of basic categories important in the valuation process.

Although globalisation did not constitute the original reason for standardising the valuation principles, it rapidly accelerated this process. The impact of globalisation on standardisation of valuation principles was apparent in the role allocated to International Valuation Standards. Their task was to:
- facilitate cross-border transactions and contribute to increasing the activity of international real estate markets by promoting the reliability of valuations conducted for the purpose of securing the creditor's debt claims, transfer of ownership right, as well as rulings in court cases and tax matters,
- contribute to the acceptance and application of common valuation principles, which is in the interest of the community of property valuers who can provide services to foreign investors and operate in international markets (MSW 2007).

An additional, new phenomenon which has strengthened the endeavour to standardise has been the collapse of large business entities. This is because a concern has arisen that a property valuer's work may be considered the main reason behind this occurrence.

Strong tendencies to standardise valuation principles manifested themselves at the beginning of 1980s and in the 1990s. They were expressed in the establishment of European Valuation Standards and International Valuation Standards. All of the valuation schools mentioned influenced the development of international valuation standards. The aspiration for standardisation of valuation principles was very strongly justified. It seems that reasons behind this aspiration are not getting any weaker, on the contrary – they are intensifying and they will continue to do so, because:
- both in the issuing prospectuses and in annual financial statements stock exchange companies must – regardless of the country of origin – disclose the value of real estate in accordance with International Accounting Standards,
- investors operating in spatially different real estate markets must have the possibility of comparing the effectiveness of material investments. The assessment of effectiveness requires having common real estate valuation principles, regardless of their location,
- the development of indirect forms of investing in the real estate market, consisting in purchasing shares, certificates and other securities issued on the basis of real estate requires uniform, transparent real estate valuation principles,

- although the real estate valuation is an opinion about its value, this opinion should be as objective as possible in the eyes of an investor who compares this direction of investing against other opportunities in the investment markets,
- because many bank loans are secured on real estate, one valuation basis should be used for the comparison of the financial stability of banks.

International and European Valuation Standards definitely contributed to the promotion of common definition and interpretation of market value, based on the principle of most beneficial use, and to the rejection of the replacement value[10]. In the opinion of many methodologists, experience and professional dialogue between nations, conducted via the International Valuation Standards Council, caused the existence of a global universally binding agreement concerning fundamental valuation principles (Adair et al. 1996). It was noticed, however, that there were local problems in domestic markets, influencing the valuation process (Mackmin 1999). There are differences in understanding the valuation concept, which has an impact on the value level. Local customs and valuation practice enhance these differences even further.

Unfortunately, both organisations withdrew from striving to standardise the valuation methodology. This is because it was deemed that IVS had become a mixture of principles, they resembled a dictionary and a textbook (Thorn 2007). A large group of influential oservers stated that – compared to accountants' standards – they do not look like a set of standards. That is why the IVS Council decided to focus on definition standards and process standards. It was agreed that two remaining types of standards – standards of conduct and technical standards were to remain outside the arrangements contained in the IVS, because:
- despite the fact that the standards of conduct constitute an essential element of the valuation services, the establishment of ethical rules of conduct is delegated by the Council to institutions operating in individual countries (professional organisations or authorities granting professional qualifications). The IVS Council is not a professional institution, it does not have any legislative powers,
- the Council believes that imposing valuation principles on individual countries could be treated by them as a threat, it would restrict the development of the valuation methodology which should be free, so that it is perfected in response to market evolutions and newly established valuation concepts (THORN 2007).

The exclusion of valuation methodology from the IVS is strongly supported by the British property valuers, because methodologies are dynamic, they change according to needs, fashion, demand and analytical techniques. Some believe that methodology should only constitute an element of manuals, and the set of tools has a practical form regulated in national standards, others that it should be an integral part of national standards (NUBEREIT  2008).

Undoubtedly, the withdrawal from valuation of methodology as part of the IVS is increasingly influenced by the awareness that there is an insurmountable, diverse, so-called institutional dimension of the market barring the way to its standardisation, composed of: substantive law, codes of conduct, professional organisations, social attitudes, tradition and practice.

The institutional dimension of the market has a significant impact on the adoption and acceptance of valuation principles at the national level, and thus also on the valuation process and the level of value. It may greatly restrict the freedom of interpenetration and adaptation of international real estate valuation principles.

**Changes of endogenous nature**

Changes of endogenous nature are equated with processes taking place in domestic real estate markets. Their source is in the influence of domestic professional organisations, creation of new valuation concepts in the academic circles, innovations introduced by practitioners, constituting a departure from the established valuation model.

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[10] This is because it was assumed that the definition of replacement value is not a definition of value as an economic category, it indicates the valuation method. A definition should not refer to methodology.

### The valuation concept is subject to constant evolution

Concepts contained in traditional valuation schools are subject to evolution. This evolution is apparent both in the definition and interpretation of the market value, withdrawal from the replacement value (IVS 2005) as well as creation of new valuation methods and techniques in the academic circles. For example, market value was initially defined in the American School as the highest price. In 1953, the "highest price" was replaced by the term "most probable market price", the most rational use has been replaced with the "most probable use". In the valuation practice in the USA, the departure from the three approaches in the valuation of a given real estate in favour of two approaches is apparent (RATTERMANN 2009). The British, not without resistance, abandoned the replacement value – the cost approach, similar as in the American school, leads to the determination of the market value. At the same time, they accepted – besides the "hope value" principle, the developed and well-understood in the USA - concept of the "highest & best use"

Regardless of those changes, the valuation methodologists perceived biases in the reasoning, made in the valuation practice, which caused a significant decline in the stature of the appraisal profession to that of journeymen (VANDELL 2007). Vandell's historic look at the development of the valuation methodology revealed that in the opinion of many appraisal methodologists most practicing property appraisers had an insufficient awareness of models they were using. These models are used mechanically. Corrections in the comparative approach are also dome in a mechanical way. Property valuers have been accused of paying insufficient attention to the inclusion of contemporary market data, which would increase the precision of value appraisal. The reasoning biases were manifested particularly strongly in the case of valuations for savings and loan institutions – appraisers overstated the values of real estate, valuing projects as if sold and occupied, and "kiting" appraisals by way of using unsubstantiated or non-arms-length transactions as comparables for appraisals in subsequent sales. The collapse of the savings and loan funds resulted in the response of the government which forced changes in valuation standards. The possibility using statistical methods and econometric models in the analysis of factors affecting value was indicated in the academic circles (VANDELL 2007).

### Impact of economics and behavioural finance on the perception of the valuation model

The complexity of the valuation process, its importance for buyers seeking the value of real estate, caused the valuation to be presented as a defined process, determining the property appraiser's conduct pattern. In many countries, a valuation model with several stages was developed.

This normative valuation model resembles a cook book. However, as DIAZ and HANSZ aptly emphasise, appraisers, just like chefs, usually do not approach valuation as a strictly systematised process (DIAZ, HANSZ 2002). A doubt arose in the Appraisal Institute – to what degree the use of the normative valuation model was compliant with the actual tasks, whether the model analysed well the forces affecting the value and how exactly it interprets actions and motivations of market participants (DIAZ, HANSZ 2002). The attention was directed at the appraiser's behaviour in the valuation process. It turned out that such behaviours differ from the normative valuation model, depend on the context in which the valuation process takes place. This context may be access to data from the market, time pressure, volatility of the environment, level of uncertainty, social context (e.g. confiscation of property). Similarly as transaction participants, the property valuer encounters serious situational restrictions (e.g. time pressure), he also has to cope with the cognitive restrictions of the mind. In consequence, opinions are formulated on the basis of fragmentary data, information is processed in a heuristic manner. The achievements of economic psychology were reached for as a result of the awareness of such behaviours, as it had numerous studies concerning the processing of information by people and heuristic behaviour at its disposal. In accordance with the definition stated in the psychological dictionary, heuristics means the "...rule of conduct which helps solve a specific class of tasks. Due to the generality and lack of precision of the formulation, its application to a specific task does not guarantee achieving the desired effect" (SZEWCZYK 1985). Heuristics is based on the

intuitive evaluation of the reality, allows the bypassing of a complex process of analysis and estimation of probability that the given value will be achieved.

In accordance with the problem solving theory, behaviour constitutes the function of two main components: work environment and the human data processing system. The work environment is an external environment in which the property valuer operates (DIAZ, HANSZ 2002). It covers market data necessary to conduct the valuation. These may be incomplete and inaccurate. It also covers feedback in the form of transaction prices of real estate valued earlier, but also the influence of the client on the value. The external information is subject to processing. The human data processing system includes two elements: short-term memory and long-term memory. Information originating from the environment is filtered by the short-term memory. Its storage capacity and the processing ability are limited, therefore it acts as the information filter. Here, the problem should be understood and solved in reality. Because the capacity is limited, only between four to nine pieces of information are stored, these are processed serially, which reduces the speed of their processing. Long-term memory, also referred to as the semantic memory, has unlimited storage capacity. It is composed of recognition memory and association structures. Unfortunately, the recognition memory system is slow and laborious. The association memory works faster, establishing intelligent shortcuts to semantic information and association connections. The continuously changing circumstances, the overload of information and high requirements placed before market participants cause the adaptation of human mind to new conditions. The limited capacity and processing ability of the short-term memory causes people to unconsciously develop cognitive shortcuts or establishing simplified rules in order to solve complex problems.

Psychologists have defined several types of heuristics, often used in resolving problems, such as: representativeness, availability, anchoring and adjustment (KAHNEMAN 2012). Heuristic of representativeness is often used to estimate the probability of an event in the given sample. During the appraisal of value, the size of the sample is often not taken into account. Conclusions concerning the entire population are drawn on the basis of a sample which is too small and not representative. It turns out that our intuition is completely at variance with the rules of the probability account (ZALEŚKIEWICZ 2011). An example of use of heuristic of representativeness leading to a cognitive bias is the faith in continuation of a given trend, e.g. increase in real estate prices (ZALEŚKIEWICZ 2011). The heuristic of availability reveals that people draw conclusions based on the ease with which they are capable of reconstruct past events. This means that information which is much less important but clearer will impact the assessment of a situation stronger than information which is more important but less clear. The use of this heuristic causes a collapse at a stock exchange or drops in prices in real estate markets remain in the memory for a long time, stopping investors from going back to investing. In the estimation of risk, the most significant role is played by the level of anxiety – i.e. a psychological factor, a much less important role – by the variability of the rate of return, which constitutes a good proof for the use of the availability heuristic (ZALEŚKIEWICZ 2011). The use of this heuristic is characteristic not only for laymen, but also for experts. The anchoring and adjustment heuristic reveals that people estimate on the basis of initial values. These initial values may be the result of the formulation of the problem or preliminary calculations. The effect of anchoring appears, as a result of which different initial values imply different estimated values. The use of heuristics, i.e. shortcut data processing, may constitute a source of not necessarily optimum decisions. Their authors optimise their decisions within the scope of information available to them. The decision-making is characterised by limited rationality. It is based on intuitive processing of information.

Heuristics is ever-present at the problem solving stage, also for problems appearing in the real estate market. It is believed that the real estate market is susceptible more than other markets to the influence of non-economic factors, including social, cultural and psychological ones. The deficit information in that market has a significant impact. Traditional economic theories fail. The behaviour of participants may be explained by referring to economics and behavioural finance.

Two psychologists (G. Nortcraft i M.Neal) noticed the presence of heuristics in the valuation process. They conducted an experiment in the property appraisers' community (ZALEŚKIEWICZ 2011). The authors of the experiment divided respondents into two groups. Their task was to conduct a valuation of a house. Each of the participants of the experiment received a catalogue describing the property and information about the price which the owner expected to obtain. In the first group the price stated was higher than in the second one. Only 8% of appraisers admitted that they took the price stated by the owner into account, 92% assured that they only followed information about the property. The results of the experiment did not confirm the above numbers. However, they confirmed the strong dependence on the price stated by the owner: in the first group in which the price provided by the owner was higher, the estimated values were higher. The differences between specialists' appraisals exceeded 10,000 dollars. The experiment proves that the appraiser may fail to go through the entire normative valuation process, e.g. will conduct a simplified market analysis, may fail to notice the changes taking in the given spatial or generic market segment, will not conduct the analysis of the most beneficial method of use of the property. Evidence has been found that appraisers have a higher tendency to attach higher importance to information received recently, which means that they are also subject to availability heuristic.

Focusing on behaviour directs the attention to psychological constraints of the decisions made, which helps better explain the processes taking place in the market in which the participants do not always follow rationality of behaviour. The participants' behaviours are psychologically motivated. This, in turn, forces one to think about the justification of purely cognitive situations and the possibility of learning about the objective reality. It was noticed in the trend of behavioural research devoted to valuation that:

- in valuation practice, normative valuation models are often abandoned. This means that appraisers do not act in a rational way. The influence of personality traits on decision-making in the valuation process was noted in research, e.g. through subjective perception of features of the property important for market participants,
- appraisers often select comparable sales in a simplified way. Experienced appraisers have a tendency to consider a smaller quantity of data for comparison than novices, they focus on key attributes only, such as the location, which may lead to erroneous estimates (DIAZ, HANSZ 2002),
- appraisers have a tendency of being affected by simplified patterns of thinking called heuristics. Most of the studies on behavioural aspects of valuation have been devoted to anchoring and adjustment heuristics. The presence of these heuristics has been confirmed among other things by Gallimore's research (1994). This means that the appraisers which – due to their profession – should adopt the conduct of an independent expert, made the anchoring bias. It works as an unconditioned reflex and even specialist knowledge does not protect against it. Such heuristics as representativeness and availability are less recognised (DIAZ, HANSZ 2002). Being subject to heuristics proves bias in the valuation process,
- there is proof for the existence of feedback – clients may choose appraisers who succumb to their suggestions, exert pressure on them. In response, appraisers may be ready to change the final result of the appraisal, adjusting it to the expectations. They may be aware of the unethical behaviour, but they do this in order to survive in the market. In the literature, results of research are quoted which indicate that 41% of entities surveyed adjusted the level of value at the client's request (DIAZ, HANSZ 2002).

The examples of behavioural conduct quoted in the literature on the subject encouraged us to conduct our own research. A questionnaire survey was used. The survey was conducted in March 2014. The questionnaire consisted of 28 questions. Their goal was to detect the anchoring and adjustment heuristic, as well as availability heuristic, and pressure of the environment on the result of the appraisal (KUCHARSKA-STASIAK 2014).

The questionnaires have been addressed to professional associations, including property valuers operating in the following provinces: Łódź (32.9% of respondents), Silesia (30%), Kujawy-Pomorze (20%). The rest of the valuers operated in the Świętorzyskie (14.2%) and Wielkopolska (2.9%) provinces. 76 questionnaires were sent back. The majority of respondents

were men. 75% of respondents had technical degrees, around 19.5% - economic degrees, the remaining respondents had law degrees. Most of them were property valuers with long-term experience: over 80% of survey participants had more than 8 years of service, over 60% - 12 years and more, less than 10% have been working in this profession for up to 3 years, the same proportion in the 4-7 years brackets. The evidence of the valuers' experience is also the number of valuation surveys conducted annually: 84.5% of the respondents performed over 30 valuations per year.

The answers obtained, similarly as the results of literature surveys cited, reveal behavioural aspects in the valuation of real estate. The respondents are clearly subject to anchoring and adjustment heuristic:

- Over 70% of appraisers were in the situation in which they knew the negotiated transaction price when performing a valuation for the purpose of sale; 36.5% of them disclosed that knowing the price affected the market data adopted, 59.6%, that it affected the value,
- Possibly the earlier estimated value of the property which was subject to repeated valuation also proved to be an anchor: for 66.2% of respondents the previous result of the appraisal affected the estimated level of value. Among them, over 65% of respondents believed that they were often influenced by the previous level of value, 18.4% - always, 16.3% - seldom. For 81.6% of respondents, the previous result of the appraisal has less impact in a market with a growing number of transactions, growing prices and rents, for 65.3% of the respondents, this impact is lower in a waning market.

This survey did not confirm that appraisers were influenced by opinions about values provided by other valuers, when an appraiser operates in a known environment: as many as 58% gave a negative answer. The fact that as many as 42% gave a positive answer proves that the heuristic exists, but is not widespread. This conclusion is also confirmed by the question concerning the frequency of occurrence of this phenomenon: as many as 70% of those who stated that the opinions of other valuers influenced the level of the estimated value claimed that this phenomenon was rare. The susceptibility to opinions of other valuers proved to be much greater when the valuer operated in a market unknown to him: over 66% of the respondents admitted to "anchoring" to the opinions of others. Among them, 63.2% claimed that they did it frequently, and 16.3% - that they did it always.

That the appraisers are affected by the availability heuristic is also supported by answers which reveal that the level of value is affected by the order in which information is obtained from the market: this was confirmed by as many as 33.2% of respondents. Among those who said yes, 44% claimed that the order of data obtained always affected the level of the estimated value, the same number of respondents admitted that they were often influenced by the order of information.

The answers given by respondents provide evidence to the existence of the availability heuristic: appraisers prefer information which confirms the previous expectations and hypotheses: 66.2% of the respondents have tried to initially estimate the value of the real property during the first inspection. Among those trying to initially estimate the value, 8.2% of the respondents admitted that they tried to do it always, as many as 63.2% do it frequently and 16.3% do it rarely; for 65.3% appraisers this first notion of value affects their search for market data confirming the initial estimate, including almost 49% who stated that following the image of value often decides of their choice of market data, 22.4% - rarely, and 2% - always. Among those who disclosed that the first notion of value affects the result of the appraisal as many as 65.2% claimed that this was a frequent occurrence, almost 35% - rare. That the appraisers are affected by the availability heuristic is also supported by answers which reveal that the level of value is affected by the order in which information is obtained from the market: this was confirmed by as many as 33.2% of the respondents. Among those who said yes, 44% claimed that the order of data obtained always affected the level of the estimated value, the same number of respondents admitted that they were often influenced by the order of information.

Unfortunately, the surveys have confirmed that clients are trying to influence the process of valuation and its outcome (level of value): this was confirmed by as many as 63.5% of respondents asked about the influence exerted on them. However, respondents were reluctant

to answer the questions about the area of the influence: the client's influence on the selection of valuation methodology, on the level of value estimated or even forcing a correction of the appraisal level presented. Among the respondents, 68.1% answered that the client forced the evaluation methodology (selection of the approach, method and technique), 46.8% answered that the client influenced the level of the estimated value, 51.1% - that the client forced the correction of the value presented by the valuer. The positive phenomenon is the fact that in all areas the exerting of influence was assessed as a rare occurrence. The entities which most frequently exert influence on the level of value are investors, banks and local councils.  The questionnaire survey revealed that appraisers give in to expectations of large clients who often appear in the market as clients (38.1% of the respondents pointed to those clients). The same percentage of appraisers answered that they gave in to the expectations of a one-off client. In the eyes of the respondents, the pressure exerted by the client on the result of the appraisal increases when a small number of orders exists in the market.

The questionnaire survey revealed that the lack of acquiescence to the client may result in the punishment in the form of: deprivation of the fee, reduction of the fee, as well as being cut off from further market orders. Among the penalised appraisers almost 52% admitted that they had been deprived of a fee for the valuation survey, 7.4% had their fee reduced, over 70.3% did not receive further orders from that client.

Over 89% admitted that they heard of clients' attempts at exerting influence on their practicing colleagues. More than 50% admitted that these attempts were frequent or very frequent, others classified them as rarely occurring.

Higher inclination to create an image of the value of the property during the first inspection on site is displayed by experienced appraisers – almost 40% of respondents with 12 or more years of experience said yes, over 72% of respondents admitted that the first judgment concerning the value affected the outcome of the appraisal. An experienced property valuer has knowledge from which they can draw information. Using the experience, they form a preliminary opinion during the first inspection on site. This opinion may become an anchor, exerting influence on the data obtained from the market, confirming the assumed value. This may lead to a cognitive bias. It could seem that an appraiser with lower experience, who does not have the knowledge to draw information from, should not be subject to this heuristic. Each valuation stage should be treated with the same attention. Having less experience, they would find it more difficult to create the notion of value. However, research has shown that persons with less experience have even more tendency to make judgments about the value during the first inspection on site: as many as 75% of the respondents operating in the valuation market for up to three years admitted that they form the first judgment about the value, the same percentage admitted that this judgment affected the outcome of the appraisal. Among the respondents with four to seven years of experience, as many as 83.3% confirmed the impact of the first judgment on the value, as did 85.7% of respondents with eight to eleven years of experience.

Regardless of the level of professional experience, the awareness of the price of real estate valued during the sale affected the data obtained from the market and the level of value: 25% of the respondents with experience of up to three years confirmed the impact of the information about price on the data adopted, 50% in this group confirmed the impact on the level of value. For those who have been working for twelve or more years in the valuation market – the results were, respectively, 32.7% and 51.0%.

The research conducted is preliminary, it reveals the existence of heuristics, it does not show how in the valuation practice they affect the cognitive biases. This are requires the conducting of further, in-depth research.

### *Towards the descriptive valuation model*

Both the literature on the subject and the research conducted confirmed that in the process of valuation appraisers often use three heuristics: anchoring and adjustment and availability. The use of the anchoring and adjustment heuristics may lead to the **smoothing of estimates**, to the creation of the **priority effect** (the first information obtained constitutes the starting point for

other), **focus effect,** or excessive concentration on one aspect at the expense of others. The use of availability heuristic may lead to the **confirmation bias**, which makes us prefer our earlier notions, therefore we look for information which is consistent with our expectations, the **freshness effect**, which means that we attach more value to information which we have received last. These biases do not have to be the consequence of motivation effects, such as rewards and punishments. However, the motivation effects deepen the scale of cognitive biases. Heuristics and motivation effects affect both appraisers with short- and with long-term experience. The errors made may lead to systematic biases in valuation, they constitute evidence of the partiality in valuation.

Better understanding of those heuristics and the resulting cognitive biases should lead to improved appraisals. In order for this to be possible, the normative valuation model should be replaced with a descriptive model, allowing for the conduct of appraisers in the valuation. The awareness of weakness of the normative model constituted a temptation (so far unrealised) to create the basis of a descriptive model, describing the actual valuation process[11]. The previous approach focused on the same result, the inclusion of elements of psychological behaviour focuses on the description of the valuation process. The abandonment of the normative valuation model is not deemed an error, in reality it is the result of experience and development of knowledge.

**Unresolved and contentious problems in the area of valuation**

Many problems in the valuation of real estate have not been resolved. The most import ant one s include:

- the need to correctly allow for low liquidity in the valuation (difficult transferability) or real estate. The period of searching for a buyer in the real estate market usually takes months. The low liquidity of the real estate results in additional risk in comparison with the valuation of liquid assets, which must be allowed for in the estimation process. The estimation of the amount of the premium is difficult, moreover it is not constant in time, it changes as the economic situation and the situation of the real estate market changes. For example, research conducted in the United States showed that in the years 2005-2008, and thus in the period of strong shocks in the financial markets, the premium for liquidity risk in real estate markets was constant, and it was relatively constant also in the years 2009-2010, but it was established at a higher level – it increased from 25-33 points to 61-89 (D. Andrews 2011). The ability to correctly value low liquidity is particularly important for institutional investors at the stage of construction of investment portfolios.

- the problem of mapping the dynamics of changes in the market. The requirement for the value of real estate to be determined as of the valuation date may suggest that the valuation is of static nature. The static nature of the valuation is supported by certain economic principles of valuation, such as: internal equilibrium principle, substitution principle, or conformity principle[12]. However, the very fact that the value is determined as at the given date, the valuation date constitutes an attempt at overcoming the market volatility. The need to allow for market volatility in the valuation process is indicated by subsequent valuation principles: the anticipation principle, the variability principle or competition principle.

   The real estate markets show dynamics. In the literature on the subject, three rights of the dynamics are indicated: markets are driven by the occurring differences between demand and supply, the rate of changes is proportional to the size of those differences (for example, the more the demand exceeds supply, the quicker the prices will change, aiming to achieve balance) and a turning point takes place in the form of the new adjustment of demand and supply (BRADLEY 1990). The market volatility may reduce the validity of the estimated value level, which means that the market value as of the valuation date is not sufficient for users. The awareness of changes taking place in real estate markets puts a question mark on the

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[11] J.Diaz III, J.A. Hansz, Behavioral Research into the Real Estate Valuation Process: Progress Toward a Descriptive Model /W/ Real Estate Valuation Theory, edited by: Ko Wang and Marvin L. Wolverton, Research Issues in Real Estate, , ss.3-4

[12] Economic valuation principles have been very well clarified in the American literature. Cf. Real Estate Valuation. Polish edition,

expression of value in the form of one number suggests – besides the determination of the current value of the property – the need to publish the analysis of disclosing future directions of changes in real estate markets and their impact on the level of the estimated value[13]. The recipient of the valuation should be aware that the value calculated as at the valuation moment may be subject to fluctuations within certain anticipated boundaries as the effect of market instability (TURCAS 2008)

- the valuation of new products connected with real estate, e.g. shares of legal securities issued on the basis of the real estate, i.e. "future" type contracts for the future prices of houses, which requires the development of new methodologies.
  Each of the products must be valued in a manner appropriate for their own features and markets from which they originate, it must allow for risks specific to the real estate assets, despite the fact that that the place of their trading is the securities market. Problems with the correct separation of the value of enterprise and the value of real estate. This problem has become the subject of a global discussion. It becomes particularly relevant in the case of valuations for the purpose of assessment of the real estate tax on such properties as hotels or shopping centres,

- difficulties in obtaining and maintaining databases in real estate markets, which causes, as Vandell writes, the possibility of occurrence of the "Garbage in – garbage out" situation. One of the more serious problems related to real estate is not just the meagreness of market data, but also the low speed in their acquisition in comparison with the equity and bond market – months may pass between the signing of the preliminary agreement and its finalisation and recording the change of the owner. For subsequent months, the transaction may not be disclosed, which may suggest that the market is not responding to current events. However, the determination of the value requires having market data defining the market on the valuation date,

- growing gap between the valuation theory and practice. Not just the theory but also the market has outstripped the valuation practice. The establishment of new products caused a new participant to appear in the valuation area – besides practitioners and academics, financial economics has appeared, which substantially hinders the integration of valuation theory with practice.

### 1.1.3. Future of valuation methodology

The valuation methodology is not constant. Although the aspirations for institutional standardisation of the valuation methodology in global terms have failed, the establishment and popularisation of uniform definition standards, as well as the valuation process standards, undoubtedly contributed to bringing together the concept of value and the process of its determination.

A single, common valuation methodology will probably never be created – due to the institutional barriers. The aspiration for brining valuation methodologies together will remain topical. It seems that in the integrated world, this aspiration is moving from global organisations to the education level and the level of practical applications. The national valuation methodologies merge from the bottom up to international markets through their practical application in the area of operation of entities servicing real estate markets, and through the education system. It seems that a new channel of slow interpenetration is being created, and in the long term the valuation methodologies will come closer together. Although this process is very slow, its effectiveness may prove greater than the influence of the International Valuation Standards Council.

The methodology is evolving towards more and more accurate mapping of the market. This requires the creation of data collection systems, analytical methods and understanding of the market. It is supported by the changes taking place in real estate markets, consisting in the growing institutionalisation. In such markets, ownership is separated from the user. The user's

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[13] In the income approach the justifiability of using the feasibility analysis is suggested (F. Turcas 2008)

market becomes the market of a tenant or lessee. There is richer market data in such a situation, and the access to such data is also better.

In the USA, among the supporters of the better mapping of the market, some are speaking for taking account of the cyclical nature of the real estate market by replacing the existing approach, consisting in the trend extrapolation, with the simulation of changes taking place in the market environment (PYHRR BORN 1994; PYHRR ET AL. 1996).

The evolution of the valuation process must have more and more consideration for the client's requirements. The example may be the valuations prepared for the purpose of financial statements the shape of which is affected by the International Accounting Standards, and also those for mortgage banks which impose the requirement to determine the so-called bank-mortgage value, the level of which is maintained during the entire period of loan repayment. The appraiser community has understood that if they do not accept the process of valuation subordinated to clients, they will lose them.

The inclusion of the academic circles in real estate market research definitely influenced the shape of the valuation methodology, as did the development of valuation standards together with practitioners. The inclusion of theoreticians into the process results in the creation of more and more complex valuation models, it shows that the behaviours of property valuers are not consistent with the normative valuation model, it directs the process towards the establishment of a descriptive valuation model.

Not only the valuation methodology is subject to changes, but also the level of valuers. More and more complex valuations, but also strong influence of the valuation on the financial standing of business entities require that professional qualifications of valuers are increased and evened out. The development of education constitutes an important element of this process, facilitating the development of standards, research and innovations in valuation methodologies. Despite their undoubted effectiveness at the level of promoting standards, the opinion concerning their level has not always been high. It is difficult not to agree with the voices of the critics, which may also be adapted to the Polish education system, that the education system reaches for the "lowest common denominator", focusing more on form and mechanical application of often unsuitable mathematical formulas than on the essence and observance of healthy principles of unbiased value appraisal[14].

In practice, significant changes are taking place and they will probably intensify. These changes are caused by the IT and Internet revolution. Its influence will be both positive and negative. The positive one is manifested both at the stage of collection and classification of data, and at the calculation stage. The negative impact becomes apparent at the final stage of work because the real estate valuation does not reflect individual features of the property, which reduces its credibility.

Securitisation, consisting in liquidating assets which are of low liquidity, may influence changes in the valuation process. THe traditional valuation will be replaced with the valuation of securities. However, the role of valuation of real estate as a property portfolio will increase. Thus, the demand may grow for services consisting not on valuation of a single property but on the valuation of property as the component of a portfolio. The requirements placed before the appraiser move this profession closer to the role of an advisor in the real estate market.

### 1.1.4. Summary

Despite common economic grounds for the valuation, as well as responding to common needs, in individual states the valuation methodology remains different. Moreover, the theory and the market are ahead of practice. A clear time gap before a new concept and its implementation may be seen. Practitioners are clearly resisting[15]. The lack of progress among

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[14] The reservations against the execution of formal education curricula were submitted by R.Ratclifrf, A.Ring, J. Graaskamp, cf. K.D. Vandell,. Expanding the Academic Discipline of Real Estate Valuation. A Historical perspective with Implications for the Future, Journal of Property Investment & Finance 2007 Vol.25. No5

[15] In Poland, an example of such resistance from practitioners is the rejection of the concept of the best use within the market value interpretation area. The resistance was so strong that valuation practitioners caused the withdrawal of the professional standard

appraisers, who find it difficult to experiment and apply new techniques, is probably often down to the lack of understanding of the changes as well as the fear of court proceedings (MILLER, MARKOSYAN 2003).

An attempt at reviewing changes in the valuation area reveals that the theory, methods and practice undergo constant evolution processes. This field has not been and will not be static. These changes will continue to take place. It seems that factors of endogenous nature, leading to the merging and creating common grounds for the valuation, will have more influence on the future shape of valuation. However, institutional barriers will constitute an obstacle which will prevent the promoting of a single, generally accepted valuation concept. The merging of concepts may only lead to bringing the valuation methodology together but standardizing it. The world of real estate is condemned to diversity.

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"Market value and replacement value", in which the value concept, consistent with the concept contained in the International and European Valuation Standards, introduces the term "highest and best use".

## 1.2. Valuation of special-purpose real estates with special focus on the profit method

The concept of market value developed in Poland is consistent with and based upon the definition of market value set out in the International Valuation Standards (IVS), the European Valuation Standards (EVS) and the EU directives.

Article 151, paragraph 1 of The Real Estate Management Act defines market value as the most probable price which can be obtained on the market, assessed with regard to transaction prices based on the following assumptions:
- the parties to the transaction were independent, did not act under pressure and had a firm intention of concluding an agreement,
- the time before the transaction was sufficient for the property to be exposed on the market and for the parties to negotiate conditions of the agreement.

The definition mentioned above is in compliance with market value definitions stipulated in the International Valuation Standard No. 1 "Market value as a basis for valuation" (IVS1), and European Valuation Standard No.1 "Market value" (EVS1).

Valuation approaches are defined in The Real Estate Management Act of 21.08.1997, (consolidated text in journal of laws *Dziennik Ustaw* of 2011, No. 102, item 341 with further amendments) and the Regulation of the Council of Ministers of 21.09.2004 concerning property valuation and valuation reporting (journal of laws *Dziennik Ustaw* 2004, No. 207, item 2109).

The Regulation distinguishes valuation approaches, methods, and detailed valuation procedures called techniques.

The appropriate approach, method and technique of real estate valuation are selected by a professional valuer with regard to:
- purpose of the valuation,
- type and location of the real estate,
- intended use of the real estate according to the local area development plan,
- accessibility of technical infrastructure, stage of development etc.,
- availability of data concerning characteristics, prices and income gained from similar real estates.

The subject of the study comprises selected problems of applying the profit method in the process of assessing market value of real estates. The method is applied in case of untypical real estates that are rarely traded on the market (e.g. petrol stations, hotels, motels, pubs, restaurants, cinemas, theatres, rubbish dumps, incineration plants etc.). For better understanding of the discussed issues, the author presents two examples of valuation carried out with use of profit method.

### 1.2.1. Assumptions of the income approach

One of the approaches applied in the process of assessing the market value of real estate is the income approach. In applying the income approach, the knowledge of income derived from or possible to derive from rents and other income from property being the subject of valuation and comparable properties is necessary.

The basic assumption of the approach is that there is dependency between: the market value of a real estate, the income it can generate, and the market rate of return.

While applying the income approach, it is crucial to determine the following:
- market income or income flows,
- capitalization rate or capitalization ratio,
- discount rate,
- expected period in which the real estate generates income flows,
- residual value of the real estate.

Depending on the path of assessing income from the real estate, the investment method or profit method are employed. The investment method is applied in arriving at the value of a real

estate that generates or is able to generate income from rents from occupational or land leases, the level of which can be established on the basis of market analysis. In the profit method, the income is equivalent to the owner's share in the income derived from an activity carried out on the real estate. It concerns special-purpose real estates that are rarely traded (e.g. petrol stations, hotels, motels, pubs, restaurants, cinemas, theatres, rubbish dumps, incineration plants etc.).

### 1.2.2. Calculation of income generated by real estate

Calculation of income from a real estate comprises the following stages:

✓ **Estimating the potential gross income from a real estate (PGI)**
The income comprises both the rental income and the non-rental one (if there is any). The non-rental income involves e.g. income from billboards placed on the buildings, mobile communications devices located on the roofs, and other transmitting devices. While calculating the potential income, the valuer makes an assumption that the whole area of a property generates maximal income over a year.

Rental/lease rate results from a rental/lease contract, and the parties are free to determine its terms. In the rental/lease contract each of the parties involved (landlord/lessor and tenant/lessee) agree on contract conditions and thus secure their own rights and interests.

The landlord/ lessor receives:
- rent paid according to agreed terms,
- right to take over the real estate after the rental/lease period,
- right to pursue rent/leasehold arrears,
    The level of rent should depend on various circumstances, particularly on:
    - subject of rent/lease and its market value,
    - situation on the monetary and credit market,
    - level of market rents for similar real estates,
    - location of the real estate subject to the rental/lease contract,
    - rental/lease contract duration,
    - technical condition of the real estate subject to the rental/lease contract,
    - contract terms,
    - scope of state intervention (e.g. rent control within selected segments of the housing stock),
    - special provisions stipulated in the contract.
There are many categories/types of rents/lease fees. Among the most popular are the following types (THE APPRAISAL OF REAL ESTATE, KONOWALCZUK 2009, BRYX 2009):
– **market rent** - the amount of money that the real estate would command under current market conditions. It is expressed at current rates that are up-to-date at the valuation date, offered and received for comparable (similar) real estates with the same allocation of operating expenses between the landlord/lessor and the tenant/lessee;
– **contract rent** - the actual rent agreed by the parties to a contract. Its level may differ from market rates and it depends on terms and conditions stipulated in the contract;
– **excess rent** - the amount of money paid in a lease contract that exceeds the market rate at the valuation date. It may result from better management, entering the contract in times of higher market rents, lack of market knowledge or non-market incentives of the contract parties;
– **deficit rent** - the amount of money paid in a lease contract that exceeds the market rate;
– **percentage rent** - the rental income paid by the tenant in a retail building that is tied to the level of sales.;
– **overage rent** – the type of percentage rent. The amount paid over the base rent fixed at the agreed level of sales. The overage rent should not be confused with excess rent.
– **base rent** is a minimum rental/lease rate stipulated in the contract;

- **nominal rent** - the rental rate expressed in terms of money,
- **real rent** – the rental rate after adjusting for the effects of inflation;
- **effective rent** - equals contract rent less free rent and any one-time or periodic cash allowances due to e.g. improvements made by the tenant/lessee.

Depending on the scope of participation of the landlord/lessor and tenant/lessee in operational expenses, two types of rent can be distinguished:
- **gross rent** – all operational expenses are incurred by the landlord/lessor;
- **net rent** - all operational expenses are incurred by the tenant/ lessee.

There are various variant solutions between the two categories mentioned above, where operational expenses are covered by both parties.

The typology presented above proves that there is a wide range of rents, which means that in the valuation process the valuer needs to carefully study and compare the conditions and terms stipulated in the rental/lease contracts.

While calculating market value of real estate, one has to analyze the market and estimate the appropriate rent for real estate subject to valuation. It is necessary to:
- define the type and scope of the local market, where the property subject to valuation is placed (e.g. single-family housing, A-class office space),
- decide on the period of the research,
- decide on the property characteristics and their influence on rental rate, e.g. for single-family housing it might be location, usable floor area, stage of development of the plot of land, age and condition of the building.

On the basis of the criteria mentioned above, one may estimate the rental rate for the real estate subject to valuation. On calculating the potential income, the valuer takes into account revenues that the entire real estate can generate over a year.

✓ **Estimating vacancies, collection losses and the so called free rent periods**

In terms of economy, the income received by the owner (effective gross income) is rarely equal to potential gross income. The amount of lost profit (income) may vary and depends on the vacancy rate and collection losses (rent arrears or lack of payment), the overall economic situation, condition of local market, property type, and opportunity cost.

✓ **Estimating effective gross income (EGI)**

It is the difference between potential gross income and losses due to vacancy, tenants' negligence, periodic cash allowances or the so called free rents.

✓ **Estimating the level of operating expenses (OpEx)**

They can be divided into fixed and variable expenses. The first do not depend on the vacancy rate. Fixed operating expenses usually include insurance, property security, daily maintenance etc. Variable operating expenses may occur periodically (e.g. cost of heating) or continually (e.g. cost of power and water supply).

Operating expenses include:
- property taxes,
- payments for perpetual usufruct,
- media fees,
- cost of security,
- cost of insurance,
- cost of maintenance and running repairs,
- management cost.

However, the group does not comprise the following:
- depreciation cost,
- value added tax (VAT),
- installments and interests on loans,
- refurbishment costs.

✓ **Estimating net operating income (NOI)**

Net operating income is the company's effective gross income (EGI) less operating expenses (OpEx).

The process of calculating net operating income in the profit method involves the stages depicted in the fig. 1 below:

```
┌─────────────────────────────────┐
│   potential gross income (PGI)  │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│          (-) lossess            │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│  = effective gross income (EGI) │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     (-) operational expenses    │
│             (OpEx)              │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│  = net operating income (NOI)   │
└─────────────────────────────────┘
```
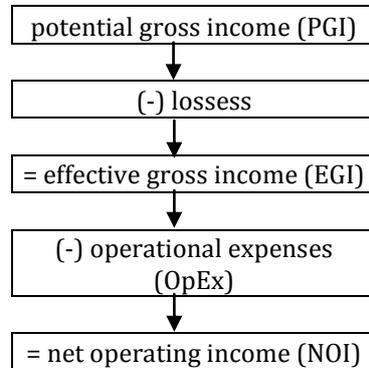
Fig 1. Stages of income calculation in the profit method

In the profit method, there are some characteristic features of the net operating income calculation procedure. First, the income generated by the user's business activity conducted on the property is estimated (UI). Next, costs of conducting business activity are deducted (BAC), e.g. supply of goods, employees' salaries etc. In this way the user's gross income generated by the business activity conducted on the property is calculated (UGI). After further deduction of operating expenses, the result is user's net operating income (UNOI). While operating expenses are calculated according to the rules applied in the profit method, the income mentioned above is calculated on the basis of market data, as the real estate owner's share in the income generated by the business activity conducted on the property (UNOI). The process of calculating net operating income in the profit method involves the stages depicted in the fig. 2 below:

```
┌─────────────────────────────────┐
│      Income from business       │
│       activity conducted        │
│        on property (UI)         │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     - Costs of conducting       │
│     business activity (BAC)     │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     = User's gross income       │
│             (UGI)               │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│      - Operating expenses       │
│             (OpEx)              │
└─────────────────────────────────┘
                 │
                 ▼
┌─────────────────────────────────┐
│     = User's net operating      │
│          income (UNOI)          │
└─────────────────────────────────┘
          ╱               ╲
         ▼                 ▼
┌──────────────┐    ┌──────────────┐
│     User     │    │  NOI Owner   │
└──────────────┘    └──────────────┘
```
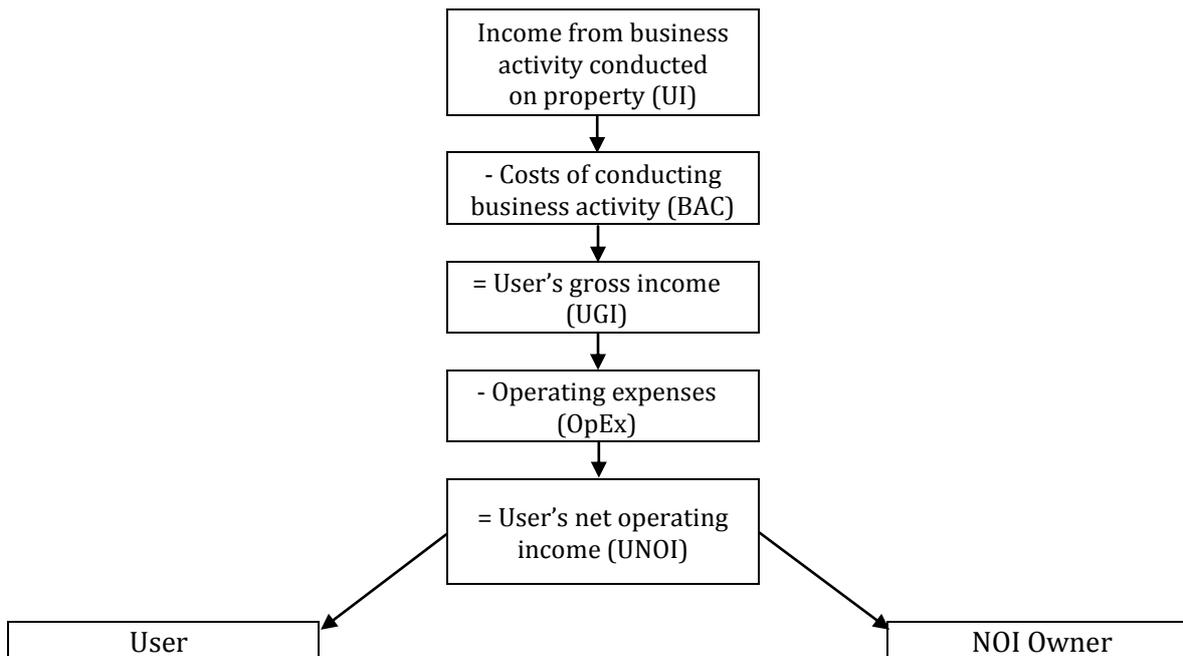
Fig. 2. Stages of income calculation in the profit method

### 1.2.3. Choice of valuation techniques

Calculation procedures, which lead to converting income from the real estate into value, are called techniques. They are further divided into the direct capitalization technique and the discounted cash flows technique, where cash flows are generated for an indefinite period of time. In case the income generated by a real estate varies over periods of time (cash flows are changeable), the discounted cash flows technique should be applied.

The direct capitalization is applied when the real estate generates stable income flows over the infinite time horizon (fig. 3). Income generated by the real estate is measured in real amounts, i.e. inflation is not a diversification basis for cash flows.
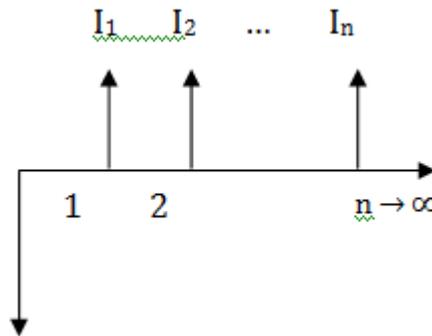


Fig. 3. Stable income flows over the infinite time horizon

The value of the real estate, (as appraised with use of direct capitalization technique) is calculated as a product of stable stream of annual income possible to receive from the real estate subject to valuation and capitalization factor, or as a quotient of stable income stream and capitalization rate.

$$MV = I \times C_f \quad \text{or}$$

$$MV = \frac{I}{R}$$

where:
MV – market value
$D_1 = D_2 = D_3 = ... = D_n$ – annual income (constans)
$C_f$ – capitalization factor
R – capitalization rate

In case the income earned by the real estate is changeable (due to the preplanned activities on a property or the contracts entered), discounted cash flows technique is used in the process of calculating market value (fig. 4).
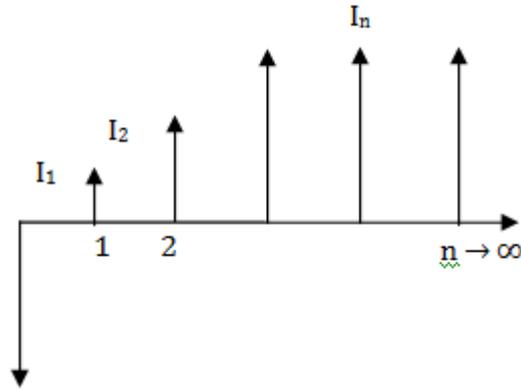
Fig. 4. Changeable income earned by the real estate

The real estate value is thus estimated as the sum of discounted cash flows possible to achieve in the consecutive years of the forecast period and the discounted residual value. Residual value is the value of a property after the forecast period.

$$MV = I_1 \cdot \frac{1}{(1+r)^1} + I_2 \cdot \frac{1}{(1+r)^2} + ... + I_n \cdot \frac{1}{(1+r)^n} + \frac{RV}{(1+r)^n}$$

where:
MV – market value
$I_n$ – income flow at the end of the year
r – discount rate
i – forecast year, $i$=1,2, …, n,
RV – residual value

### 1.2.4. Capitalization rate and discount rate as rates of return

**Capitalization rate**
A frequently used method of estimating capitalization rate is based on market data, as a quotient of net operating income (NOI) possible to receive on the market and transaction price of real estate:

$$R = \frac{NOI}{P}$$

where:
R – capitalization rate
I – net operating income
P – transaction price

Capitalization rate is defined as a market rate of return for similar real estates in a selected real estate market segment in definite time. It is determined on the basis of many transactions entered on the market excluding the prices that deviate from the most common ones. Furthermore, the capitalization rate applied in the valuation of real estate should be adjusted in case there is a difference between the real estate subject to valuation and real estates used as bases for calculating the market capitalization rate. The capitalization rate applied in the valuation process should reflect income risk from the subject real estate.

The capitalization rate calculated on the basis of market data defines rate of return for a particular real estate market segment.

**Discount rate**

Discount rate should:

- reflect investor's expected rate of return on the capital market,
- reflect the risk rate desired by the investors in a particular market segment. The discount rate does not have to involve the risk of changes in rental fees, as well as the final (residual) value of a property, which are expressed in a real estate valuation formula.

The preferable way of calculating discount rate (r), is the correction of market capitalization rates, taking into consideration the expected changes of income earned by a property and the possible changes in property prices after the forecast period. While calculating the rate, one needs to take into consideration the difference between the risk rate related to earning income flows from the valued property, and the one related to properties for which market capitalization rates have been calculated. The risk related to earning a particular income may stem from the differences in:

- location of a property,
- technical condition,
- functional standard,
- terms and conditions of the contracts entered,
- tenants' credibility,
- other.

If it is not possible to calculate discount rate by the correction of market capitalization rates (lack of transactions in similar properties on the subject market), it may be estimated on the basis of capital market, with the application of market rates of return from risk-free investments, corrected by the system and risk premium[16]. While calculating discount rate, the following factors need to be taken into consideration:

- average rentability of government bonds with a maturity period longer than a year,
- inflation rate (as the income is expressed as a real value),
- systematic risk premium (the risk may be caused by crisis, inflation rise, changes in law and regulations, increase in rentability of other types of deposits),
- specific risk premium (it is a bonus related to investing in a particular real estate market segment in the area).

Both capitalization and discount rate are the rates of return from real estates. While discount rate reflects the return on invested capital, capitalization rate shows the relation of the annual income from the real estate to the price or value of the real estate. The two rates cannot be considered equivalent, as their economical interpretations are different.

If the valued real estate has potential to increase in value, the capitalization rate (R) will be lower than the discount rate (r) applied in the process of discounting cash flows in the forecast period. In case the income flow and the value show the downward tendency, the capitalization rate will be higher than the discount rate.

Valuing real estates by means of income approach means calculating market value of the right to receive cash flows for an indefinite period of time. To provide accuracy of calculation, it is crucial to properly assess market rent rates, capitalization rates, discount rates and other measures describing real estate market segment represented by the subject property.

On calculating the value of real estate it is necessary to exercise commensurability of rates of return and income rates. The capitalization rate ranks among income rates of return reflects the relation between the current annual income from real estate and its price or value. The capitalization rate enables the valuer to convert income into value of real estate [Ling and Archer 2005, p.202]. Calculating capitalization rates on the basis of market transactions with similar real estates, various income types generated by real estates can be taken into account.

Thus:

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[16] Real estate investment risk has been thoroughly discussed in: P.J. Rowland [1993, p.178].

- if the effective gross income (EGI) was applied when determining capitalization rates for similar real estates subject to transactions, it must also be applied when valuing the subject real estate, i.e.

$$\text{transaction } 1 : R_1 = \frac{EGI_1}{C_1}$$

$$\text{transaction } 2 : R_2 = \frac{EGI_2}{C_2}$$

$$\text{transaction } 3 : R_3 = \frac{EGI_3}{C_3}$$

$$\text{transaction } 4 : R_4 = \frac{EGI_4}{C_4}$$

thus:

$$R_B = \frac{R_1 + R_2 + R_3 + R_4}{4}$$

and:

$$MV = \frac{EGI}{R_G}$$

where:
MV – market value of the real estate,
$R_G$ – gross capitalization rate

- if the net operating income (NOI) was applied when determining capitalization rates for similar real estates, it should also be applied when valuing the subject real estate, i.e.

$$\text{transaction } 1 : R_1 = \frac{NOI_1}{C_1}$$

$$\text{transaction } 2 : R_2 = \frac{NOI_2}{C_2}$$

$$\text{transaction } 3 : R_3 = \frac{NOI_3}{C_3}$$

$$\text{transaction } 4 : R_1 = \frac{NOI_4}{C_4}$$

and the capitalization rate is:

$$R_N = \frac{R_1 + R_2 + R_3 + R_4}{4}$$

thus:

$$MV = \frac{NOI}{R_N}$$

where:

MV – market value of the real estate,

$R_N$ – net capitalization rate calculated on the basis of transactions with similar real estates by means of net operating income (NOI).

The described real estate valuation procedures employing profit method are presented in two case studies, i.e. a petrol station (1) and a hotel (2).

## 1.2.5. Valuation of a real estate developed with petrol station facilities – case study 1

**Valuation assumptions:**

The task is to calculate market value of real estate developed with petrol station facilities including: petrol station building with a shop and a bar, 7 fuel underground storage tanks (4 with capacity of 26,3 $m^3$ and 3 with capacity of 21 $m^3$). The location of the station is attractive.

The average monthly revenues from sales of fuels in the last two years equaled 80% of the total sales proceeds of: fuels as well as services and products sold in the shop and in the bar. In the valuation process, consider the following information gathered on the local market:

- monthly sales of fuels      –      300 000 liters,
- average sales price of 1 liter of fuel      –      5,80 PLN,
- the user's gross income from sale of 1 liter of fuel      –      0,55 PLN,
- monthly turnover from sales of goods in the shop amounts to 10% of total revenue,
- monthly cost of supplies and staff remuneration      –      65 000 PLN,
- monthly costs of running the bar (supplies, remuneration etc.)      –      96 000 PLN,
- monthly operational expenses incurred by the entrepreneur running the station on the real estate      –      15 000 PLN,
- percentage share of the owner of the real estate in net operational income      –      30%
- net capitalization rate      –      10,5%

**Procedure**:

The market value of the subject property is to be defined with the use of income approach, profit method, direct capitalization technique employing net operating income. In this method, net operating income of the owner of the real estate (NOI) is calculated on the basis of his/her share in net operating income earned by the user of the real estate.

The valuer has to:

- assess the user's revenues (UR) derived from business activity on the real estate,
- assess the user's gross income (UGI) by deducting the user's operational expenses (UOpExp) from his/her revenues derived from business activity (UR);
- calculate the user's net operating income (UNOI) by deducting operational expenses (OpExp) from the user's gross income,
- calculate NOI (using the path described above); here: 30% share in UNOI.

1. Annual revenues from the sales of fuels
   300 000 l · 5,80 PLN/l · 12 months = 20 880 000 PLN
2. Annual revenues from business activity on the real estate
   20 880 000 PLN : 0,90 = 26 100 000 PLN
3. Annual revenues from sales of goods and services in the shop and in the bar
   26 100 000 zł · 0,10 = 2 610 000 PLN
4. Annual tax deductible revenues (the shop and the bar)
   (65 000 PLN + 96 000 PLN) · 12 months = 1 932 000 PLN
5. The user's gross revenues from sales of food in the shop and in the bar
   $UGI_S$ = income (the shop + the bar) - expenses (the shop + the bar)

$UGI_S$ = 2 610 000 PLN - 1 932 000 PLN = 678 000 PLN

6. The user's annual gross income from sales of fuel
   UGIF = 300 000 l · 0,55 PLN/l · 12 months = 1 980 000 PLN
7. Total gross income from business activity run on the real estate (the shop, the bar, sales of fuels) - *UGI*
   $UGI = UGI_S + UGI_P$ = 678 000 PLN + 1 980 000 PLN = 2 658 000 PLN
8. Annual operational income from business activity (UNOI)
   UNOI = UGI – OpExp
   UNOI = 2 658 000 PLN - 15 000 PLN · 12 = 2 658 000 PLN - 180 000 PLN = 2 478 000 PLN
9. The owner's net income
   NOI = 0,30 · 2 478 000 PLN = 743 400 PLN
10. Market value of the subject Real estate

$$MV = \frac{NOI}{R} = \frac{743\,400\,PLN}{0,105} = 7\,080\,000\,PLN$$

The market value of the real estate developed with petrol station feasibilities is estimated at the level of 7 080 000 PLN.

### 1.2.6. Valuation of real estate developed with a hotel and restaurant building – case study 2

**Valuation assumptions:**
The task is to calculate the market value of the real estate developed with a hotel and restaurant building, knowing that:
- there are 50 rooms in the hotel, each is rented for 220 PLN/day,
- hotel occupancy rate is 62,5%,
- cost of running the hotel equals 30% of revenues,
- average monthly revenues from the restaurant is 120 000 PLN,
- costs of running the restaurant equals 40% of revenues,
- operational expenses related to real estate maintenance are at the level of 6,5% of revenues from business activity run on the real estate,
- share of the owner of the real estate in the user's net income from business activity is 45%.

The figures given above result from market analysis and are typical income rates and costs of running similar hotels and restaurants. The operational expenses are also at the market level. Due to the fact that the capitalization rate cannot be calculated on the basis of market data, estimate its level by means of data from the capital market:

| | |
|---|---|
| – inflation rate | – 3,0% |
| – average yield on bonds issued by the city where the subject real estate is located | – 7,0% |
| – average yield from bonds | |
| • 5-year | – 5,8% |
| • 10-year | – 6,2% |
| – average deposit interest rate calculated on the basis of data from 20 biggest banks | – 5,8% |
| – Warsaw Interbank Offer Rate (WIBOR 3M) | – 5,07% |
| – bill rediscount rate | – 5,0 % |
| – total system and specific risk premium | – 7,0% |

**Procedure**:
The market value of the subject real estate is calculated with the use of income approach, profit method, direct capitalization technique (employing net operating income).
The following steps should be taken:

1. Assess the user's revenues (UR) derived from business activity on the real estate

$UR = UR_1 + UR_2$

where:

$UR_1$ – revenues from the hotel
$UR_2$ – revenues from the restaurant

| Income | Number of rooms | Price per room | Average occupancy rate | Income [PLN/year] |
|---|---|---|---|---|
| Hotel | 50 | 220 PLN | 62,5% | 2 509 375 |
| Restaurant | 120 000 PLN x 12 months | | | 1 440 000 |
| Total | | | | 3 949 375 |

$UR_1$ = number of rooms x price per day x average occupancy rate x 365 days = 50 x 220 x 0,625 x 365 days = 1 440 000 zł
$UR_2$ = 120 000 PLN $\cdot$ 12 months = 1 440 000 PLN
$UR$ = 2 509 375 PLN + 1 440 000 PLN = 3 949 375 PLN

2. Calculation of the user's operational expenses (UOpExp)
   The expenses comprise spending of the entrepreneur on running business on the real estate. In this case study, they are expenses connected to running a hotel and a restaurant.
   $UOpExp = UOpExp_1 + UOpExp_2$
   where:
   $UOpExp_1$ – expenses related to the hotel
   $UOpExp_2$ – expenses related to the restaurant

| Business type | Share in income | Operational expenses [PLN] |
|---|---|---|
| Hotel | 30 % | 752 812,50 |
| Restaurant | 40 % | 576 000,00 |
| Total | | 1 328 812,50 |

3. Calculation of the user's gross income (UGI) from business activity run on the real estate
   $UGI = UR – UOpExp$
   $UGI$ = 3 949 375 PLN – 1 328 812,50 PLN = 2 620 562,50 PLN

4. Calculation of the user's net operating income from the business activity on the real estate (UNOI)
   $UNOI = UGI - OpExp$
   where:
   $OpExp$ – operational expenses
   $UNOI$= 2 620 562,50 PLN - 0,065 $\cdot$ 3 949 375 PLN = 2 620 562,50 PLN - 256 709,40 PLN
   $UNOI$ = 2 363 853,10 PLN

5. Calculation of the owner's net operating income
   The income is determined as the owner's percentage share in the user's net operating income from business activity run on the real estate
   $NOI$ = 0,45 $\cdot$ 2 363 853,10 PLN = 1 063 733,80 PLN

6. Calculation of capitalization rate (R)
   The preferred way to calculate capitalization rate (R), is the application of real estate market data. If there is lack of data, the capitalization rate can be determined on the basis of rates of return from risk-free long term investments (in this case study, these are five- and ten-year bonds).
   The capitalization rate is calculated as:

$R = r_s + r_1 + r_2$

where:

$r_s$ – real risk-free rate, calculated on the basis of yield from long-term securities,

$r_1$ – premium for systemic risk,

$r_2$ – premium for specific risk.

In the studied example, the rate is equal to 3%, i.e.:

$$r_s = \frac{5,8\% + 6,2\%}{2} - 3 = 3\%$$

(the average yield of five- and ten-year bonds and the inflation rate)

Thus:

R = 3% + 7% = 10%

7. Calculation of market value of the real estate (MV)

$$MV = \frac{NOI}{R} = \frac{1\ 063\ 733,80\ PLN}{10\%} = 10\ 637\ 338,00\ PLN$$

The market value of the real estate (in round figures) is: 10 637 000 PLN.

### 1.2.7. Summary

The profit method discussed above is applied in determining market value (yet it may also be used in calculation of non-market values) of untypical real estate. On calculating market value of real estates, the valuer determines value of the right to earn infinite income flows (which is an assumption of the income approach). The income calculated by means of profit method is a share of the owner of the real estate in the user's income from business activity run on the real estate.

To provide accuracy of calculation, it is crucial not only to properly assess the owner's income, but also the level of capitalization rates and measures describing the real estate market segment represented by the subject real estate.

## 1.3. Management of historic property by its value: the case of a castle and palace complex

Europe abounds in historic properties that constitute the continent's heritage. The website of GUS (Central Statistical Office) features a list of "immovable objects enlisted in the register of objects of cultural heritage" from 2009, which states that in Poland there are 419 castles and 2021 palaces, with the total number of heritage objects amounting to 64027. These numbers seem to indicate a vast potential market in Poland (www.stat.gov.pl).

According to the International Valuation Standards 2011, historic property is "real property publicly recognized or officially designated by a government-chartered body as having cultural or historic importance because of its association with a local/regional historic event or period, with an architectural style, or with the nation's heritage". Problem with valuation of such properties is due to their specificity and rarity on the market. There is yet another complication; namely, when utilizing such property, one must adhere to the rules established by the Office for Preservation of Objects of Cultural Heritage. Moreover, valuation process requires a profound and specialist knowledge from the valuer, who has to be experienced in various valuation methods and approaches. Valuation of historic properties also involves special considerations dealing with the nature of older construction methods and materials, the current efficiency and performance of such properties in terms of modern equivalents. It is important to gather additional information on the property being valued. The factors that distinguish historic properties from other types of property are: relation of integrity with the surrounding space and immediate environment (land, spatial structure, interrelation of views from the property and at the property, etc.) There is often a loss or deterioration of a certain spatial, functional and utilitarian standard ascribed to the original function of the property (General National Principles of Valuation).

### 1.3.1. Castle and palace complex as a specific object of valuation and investment

Despite various unfavorable circumstances, many mansions, palaces and castles have survived throughout Europe. Without them, the continent's history would be incomplete. It is necessary to bear in mind that these buildings constitute the appeal of the places where they can be found, adding to the local color and attracting tourists and researchers from all over the world.

Palaces or castle and palace complexes cannot preserve their historic substance without a patron or an investor, who would ensure that the buildings could be used by present and future generations. Patrons take care for historic heritage because they are aware that a unique piece of cultural heritage needs to be saved; otherwise, we would become impoverished and no longer would be able to admire and be inspired by the wisdom and aesthetics of the past. Although the activities of private and institutional patrons are relatively frequent, it is still a fraction of what is needed to preserve the deteriorating historic buildings. Therefore, restoration and revitalization of mansions, castles and palaces by investors or developers is also necessary. Fortunately, many people are aware of the business potential that historic estates reveal.

However, development of a historic property in order to achieve a satisfactory rate of return on the invested capital, along with the preservation of cultural and historic merits, is a specialist task.

An entrepreneur deciding to invest his capital in a historic palace complex must be aware of various risks: investment risk, typical for the property market, but also the additional risk resulting from the very fact that the object of investment is a historic property. Oftentimes these buildings are dilapidated or even ruined. An investor interested in such an object needs to carry out historical examination and confront it with the present use designated by the local area development plan, if such a plan exists for the given property. It should be remembered that the Office for Preservation of Objects of Cultural Heritage has the decisive voice with respect to restoration, refurbishment, extension and revitalization. The investor, after an analysis of

documents, seeks to find a new role for the historic property, give it a new life. Therefore, it is so important to thoroughly examine the potential development perspectives. It is crucial to find business potential in a particular object, confront it with the possibilities outlined by the authorities and compare the final value (of the property once development is completed) with costs of development.

Successful development of historic property at all stages, from investment planning, through implementation of the plan, and finally to utilization, depends on the accurate and effective **management of the property and its value**.

In order to manage value effectively, it is in turn necessary to learn how to manage the entity that contains this value – namely, the historic property. Without the ability to manage the value of the development at all stages (including the final one, utilization), there cannot be any efficient  property management on the investor's part. However, a piece of information on value (of, e.g. a palace complex) expressed as a number, does not give any opportunity to manage the property by its value. **Value management means controlling and influencing the factors that may affect the said value.**

The above considerations raise two questions:
- What is the value of unique historic properties such as palaces or castle and palace complexes?
- How to estimate the value of such properties? How to appraise them so that the value could be adequate to the property's potential and could include all particular dangers and costs related to the given property?

### 1.3.2. Methods of valuation of historic properties

In Poland, valuation of historic properties could be undertaken with the use of all legally permissible valuation approaches, methods and techniques – comparative, income, cost, mixed (Polish Property Management Act, 21 August 1997; Regulation of the Council of Ministers, 21 September 2004, on property valuation and valuation report). In principle, the value of a historic property should be determined as the value of its components, together with land and immediate surroundings, views from and at the property. Moreover, the role of natural environment affecting the property should be also taken into account. Due to the particular, unique character of historic properties, it is necessary to collect information and data from various property markets: local, regional and national or even international (in the case of property of exceptional importance or unique value). If a historic property does or can generate profit, its value can be determined within the income approach. In the process, the valuer includes both the profits that could be achieved, costs that will be borne in order to protect the property, as well as certain limitations that the owner (user) will have to face. With the cost approach, in the case of historic properties, valuers should not use the replacement cost method. Application of this approach in order to determine the value of a historic property obliges the valuer to carry out an in-depth assessment of the property's technical condition, along with assessing the wear of architectural elements.

### 1.3.3. Analysis of data availability for the valuation of palace complexes

What method should be applied in the valuation of a property where a palace is built? Apparently, the easiest thing to do would be a comparison of the valued palace with other properties being sold and offered on the market. However, a fragment of an extensive offer analysis presented in Table 1 shows that there are not even two similar properties of that kind, both in terms of location and physical features. Presumably, the development potential is also different for each of them. However, there is too little data to determine it. Therefore, the number of transactions and lack of similarities between previously sold historic properties and the valued property can rarely permit to apply the sales comparison approach in valuation.

Table 1 includes data from notarial deeds drawn up between 2006 and 2013, where the transaction items were palaces and mansions. However, the documents often did not include the

objects' area, and their descriptions tended to be lapidary. Still, even with such a limited source material, it can be seen that the prices vary from several hundred thousand PLN up to several dozen million PLN per property.

Table 1: Sales transactions of historic properties described in notarial deeds

| Date of transaction | Province | Town | Price of plot and building | Usable area | Price per 1 m² u.a. | Plot(s) area |
|---|---|---|---|---|---|---|
| 28-09-2012 | Wielkopolskie | Brzoza | 534 494 | 382,74 | 1 396 | 42 200 |
| 19-09-2012 | Małopolskie | Cianowice Duże | 1 690 000 | 1056,2 | 1 600 | 20 585 |
| 18-09-2012 | Wielkopolskie | Lutomek | 7 296 100 | | | 2 444 398 |
| 23-05-2013 | Wielkopolskie | Czeluścin | 1 158 181 | | | 73 942 |
| 04-09-2013 | Kujawsko - Pomorskie | Koszelewy | 2 410 000 | | | 963 736 |
| 13-06-2012 | Wielkopolskie | Pomarzanowice | 1 400 379 | 475,5 | 2 945 | 68 518 |
| 10-08-2012 | Wielkopolskie | Ługowiny | 2 089 200 | | | 723 683 |
| 20-05-2008 | Wielkopolskie | Środa Wielkopolska | 6 009 720 | 2700 | 2 226 | 3 037 |
| 17-04-2008 | Wielkopolskie | Luboń | 6 104 800 | 1735 | 3 519 | 8 502 |
| 12-04-2008 | Wielkopolskie | Piła | 7 766 520 | 1570 | 4 947 | 7 863 |
| 23-01-2008 | Wielkopolskie | Kalisz | 1 044 000 | 1058 | 987 | 3 540 |
| 30-12-2008 | Wielkopolskie | Jarocin | 1 965 010 | | | 2 148 |
| 08-12-2008 | Wielkopolskie | Poznań | 1 800 000 | | | 507 |
| 24-09-2008 | Lubuskie | Zielona Góra | 4 795 080 | | | 4 202 |
| 03-09-2008 | Lubuskie | Gorzów Wielkopolski | 2 074 000 | 814 | 2 548 | 2 582 |
| 13-08-2008 | Wielkopolskie | Piła | 2 600 000 | 2894,12 | 898 | 2 563 |
| 02-07-2008 | Wielkopolskie | Gołańcz | 20 272 800 | | | 85 023 |
| 17-10-2008 | Wielkopolskie | Wolsztyn | 1 600 000 | | | 1 447 |
| 24-09-2008 | Lubuskie | Zielona Góra | 4 795 080 | | | 4 202 |
| 03-09-2008 | Lubuskie | Gorzów Wielkopolski | 2 074 000 | 814 | 2 548 | 2 582 |
| 10-07-2008 | Wielkopolskie | Plewiska | 3 416 000 | | | 5 108 |
| 03-08-2007 | Wielkopolskie | Ostroróg | 950 000 | | | 6 087 |
| 30-12-2008 | Wielkopolskie | Jarocin | 1 610 664 | 745 | 2 162 | 2 148 |
| 30-12-2008 | Wielkopolskie | Jarocin | 1 610 664 | 745 | 2 162 | 2 148 |
| 13-08-2008 | Wielkopolskie | Piła | 2 600 000 | 2894,12 | 898 | 2 563 |
| 18-12-2008 | Wielkopolskie | Poznań | 3 452 600 | 762 | 4 531 | 2 268 |
| 28-04-2008 | Pomorskie | Sześć | 9 834 176 | | | 5 058 |
| 15-04-2008 | Małopolskie | Olkusz | 7 060 000 | 1109 | 6 366 | 4 642 |
| 12-03-2008 | Zachodniopomorskie | Szczecin | 1 927 600 | 1 | 1 927 600 | 2 660 |
| 05-03-2008 | Zachodniopomorskie | Międzywodzie | 1 712 672 | 1 | 1 712 672 | 2 792 |
| 13-02-2008 | Warmińsko - Mazurskie | Giżycko | 2 900 000 | 1 | 2 900 000 | 3 616 |
| 29-01-2008 | Pomorskie | Gdańsk | 3 200 000 | 1000 | 3 200 | 594 |

Source: Database collected from property valuers

A reliable property valuation requires additional information that could be collected by means of site inspection, research of other documents and reading of internet publications. Table 2 includes some additional, though not exhaustive, data concerning sample transactions of historic properties, collected mainly from notarial deeds and the internet.

Table 2: Transaction data supplemented from other sources

| No. | Date of sale | Address | Price in PLN | Property description |
|---|---|---|---|---|
| 1. | 2013-05-13 | Mazowieckie province, Siedlce district, Suchożebry commune, area of Wola Suchożebrska | 2 101 000 | Land area 2,90 ha, usable area of palace 467 m$^2$, Price per 1 m$^2$ u.a. 4499 PLN. Brick, one-floored building of Classicist style, with a portico of 4 columns, mansion from 1835, with surrounding park. Currently a hotel and conference center |
| | | | |  |
| 2. | 2012-01-19 | Pomorskie province, Lębork district, Wicko commune, area of Kopaniewo | 1 200 000 | Land area 1,9793ha, built-up area 680,2 m$^2$, u.a. 1360m$^2$ **Price per 1 m$^2$ u.a. 882 PLN** 2 floors above ground level, basement, mansion from 1922, with surrounding park |
| | | | |  |

| 3. | 2011-08 | Mazowieckie province, Grodzisk district, area of Ojrzanów Towarzystwo | 5 166 000 | Land area 15,5795ha, u.a. 1169 m$^2$<br>Price per 1 m$^2$ u.a. 4419 zł<br>Palace and park complex, fenced, park with diverse trees. Classicist palace from the 2nd half of the 19th c. Two floors, basement, usable attic. Ground floor: three sitting rooms, fireplace and hall. Attic: hotel rooms and apartments. 35 km from Warsaw. |
|---|---|---|---|---|



Source: Database collected by property valuers

Even a cursory analysis of the above transactions clearly shows an apparent lack of logic with respect to the prices of properties. It seems to support the thesis that the sales comparison approach is not really functional in the case of valuation of historic property. The same conclusion could be made on the basis of the following examples presented in Table 3.

Table 3: Descriptions of historic properties on sale

| No. | Location | Area | Offer price | Description | Picture |
|---|---|---|---|---|---|
| 1 | Puszcz, Kujawsko – pomorskie province , by the lake | 456 | 6 480 000 PLN<br>14 211 PLN/m$^2$ | The property includes: residential building, residential building with garage and a stable. The property is surrounded by 23 natural monuments on a plot of 42 457 m$^2$ that includes a multi-functional sports court for basketball, handball, football and tennis. A heliport can be created on the property. |  |
| 2 | Polanów, Krąg 16, Zachodniopomorskie province | 3 700 | 34 950 000 PLN<br>9 446 PLN/m$^2$ | A Knights' Castle built in 1494. Last overhaul repair in 2006. The farm buildings from 1970, last overhaul repair in 2011. Lake – lease for an indefinite period. Plot area: land with park 26 000 m$^2$, lake 18 000 m$^2$, usable area: castle 2 880 m$^2$, farm: 750 m$^2$, stable in basement. Hotel rooms – 4 single rooms, 35 double rooms, 11 apartments, restaurant for 130 guests |  |

| 3 | Jawor, Dolnośląskie province | 2 420 | 9 900 000 PLN 4 089 PLN/m² | Palace with a beautiful park of 8 000 m². Farming land of ca. 49 ha. The palace is brick and stone, with basement, two floors with usable attic, covered by mansard roof with dormers. Elevations plastered, decorative elements made of stone and ceramic. In the central part of the complex there is a pond, and the area is enclosed by a stone wall from the south. There are numerous farm buildings on the property, their area ca. 2000 m² (incl. a residential building of 400 m²) | |

Source: Self-compiled data based on internet publications

Analysis of sales transactions samples from Table 1 and sales offers of historic properties from Table 3 confirms a high level of diversification among both transaction and offer prices. This raises the following questions:

- Does the fact that some properties were sold for seemingly inadequate low sums indicate that all such properties are not worth much?
- On the other hand, does the fact that some properties were sold for very high sums allow to claim that the valued property is also equally expensive?

If we reject the impact of emotion and sentiment on the purchaser's part, the key element in the valuation is the property's potential. If we are to treat historic property as an investment, we need to compare it to other investments available on the market. In the process of valuation it requires a method that would allow to take into consideration **the potential of a specific property.**

The role of professionals is to show and quantify the phenomena that have influence on the property's potential, and, by extension, on space understood in broad terms. The role of researchers is to present models that allow to discover and measure that potential. It seems that one of such methods, appropriate for valuation of unique properties like palaces and castles is the residual method, which is in itself a profitability analysis of the planned investment. **In valuations undertaken with the use of the residual method it is possible to take into account the potential of the property, as well as drawbacks, charges and dangers related to the property itself and to the micro- and macroeconomic phenomena that might disturb the development.** The residual method, supplemented with sensitivity analysis of the sought value, allows the estimation of an adequate value and reasonable management of the property's value, the property itself and the risk related to its value and utilization.

### 1.3.4. Case study

The following analysis concerns the castle and palace complex in Międzylesie (Figure 5). This property is situated in the mountain region of Kotlina Kłodzka, a few kilometers from the Czech border, about 30 km from Kłodzko and 125 km from Wrocław – one of the five major Polish cities and the capital of Lower Silesia.
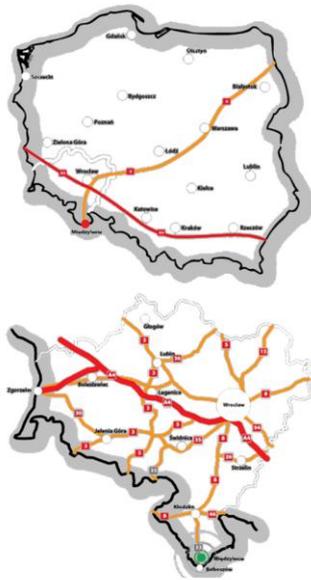
Central location – town square

Estate situated in Klodzko district, in Miedzylesie, near the international route Poland-Czech Republic, approximately 6 km from the Czech border.

Fig. 5. Location of the complex in Poland, region and town
Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

The next Figure 6 shows the present state of the complex on a satellite photograph and a schematic structure of the palace and castle components together with a brief description.
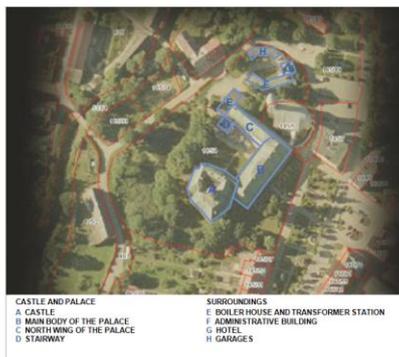


BASIC DATA

Plot number – 185/4
Plot area – 1,78 ha
The property is registered as object of cultural heritage under numbers A/5241/1468 and A/970/637/Wł.

Approximate useable area of particular estate parts (m²):

| A | B | C | D | E | F+G | H | SUM |
|------|------|------|-----|-----|-----|-----|--------|
| 3955 | 2515 | 1415 | 215 | 465 | 600 | 185 | 9350m² |

CASTLE AND PALACE
A CASTLE
B MAIN BODY OF THE PALACE
C NORTH WING OF THE PALACE
D STAIRWAY

SURROUNDINGS
E BOILER HOUSE AND TRANSFORMER STATION
F ADMINISTRATIVE BUILDING
G HOTEL
H GARAGES

Fig. 6. Division of the object
Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

The following Figure 7 presents the planned property development process and concisely demonstrates the main plans of the investors.

## PROPERTY DEVELOPMENT PROCESS

**STAGE I:**
**INITIAL STATE**

**STAGE II:**
**APPROVED REVITALIZATION PLAN**

**STAGE III:**
**REDEVELOPMENT OF THE AREA NOT INCLUDED IN THE BUILDING PERMIT DESIGN**

**POTENTIAL USED – 15%**

**POTENTIAL USED – 75%**

**POTENTIAL USED – 100%**

At present, the castle and palace complex is able to accommodate 58 guests. There is also a Baroque restaurant for 120 guests, two hunting halls for 70 guests, two conference rooms (for 55 and 40 guests), a spacious courtyard and a car park. Areas C and D have been restored. Buildings on the castle grounds are useable, as well as the partly renovated ballroom with a gallery (for 200 guests).

Revitalization plan comprises the entire area A and a fragment of area B (ballroom with gallery and grand stairway). Once the works are finished, the castle hotel will accommodate up to 185 guests. New facilities will be introduced, including an indoor swimming pool and spa, one more restaurant, a night club with a separate entrance, a cafe, a spacious glazed lobby in the inner courtyard (area A) and an elevator.

The subsequent development stage comprises the remaining part of the castle. Works planned at that point: conversion of the attics of B and C areas to hotel rooms; renovation of enfiladed palace halls on the ground floor and first floor of B wing; conversion of the remaining parts of A building attics to hotel rooms; renovation of basements in B wing and of the unused basements in A building.

| | | | | | |
|---|---|---|---|---|---|
| ROOMS | 20 | ROOMS | 67 | ROOMS | 100 |
| GUESTS | 58 | GUESTS | 185 | GUESTS | 275 |

Fig. 7. Stages of development process.
Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Finally, Figure 8 outlines the current and target land development.
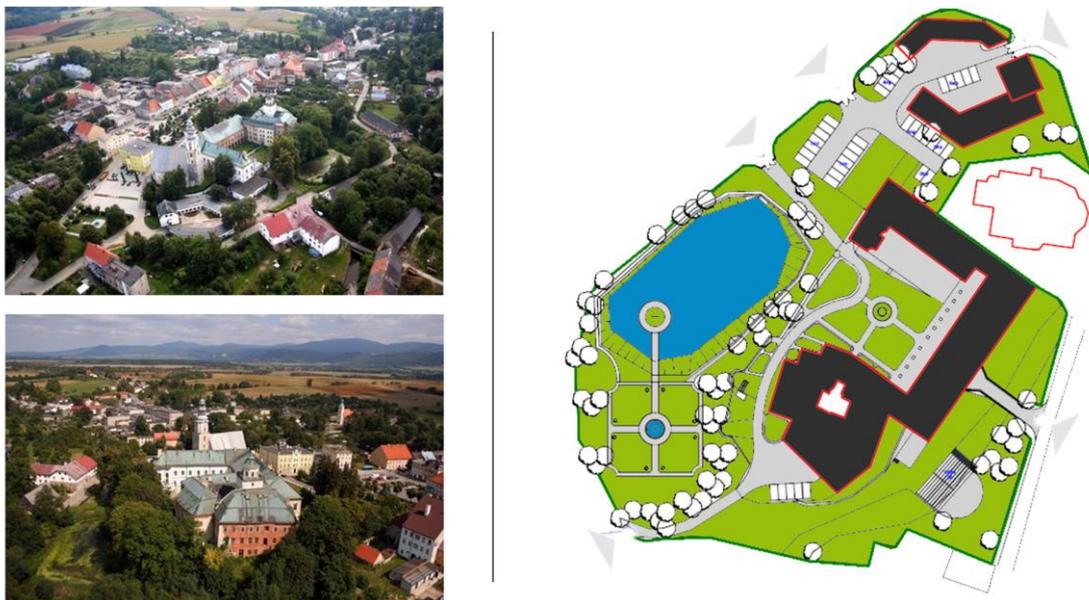


Fig. 8. Master plan
Source: own materials based on the approved master plan

The attempt of valuation in the comparative approach failed with respect to the presented castle and palace complex. No properties similar enough to the Międzylesie Castle could be found to carry out a valuation process by one of the comparative methods. The traditional income approach was also inadequate for this property. At the current stage of the development,

only a part of the property generates profit, and there are several thousand square meters left for revitalization. According to the Polish law, when there is no way to apply either the comparative approach or the classic income approach, then **the residual method** can be used. It has been done so, although the authors of this study think that it is the only appropriate method in such cases.

### 1.3.5. Procedure of determining the value of the palace

The following section presents the consecutive stages of valuation process. It presents the guidelines for valuation resulting from market analyses and the determination of input data for the residual model. The general formula of the residual method can be presented as the following equation (Interpretation Note No. 4 „Residual method in property valuation"*):

$$W_{N_I} = W_{N_{II}} - \left( W_{RB} + Z \right)$$

where:
1) $W_{N_I}$ - value of the property in its state at the time of valuation

2) $W_{NII}$ - value of the property after the completion of development

3) $\left( W_{RB} + Z \right)$ - total cost of development (construction costs with investor's profit).

The investor has completed STAGE I and has gained experience in relations with the authorities and designers, as well as experience with respect to costs and planning for the next stages. Presently, the owner utilizes part of the object as a hotel for 60 guests and a restaurant for up to 150 guests. Simultaneously, STAGE II of revitalization has begun. The investor has been granted the approval of the construction design, the building permit and the site record book. The construction started with the C Wing elevation on the courtyard's side, also the restoration of the ballroom and gallery in the B Wing. Offers of construction companies that deal with renovations of historic buildings have been collected. On the basis of offers and experiences from STAGE I, the construction costs for STAGE II have been estimated according to the construction design and the detailed design. At the close of STAGE II there should be, as the figure depicting the development process shows, a conference center with SPA and swimming pool in the basements, with an exit to the pond by the fortifications, which is a residue of the former moat. STAGE III, which does not yet have an approved construction design, has been based, in terms of planning the scope and costs, on the indices from STAGES I and II and on the concept created by the design studio.

Thus, the plan for stage II is certain and predictable, but the implementation of stage III is burdened with a risk of receiving the building permit. Therefore, the decision was made to divide not only the investment, but also its valuation, into stages. Input data for stage II model is far more plausible than for stage III model, particularly when it comes to dimension parameters of the property being developed. Moreover, there are no offers for construction at stage III and the costs could be estimated only in relation to previous stages.

### 1.3.6. Problem with collecting reliable data

Data is an important element that the manager of the property, the investor and the valuer need to seek on the market. It includes prices of services that the object offers at particular stages, occupancy and operating costs that are inherent in the hotel-restaurant business.

The property owner is aware of the ranges in the aforementioned areas at the current stage of the development. He is also aware that presently his target are clients of lower and middle segments. Once stage II is completed, the majority of facilities will serve upper and Premium segments. However, the calculations of value and profitability analysis of the investment do not include the Premium segment. Taking it into account is fairly risky, as this segment is rather unstable, prone to changing trends, and it is not sure whether such calculations would

eventually be confirmed in reality. Therefore, a safe assumption was made that only middle and upper segments will be the clients, and occupancy was assumed lower than average for such objects.

Service rates for stages II and III were adopted on the basis of an analysis of similar objects in the country. In the case of occupancy, publications are rarely available, so it is essential to rely on confidential information provided by clients who run similar businesses and have at some point commissioned such analyses. Consultancy companies can also exchange information. **Unfortunately, on the Polish market there is no institution that would collect, aggregate and give access to such data for investors and consultants who attempt to estimate the profitability of that kind of business.** The same problem appears when one tries to obtain information on rates of return on such investments. With an analysis relying on the profit method, information on the capitalization rate is necessary for valuation after development. The income on the property has to be capitalized. Valuers often determine capitalization rate on the basis of parametric formulas which in many cases is an invalid method. Quantification of risk remains highly intuitive and arbitrary. It would be more correct to relate the rate of return to other investments on the market. Unfortunately, also here the lack of an institution that would professionally collect data on a large scale is noticeable. For a model that determines the value of the property after development by profit (or investment) method and for a residual model that determines the current value of a property, more market data is needed, above all: the assumed profit of the developer, time span of development, costs pertaining to development, e.g. cost of external financing. All the mentioned data is essential for an accurate valuation of investment property, regardless of whether it is investment land or built-up property for development. It should be emphasized that the search for the aforementioned information undertaken by individual valuers may lead to the risk of errors and contributes to uncertainty in valuation and, by extension, uncertainty of the final outcome. Even though the valuer may collect all necessary data, he cannot entirely trust it. One can never be sure whether the final result is correct, when it is not certain if the market data conforms to the data inserted in the valuation model. Oftentimes valuers lack information, for instance, about capitalization rates from sold objects – what elements have been taken into account in calculation of income and expenses. This is an important element that shows the need for market analyses to be carried out by a specialized institution. Valuers assume, according to their knowledge, that data is compatible. However, without a detailed analysis of the way particular rates have been established, it is impossible to ensure the conformity of data. What is more, the uncertainty of the valuation result increases, as does the uncertainty of valuation process itself.

### 1.3.7. Valuation guidelines and models applied in the valuation of the palace

Property valuation should be in each case, according to the legal definition of market value, an attempt at treating the market objectively, reflecting the behaviors of buyers and sellers. Thus, it is important to demonstrate all crucial guidelines for valuation, i.e. input elements that represent the market and the way a valuer should consider them.

For the sake of this study, essential guidelines have been adopted on the basis of property market examination and the state of the property being valued. Numeral results of these analyses are mentioned further in the paper.

The presented guidelines stem from the analysis of local market and reflect typical behaviors on that market.

**General guidelines**
All the following values, costs, expenses etc. do not include VAT. Value of the property estimated in this study does not include VAT either.

*Highest and best use is the use of a property which is physically possible, appropriately justified, legally permissible financially feasible, and which results in the highest value of the property being valued* (The Appraisal of Real Estate; GRZESIK, ŹRÓBEK 2012). For the given property the most probable and profitable – optimal – use is the current one: a hotel with a restaurant and

additional services such as conference room rental, SPA, organization of events (first communion and wedding reception, corporate events etc.)

In order to determine value after development – completion of stages II and III – we used the income approach, profit method and simple capitalization technique (Interpretation Note No. 2, "Income approach in property valuation") Next, residual method was used for valuation of the property in its present state, on the day of valuation.

The valuation takes into consideration the investment potential of the property that results from the approval of construction design and building permit (stage II). Table 4 enumerates areas intended for revitalization at particular stages of the development.

Table 4: Inventory of area for revitalization in consecutive stages

| Building | Currently used area (stage I completed) [m²] | Area after stage II completion[m²] | Area after stages II & III completion[m²] |
|---|---|---|---|
| Building A | 0,00 | 3 185,89 | 3 956,35 |
| Building B | 156,94 | 1 059,21 | 2 516,91 |
| Building C | 1 031,42 | 1 031,42 | 1 411,42 |
| Building D | 215,49 | 215,49 | 215,49 |
| Building outside castle walls | 600,00 | 600,00 | 600,00 |
| Former boiler house and transformer station | 465,00 | 465,00 | 465,00 |
| Garages | 185,00 | 185,00 | 185,00 |
| Total | 2653,85 | 6 742,01 | 9 350,17 |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Values related to revenues and operating costs for the property after completion of stage III were set at the level of proportional area expansion due to the implementation of that stage in relation to the area after stage II, the index being 1,4281. In order to determine this relation only the income-generating areas were included (castle, administration building outside the castle walls), boiler house, transformer station and garages were excluded.

The scope of this study does not allow to present details of guidelines and market analyses for similar objects, which were the basis for calculation of input data parameters in the valuation model. Usually such a study is 100-200 pages long, including a minimum of information needed to convince the investor that the numbers in the model are correct. Elements such ase the number of rooms and service rates (prices on weekdays and weekends) for particular stages of development have been featured in a relatively detailed valuation model.

For stage III, accommodation structure has not been analyzed in detail, with increase estimated at 71 beds (only double rooms have been planned at that stage). The increase in costs and revenues was determined according to the aforementioned area expansion index.

Operating expense was calculated on the basis of market data and actual tax rates, as in Table 5.

Table 5: List of operating expenses

| Operating expense | Amount of operating expense after stage II [PLN] | Amount of operating expense after stage III [PLN] |
|---|---|---|
| Property tax - estimated | 97 021 | 130 144 |
| Perpetual usufruct charge | 2 500 | 2 500 |
| Current repairs and maintenance | 243 680 | 324 013 |
| Insurance and security | 20 000 | 30 000 |
| **Total operating expenses** | **363 201** | **486 657** |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

The owner's share in the income generated by the property was set at 70% of the income from operating activities. This percentage has been determined on the basis of the examination of hotel business in Poland.

On the basis of analyses of Polish and European markets, capitalization rate was set at 9%. It takes into account the risk related to investing in a historic property, as well as the property's large size, but it also demonstrates the object's potential. A typical capitalization rate for hotels would be higher, as these rates fluctuate between 6,5% and 9,5%, the most common being ca. 7,5%.

Direct construction costs at stage II have been determined on the basis of estimates by construction companies according to the construction design guidelines at the level of 11 500 000 PLN, and for stage III – 17 003 000 PLN (construction costs for stage III only, after the completion of stage II will amount to 5 503 000 PLN).

Costs of construction insurance are 0,1% of the direct construction costs (for both stages, II and III).

The time span for the completion of the investment was set at 1 year for stage II and 1,5 years for completing stage II and III (including preparation for construction and construction works). Opportunity cost, calculated by investors at the level of the cost of capital possible to obtain, in the residual method taking into account the time value of money, has been set at 6% per year. In accordance with the practice of the investment market, costs related to the acquisition of the property for development (current stage I) were calculated as opportunity cost. This is calculated at the level of cost of capital. The cost was set at 6% per year and has been calculated for the whole time span of the investment – 1 year (stage II) or 1,5 years (stages II and III). The relevance of including that cost in calculation is related to the behaviors of buyers and reflects, as was seen earlier, the lost profits. A typical investor on the market does calculate this cost even if he does not acquire any external financing (cost understood as opportunity cost).

The investor's profit was set at 20% of all the investment costs, including the cost of capital for development, property taxes and perpetual usufruct charge. It reflects typical investor behaviors for similar investments on the day of valuation. The investor's profit on the developed property is set at 3% (opportunity cost of investing the capital at the current deposit market). Due to the scope of the material, this paper does not exhaustively discuss all the costs involved in the investment. However, the tables include all necessary costs and their amounts.

The index of revitalized area in income-generating buildings after the completion of stage III was established on the basis of relation between the area of income-generating buildings after the completion of stage II and the area of these buildings after the completion of stage III (Table 6).

Table 6: List of revitalized areas

| No. | Specification | Area | Unit |
|---|---|---|---|
| 1 | Stage I and II area - castle | 5 492,01 | m² |
| 2 | Area of the building outside castle walls | 600,00 | m² |
| 3 | Area after stage II (no. 1+2) | 6 092,01 | m² |
| 4 | Additional area produced in stage III - castle | 2608,16 | m² |
| 5 | Area after stage III (no. 3+4) | 8 700,17 | m² |
| 6 | Area expansion index (no. 5/3) | 1,4281 | - |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

A detailed analysis of the market and of the sales possibilities for services offered at particular stages has allowed to determine revenues in reference to the planned standard of services and market demand for these services, with maintaining the prudence principle both in the case of rates and occupancy (Table 7).

Table 7: List of revenues received from business activity after the completion of stages II and III

| Type of operating revenue | Amount after stage II completion [PLN] | Amount after stages II & III completion [PLN] | Percentage of revenue in total revenue |
|---|---|---|---|
| Total revenue - rooms | 2 936 576 | 4 193 806 | 39,4% |
| Total revenue - SPA and FITNESS | 1 007 400 | 1 438 696 | 13,5% |
| Total revenue – conference rooms | 66 816 | 95 422 | 0,9% |
| Total revenue – wedding receptions | 264 000 | 377 026 | 3,5% |
| Total revenue – first communion receptions | 21 000 | 29 991 | 0,3% |
| Total revenue - restaurant | 1 401 625 | 2 001 700 | 18,8% |
| Total revenue – other events | 1 547 235 | 2 209 650 | 20,7% |
| Other - 3% EDB (extra alcohol, extra wedding services, IT services etc.) | 217 340 | 310 389 | 2,9% |
| **Total revenue from the activity** | **7 461 992** | **10 656 680** | **100%** |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Costs of purchasing (goods, materials) services, as well as the employees' salary have been determined, on the basis of a market analysis of hotels and restaurants and similar historic sites, at 50% of the operating revenues. The adopted quantities are presented in Table 8 which shows the valuation of the property after the completion of particular stages, carried out by the simple capitalization technique (profit method).

Table 8: Property valuation after the completion of particular development stages

| Specification | Value after stage II completion [PLN] | Value after stages II & III completion [PLN] |
|---|---|---|
| **Revenues received by the user from business activity** | | |
| **Sale revenues including:** | **7 461 992** | **10 656 680** |
| rooms | 2 936 576 | 4 193 806 |
| SPA and fitness | 1 007 400 | 1 438 696 |
| conference rooms | 66 816 | 95 422 |
| wedding receptions | 264 000 | 377 026 |
| first communion receptions | 21 000 | 29 991 |
| restaurant | 1 401 625 | 2 001 700 |
| other events | 1 547 235 | 2 209 650 |
| other | 217 340 | 310 389 |
| **Costs of purchasing (goods, materials) services and employees' salary** | | |
| **Purchase costs including:** | **3 730 996** | **5 328 340** |
| rooms | 1 468 288 | 2 096 903 |
| SPA and fitness | 503 700 | 719 348 |
| conference rooms | 33 408 | 47 711 |
| wedding receptions | 132 000 | 188 513 |
| first communion receptions | 10 500 | 14 995 |
| restaurant | 700 813 | 1 000 850 |
| other events | 773 618 | 1 104 825 |
| other | 108 670 | 155 195 |
| **User's gross income** | | |
| **Result on sales (gross income)** | **3 730 996** | **5 328 340** |
| **Operating expenses** | | |
| **Operating expenses, including:** | **363 201** | **486 657** |
| Property tax (buildings and land) | 97 021 | 130 144 |
| Perpetual usufruct charge | 2 500 | 2 500 |

| | | |
|---|---|---|
| Current repairs and maintenance | 243 680 | 324 013 |
| Insurance and security | 20 000 | 30 000 |
| | | |
| **Total costs of purchasing (goods, materials) services, employees' salary and operating expenses** | | |
| Cost of purchase related to business activity and operating expenses total | 4 094 197 | 5 814 997 |
| **User's net operating income (gross income – operating expenses)** | | |
| **Net operating income** | **3 367 795** | **4 841 683** |
| **NOI (per month)** | **280 650** | **403 474** |
| **Owner's share in user's net income** | | |
| | | |
| **Owner's share 70% - per year** | **2 357 457** | **3 389 178** |
| **Owner's share 70% - per month** | **196 455** | **282 431** |
| Estimation of value of the property | | |
| **Net income of the property(CF)** | **2 357 457** | **3 389 178** |
| Capitalization rate | 9% | 9% |
| **Value of the property possible to achieve on the market on the day of valuation with the assumption of completed development** | **26 193 961** | **37 657 533** |
| **Assumed value of the property after completion of the development** | **26 194 000** | **37 658 000** |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

### 1.3.8. Sensitivity analysis concerning the development of the property

Tables 9 and 10 show examples of sensitivity analysis that demonstrates a change in the value of the property after the completion of stages II and III with regard to a change of parameters: occupancy on weekdays and costs related to business activity (purchase costs) together with operating expenses after the completion of respective stages. The results for a given value within the valuation guidelines are marked in blue and pink.

Table 9: Sensitivity analysis – state after completion of stage II

| | | Occupancy on weekdays after completion of stage II | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 55% | 60% | 65% | 70% |
| | 2 000 000 | 37 770 000 | 40 126 000 | 42 482 000 | 44 838 000 | 47 194 000 | 49 551 000 | 51 907 000 | 54 263 000 | 56 619 000 | 58 975 000 | 61 331 000 |
| | 2 200 000 | 36 214 000 | 38 570 000 | 40 927 000 | 43 283 000 | 45 639 000 | 47 995 000 | 50 351 000 | 52 707 000 | 55 063 000 | 57 420 000 | 59 776 000 |
| | 2 400 000 | 34 659 000 | 37 015 000 | 39 371 000 | 41 727 000 | 44 083 000 | 46 439 000 | 48 796 000 | 51 152 000 | 53 508 000 | 55 864 000 | 58 220 000 |
| | 2 600 000 | 33 103 000 | 35 459 000 | 37 815 000 | 40 172 000 | 42 528 000 | 44 884 000 | 47 240 000 | 49 596 000 | 51 952 000 | 54 308 000 | 56 665 000 |
| | 2 800 000 | 31 548 000 | 33 904 000 | 36 260 000 | 38 616 000 | 40 972 000 | 43 328 000 | 45 684 000 | 48 041 000 | 50 397 000 | 52 753 000 | 55 109 000 |
| | 3 000 000 | 29 992 000 | 32 348 000 | 34 704 000 | 37 060 000 | 39 417 000 | 41 773 000 | 44 129 000 | 46 485 000 | 48 841 000 | 51 197 000 | 53 553 000 |
| | 3 200 000 | 28 437 000 | 30 793 000 | 33 149 000 | 35 505 000 | 37 861 000 | 40 217 000 | 42 573 000 | 44 930 000 | 47 286 000 | 49 642 000 | 51 998 000 |
| | 3 400 000 | 26 881 000 | 29 237 000 | 31 593 000 | 33 949 000 | 36 306 000 | 38 662 000 | 41 018 000 | 43 374 000 | 45 730 000 | 48 086 000 | 50 442 000 |
| Costs related to | 3 600 000 | 25 325 000 | 27 682 000 | 30 038 000 | 32 394 000 | 34 750 000 | 37 106 000 | 39 462 000 | 41 818 000 | 44 175 000 | 46 531 000 | 48 887 000 |
| business activity | 3 800 000 | 23 770 000 | 26 126 000 | 28 482 000 | 30 838 000 | 33 194 000 | 35 551 000 | 37 907 000 | 40 263 000 | 42 619 000 | 44 975 000 | 47 331 000 |
| (purchase costs) | 4 000 000 | 22 214 000 | 24 570 000 | 26 927 000 | 29 283 000 | 31 639 000 | 33 995 000 | 36 351 000 | 38 707 000 | 41 063 000 | 43 420 000 | 45 776 000 |
| with operating | 4 094 197 | 21 482 000 | 23 838 000 | 26 194 000 | 28 550 000 | 30 906 000 | 33 262 000 | 35 618 000 | 37 975 000 | 40 331 000 | 42 687 000 | 45 043 000 |
| expenses after | 4 400 000 | 19 103 000 | 21 459 000 | 23 815 000 | 26 172 000 | 28 528 000 | 30 884 000 | 33 240 000 | 35 596 000 | 37 952 000 | 40 308 000 | 42 665 000 |
| completion of | 4 600 000 | 17 548 000 | 19 904 000 | 22 260 000 | 24 616 000 | 26 972 000 | 29 328 000 | 31 684 000 | 34 041 000 | 36 397 000 | 38 753 000 | 41 109 000 |
| stage II | 4 800 000 | 15 992 000 | 18 348 000 | 20 704 000 | 23 060 000 | 25 417 000 | 27 773 000 | 30 129 000 | 32 485 000 | 34 841 000 | 37 197 000 | 39 553 000 |
| | 5 000 000 | 14 437 000 | 16 793 000 | 19 149 000 | 21 505 000 | 23 861 000 | 26 217 000 | 28 573 000 | 30 930 000 | 33 286 000 | 35 642 000 | 37 998 000 |
| | 5 200 000 | 12 881 000 | 15 237 000 | 17 593 000 | 19 949 000 | 22 306 000 | 24 662 000 | 27 018 000 | 29 374 000 | 31 730 000 | 34 086 000 | 36 442 000 |
| | 5 400 000 | 11 325 000 | 13 682 000 | 16 038 000 | 18 394 000 | 20 750 000 | 23 106 000 | 25 462 000 | 27 818 000 | 30 175 000 | 32 531 000 | 34 887 000 |
| | 5 600 000 | 9 770 000 | 12 126 000 | 14 482 000 | 16 838 000 | 19 194 000 | 21 551 000 | 23 907 000 | 26 263 000 | 28 619 000 | 30 975 000 | 33 331 000 |
| | 5 800 000 | 8 214 000 | 10 570 000 | 12 927 000 | 15 283 000 | 17 639 000 | 19 995 000 | 22 351 000 | 24 707 000 | 27 063 000 | 29 420 000 | 31 776 000 |
| | 6 000 000 | 6 659 000 | 9 015 000 | 11 371 000 | 13 727 000 | 16 083 000 | 18 439 000 | 20 796 000 | 23 152 000 | 25 508 000 | 27 864 000 | 30 220 000 |
| | 6 200 000 | 5 103 000 | 7 459 000 | 9 815 000 | 12 172 000 | 14 528 000 | 16 884 000 | 19 240 000 | 21 596 000 | 23 952 000 | 26 308 000 | 28 665 000 |
| | 6 400 000 | 3 548 000 | 5 904 000 | 8 260 000 | 10 616 000 | 12 972 000 | 15 328 000 | 17 684 000 | 20 041 000 | 22 397 000 | 24 753 000 | 27 109 000 |
| | 6 600 000 | 1 992 000 | 4 348 000 | 6 704 000 | 9 060 000 | 11 417 000 | 13 773 000 | 16 129 000 | 18 485 000 | 20 841 000 | 23 197 000 | 25 553 000 |
| | 6 800 000 | 437 000 | 2 793 000 | 5 149 000 | 7 505 000 | 9 861 000 | 12 217 000 | 14 573 000 | 16 930 000 | 19 286 000 | 21 642 000 | 23 998 000 |
| | 7 000 000 | -1 119 000 | 1 237 000 | 3 593 000 | 5 949 000 | 8 306 000 | 10 662 000 | 13 018 000 | 15 374 000 | 17 730 000 | 20 086 000 | 22 442 000 |
| | 7 200 000 | -2 675 000 | -318 000 | 2 038 000 | 4 394 000 | 6 750 000 | 9 106 000 | 11 462 000 | 13 818 000 | 16 175 000 | 18 531 000 | 20 887 000 |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Table 10: Sensitivity analysis – state after completion of stages II and III

| | | Occupancy on weekdays after completion of stage II and III | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 55% | 60% | 65% | 70% |
| | 2 000 000 | 60 600 000 | 63 965 000 | 67 330 000 | 70 695 000 | 74 059 000 | 77 424 000 | 80 789 000 | 84 154 000 | 87 519 000 | 90 884 000 | 94 249 000 |
| | 2 200 000 | 59 044 000 | 62 409 000 | 65 774 000 | 69 139 000 | 72 504 000 | 75 869 000 | 79 234 000 | 82 599 000 | 85 963 000 | 89 328 000 | 92 693 000 |
| | 2 400 000 | 57 489 000 | 60 854 000 | 64 219 000 | 67 583 000 | 70 948 000 | 74 313 000 | 77 678 000 | 81 043 000 | 84 408 000 | 87 773 000 | 91 138 000 |
| | 2 600 000 | 55 933 000 | 59 298 000 | 62 663 000 | 66 028 000 | 69 393 000 | 72 758 000 | 76 122 000 | 79 487 000 | 82 852 000 | 86 217 000 | 89 582 000 |
| | 2 800 000 | 54 378 000 | 57 743 000 | 61 108 000 | 64 472 000 | 67 837 000 | 71 202 000 | 74 567 000 | 77 932 000 | 81 297 000 | 84 662 000 | 88 026 000 |
| | 3 000 000 | 52 822 000 | 56 187 000 | 59 552 000 | 62 917 000 | 66 282 000 | 69 647 000 | 73 011 000 | 76 376 000 | 79 741 000 | 83 106 000 | 86 471 000 |
| | 3 200 000 | 51 267 000 | 54 632 000 | 57 996 000 | 61 361 000 | 64 726 000 | 68 091 000 | 71 456 000 | 74 821 000 | 78 186 000 | 81 550 000 | 84 915 000 |
| Costs related to business activity (purchase costs) with operating expenses after completion of stage II and III | 3 400 000 | 49 711 000 | 53 076 000 | 56 441 000 | 59 806 000 | 63 171 000 | 66 535 000 | 69 900 000 | 73 265 000 | 76 630 000 | 79 995 000 | 83 360 000 |
| | 3 600 000 | 48 156 000 | 51 520 000 | 54 885 000 | 58 250 000 | 61 615 000 | 64 980 000 | 68 345 000 | 71 710 000 | 75 074 000 | 78 439 000 | 81 804 000 |
| | 3 800 000 | 46 600 000 | 49 965 000 | 53 330 000 | 56 695 000 | 60 059 000 | 63 424 000 | 66 789 000 | 70 154 000 | 73 519 000 | 76 884 000 | 80 249 000 |
| | 4 000 000 | 45 044 000 | 48 409 000 | 51 774 000 | 55 139 000 | 58 504 000 | 61 869 000 | 65 234 000 | 68 599 000 | 71 963 000 | 75 328 000 | 78 693 000 |
| | 4 200 000 | 43 489 000 | 46 854 000 | 50 219 000 | 53 583 000 | 56 948 000 | 60 313 000 | 63 678 000 | 67 043 000 | 70 408 000 | 73 773 000 | 77 138 000 |
| | 4 400 000 | 41 933 000 | 45 298 000 | 48 663 000 | 52 028 000 | 55 393 000 | 58 758 000 | 62 122 000 | 65 487 000 | 68 852 000 | 72 217 000 | 75 582 000 |
| | 4 600 000 | 40 378 000 | 43 743 000 | 47 108 000 | 50 472 000 | 53 837 000 | 57 202 000 | 60 567 000 | 63 932 000 | 67 297 000 | 70 662 000 | 74 026 000 |
| | 4 800 000 | 38 822 000 | 42 187 000 | 45 552 000 | 48 917 000 | 52 282 000 | 55 647 000 | 59 011 000 | 62 376 000 | 65 741 000 | 69 106 000 | 72 471 000 |
| | 5 000 000 | 37 267 000 | 40 632 000 | 43 996 000 | 47 361 000 | 50 726 000 | 54 091 000 | 57 456 000 | 60 821 000 | 64 186 000 | 67 550 000 | 70 915 000 |
| | 5 200 000 | 35 711 000 | 39 076 000 | 42 441 000 | 45 806 000 | 49 171 000 | 52 535 000 | 55 900 000 | 59 265 000 | 62 630 000 | 65 995 000 | 69 360 000 |
| | 5 400 000 | 34 156 000 | 37 520 000 | 40 885 000 | 44 250 000 | 47 615 000 | 50 980 000 | 54 345 000 | 57 710 000 | 61 074 000 | 64 439 000 | 67 804 000 |
| | 5 600 000 | 32 600 000 | 35 965 000 | 39 330 000 | 42 695 000 | 46 059 000 | 49 424 000 | 52 789 000 | 56 154 000 | 59 519 000 | 62 884 000 | 66 249 000 |
| | 5 814 997 | 30 928 000 | 34 293 000 | 37 658 000 | 41 022 000 | 44 387 000 | 47 752 000 | 51 117 000 | 54 482 000 | 57 847 000 | 61 212 000 | 64 576 000 |
| | 6 000 000 | 29 489 000 | 32 854 000 | 36 219 000 | 39 583 000 | 42 948 000 | 46 313 000 | 49 678 000 | 53 043 000 | 56 408 000 | 59 773 000 | 63 138 000 |
| | 6 200 000 | 27 933 000 | 31 298 000 | 34 663 000 | 38 028 000 | 41 393 000 | 44 758 000 | 48 122 000 | 51 487 000 | 54 852 000 | 58 217 000 | 61 582 000 |
| | 6 400 000 | 26 378 000 | 29 743 000 | 33 108 000 | 36 472 000 | 39 837 000 | 43 202 000 | 46 567 000 | 49 932 000 | 53 297 000 | 56 662 000 | 60 026 000 |
| | 6 600 000 | 24 822 000 | 28 187 000 | 31 552 000 | 34 917 000 | 38 282 000 | 41 647 000 | 45 011 000 | 48 376 000 | 51 741 000 | 55 106 000 | 58 471 000 |
| | 6 800 000 | 23 267 000 | 26 632 000 | 29 996 000 | 33 361 000 | 36 726 000 | 40 091 000 | 43 456 000 | 46 821 000 | 50 186 000 | 53 550 000 | 56 915 000 |
| | 7 000 000 | 21 711 000 | 25 076 000 | 28 441 000 | 31 806 000 | 35 171 000 | 38 535 000 | 41 900 000 | 45 265 000 | 48 630 000 | 51 995 000 | 55 360 000 |
| | 7 200 000 | 20 156 000 | 23 520 000 | 26 885 000 | 30 250 000 | 33 615 000 | 36 980 000 | 40 345 000 | 43 710 000 | 47 074 000 | 50 439 000 | 53 804 000 |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Another element of the residual method model that uses the previously determined values after the consecutive development stages is an accurate residual calculation carried out for respective development stages.

At this stage of calculation it is assumed that the development will occur only throughout stage II and the present value of the property will be determined by the work done at stage I and the work that is to be done at stage II. This value will not include the potential of stage III and the fact that the buyer would acquire the entire present area of the castle (over 9 000 $m^2$) while paying (theoretically) for 8100 $m^2$.

Next, the same calculations were carried out with the use of the residual method and with the assumed completion of stage III. Table 11 presents a model only for stage III. Further, the study will demonstrate joint results for both stages.

Table 11: Property valuation for completion of stage III only

| Specification | Quantity | Unit |
|---|---|---|
| **Property – basic data:** | | |
| Area of the property (plot) being valued | 17 800,00 | $m^2$ |
| **Investment data after the completion of stages II and III:** | | |
| Usable area of building A | 3 956,35 | $m^2$ |
| Usable area of building B | 2 516,91 | $m^2$ |
| Usable area of building C | 1 411,42 | $m^2$ |
| Usable area of building D | 215,49 | $m^2$ |
| Area of administration building | 600,00 | $m^2$ |
| Area of boiler house and transformer station | 465,00 | $m^2$ |
| Area of garages | 185,00 | $m^2$ |
| **Value of the property after completion of investment:** | | |
| **Value of the property after completion of investment** | **37 658 000,00** | PLN/$m^2$ |
| **Direct construction costs:** | | |
| Direct construction costs for stages II and III | 17 003 000,00 | PLN |
| **Direct construction costs total** | **17 003 000,00** | PLN |
| **Remaining investment costs – basic data:** | | |
| Costs of design, supervision, land surveying | 2,00% | of dir. const. costs |
| Cost of construction insurance | 0,10% | of dir. const. costs |
| General costs and reserve | 7,00% | of dir. const. |

|  |  | costs |
|---|---:|---|
| Time span of the investment since the day of valuation | 1,5 | years |
| **Remaining investment costs and expenses on the property at the time of development:** | | |
| Costs of design, supervision, land surveying (amount) | 110 100,00 | PLN |
| Cost of construction insurance (amount) | 17 000,00 | PLN |
| General costs and reserve (amount) | 1 190 200,00 | PLN |
| **Total list of costs and expenses related to development, without the cost of capital and selling costs:** | | |
| Direct construction cost + remaining investment costs | 18 320 300,00 | PLN |
| Property tax | 12 000,00 | PLN |
| Perpetual usufruct charge | 2 500,00 | PLN |
| **Total costs and expenses** | **18 334 800,00** | PLN |
| **Total list of costs and expenses with the cost of capital, selling cost and marketing:** | | |
| Interest rate of loans for construction (market cost of capital reflecting opportunity costs of investing the capital elsewhere on the market, showing the time value of money) | 6,0% | per year |
| Cost of capital | 825 100,00 | PLN |
| Selling costs with marketing cost (percentage of final value after completion of the development) | 1,5% | |
| Selling costs with marketing cost | 564 900,00 | PLN |
| **Total construction costs without the developer's profit and costs of land acquisition (property for development)** | **19 724 800,00** | PLN |
| **List of total investment costs with the cost of capital and the developer's profit:** | | |
| Developer's profit on costs of improvement | 20,00% | |
| Developer's profit on costs of improvement | 3 945 000,00 | PLN |
| Total construction costs with the developer's profit, without the cost of property acquisition | 23 669 800,00 | PLN |
| **Value of residue:** | **13 988 200,00** | PLN |
| **Costs related to land acquisition (property for development):** | | |
| Total index of the price of the property acquired for development in its present state in relation to the value of residue (formula of 1 PLN engagement in investment) | 1,1466 | |
| Residual price of the property for development by formula of 1 PLN engagement in investment | 1 | |
| Costs of property purchase (including agents' fees, legal, notarial and court fees that apply with the purchase of the property) - percentage | 2,00% | |
| Residual price of the property for development plus costs of property purchase | 1,0200 | |
| Cost of capital for property purchase (in present state) at the beginning of investment and cost of maintaining it throughout the investment until sale, with yearly capitalization by the market possibility of capital acquisition | 1,0913 | |
| Developer's profit on the cost of the property in its present state | 3% | |
| Index of developer's profit on the cost of the property in its present state | 1,0300 | |
| **Calculated residual value of the property in its present state** | **12 199 721,00** | **PLN** |
| **Value of the property** | **12 200 000,00** | **PLN** |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Table 12 presents a sensitivity analysis that shows a change in the property's value (by its present state), taking into consideration the development potential resulting from stages II and III. The analysis depends on the change of parameters: values after completion of stage III and direct costs of development. Results for market value from the residual model that was presented above (Table 11), with adopted valuation guidelines, are marked in blue and pink.

Table 12: Sensitivity analysis by the present technical and functional state of the property

| Value after completion of investment | Direct construction costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 14 500 000 | 15 000 000 | 15 500 000 | 16 000 000 | 16 500 000 | 17 003 000 | 17 500 000 | 18 000 000 | 18 500 000 | 19 000 000 |
| 32 000 000 | 10 300 000,00 | 9 700 000,00 | 9 100 000,00 | 8 500 000,00 | 7 900 000,00 | 7 400 000,00 | 6 800 000,00 | 6 200 000,00 | 5 600 000,00 | 5 000 000,00 |
| 32 500 000 | 10 700 000,00 | 10 100 000,00 | 9 500 000,00 | 9 000 000,00 | 8 400 000,00 | 7 800 000,00 | 7 200 000,00 | 6 600 000,00 | 6 000 000,00 | 5 400 000,00 |
| 33 000 000 | 11 100 000,00 | 10 600 000,00 | 10 000 000,00 | 9 400 000,00 | 8 800 000,00 | 8 200 000,00 | 7 600 000,00 | 7 000 000,00 | 6 500 000,00 | 5 900 000,00 |
| 33 500 000 | 11 600 000,00 | 11 000 000,00 | 10 400 000,00 | 9 800 000,00 | 9 200 000,00 | 8 600 000,00 | 8 100 000,00 | 7 500 000,00 | 6 900 000,00 | 6 300 000,00 |
| 34 000 000 | 12 000 000,00 | 11 400 000,00 | 10 800 000,00 | 10 200 000,00 | 9 700 000,00 | 9 100 000,00 | 8 500 000,00 | 7 900 000,00 | 7 300 000,00 | 6 700 000,00 |
| 34 500 000 | 12 400 000,00 | 11 800 000,00 | 11 300 000,00 | 10 700 000,00 | 10 100 000,00 | 9 500 000,00 | 8 900 000,00 | 8 300 000,00 | 7 700 000,00 | 7 200 000,00 |
| 35 000 000 | 12 900 000,00 | 12 300 000,00 | 11 700 000,00 | 11 100 000,00 | 10 500 000,00 | 9 900 000,00 | 9 300 000,00 | 8 800 000,00 | 8 200 000,00 | 7 600 000,00 |
| 35 500 000 | 13 300 000,00 | 12 700 000,00 | 12 100 000,00 | 11 500 000,00 | 10 900 000,00 | 10 400 000,00 | 9 800 000,00 | 9 200 000,00 | 8 600 000,00 | 8 000 000,00 |
| 36 000 000 | 13 700 000,00 | 13 100 000,00 | 12 500 000,00 | 12 000 000,00 | 11 400 000,00 | 10 800 000,00 | 10 200 000,00 | 9 600 000,00 | 9 000 000,00 | 8 400 000,00 |
| 36 500 000 | 14 100 000,00 | 13 600 000,00 | 13 000 000,00 | 12 400 000,00 | 11 800 000,00 | 11 200 000,00 | 10 600 000,00 | 10 000 000,00 | 9 500 000,00 | 8 900 000,00 |
| 37 000 000 | 14 600 000,00 | 14 000 000,00 | 13 400 000,00 | 12 800 000,00 | 12 200 000,00 | 11 600 000,00 | 11 100 000,00 | 10 500 000,00 | 9 900 000,00 | 9 300 000,00 |
| 37 658 000 | 15 100 000,00 | 14 500 000,00 | 14 000 000,00 | 13 400 000,00 | 12 800 000,00 | 12 200 000,00 | 11 600 000,00 | 11 000 000,00 | 10 400 000,00 | 9 900 000,00 |
| 38 000 000 | 15 400 000,00 | 14 800 000,00 | 14 300 000,00 | 13 700 000,00 | 13 100 000,00 | 12 500 000,00 | 11 900 000,00 | 11 300 000,00 | 10 700 000,00 | 10 200 000,00 |
| 38 500 000 | 15 900 000,00 | 15 300 000,00 | 14 700 000,00 | 14 100 000,00 | 13 500 000,00 | 12 900 000,00 | 12 300 000,00 | 11 800 000,00 | 11 200 000,00 | 10 600 000,00 |
| 39 000 000 | 16 300 000,00 | 15 700 000,00 | 15 100 000,00 | 14 500 000,00 | 13 900 000,00 | 13 300 000,00 | 12 800 000,00 | 12 200 000,00 | 11 600 000,00 | 11 000 000,00 |
| 39 500 000 | 16 700 000,00 | 16 100 000,00 | 15 500 000,00 | 15 000 000,00 | 14 400 000,00 | 13 800 000,00 | 13 200 000,00 | 12 600 000,00 | 12 000 000,00 | 11 400 000,00 |
| 40 000 000 | 17 100 000,00 | 16 600 000,00 | 16 000 000,00 | 15 400 000,00 | 14 800 000,00 | 14 200 000,00 | 13 600 000,00 | 13 000 000,00 | 12 500 000,00 | 11 900 000,00 |
| 40 500 000 | 17 600 000,00 | 17 000 000,00 | 16 400 000,00 | 15 800 000,00 | 15 200 000,00 | 14 600 000,00 | 14 100 000,00 | 13 500 000,00 | 12 900 000,00 | 12 300 000,00 |
| 41 000 000 | 18 000 000,00 | 17 400 000,00 | 16 800 000,00 | 16 200 000,00 | 15 700 000,00 | 15 100 000,00 | 14 500 000,00 | 13 900 000,00 | 13 300 000,00 | 12 700 000,00 |
| 41 500 000 | 18 400 000,00 | 17 800 000,00 | 17 300 000,00 | 16 700 000,00 | 16 100 000,00 | 15 500 000,00 | 14 900 000,00 | 14 300 000,00 | 13 700 000,00 | 13 200 000,00 |
| 42 000 000 | 18 900 000,00 | 18 300 000,00 | 17 700 000,00 | 17 100 000,00 | 16 500 000,00 | 15 900 000,00 | 15 300 000,00 | 14 800 000,00 | 14 200 000,00 | 13 600 000,00 |
| 42 500 000 | 19 300 000,00 | 18 700 000,00 | 18 100 000,00 | 17 500 000,00 | 16 900 000,00 | 16 300 000,00 | 15 800 000,00 | 15 200 000,00 | 14 600 000,00 | 14 000 000,00 |
| 43 000 000 | 19 700 000,00 | 19 100 000,00 | 18 500 000,00 | 17 900 000,00 | 17 400 000,00 | 16 800 000,00 | 16 200 000,00 | 15 600 000,00 | 15 000 000,00 | 14 400 000,00 |
| 43 500 000 | 20 100 000,00 | 19 500 000,00 | 19 000 000,00 | 18 400 000,00 | 17 800 000,00 | 17 200 000,00 | 16 600 000,00 | 16 000 000,00 | 15 400 000,00 | 14 900 000,00 |
| 44 000 000 | 20 600 000,00 | 20 000 000,00 | 19 400 000,00 | 18 800 000,00 | 18 200 000,00 | 17 600 000,00 | 17 000 000,00 | 16 500 000,00 | 15 900 000,00 | 15 300 000,00 |
| 44 500 000 | 21 000 000,00 | 20 400 000,00 | 19 800 000,00 | 19 200 000,00 | 18 600 000,00 | 18 100 000,00 | 17 500 000,00 | 16 900 000,00 | 16 300 000,00 | 15 700 000,00 |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

Table 13 presents measures of the planned investment for the property being valued, for particular stages of development.

Table 13: Measures of investment

| Specification | Value after completion of stage II | Value after completion of stages II and III |
|---|---|---|
| Developer's profit on the investment at respective stages | 2 900 800 | 4 311 000 |
| Rate of return on invested capital | 12,56% | 13,07% |
| Direct investment costs | 11 500 000,00 | 17 003 000,00 |
| Sale revenues (per year) | 7 461 992 | 10 656 680 |
| Sale revenues (per month) | 621 833 | 888 057 |
| Costs of business activity with operating expenses – per year | 4 094 197 | 5 814 997 |
| Costs of business activity with operating expenses – per month | 341 183 | 484 583 |
| Net operating income – per year | 3 367 795 | 4 841 683 |
| Net operating income – per month | 280 650 | 403 474 |
| Operating income per month per m$^2$ on the area of castle and surrounding areas | 46 | 46 |
| Net operating income per year per bed on the area of castle and surrounding areas | 18 303 | 18 987 |
| Operating income per month per bed on the area of castle and surrounding areas | 1 525 | 1 582 |
| Costs and expenses without selling costs, marketing and cost of capital | 12 331 000 | 18 334 800 |
| Cost of capital on costs of construction | 369 900 | 825 100 |
| Selling costs with marketing cost | 392 900 | 564 900 |
| Costs and expenses with marketing cost and cost of capital | 13 093 800 | 19 724 800 |

| | | |
|---|---|---|
| Value of the property after completion of the development | **26 194 000** | **37 658 000** |
| Value of the property after completion of development per 1 m² of the entire property's area | **2 801,45** | **4 027,52** |
| Value of the property in its present state | **9 400 000** | **12 200 000** |
| Value of the property in its present state per 1 m² of the entire property's area | **1 005,33** | **1 304,79** |

Source: Źróbek, Adamiczka, Cellmer (2014) – unpublished.

### 1.3.9. Summary and conclusions

After the analysis of calculations carried out in relation to a specific castle and palace complex in Międzylesie, there emerges a question – what is its market value in the state on the date of calculations? If we assume that the valuation guidelines are "*physically possible, appropriately justified, legally permissible financially feasible, and result in the highest value of the property being valued*", then the palace's value equals 12 200 000 PLN. However, is that really so for certain? It is worth noticing that in valuations, the value is usually provided as a range of values. It is a similar practice among art valuers. And on the most transparent market in the world, the Stock Market, values of assets can change by several or even several dozen percent in one day.

Authors of this paper suggest that a similar rule is applied in Poland in property valuation as well. Indeed, in applying any valuation model, we need to determine quantities of input data. Then, we consider (just like the participants of the market) ranges in which that data would fit, e.g. capitalization rate level or prices of hotel rooms. Moreover, the value of the property itself changes, both the value after the development and the value at the present stage, depending on the change in market parameters that influence value. This has been demonstrated by a sensitivity analysis carried out in the study. The conclusion addresses further challenges of property valuation that must be tackled urgently, because valuation results are strictly connected with the profitability and safety of investments in the property market (Źróbek et al. 2013).

In the case study of the palace complex we are also dealing with a division of development into stages. Thus, if we assume that all parameters used in valuation, concerning input data for stage II of the development, were determined correctly (resulting from the approved construction design and tenders for its implementation), the value of the property is at least 9 400 000 PLN. It is possible to imagine a scenario in which an investor will stop at stage II or the scope of stage III will be narrower than the one planned in valuation. In this case, would a buyer pay 12 000 000 PLN for this property? If the "certain" stage II scenario generates a lesser value, and the "uncertain" yet optimal stage III scenario generates a greater value, it can be assumed that the value of the palace very likely can be estimated within a range between 9 400 000 PLN and 12 000 000 PLN.

Thus, have the authors of this article carried out a property valuation, or is it rather an element of value management? It can be seen that property valuation with the use of the residual method, supplemented by sensitivity analyses, not only provides information on value and its variability in relation to market parameters; it also allows to manage value. Therefore, it is helpful in property management for investors, banks and other institutions that give loans for property development.

Nevertheless, one must be aware of the limitations of the presented model. Sensitivity analysis shows the dependence of result on two parameters at a time. In a valuation model there are usually more variables. Then, how can we demonstrate the variability of value depending on a simultaneous change in many parameters in a way that would allow to easily manage such variability? It is an issue to be tackled perhaps in another study.

Furthermore, we should postulate the need for an institution that would collect, aggregate and provide public access to data that could be used by professionals in valuation models. It would increase transparency of the property market and investment market in general,

contributing to sustainable development of these markets and the market of historic properties as well.

Finally, it is worth emphasizing that restoration of historic buildings to the position of national heritage is a costly task, but also an important one. Investors who decide to engage in such activity should receive support, so that – as it happens in other European countries – the preservation and protection of cultural heritage was not perceived as an obstacle, but rather as an opportunity for local development, making places and landscapes more attractive and unique.

## 1.4. The importance of dominant variable in commercial and retail real estate value appraisal in the context of Recomendation J and changes in the plan of spatial management

The first shopping centers began to appear in the United States at the beginning of the twentieth century. In Central Europe, their development started after 1990 - that is only after the system transformation and introduction of the principles of the market economy (Makowski 2003). Domański (2005) emphasises that the modern shopping center is a new generation "product" and its specific nature consists, on one hand, in the accumulation of rich and diverse retail and service offer (Jałowiecki 2010) and the creation of improved architectonic and urban space for this offer, on the other.

In Kaczmarek's (2010) opinion, rational and effective spatial planning requires diagnosing concerning the performance of the basic urban functions and forms of land use. It applies particularly to those functions which remarkably affect not only the spatial arrangement but also the economy and social life of the city and, as a result, the whole urban organism and its surroundings.

Within the last few years an increasing attractiveness of the Polish market for the international retail chains may be observed. According to GfK Polonia, the purchasing power of a statistical Polish citizen in 2006 amounted to PLN 21.286, as compared to PLN 600 more four years later. In recent years, retail sale recorded visible growth. In 2008 it increased by 6.6 percent and in 2009 by 7.2 percent. In Spain, in the corresponding years, a decrease has been recorded (by -0.3 percent in 2009 and by -6.1 percent in 2010) as well as, for example, in Hungary (-3.6 percent in 2010) or Czech Republic (-0.6 percent). According to the CB Richard Ellis report, more than 30 percent of retail and service chains operating in Poland are international chains. Forecasts for the next years foresee strengthening of the position of international consortia market by about 10 percent annually. Large corporations invest mostly in big cities. The level of saturation with brands included into different categories is proportional to the size of the city. In Warsaw, the penetration indicator for all analysed brands exceeded 94 percent in 2012. In other agglomerations it remains at the level of 60 percent, whereas in the medium-sized cities it exceeded 30 percent. The coverage of the smallest markets is at the level of a dozen or so. The extensive growth of the retail chains position is accompanied by very low "official" profitability. In practice, enormous capital expenditure of the retail tycoons eliminates competition and monopolises the market. According to Maciej Ptaszyński, the managing director of the Polish Chamber of Commerce, "discount stores, which develop in an uncontrolled manner, are mostly responsible for the decrease of mobile sale points. As a result, there are localities in Poland, where there is only one discount store per 5 thousand inhabitants". It is considered that high retail sale and growing purchasing power of Polish citizens places Poland at a second position in Europe, right behind Germany, in terms of attractiveness for retail chains. According to the author, the main cause of this status quo is the absence of appropriate legal regulations protecting the domestic trade, which generates over 16 percent of GDP, making it the second largest GDP generating sector after industry and the third largest sector in terms of employment. The volume of expenditure reflects the retail chains' expansion in the clearest manner. According to Central Statistical Office, in 2009 foreign retail chains ran 2.6 percent of stores with total commercial space of 22.4 % of all commercial space in Poland.

The development of large-format stores together with tax privileges must, in longer time-perspective, lead to a complete domination on the market. Such situation cannot be without effect on the commercial real estate market. Total commercial space constitutes undoubtedly a good explanatory variable for both local and regional commercial and retail real estate market. According to the author, after exceeding certain values, it has the attributes of the dominant variable, which is the one that determines the market, therefore many other variables, hereto significant, have minimal significance for describing the actual conditions (reality). Among many possible dominant variables, the author defined one and, despite lack of sufficient data, proves that if one of the variables describing the reality exceeds certain value, it will completely

dominate the market. Domination on the market is nothing else than a monopoly and each monopoly leads to pathologies and negative social and economic effects. Since for each local market the same dominant variable may have individual value, the issue itself is very complex and requires more in-depth and extensive research.

### 1.4.1. Conceptual definition of dominant variable

Definition (author) – the dominant variable is an explanatory (component) variable which, after reaching strictly specified (individual) value for given market, determines the model describing the reality.

In everyday life, everyone can quote a list of variables, which have the attributes of a dominant variable. The simplest example of an independent variable may be health, allowing to explain credibly a number of decisions and activities of a human being. In his book *„Stres – wróg czy przyjaciel ?" ("Stress enemy or friend?"),* Zbigniew Karapuda claims that for most people at the oncology wards health is the only thing that counts. Any other previously defined goals become somehow irrelevant.

In economics, the phenomenon of dominant variable has been precisely described and appears under different names. Dominance and hegemony on the market are nothing else than monopoly, oligopoly and other varieties of the same phenomenon. Today, looking at the ascending dominance of the large-format store chains and their impact on local business, we can add such concepts as "retail chains" or "large-format store chains" to the list of synonyms of monopoly. Real estate market is a very important branch of national and local economy. Each imbalance may lead to many unfavorable circumstances for economy management and social order. There are many definitions of the free market. The simplest and most comprehensible definition says that "free market is when any entity entering or leaving the market causes no imbalance of its structure". According to this definition, if we ascertain the existence of a defining variable on the real-estate market, we cannot speak about the entirely free market with regard to this specific market. If an expert claims that, in a certain segment of the market, the mechanisms of free market are not functioning, the question arises: "to what extent can we utilise the statistical models to describe the reality?" This issue is extremely important for the banking sector, especially the banks' mortgage assets.

**Dominant variable in the context of Recommendation J**

In order to establish the conditions for the banks to ensure better protection of mortgage assets, the Financial Supervision Authority published "Recommendation J", based on section 137(5) of the Act of 29 August, 1997 - Banking Law (Dz.U. of 2002, No. 72, item 665, as amended) on good practices in managing the credit risk related with mortgage-backed credit exposures, regulating the banks' approach to the collection and processing of data on the real estate market comprised in banks' internal databases or interbank databases in order to manage the credit risk related with mortgage-backed credit exposures. Those regulations will be binding for all banks having more than 10% of mortgage-backed exposures in their credit portfolios or the mortgage-backed credit exposure portfolio exceeds 2% of the total mortgage-backed exposure for the whole banking sector in Poland. Safety of all kinds of financial services requires the highest possible accuracy within the mortgage value appraisal. It applies particularly to those institutions, which hold a significant share of mortgage-backed credit exposure portfolio in the bank's credit portfolios. Incorrect or erroneous mortgage values accepted by the banks pose a serious risk for the system safety. Indicating and defining the dominant variable is possible only with participation of the real estate market value appraisal experts. Even the best computer program cannot associate many different events which precede the occurrence problems on the local market. In order to avoid the negative effects for the banks as well as the significant adjustments of mortgage real estate price, it is essential to introduce an ongoing monitoring of the real estate market, especially in terms of the dominant variable occurrence. When the market is stable and predictable, local databases are usually sufficient enough for the bank's crediting purposes.

**Dominant variable in the context of Local Spatial Development Plan and administrative decisions**.

In order to achieve a stable and optimal progress rate of the commercial activity on their territory, the self-government units should introduce the Retail Plans. Those plans are always prepared based on the real estate market analyses as well as demographic prognoses. The Retail Plan is in fact the analysis of retail development effects, provided in both graphic and descriptive form. One might risk putting forward the thesis that "the self-government authorities do not need to care about the retail development, because it will care about itself". The self-government should care especially about the local trade and, as far as possible, foresee the results of locating new commercial facilities on its territory, especially considering the socioeconomic repercussions. It is important that the Retail Plan complies with specialist literature and expertise. Such plans should not be prepared ad hoc but in long-term perspective. In practice however, the Retail Plans or their substitutes are created at the expense of the investor, who designates a company to prepare the study. In such case no great reliability of the results can be expected. According to the author, acceptance of the Retail Plan by the self-government should be preceded by traditional urban indicators analysis described in specialist literature as well as the real estate market analysis complemented by the socioeconomic indicators analysis, supply and demand dynamics on the real estate market and thematic map analysis.

In numerous cities, the income from the tenancy of premises which belong to the self-government is a crucial part of the budget. Changing the real estate market structure may, in practice, mean that real estate in the local government's possession will not only bring no income, but it will generate loss due to maintenance of the facilities without any tenant.

For the local and national economy the monopolization of trade may, in consequence, lead to takeover and monopolization of production. It is easy to imagine that trade monopoly may, on one hand, lead to unjustified rise of the margins and on the other hand, to the buy-out of production companies being completely dependent on one output market. There were many examples of "hostile takeovers" of the producers by retail chains in global scale.

Thus the dominant variable, apart from purely exploratory aspect, may also serve as a sort of a proxy for free market level or even for democracy. Thus the dominant variable can be an important element during enacting the Retail Plan. In the opinion of the author, based on the self-government politics observation, it is necessary to implement the maximum development indicators for large-format stores on given territory on the legislative level. Those indicators should apply independently to gminas, poviats and voivodeships.

To specify the value of an independent variable, in order to classify it as a dominant variable, information about supply, demand, commercial space, trade structure, rent rates etc. should be acquired over at least a period of a few years. The main issue of concern in analyzing the problem is the general lack of sufficient data.

## 1.4.2. Proposals for mathematical definition of the dominant variable

In order to mathematically describe the *dominant variable* it is necessary to specify the rules (guidelines), boundary conditions (critical) and target to be accomplished by the variable. First, the independent (component) variables describing the model should be specified and defined. The component variables may be included in the model directly or may be used to calculate the dominant variable index (DVI). Comparison of the dominant variable index value with economic indicators and behavioural research over at least a period of a few years may allow for determining the value of the dominant variable. Assuming that the commercial space is being analysed in correlation with economic, demographic and behavioural indicators, in long-term perspective, the market value of the commercial space, which causes the exceeding of the critical value and significant adjustments of real estate prices as well as rent rates may be determined. If the commercial real estate market develops in a sustainable manner, as planned, for instance, in line with architectonical indicators, it may be impossible to set the index value empirically, but to estimate it at best.

In order to describe the problem more adequately, a model for marking out and calculating the dominant variable value is provided below.

**Stages of dominant variable (DV) value estimation.**
1. Marking out - from among independent variables describing the model - those which, after exceeding certain hypothetical values, may cause significant adjustments of the real estate prices and rents or social discontent on the given market (Dąbrowski 2013). Those variables, as opposed to independent variables, further in this study will be called "component variables".
2. Defining the dominant variable index (DVI) as a function of component variables.
3. DVI calculation and comparison with socioeconomic variables as well as behavioural research over a period of time that is as long as possible.
4. Estimating the dominant variable value, which when it is exceeded causes a significant adjustment of real estate prices and rent rates as well as rises social discontent.
5. Adjusting the statistical model describing the market using the dominant variable.
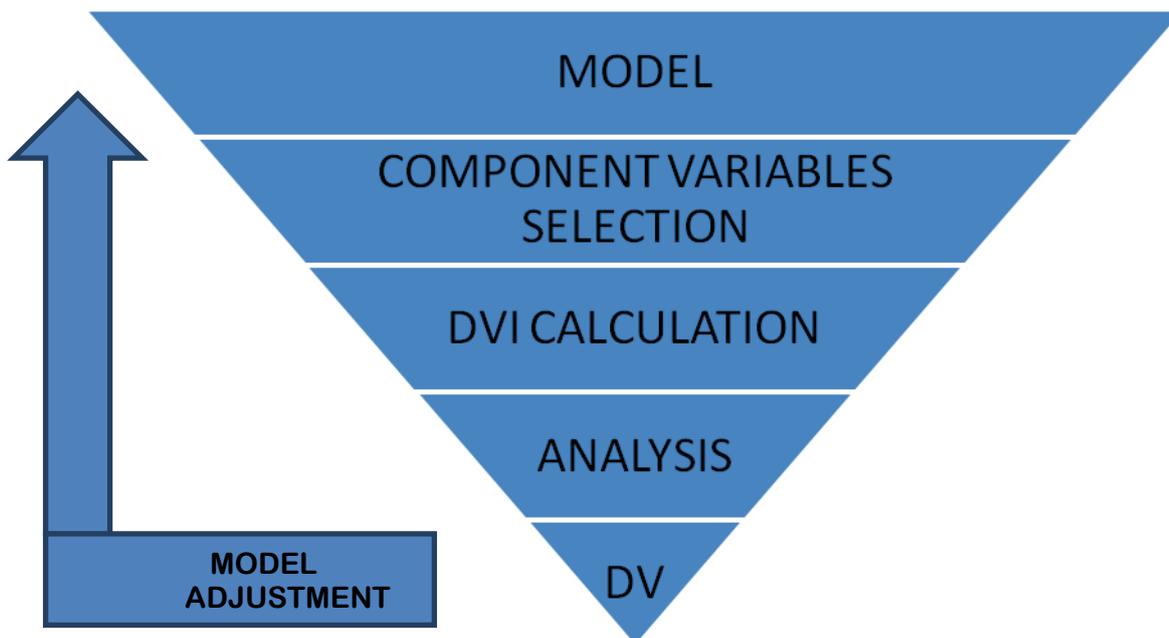


Fig. 9. Dominant variable estimation model
Source: own study

**Initial assumptions**
The initial assumptions on component variables for the dominant variable:
1. The component variable should describe the researched phenomenon directly or implicitly.
2. The function describing the dominant variable should be simple, clear and easy to interpret.

**Examples of component variables**
1. Commercial space of a single store in sq m in given year, e.g. 2014 ($P_{CS/2014}$).
2. Commercial space in analysed area (market) in sq m in given year ($P_{CM/2014}$).
3. Commercial space per one inhabitant ($P_{CM/1\ inhabitant/2014}$).
4. Number of stores on analysed market in given year (n or $n_{2014}$ depending on context and legibility of the variable use).
5. Store's sales (turnover) in given year in PLN ($S_{S/2014}$) e.g. 2014.
6. Store's sales (turnover) per 1 sq m in given year (or other time interval) in PLN ($Ss_{/1sq\ m/2014}$).
7. Total sale (turnover) on the given market in given year w PLN ($S_{M/2014}$).
8. Total sale on the given market per 1 sq m in given year (or other time interval) in PLN ($S_{M/1sq\ m/2014}$).
9. Number of working hours of the unit in given year ($T_{S/2014}$).

10. Number of working hours of all units on the market in w 2014 ($T_{M/2014}$).
11. Trade on Sundays and holidays - weight for calculation purposes, calculated as relation between 7 day retail and 6 or less days retail (bazaar retail usually takes place 2-3 days a week).
12. Number of available parking spots in the store's neighborhood in given year $AUTO_{2014}$.
13. Number of available parking spots in the store's neighborhood per 100 sq m of commercial space in given year ($AUTO_{100\ sq\ m/2014}$).
14. Number of stores per one inhabitant in given year ($N_{S/1\ inhabitant/2014}$).
15. Total income of potential buyers on the given market in given year ($I_{2014}$).
16. Relation between the total income of potential buyers on the given market over a year (or other time interval) and total commercial space on the given market, i.e. income per 1 sq m of commercial space ($I_{M/1\ sq\ m/2014}$).
17. Relation between the total income of potential buyers per one store over one year (or other time interval) and total commercial space in analysed premises ($I_{S/1\ sq\ m/2014}$).
18. Number of inhabitants - potential buyers in given store in given year ($N_{S/2014}$).
19. Number of all potential buyers on the given market in given year ($N_{M/2014}$).

**Examples of dominant variable indices (DVI)**
Examples of dominant variable indices (DVI) based on component variables:

$$DVI_1 = DVI_{P/2014} = P_{CM/2014} = \sum_{i=1}^{n} P_{CS/2014}$$

$$DVI_2 = DVI_{PCS/PCM/2014} = \frac{P_{CS/2014}}{P_{CM/2014}} = \frac{P_{CS/2014}}{\sum_{i=1}^{n} P_{CS/2014}}$$

$$DVI_3 = DVI_{PCM/1inhabitant\ /2014} = P_{CM/1inhabitant\ /2014}$$

$$DVI_4 = DVI_{PCM/I/2014} = \frac{P_{CM}}{I_{M/2014}}$$

The indices presented above are substantially simple but do not take into account i.e. the working hours of the units. The retail chains are very often open between 6 a.m. and 10 or 11 p.m., or even 24 hours a day. Compared to a store which is open only 8 hours a day the competitiveness of the retail chains grows disproportionately. If we add working hours on Sundays and holidays the competitive dominance may be, simplifying, at least twice as large. A proposal of a dominant variable index (DVI) which takes into account the number of the unit's working hours is presented below.

$$DVI_5 = DVI_{P/T/2014} = \frac{P_{CS/2014} \cdot T_{S/2014}}{\sum_{i=1}^{n} P_{CS/2014} \cdot T_{S/2014}}$$

$$DVI_5 = DVI_{P/T/2014} = \frac{P_{CS/2014} \cdot T_{S/2014}}{\sum_{i=1}^{n} P_{CS/2014} \cdot T_{S/2014}}$$

$$WZD_6 = WZD_{P/T/2014} = \frac{P_{HSi/2014} \cdot T_{Si/2014}}{\sum_{i=1}^{n} \left( P_{CS/2014} \cdot T_{P_{CS/2014}} \right) \cdot P_{CSi/2014} \cdot T_{Si/2014}}$$

The examples of dominant variable indices do not exhaust the subject and are only a display of previous deliberations which leave complete freedom of defining for the experts. Access to data is the basic factor or even a prerequisite.

### 1.4.3. Practical use of dominant variable index

To picture one of dominant variable indices presented above, actual data collected within the framework of EU grant based on the example of Jarosław city have been provided. The dominant variable index presented below shows the commercial space per one inhabitant on analysed market. Indices for European Union and selected major Polish cities have been confronted for better picture and comparative scale. Dominant variable Index DVI3 represents the commercial space per one inhabitant on the analysed market.

$$WZD_3 = WZD_{PCM/1inhabitant\ /Year} = P_{CM/1inhabitant\ /Year} = P_{m2}$$

Table 14. Marketing space in sq m per 1 inhabitant ($P_{sq\ m}$) for selected markets

| Country/City | UE 2013 | Poland according to EU standard 2013 | Poznan 2013 | Wroclaw 2013 | Warsaw 2013 | Lodz 2013 | Standard for Poland 2013 70/100 | Standard for Jarosław 2013 50/100 | Jarosław 2000 | Jarosław 2006 | Jarosław 2010 | Jarosław 2013 | Jarosław 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| $P_{sq\ m}$ | 2.0 | 0.8 | 0.98 | 0.86 | 0.83 | 0.65 | 0.7 | 0.5 | 0.5 | 0.6 | 0.7 | 1.1 | 1.8 |

Source: own study

In table 14 the commercial space per one inhabitant for different analysed markets has been compared. Average commercial space per one inhabitant in the EU-15 in 2013 was 2 sq m. Considering the purchasing power of money in corresponding period of time in Poland it will be equal to 0.8 sq m per one inhabitant. Comparing the EU indices to large agglomerations such as Wroclaw, Poznan and Warsaw (Kaczmarek 2006), the commercial space per one inhabitant is between 0.83 and 0.98 sq m. It means that from among the richest agglomerations at most 25 % exceed the normative value for Poland. Considering the purchasing power of Jarosław inhabitants, the normative value should be about 0.5 sq m per one inhabitant. In the years following the year 2000, an ongoing strong upwards trend for the commercial space may be observed (Dąbrowski 2010). Assuming that the purchasing power of the inhabitants of the compared cities is proportional to the commercial surface in those cities, the commercial surface in Jarosław should not exceed, correspondingly, 60% of commercial space per one inhabitant in Warsaw. In the last column the granted building permits have been taken into account, which constituted the basis for the prognosis for 2018. In order to specify the dominant variable value, the values of the dominant variable indices (commercial space per one inhabitant in given year) have been compared with the income of potential buyers (table 4.2) between 2008 and 2012 for the Jarosław city. The analysis has been complemented by questionnaires, basic purpose of which was to measure the public moods in the group of self-employed inhabitants and

confronting them with the performed analyses. The questionnaire comprised 100 business units, which corresponds to at least 15% inventoried business units involved in trade.

Table 15. Jarosław inhabitants' income between 2008 and 2012

| PIT | 2008 | 2009 | 2010 | 2011 | 2012 |
|-----|------|------|------|------|------|
| **CONTRACT WORK (1)** | | | | | |
| PIT-37 P | 536 614 387 | 591 297 015 | 627 632 224 | 692 065 359 | 706 916 371 |
| Position | | | | | |
| PIT-37 M | PLN 115 659 829 | PLN 124 337 910 | PLN 133 900 065 | PLN 145 984 003 | PLN 152 341 961 |
| PIT-36 P | PLN 46 005 931 | PLN 53 971 486 | PLN 56 681 972 | PLN 63 086 242 | PLN 62 549 372 |
| Position | | | | | |
| PIT-36 M | PLN 20 068 818 | PLN 22 437 985 | PLN 25 406 670 | PLN 26 558 725 | PLN 29 046 610 |
| PIT-40 | PLN 26 097 186 | PLN 22 492 478 | PLN 22 440 765 | PLN 19 967 478 | PLN 17 644 521 |
| TOTAL (1) | PLN 744 446 151 | PLN 814 536 873 | PLN 866 061 695 | PLN 947 661 806 | PLN 968 498 836 |
| **SELF-EMPLOYMENT (2)** | | | | | |
| PIT-36 P | PLN 35 145 640 | PLN 47 208 694 | PLN 53 029 561 | PLN 59 155 254 | PLN 52 341 314 |
| PIT-36 M | PLN 2 712 297 | PLN 2 659 541 | PLN 3 314 999 | PLN 3 318 629 | PLN 3 132 162 |
| PIT-36 L | PLN 97 882 478 | PLN 91 082 587 | PLN 99 521 842 | PLN 107 750 173 | PLN 99 922 476 |
| TOTAL (2) | PLN 135 740 415 | PLN 140 950 822 | PLN 155 866 402 | PLN 170 224 056 | PLN 155 395 951 |
| TOTAL (1)+(2) | PLN 880 186 566 | PLN 955 487 696 | PLN 1 021 928 097 | PLN 1 117 885 862 | PLN 1 123 894 787 |

Source: own study based on Tax Office data

Data compared in table 15 show the gradual growth of the income of inhabitants of the Jarosław Poviat between 2008 and 2012. To present a better picture of this phenomenon, figure 10 shows the Jarosław Poviat inhabitants' income between 2008 and 2012.
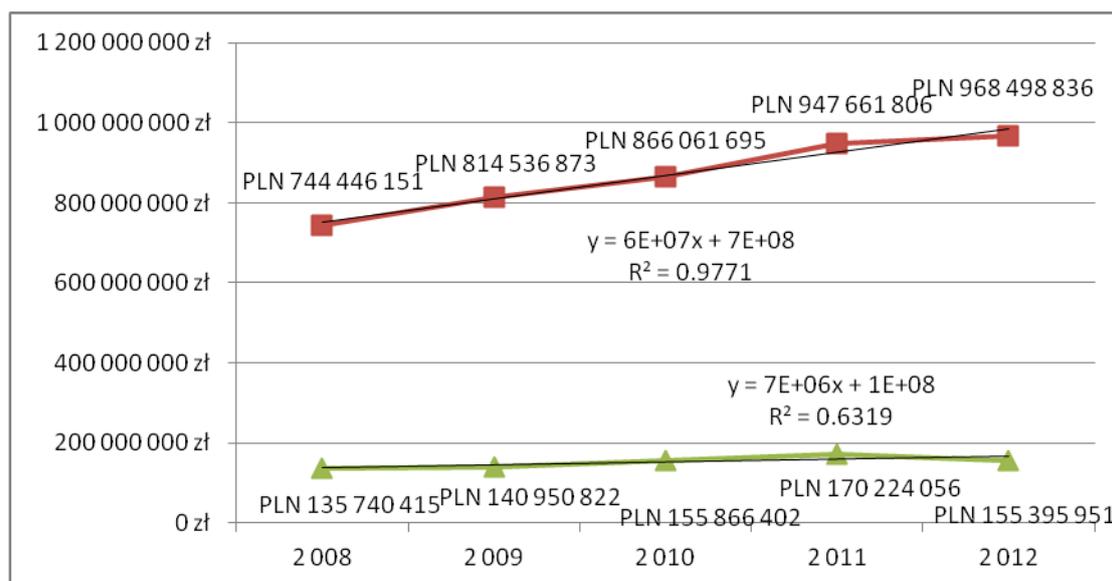
Legend:

 ▬■▬    - Contract work (1)

 ▬▲▬   - Self-employment (2)

Fig. 10. Jarosław Poviat inhabitants' income between 2008 and 2012

Source: own study based on Tax Office data

In recent years, compared to the income of inhabitants from contract work, an stable growth can be observed each year. However, the appearance of a powerful production plant in 2005 as well as the continuous employment growth (nearly 3000 employed in 2014) considered in the analysis of presented data, it should be concluded that the Poviat's global income growth does not go hand in hand with the income growth of a statistical employed person's in this Poviat. There is more money on the market, but these are probably entirely used to satisfy basic livelihood needs. As regards the people receiving income from self-employment, in 2012 there was nearly 10% income decrease as compared to 2013. Such a large drop of income accompanied by growth of purchasing power of money indicates a worsening condition of the local business entities.

### 1.4.4. Theoretic assumptions for local plans of spatial development based on real estate market development

The Jarosław inhabitants' income growth dynamics is different for self-employment, temporary contracts and retirement pensions. Income from self-employment in 2012 was lower than in 2011, and the determination indicator reaches the level of 0.6 which fits the model much worse than the regression line corresponding to the increase of the income from temporary contracts and retirement pensions in 2008 – 2012. The questionnaire confirms very poor public moods among the people involved in trade in Jarosław. The majority of respondents, i.e. app. 80%, considered the years 2007-2008 as the years of significant slowdown, and the years 2011-2012 the years of extensive loss in profitability. In 2013 the respondents were willing to close their stores and start any contract work, because they did not see any chances for further activity. The majority of the respondents perceived no perspectives faced with the retail chains expansion, and only the complete lack of any other perspectives prevents them from suspending their activity. The vast majority of retail business owners are over 50 years old, which in practice completely excludes them from the labour market. New large and medium-format stores employ young people, without "bad habits" of former businessmen. The new employees are the inhabitants of neighbouring villages and have much lower financial aspirations.

The final dominant variable value should be estimated based on the graphic overlap of analytic calculations of commercial space per capita, inhabitants' income, public moods, tenancy

prices and similar indicators. At current levels of inhabitants' income, the commercial space in Jarosław should not exceed 0.6 - 0.7 sq m per one inhabitant. The differences between the indicator's normative value for Jarosław according to EU standards and the value estimated based on the research may be explained by the fact that the majority of local stores operates 8 hours a day, for at most 6 days a week. At the same time the markets' working hours are much longer. Assuming that the main factor that overrates the dominant variable value comparing to the value assigned by EU standards is the working time, after eliminating the local retail from the market the effective commercial space in Jarosław should not exceed 0.5-0.6 sq m of the commercial space per one inhabitant. In practice, it may lead to disrupting the already started constructions of new large-format stores or relatively large number of vacancies in already built medium and large-format stores. Within the next few years, the effective space necessary for the retail will be significantly reduced due to dynamic development of e-commerce. It is estimated that e-commerce for numerous ranges of products may reach several dozen percent, which would cause significant decrease of the demand for commercial real-estates. According to the author, the vast majority of stores ran by the local businessmen will be successively closed, and after e-commerce increases its position in retail, spectacular actions such as disrupting already started investments and shutting down already operating medium and large-format stores will occur.

### 1.4.5. Conclusions

Based on collected materials and performed research, the following conclusions are drawn:
1. Accurate defining and monitoring of the dominant variable value allows to foresee significant price adjustments on the given real-estate market.
2. The occurrence of dominant variables proves that the expert contribution is necessary in the building of the market model.
3. Automation of the dominant variable may cause significant inaccuracies due to specific nature of the market.
4. The dominant variable can act as an indicator of the free market mechanisms as well as a sort of proxy for the economic freedom.
5. Complex phenomena which have a significant impact on the market may be considered when drawing-up conditional prognoses [Bieleninik E., J. Mikuś J. 2005]
6. Searching for relations between values originating from seemingly different areas allow for carrying out the fundamental analysis of researched phenomenon.

# 2. SPATIAL ASPECTS OF REAL ESTATE MARKET ANALYSIS

## 2.1. Application of GIS in systems supporting the real estate market in Poland

The act of March 4,2010 on spatial information infrastructure (Off. J., 2010, No. 76, item 489 with later amendments), which was entered into force as a result of approval of the Directive 2007/2/EC „INfrastructure for SPatial InfoRmation in Europe" (INSPIRE) (EU Off. J. L 108 of April 25,2007, page 1) by the European Parliament and the Council was the key contribution to the increased accessibility of spatial data resources in Poland. However, Geographic Information Systems (GIS) were earlier applied in practice in almost every field of science. Relevant legal regulations responded to the growing demands in the field of access to spatial information and the possibilities to apply it.

Within the last decades GIS has been many times defined, depending on evolution of knowledge and technology and various approaches to GIS applications. Following GAŹDZICKI (2002) GIS is a system for *acquisition, storing, verification, analysing, transfer and dissemination of spatial data; in the wide sense it covers methods, technical means - hardware and software, spatial database, organisation, resources and individuals who are interested in GIS functionality.* Particular attention should be paid the GIS characteristics, i.e. the spatial information content and resulting possibility to present and perform various analyses. This multi-functionality of a GIS system has quickly become the subject of interest not only of the state administration and local governments (which mainly apply this technology to support decision making processes), but also of private companies and individual users. This has been also important for entities involved in the real estate market, such as real estate experts, agents, managers, bankers, developers and investors.

### 2.1.1. Objectives and methodology of research

The objective of the paper is to characterise and evaluate systems and applications which are mostly used by entities involved in the real estate market, with respect to the GIS functionality offered by those applications and systems. For the needs of this work, information presented on www pages of the AMRON System and asariWEB, Galactica Virgo and Walor applications was mainly used.

Considering the results of comparative analysis, user and customer demands, new functionality has been proposed, which could be implemented in order to maximise efficiency and effectiveness of work, and, as a result, to increase the standard of serviced delivered by entities involved in the real estate market.

### 2.1.2. Selected GIS functionality

The basic functions of a geographic information system may include, first of all:
a) data acquisition,
b) data management,
c) data processing,
d) dissemination of data and related descriptive attributes.

Re a. After data often originating from various sources is entered, it is necessary to verify and preprocess it. Besides the possibility of conventional data storing, GIS systems also allows for data generalisation. The user of the system should decide about the data accuracy. If objectives of the work do not require the high level of details, it is possible to "generalise" data at the stage of data input or edition. This functionality improves the technical efficiency of computer hardware, increases data editing and the speed of data analysis.

Re b. The issue of the optimum data management is important for every system user. In the past this function was connected, first of all, with the descriptive data management. At present,

GIS systems successfully allow for management of both, the descriptive and the graphical data. It is the possibility to connect both types of data, using its graphical and "tabular" (descriptive attributes) properties, which is the essence of the GIS. As a result of graphical visualisation, one can obtain descriptive data of an object and, vice versa, after formulating conditions for descriptive attributes, one can obtain graphical results.

Re c. The uniqueness of GIS results from the possibility of data processing. Such processing may concern operations on objects, without modifications, generation of new objects or modifications of existing objects. The basic data processing functions include (IZDEBSKI, 2009):
- conversion and changes of the data structure (such as automatic or interactive connection of fragments of databases, including edge matching,);
- transformations (such as vector or raster data transformation to the specified coordinate system of tie points, calculation of coordinates in various cartographic projections);
- spatial analyses (e.g. superimposing layers, aggregation of objects, generation of buffer zones);
- statistical analyses (e.g. data accuracy analysis, regression analysis).

Following GOTLIB et al. (2007), the term "analysis" may be understood as:
1. Elementary queries to the spatial databases, such as: typu *„Select all, one-family, dwelling houses of the size between 100sq m and 150sq m m".*
2. Determination of interrelations and topological relations between various information layers such as: *„Find all, non built-up, land real estates, dedicated for one-family, housing areas in local plans of physical management".*
3. Creation of complex decisive models, eg. *„What is the optimum location of a petrol pipeline, when the costs of land purchase, construction of the pipeline, as well as environmental aspects, related to the NATURA 2000 Project are considered".*

Analyses allow for getting answers to questions (LONGLEY et al., 2006): *where is it located?, what is the spatial relation between objects or classes of objects?, what has been changed since...?, does the general regularity in the spatial data distribution exist?*

Particular attention should be paid to the multifactor spatial analysis, which requires the utilisation of computational intelligence techniques (GOTLIB et al., 2007). This analysis allows for, among others, determination of the optimum location of a new shop. Statistical surfaces, which describe the population density, average incomes of inhabitants, the unemployment level etc., are utilised for that purpose. When such values are analysed and location of already existing units is considered, areas predestined for locating new objects are determined using relevant techniques.

Re d. Data stored in the database or processed for the needs of particular analysis may be made accessible in various forms. First of all, the numerical form of data (a specified data recording format, Internet accessibility) and the analog form of data (data accessible in the form of printouts, maps, lists, images displayed on the screen) should be mentioned.

Among many GIS applications, the delivery of location based services is mostly applied. This functionality allows for acquisition of information about geographic location of a given object, using tele-iformation networks. The user asks a question, for example, "Please find the closest post office (the school etc.)" gets a map with the list of selected objects which meet the required criteria. This function is accessible from the mobile telephone network, as well as from Internet, through Internet geoportals or geoinformation services.

### 2.1.3. Software tools supporting the real estate market

Specialised software applications, which are characterised by special functionality, have been developed for entities which are involved in the real estate market. Systems or applications, which support works performed by real estate experts, agents, real estate managers or banks, have been developed.

In this paper, asariWEB solution developed by PROTOSS - one of solutions which are mostly used by real estate agencies, has been described in this paper.

The characteristics of the WALOR application, dedicated for real estate experts, as well as the AMRON System, which is mainly used by banks for verification of validation documentation, have been also described.

**asariWEB**

asariWEB is one of two applications, which are mostly used by real estate agents. Installation of new software is not required. All what has to be done is connection with Internet and the www page browser.

Using the application it is possible to create a pattern www page, which may be used by the asariWEB user for displaying current offers. It is also possible to connect the own page with this software application. asariWEB ensures cooperation with nation-wide and regional portals presenting advertisements. In this application, each export of offers is confirmed by a report; it is possible o check whether all operations have been correctly performed.

Using asariWEB it is possible to present offers using photographs and movies. Besides, as a result of integration of this application with Google Street View services it is possible to virtually visit the vicinities of offered real estates.

asariWEB allows for linking any external multimedia presentation and export it to portals. Thus, not only virtual visits, but also youtube movies or Google maps may be presented.

The image editor embedded in asariWEB allows for improving the image quality and formatting images without the need to utilise expensive graphical software. The intuitive menu allows every user for easy introduction of changes and improvements of photographs, even by one click.

The application may adjust real estates to the customer preferences and automatically send offers which meets their criteria. asariWEB will also inform the user when offers, which correspond to the customer preferences are added to the existing resources.

The asariWEB user may  not only record dates of meetings and tasks, but also share the calendar with other agents, what results in the better organisation of works and the possibility to connect tasks with offers and customers.

asariWEB may store electronic or scanned documents, which may be assigned to particular real estates and to particular customers. Therefore the user may easily review and access them from any place.

The module of reports and finances allows for checking statistical data concerning displayed offers and for monitoring results of employees with respect to introduction of offers, acquisition of customers and meeting. It is also possible to calculate provisions and check the company's financial results.

As a result of integration with the MLS systems, asari WEB allows for exchanging offers in the MLS network.

Using asariWEB it is possible to start cooperation with real estate agencies, which utilise this software tool.

**Galactica Virgo**

Galactica Virgo, being an application dedicated for the real estate agents, has the great advantage - it is integrated with several dozens of portals presenting advertisements; it automatically sends, updates and withdraws offers from those portals, without the need of the user intervention.

The manufacturer of Galactica Virgo offers the fully integrated (maintenance free) Internet page. This page itself acquire offers from the database (in the online mode), registers new offers and operations of searching; it also allows for analysing statistical data.

8 categories of real estates are specified in the database maintained using the Galactica Virgo application, including: residential, commercial, for sale, for rent, with a comprehensive card-file of description of real estates. The application allows for efficient searching for offers.

Several calculators are accessible in Galactica Virgo , including the calculator of costs of purchase of a real estate and the calculator of credits.

The module of printouts offers printouts in Polish and English language versions, in several graphical forms, with photographs, the higher level of details, as well as the general printouts, printouts of individual real estates and cumulative printouts.

Galactica Virgo integrates the customer e-mail, which operates in the own domain, with the software application.

Galactica Virgo allows for sending offers as SMS messages to customers - both, to individual customers, as well as to customers found in browsers, as well as for sending offers, which are automatically paired. SMS messages sent to customers are archived in the system.

The database of customers is integrated in Galactica Virgo with the database of offers and operations of searching, with the module of investments and with the calendar. The database has its own search engine; it is possible to search using all accessible fields, as well as to apply the additional, intelligent filter of telephone numbers and the data descriptor.

Each query concerning offers, supported by specified criteria, may be recorded in the Galactici Virgo database; as a result the user has the insight into the history of queries. Besides, the system enables to edit operations of searching.

The agents' assistant is a useful tool, which reminds the user of more than 20 various types of information. The assistant in the form of an information board, displays the list of items which should be dealt with by the user in order to take care of offers and customers, to performed assumed tasks or to get familiarised with new information.

The calendar embedded in Galactica Virgo is integrated with all software objects. IT has simple and advanced remind functions, several types of events, it also allows for exchanging data with mobile devices. In the case of big real estate agencies, it offers optional solutions connected with booking the equipment, vehicles and office rooms for managers, as well as the series of tools for organising group works, repeatable tasks and for generation of several, multilevel timetables.

Using the FotoManager module the user may efficiently add photographs to offers. This module automatically adjusts the size of photographs, creates miniatures, inputs watermarks,, as well as offers the set of image editing tools.

Galactica Virgo has a multi-level log of events, which registers all software operations. Relevant reports and summaries may be obtained basing on this log.

The MAP module may be used to point to real estate on a map and the geo-location tool will mark (by one-click) the real estate, according to the input address. Besides, the user may select whether the location on a map is to be published.

Galactica Virgo allows for remote updating of offers. Notices asking for offer updating may be sent to customers, using e-mail services.

The invoice module, integrated with the database of customers, offers, searching operations also exists in the application together with reconciliation of transactions and cumulative reports.

A software tool, which is used in the cases when a person leaves for holidays or in the case of illnesses has been developed for real estate agencies, which employ several employees, or for branch offices of agencies. Using this application, another person may take over the responsibility and perform tasks of the substituted person. This module is integrated with the www page and portals displaying advertisements.

A pre-offer module exists in Galactica Virgo. Before the offer is accepted by the office, basing on the signed contract, it may exist in the system. This module allows for importing advertisements and possible offers, in order to get the knowledge whether they can possibly meet the requirements of registered customers.

Everyday at the office real estate agents utilise an entire set of documents ready to be used. Thanks to the module of documentation, their versions in the form of files of an arbitrary format, may be entered to the system and distributed to the users.

**Walor**

WALOR is the software application which is most frequently used by real estate experts.

The basic functions of this application include:

- easy creation and amendment of the own database of information concerning transactions concluded on the real estate market,

- the possibility of direct exchange of information concerning transactions between real estate experts,
- automatic updating of prices for the date of validation, according to the assumed trend of growth,
- developed functions of searching, sorting and analysing information from the database,
- implementation of validation:
  - according to the comparative approach, with the use of method of correcting the mean prices and the method of comparing in pairs,
  - according to the cost approach, with the use of as catalogue of prices by Promiks company,
  - according to the income approach, which allows for calculation of the real estate value basing on the analysis of incomes resulting from its possession,
- the possibility to define attributes for calculations,
- filtering of transactions required form validation by selected attributes (Including own attributes and attributes of calculations),
- the transparent way of creation of various printouts.

WALOR also offers the following analytical functions:
- tracing the trend of growth of real estate values, with the possibility to assign the trend value to the selected transaction, as the linear regression coefficient,
- calculation of values of weights of market features using the "remaining equal" method.

This application has been also equipped with web functions such as:
- sending information on transactions acquired from notarial acts to the central database, operating in the Partner system
- acquisition of information from the central database, what allows for insight into all transactions stored in the database.

The additional advantage of the WALOR application is the possibility to join the above mentioned Partner System, which is an information system allowing for the easy and fast information exchange concerning transaction data, which is stored by real estate experts within local markets.


**AMRON System**

AMRON System is an important source of information about the real estate market in Poland. It is a standardized data base of real estates prices and values, equipped with reporting and analytical modules. It is maintained by the Association of Polish Banks.

AMRON allows for registration, storing, analyzing and monitoring of events on the real estate market and it becomes a useful tool, which supports the development and maintenance of the real estate market.

Commencement of cooperation with the AMRON System does not require any additional technical inputs from the user. The AMRON System is an Internet application - an Internet browser ensures the access to the application for every user.

The AMRON System functionality allows for:
- storing and dissemination of selected data concerning real estates, reviewing data in the form of tables and reports,
- presentation of information concerning unit prices on the real estate market, in the form of diagrams,
- dissemination of analyses which present statistical data and current trends of changes of real estate values, generation of models used for forecasting real; estate values,
- possible updating, amendment and verification of real estate data,
- maintenance of the "own databases" for particular participants,
- reliable verification of real estate values - the possibility to monitor various types of risks connected with crtediting of real estates, with consideration of risk factors concerning acquisition of an estimated market value of a real estate.

### 2.1.4. Utilisation of GIS in selected software tools which support the real estate market

The GIS functionality may be of key importance for real estate agents, In particular, at the stage of the preliminary selection and presentation of Real estates. When a real estate which meets the assumed criteria (such as location and neighbourhood) is fund, when a specified object is clicked, the selected real estate is presented by a movie displayed on the screen.

**asariWEB**

asariWEB tool has been equipped with the functionality called maps and locations. asari WEB allows for searching for offers using a map. All what has to be done is to click several times the area, where where offers should be searched for, (Fig. 11), and selected offers will be presented as results of searching. It is particularly useful when the user does not know the names of street and is interested in real estate which are located within a specified area.



Fig. 11. Marking the area to be searched for offers.
source: (asari, 2014)

As a result of the offer visualization functionality, the fund real estate may be presented on a map (Fig. 12).
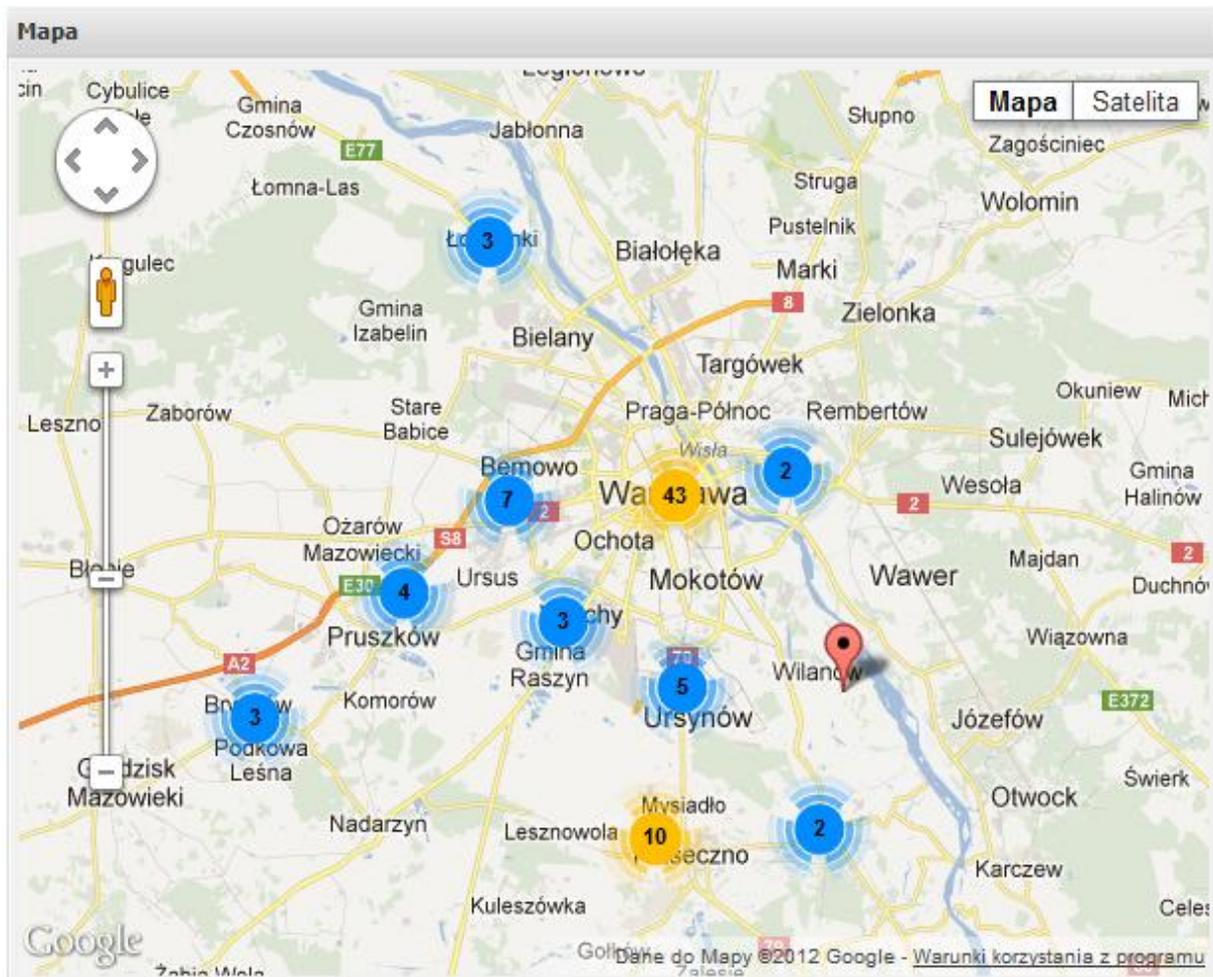
Fig. 12. Visualisation of selected Real estate offers
source: (asari, 2014)

At the same time asariWEB has a database of locations, which is compliant with the National Register of the Official Territorial Division of Poland; as a result, a uniform data standard and reliability of specified locations are ensured. When the offer is added, when the real estate agents begins to enter an address, the software will automatically hint the street name and point to the location on a map.

As a standard, it is possible to search for offers according to assumed location criteria, basing on data stored in the application.

Another important functionality of asariWEB is the virtual visiting the neighbourhood of an offered real estate and looking at it from outside. It is possible as a result of integration of the described application with Google Street View services, which allows for visiting, among others, the United Stated and Europe, including Poland. The possibility to use such services depends on its operations performed for particular locations.

Using Google Street View it is also possible to check conditions of a building from outside, as well as accessibility to parking places within the area of interest and the distance between the real estate and shops, stops of public transport, offices etc. (asari 2014).

**Galactica Virgo**
Galactica Virgo has the MAP module. Using this module it is possible to point to real estates on a map and the geo-location tool will mark - after one click - the real estate basing on its address (Fig. 13)
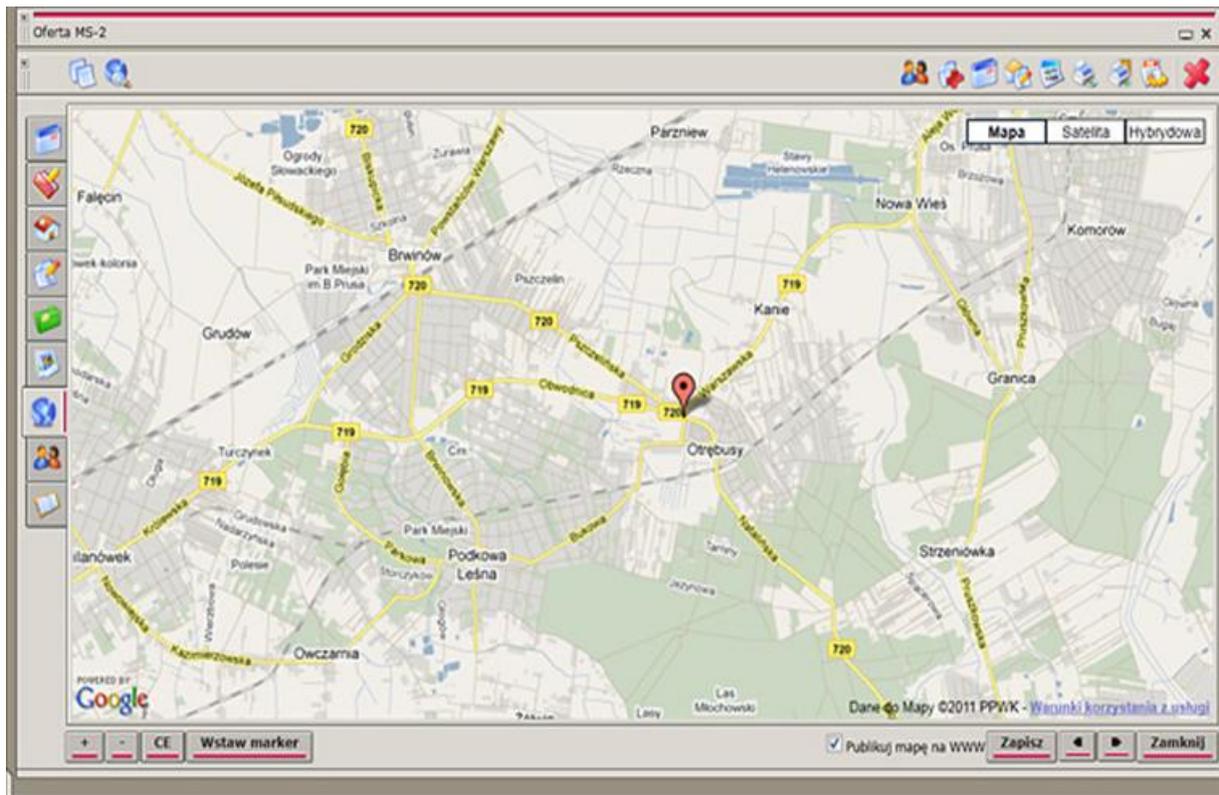
Fig. 13. Pointing to a Real estate on the map.
source: (Galactica Virgo, 2014)

The application offers the functionality of visualisation of offers on a map. At the same time the real estate agent may decide, whether the particular location should be published on a map or not (Galactica Virgo 2014).

**Walor**

Walor application allows for displaying selected transactions on a Google map. They are displayed as colour points, provided that colours correspond to the values of a index - by default it is the updated price of 1 sq m of a real estate, following the displayed legend. (Fig. 14).

After marking on a map, location of such objects, as: schools, churches, hospitals, pharmacies, restaurants, super markets, petrol stations, parks, police offices, banks and post offices will be also visible on the map.

After clicking the transaction which is presented on the map, a photograph from the Google Street View is displayed (Walor. 2014). Therefore it is the same functionality as the functionality applied in asariWEB.
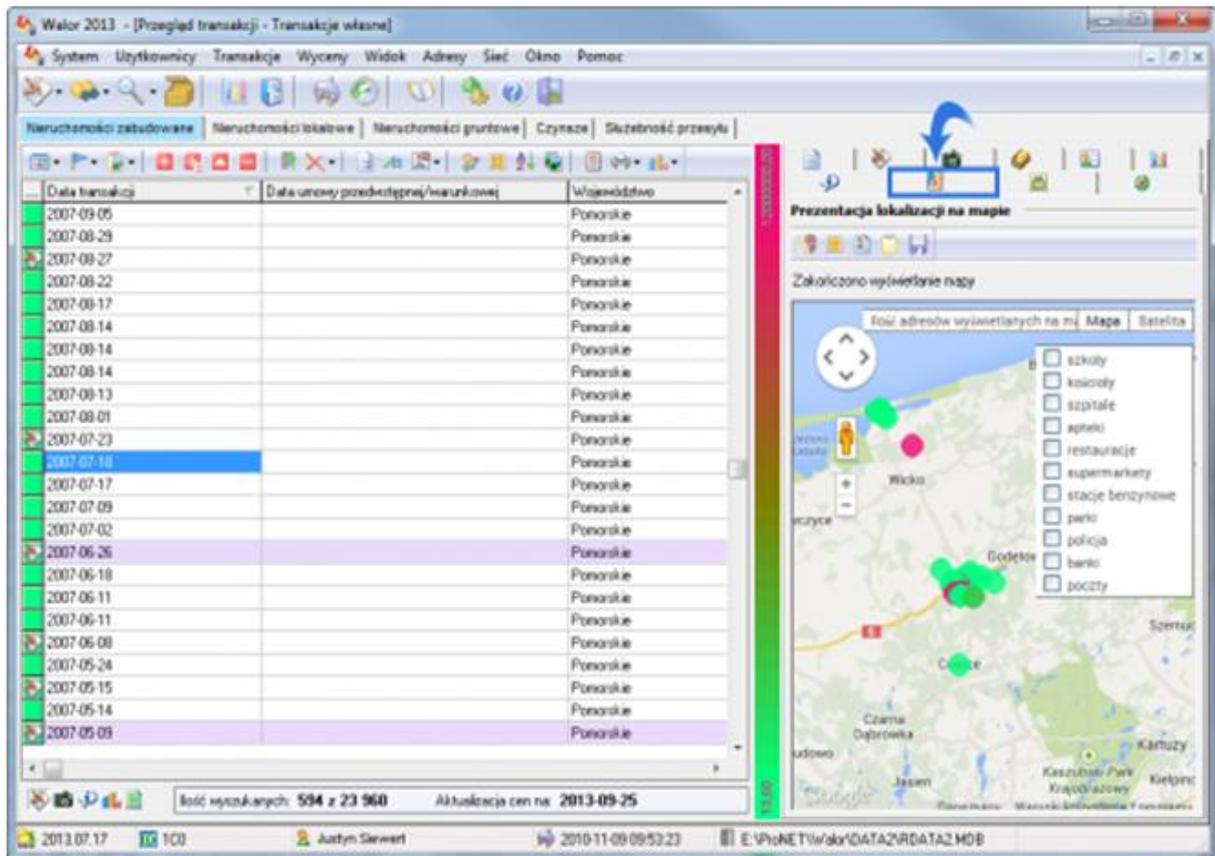
Fig. 14. Visualisation of selected transactions on the Google map in the form of colour points;
colours specify updated prices of 1 sq.m. of a real estate.
Source: (Walor, 2014)

The application also allows for searching for real estates which is the subject of transaction, basing on its location, using many criteria. They may include: the province (voivodship), the district (powiat), the town/municipality, the city district, the postal code, the street names and the parcel number (WALOR 2014). A transaction may be also found using a map and marking the area of interest on it.

**AMRON**
The AMRON system has the functionality of a digital map. One of the functions includes the definition of locations of real estates, which are searched for, with the use of an area which is specified on a map using buffer zones (AMRON 2014 ) (Fig. 15).
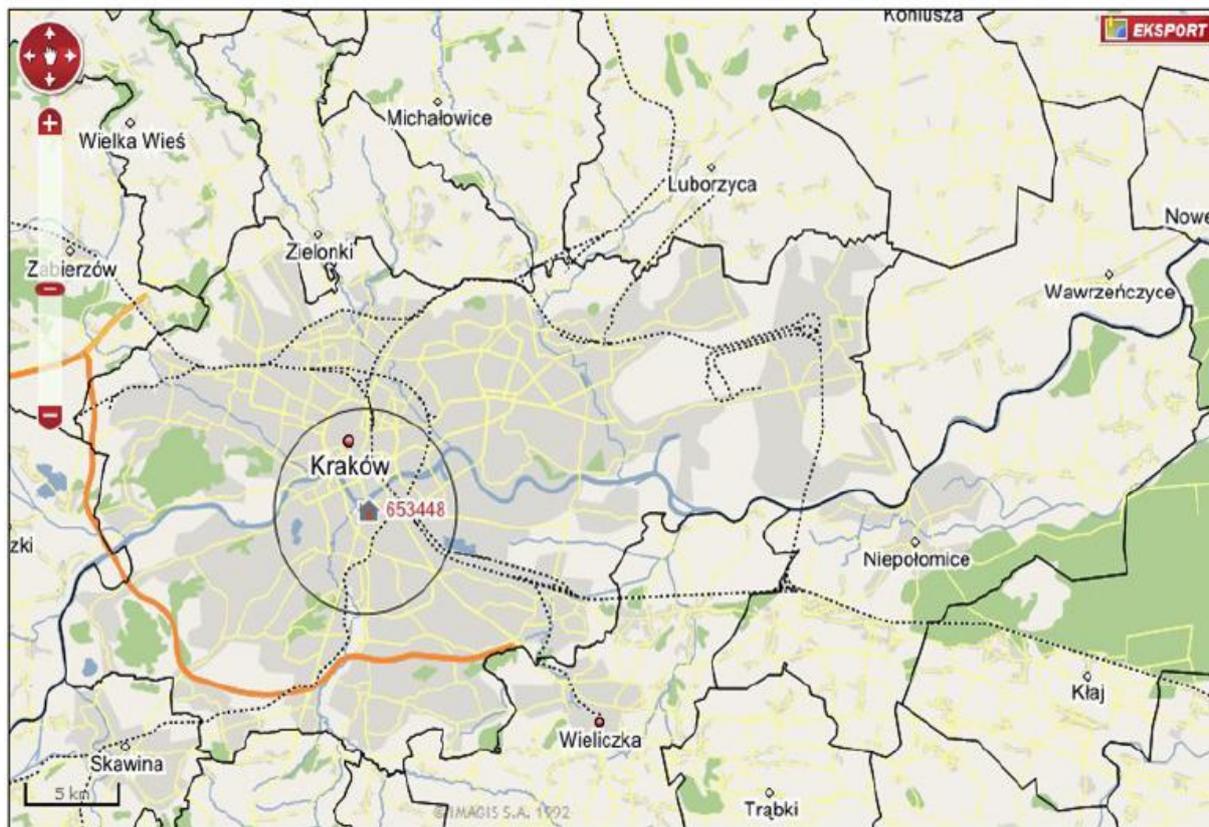
Fig. 15. Defining locations of selected real estates with the use of a specified area and buffer zones on a map.
Source: (AMRON, 2014)

The system allows for visualisation of a real estate on a map, as a result of searching with the use of the above mentioned functionality (Fig. 16).
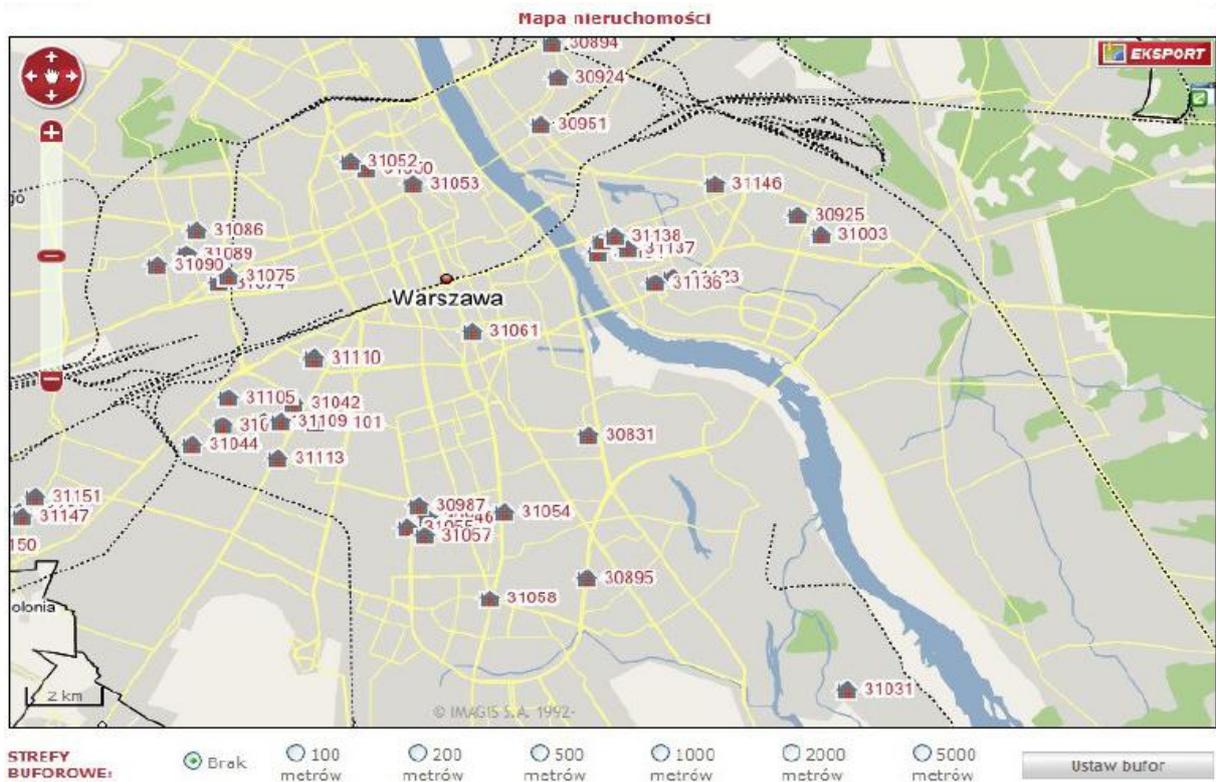
Fig. 16. Visualisation of searching results on a map
Source: (AMRON, 2014)

A map which presents the real estates is equipped with the possibility to delineate buffer zones around real estates and to present information points on a map, which allows the user to be familiarised with the closest vicinities of the interesting real estate and to measure the distances between the real estate and other points of interest, such as: an underground railway station, schools, offices, health care facilities, bus stops, railway stations or shopping centres (Fig. 17).
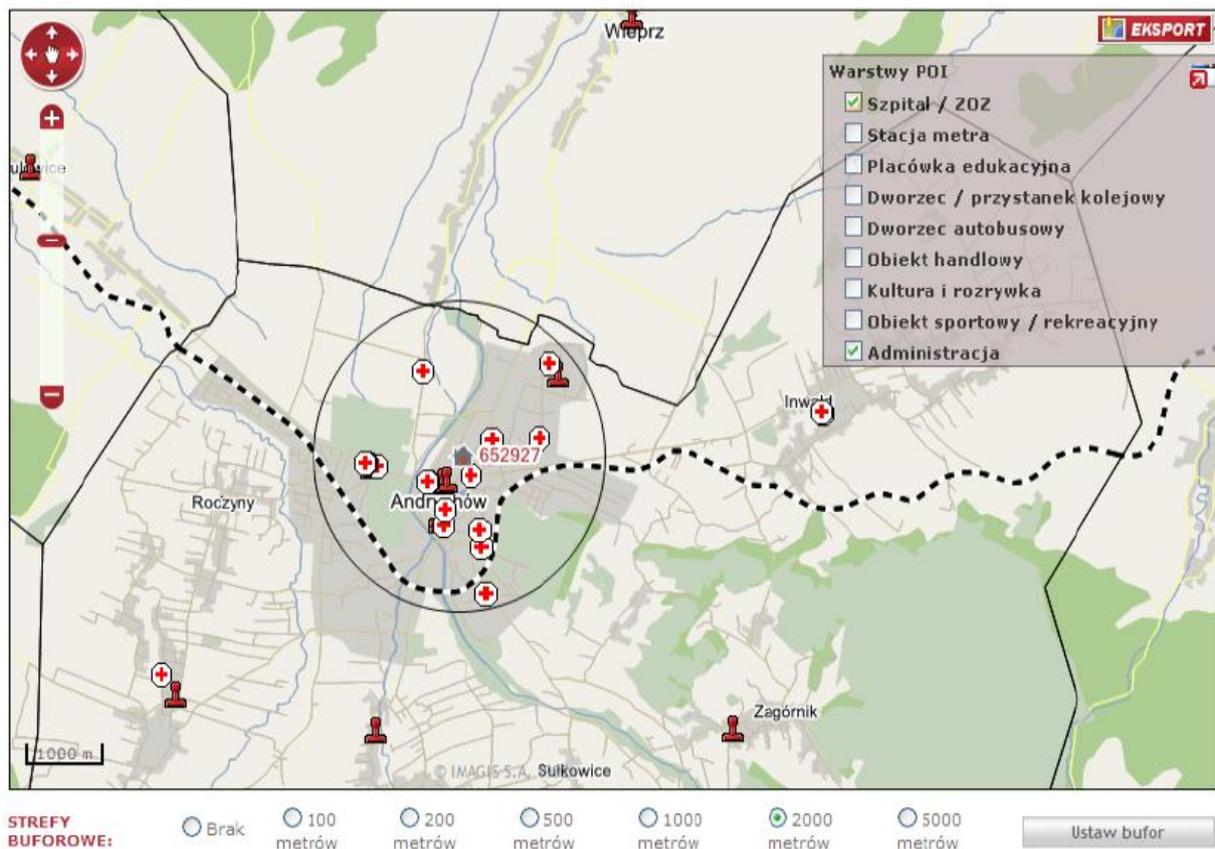
Fig. 17. Visualisation of searching results on a map
Source: (AMRON, 2014)

### 2.1.5. Comparison of GIS functionality in selected tools supporting the real estate market

When analysing GIS functionality applied in asariWEB, Galactica Virgo and Walor applications and the AMRON system one may conclude that they are similar. The highest similarity may be noticed in the case of asariWEB and Walor applications.

The basic GIS functionality is visualisation of real estates - offered or already sold - on a map. In the case of asariWEB and Walor applications these are very popular Google maps.

Another functionality concerns the possibility to define locations of real estates, which are searched for, by means of clicking an area on a map; in the case of asariWEB, Galactica Virgo and Walor applications and using buffer zones in the AMRON system.

It should be added that using all of three software tools used by entities which exist on the real estate market, it is possible to search for offers or transactions basing on their locations, by means of such criteria, as: the province, the district, the town/municipality, the city district or the street. Besides, in the discussed applications, as well as in the AMRON system it is possible to display information on important objects located within the short or longer distances from a real estate, which determine its attractiveness with respect to the location and neighbourhood. Such objects include, among others: stops of the public transport, schools, churches, pharmacies, shops.

Additionally, asariWEB and Walor applications offer the Google Street View services, which ensures the virtual visiting of the vicinities, of an offered or sold real estate and well as looking at it from outside.

An interesting functionality, which is offered by the Walor application only, concerns displaying transactions on a map as colour points; their colour corresponds to the index value - by default it is the updated price of 1 sq m of a real estate, according to the displayed legend.

## 2.1.6. Remarks and conclusions

Analysed applications: asariWEB and Galactica Virgo – dedicated to real estate agents, Walor application – which is the tool used by many real estate experts and the AMRON System developed, first of all, to meet the needs of banks - all of them are characterised by a similar set of GIS functionality. It should be noted that most of these functionalities are included in the basic categories. Functionalities described in section 6 allows for implementation of the real estate agents' operations or more effective validation of real estates values. At the same time, considering the development of GIS software, applications, which are characterised by new functionalities, may be offered to entities, which are involved in real estate transactions.

One of the functionalities, which may be particularly useful for the analysis of the real estate market, is automatic generation of a map of real estate prices or a map of rent values; and isoline type map or an object-oriented map, after special data processing. In the case of software tools dedicated for real estate agents this would be, first of all, a map of offered prices or a map of rent levels. Creation of a map of real estate transaction prices is also not excluded; such prices are stored in databases of the real estate agents, in particular, most of them are stored in the MLS system. On the other hand, software tools for real estate experts or for banks could automatically generate maps of real estate transaction prices or rent values.

Another functionality may include multifactor spatial analyses. Their goals could include specification of real estate locations, which would meet specified criteria, assumed by the real estate agent, following to the customers' preferences. In the case of searching for an apartment this may be an assumed distance to the underground railway station, the school and the park. Using this functionality the real estate agent could quickly generate a list of offered real estates or a list of apartments for rent, which would meet specified criteria. Real estate experts could also use this functionality. In this case it could be applied for the needs of assessment of validated real estates, as well as similar real estates, with respect to such market features, as locations and neighbourhood.

The multifactor spatial analysis is the functionality which might be applied for the needs of consulting services for developers, who are searching for new investment areas. The consulting services might be also offered to power supply companies. This would consist of determination of the optimum location of a power supply line, considering costs of purchase of a real estate or settled easement of transfer.

## 2.2. Discriminant functions as a tool to create homogeneous real housing estate markets

The complexity of the real estate market is adjustable in many publications and so far, it is difficult to find one objective way of modeling the unit price or the same impact assessment of the attributes of its formation. It is said that one of the key features is the location of the property, however , if eg. condition requires incurring additional expenditure of several dozen, tens of percent of the same prices it or not this attribute should play a greater role? Locality real estate market plays a key role in the case of such a large agglomerations such as Krakow, it is difficult to expect homogeneity within the administrative boundaries of the city. Discriminant analysis can bring benefits in this case, as a tool for indicating the property similar regardless of the nationality of eg the city. The division into districts was an administrative decision, which was aimed to support the creation of units of the proper functioning of the city under economic reasons, municipal or other proper facilitate its operation, but not necessarily, as a local or sub-local units of pricing of real estate premises in the area. The article presents an application of discriminant analysis as a tool to identify the attributes of the property and dividing the market analyzed in terms of homogeneous groups of the selected features. Due to the need to rely on the correlation matrix, it is necessary to transform the scale attributes to a quantitative scale. The authors focused on the problem of finding a function classification whose elements are sets of features describing created. To determine the property belonging to the failed pre- created groups using discriminant function whose value is determined based on the characteristics of the real estate classified. Particular attention has been paid to numerical problems that often occur when calculations of discriminative analysis (PREWEDA 2013).

They arise from the fact that the analysis of the property premises there are redundant variables , or there is no complete information on all the attributes of the property, which in turn causes ill conditioning of the matrix. This prevents the inversion of the covariance matrix of the model variables, which is one stage discriminant analysis .

### 2.2.1. The research material

For research material data were used by 475 real estate premises that were the subject of the transaction in the period from January 2011 to October 2012. Based on the created database, set specific parameters real estate premises for the city of Krakow. Individual values were determined for each of the districts, as well as for the entire city (Table 16).

Table 16. The characteristic parameters of the real estate market premises.

| District | The number of database | Minimum Price [zł/m²] | Maximum price [zł/m²] | The value of average prices [zł/m²] | The standard deviation of prices [zł/m²] | Dissipation factor |
|---|---|---|---|---|---|---|
| Stare Miasto | 50 | 6522 | 12500 | 8867 | 1747 | 0.20 |
| Grzegórzki | 31 | 6672 | 7492 | 7028 | 178 | 0.03 |
| Prądnik Czerwony | 18 | 4096 | 6950 | 5419 | 865 | 0.16 |
| Prądnik Biały | 43 | 5044 | 7677 | 6174 | 817 | 0.13 |
| Krowodrza | 24 | 4218 | 8323 | 6388 | 1254 | 0.20 |
| Bronowice | 22 | 5049 | 7803 | 6048 | 796 | 0.13 |
| Zwierzyniec | 22 | 7956 | 9783 | 8497 | 471 | 0.06 |
| Dębniki | 32 | 6403 | 7888 | 7399 | 357 | 0.05 |
| Łagiewniki-Borek Fałęcki | 18 | 5027 | 7617 | 5797 | 791 | 0.14 |
| Swoszowice | 21 | 5044 | 7249 | 5528 | 505 | 0.09 |
| Podgórze | 32 | 5557 | 6751 | 6138 | 358 | 0.06 |
| Bieżanów-Prokocim | 17 | 5293 | 6042 | 5599 | 214 | 0.04 |
| Podgórze Duchackie | 21 | 5045 | 6438 | 6094 | 441 | 0.07 |
| Czyżyny | 15 | 4322 | 7198 | 5526 | 848 | 0.15 |
| Mistrzejowice | 19 | 4948 | 6040 | 5655 | 318 | 0.06 |
| Bieńczyce | 19 | 4199 | 6788 | 5407 | 745 | 0.14 |
| Wzgórza Krzesławickie | 17 | 4979 | 5608 | 5146 | 142 | 0.03 |
| Nowa Huta | 54 | 4000 | 6434 | 5117 | 610 | 0.12 |
| Kraków | 475 | 4000 | 12500 | 6381 | 1435 | 0.22 |

Resource: Own study.

Each of the property is described using 11 attributes. Depending on the features it is possible to identify three types of scales, with the help of which has been expressed: nominal scale (district, the right to land), the scale of quantitative (usable area, floor, unit price), ordinal scale (communication access, location / environment, the associated space, form, functionality). However, for the purposes of the analysis, all were transformed into quantitative scale by adopting the criteria set out in Table 17.

Table 17. Description of the characteristics of the property.

| No. | Feature | Category / Scale | Description |
|---|---|---|---|
| 0 | District | Stare Miasto<br>Grzegórzki<br>Prądnik Czerwony<br>Prądnik Biały<br>Krowodrza<br>Bronowice<br>Zwierzyniec<br>Dębniki<br>Łagiewniki-Borek<br>Fałęcki<br>Swoszowice<br>Podgórze Duchackie<br>Bieżanów-Prokocim<br>Podgórze<br>Czyżyny<br>Mistrzejowice<br>Bieńczyce<br>Wzgórza<br>Krzesławickie<br>Nowa Huta | Feature determined by territorial belonging to one of the districts of the city of Krakow |
| 1 | Date of transaction | 01.2011- 09.2012 | Another month starting counting from 01 - January 2011 |
| 2 | Usable area | 0 - 180 | Determined based on the feature usable area expressed in square meters |
| 3 | Transport access | Very beneficial (2)<br>Beneficial (1)<br>Average (0)<br>Adverse (-1) | Feature determined based on the distance between the property and stop public transport and the number of available lines of public transport |
| 4 | Location / surroundings | Very beneficial (2)<br>Beneficial (1)<br>Average (0)<br>Poor (-1) | Feature determined based on the distance from the city center, parks (green areas), shops, shopping centers, preschools / schools / universities. Sense of security, fashion, prestige of the area |
| 5 | Associated rooms | There are (1)<br>There are not (0) | Feature determined on the basis of having the right to the premises belonging (basement / a storage / garage) |
| 6 | Floor | 0 - 10 | Feature determined based on the location of the premises in the building (a value of zero is assigned to the ground) |
| 7 | Technical condition | Very beneficial (2)<br>Beneficial (1)<br>Average (0)<br>Poor (-1) | Feature determined on the basis of the technical condition of the premises (floors, walls, window frames, tiles, state of the bathroom / toilet) |

| 8 | Functionality | Very beneficial (2) Beneficial (1) Average (0) Poor (-1) | Feature determined based on the number of rooms, type of kitchen - separate room / separate room with no windows / kitchenette, arrangement of rooms - transitive |
|---|---|---|---|
| 9 | The right to land | Property (1) Perpetual usufruct (0) | Feature determined on the basis of the right to part of the land associated with the ownership of the premises |
| 10 | Unit price | 0 – 12 500 | Feature determined on the basis of the price for one square meter sold apartment |

Resource: Own study, based on (CZAJA, PARZYCH, 2007) and (JASIŃSKA, 2012)

The first step in data preparation was to determine the correlation matrix for the whole city (Table 18) and for individual districts. At the same time was made the verification of the hypothesis about the statistical significance of the correlation coefficients, coefficients significant for the entire agglomeration distinguished features are described in sequence as in Table 2.

Table 18. The correlation matrix for all the research material without qualities district.

| Lp. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,0000 | -0,0431 | 0,0138 | 0,0175 | 0,0117 | -0,0402 | -0,0405 | -0,0570 | -0,0680 | -0,0293 |
| 2 | -0,0431 | 1,0000 | -0,0928 | 0,0787 | 0,0524 | -0,0658 | -0,0085 | 0,6424 | 0,1920 | 0,8746 |
| 3 | 0,0138 | -0,0928 | 1,0000 | 0,1977 | -0,0271 | 0,0434 | 0,1143 | -0,0783 | 0,0784 | 0,0671 |
| 4 | 0,0175 | 0,0787 | 0,1977 | 1,0000 | -0,0206 | -0,1395 | 0,3487 | -0,0266 | 0,3549 | 0,3745 |
| 5 | 0,0117 | 0,0524 | -0,0271 | -0,0206 | 1,0000 | -0,0410 | -0,0309 | -0,0030 | 0,0173 | 0,0696 |
| 6 | -0,0402 | -0,0658 | 0,0434 | -0,1395 | -0,0410 | 1,0000 | 0,0143 | -0,0348 | -0,1117 | -0,0872 |
| 7 | -0,0405 | -0,0085 | 0,1143 | 0,3487 | -0,0309 | 0,0143 | 1,0000 | -0,0270 | 0,1289 | 0,1548 |
| 8 | -0,0570 | 0,6424 | -0,0783 | -0,0266 | -0,0030 | -0,0348 | -0,0270 | 1,0000 | 0,1018 | 0,5020 |
| 9 | -0,0680 | 0,1920 | 0,0784 | 0,3549 | 0,0173 | -0,1117 | 0,1289 | 0,1018 | 1,0000 | 0,2870 |
| 10 | -0,0293 | 0,8746 | 0,0671 | 0,3745 | 0,0696 | -0,0872 | 0,1548 | 0,5020 | 0,2870 | 1,0000 |

Resource: Own study.

A graphical representation of the correlation matrix is shown in sequence Fig. 18, 19, 20.
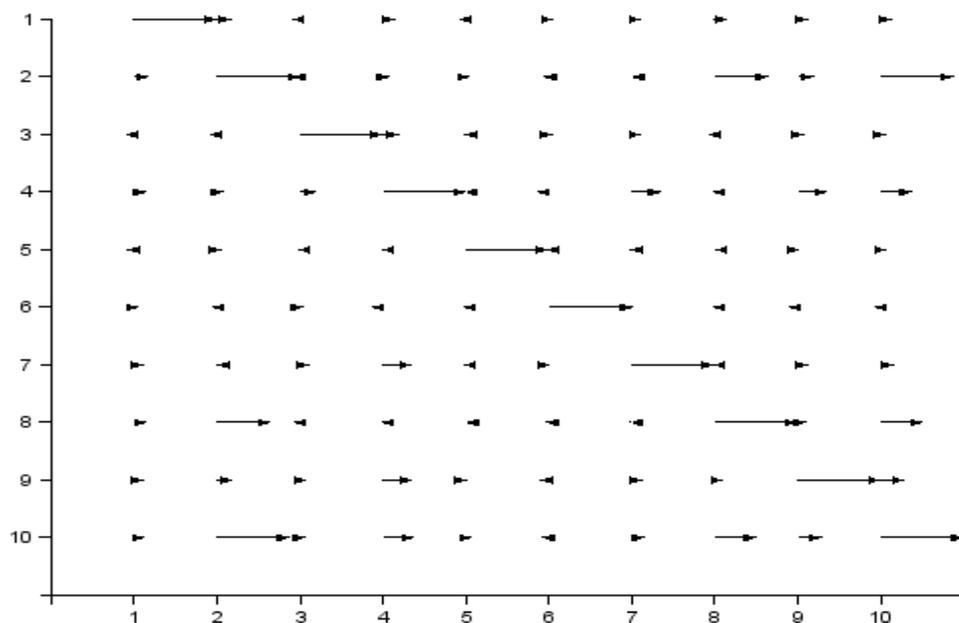
Fig. 18. The linear correlation diagram for variables without district attribute.
Resource: Own study
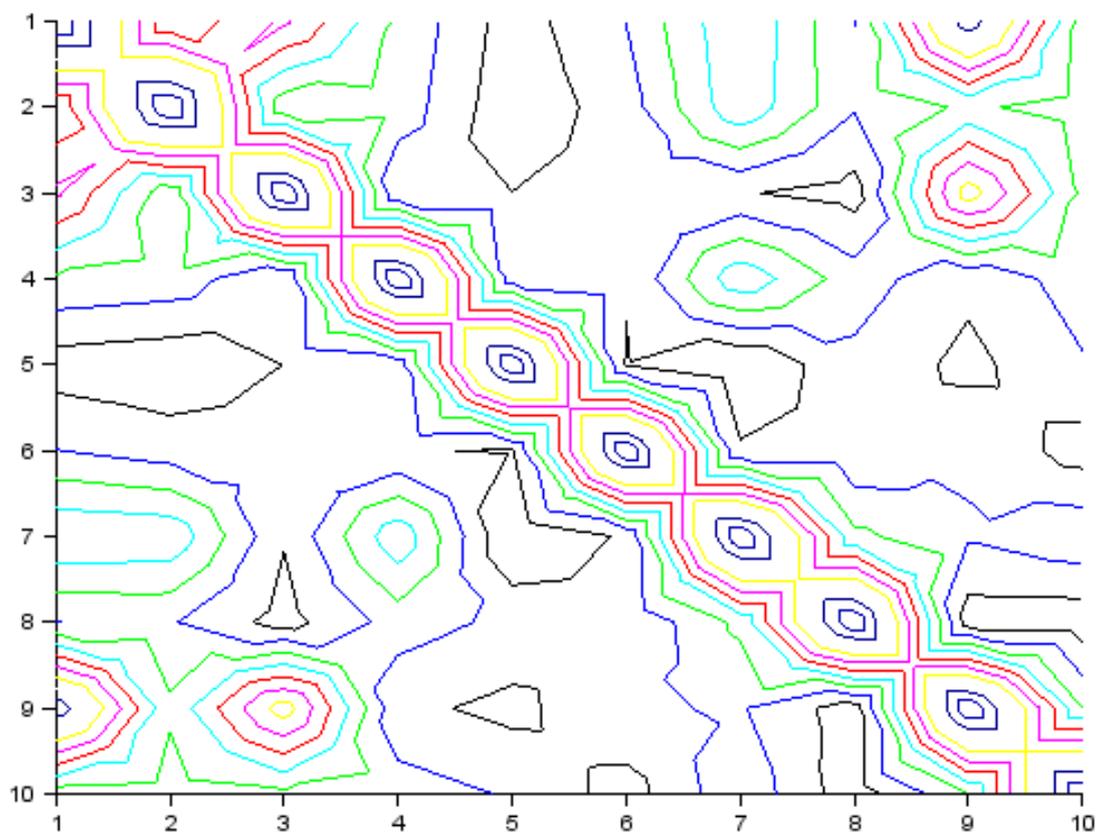


Fig. 19. Contour line graph of correlation for variables without attributes district.
Resource: Own study
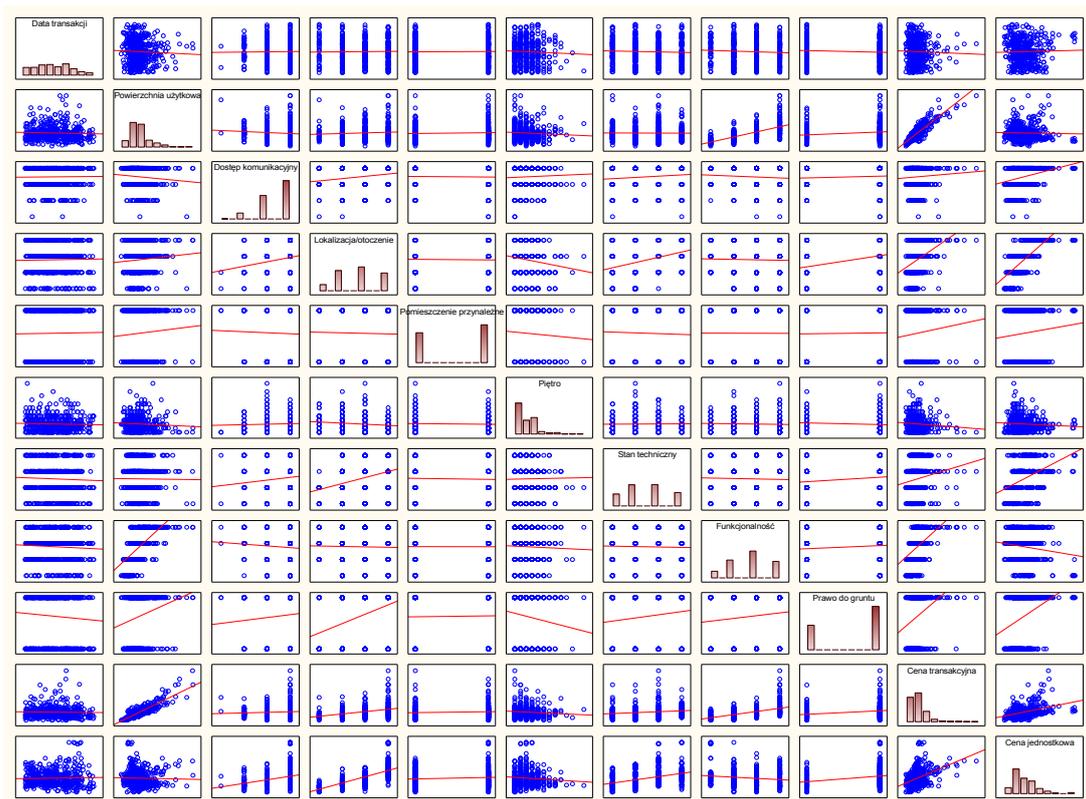
Fig. 20. Matrix of scattering diagram and correlation for selected variables.
Resource: Own study

There are several properties with a unit price 12 000 PLN-13 000 PLN, located in the Old Town district, which authors have considered as outliers (Figure 21) and missed in further calculations. These observations apply to facilities located in the prestigious area and characterized by a high standard, incomparable to other venues and much higher unit price. Hence, therefore, represent the phenomena closer to Veblen effect (JASIŃSKA, 2012), than part of a trend, or characteristics to carry out discriminant analysis in order to identify local, homogeneous real estate markets.
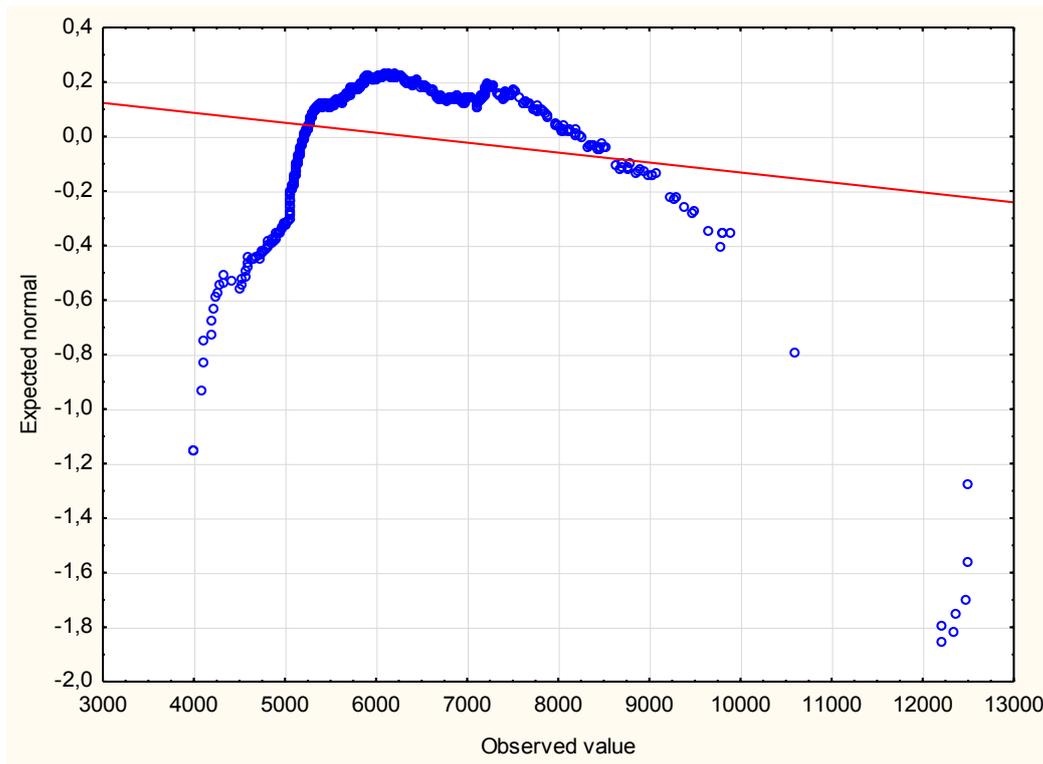
Figure 21. Chart deviations from normality for feature unit price.
Resource: Own study.

### 2.2.2. Theoretical basis of the discriminant analysis

Under the concept of discriminant analysis can hide two things (JOHNSON, WICHERN 1992):
- Presentation of the different properties of the studied phenomenon, in the form of several disjoint sets relative to each other (eg, real estate market divided into districts, not penetrating the zone). Then the goal is to create a "discriminators", which separates the variance of the collections to the disjoint as possible - a task discriminatory / separation (FISHER 1963). It has is exploratory character and should be used in the research correlation, that is, when the causal relationships between variables are not well recognized, as in the example presented, where for 11 variables is the correlation matrix presented in Table 3.
- Sorting observation, assigning them to one of the at least two sets. On the basis of the learning sample are created usually used for new objects-task of classification / allocation (FISHER 1963). It is obvious that this method can lead to misclassification when the object is characterized by the features common to more than one class, such cases are inevitable, but should strive to minimize them.

Conducted research, however, require the fulfillment of a number of requirements to the group analyzed. It is important that all cases belonged to at least two mutually exclusive groups. Their common parts, if any, were, will increase the instances of misclassification. Therefore, the authors decided to verify the homogeneity of the real estate market in selected districts, initially assuming that they created local markets are homogeneous internally and at the same time form a group of mutually exclusive. None of the observations should not be at the same time to two groups (it is impossible to simultaneously position in two districts of the city, which does not mean that districts will not be similar to each other). Features analyzed phenomenon must be presented in an ordinal scale or best quotient, so that it was possible to calculate the average value, or variations of correlation coefficients. They should have a normal distribution, but this criterion is not necessary to perform the analyzes. It is also worth noting that these features will create a function discriminatory, therefore inadmissible is their linear relationship. Such a situation leads to a defect in the covariance matrix and ultimately prevents

the proper analysis (PREWEDA, 2013). This is also your property utilitarian - there is no substantive basis to take into account the characteristics of redundant - they do not carry result in an increase of information. In contrast, the group must be defined by discrete (non-discrimination can be performed by dividing the area analyzed by the characteristics of a permanent nature, such as unit price) and categorical variable can take any number of categories, but at least two.

By creating discriminant functions should strive for to achieve homogeneous groups in terms of variability dependent variable, while creating sets of possible different from each other. Statistical characterizing the overall ability of the resulting discriminant function is Wilks' lambda coefficient that takes values from the interval <0,1> and defined as follows (RENCHER, CHRISTENSEN, 2012) :

$$\lambda = \frac{\det(g)}{\det(g+h)}$$

where:
g - matrix of intragroup variance and covariance,
h - matrix of intergroup variance and covariance.

The desired value of the statistic is the number close to zero, which proves the discriminative ability of the model. The verification of the discriminatory ability of each variable model uses the partial factor while Wilks, represented by the formula (RENCHER, CHRISTENSEN, 2012), again, the closer to zero the better the discriminant variable analyzed:

$$\lambda_k^{cz} = \frac{\lambda^1}{\lambda^0}$$

where:
$\lambda^1$ - the coefficient for the model on insertion of the variable,
$\lambda^0$ - before the introduction of the value of the variable coefficient.

Another important parameter indicative of the degree of usefulness of the application of discriminant function is the value of statistic test dependent on the multiplicity of objects in the sample (N), the number of variables (K) and the number of concerned groups (I), this statistic has a distribution F-Fischer on K-1 and N-K-I degrees freedom and readjusted the formula:

$$F_k = \left( \frac{N-K-I}{K-1} \right) \frac{1-\lambda_k^{cz}}{\lambda_k^{cz}}$$

When the value $F_K$ is lower than the desired probability level discriminatory significance for this variable must be considered and add it to the model (RENCHER, CHRISTENSEN, 2012).

### 2.2.3. Discrimination, qualifications and numerical conditions

The calculations were performed using Statistica software and copyright calculation of the eigenvalues of the matrix (PREWEDA 2013). Grouping variable was qualitative trait "District" (Fig. 21). As one of the independent variables were treated the transaction price of the property which the property valuation is the dependent variable.
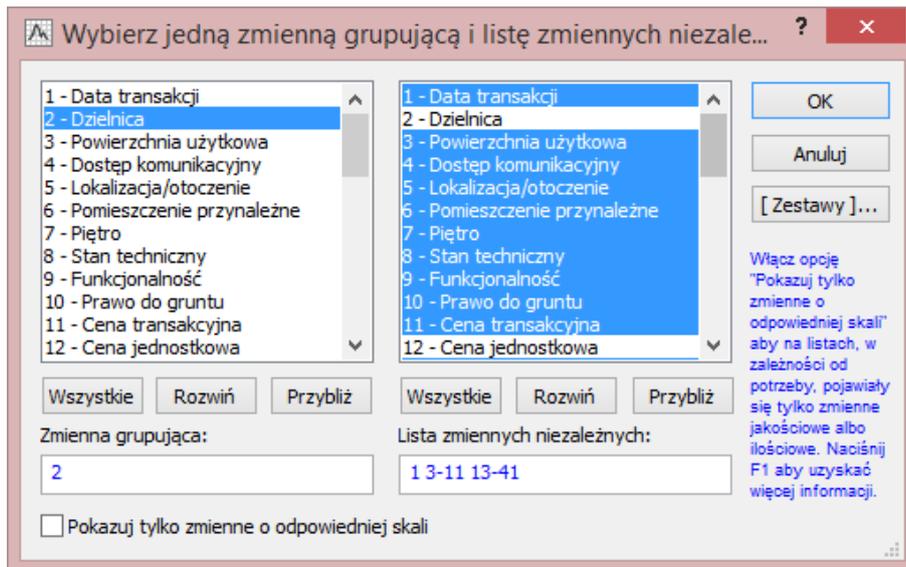
Fig. 21. Selection of variables for discriminant analysis- polish version of software
Resource: Own study

Stepwise analysis was performed (Fig. 22). The results of the final, 10-this step is given in Table 19.
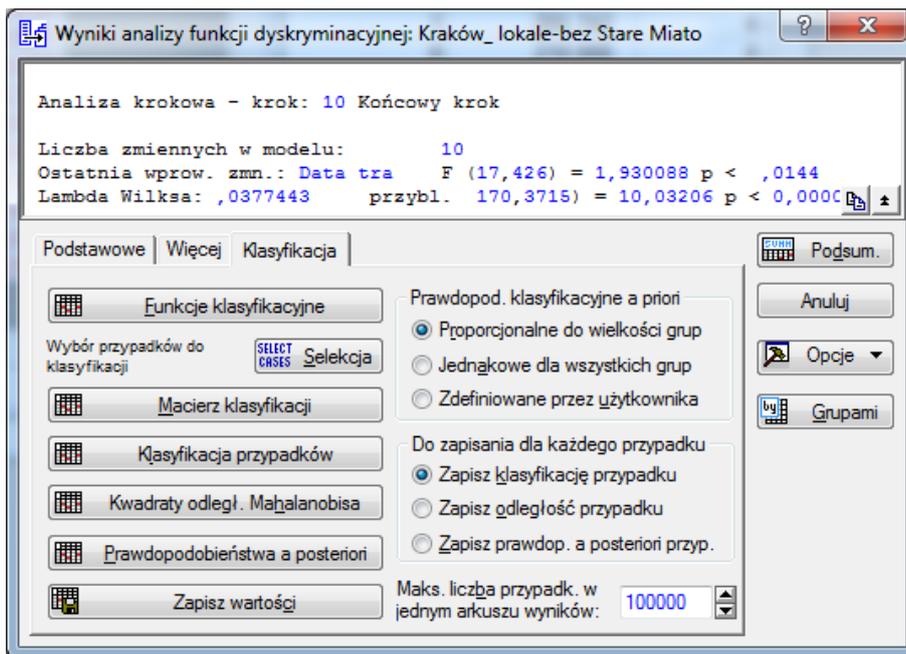


Fig. 22. The results of discriminant function analysis- polish version of software
Resource: Own study

Table 19. Summary of discriminant function analysis. Grouping: District (18 grups).

| N=453 Variables in the model: 10 | Lambda – wilks' | Partial – wilks' | F rem. - 17,426 | P | Tolerance | 1-toler. - (r-sqr) |
|---|---|---|---|---|---|---|
| Location / surroundings | 0,0731 | 0,5166 | 23,447 | 0,0000 | 0,6990 | 0,301 |
| The right to land | 0,0558 | 0,6768 | 11,969 | 0,0000 | 0,9868 | 0,013 |
| Technical condition | 0,0651 | 0,5797 | 18,167 | 0,0000 | 0,6422 | 0,358 |
| Transport access | 0,0461 | 0,8190 | 5,537 | 0,0000 | 0,9211 | 0,079 |
| Transaction price | 0,0815 | 0,4631 | 29,050 | 0,0000 | 0,0750 | 0,925 |
| Usable area | 0,0729 | 0,5179 | 23,326 | 0,0000 | 0,0689 | 0,931 |
| Floor | 0,0442 | 0,8548 | 4,255 | 0,0000 | 0,9591 | 0,041 |
| Functionality | 0,0422 | 0,8939 | 2,975 | 0,0001 | 0,5798 | 0,420 |
| Associated rooms | 0,0422 | 0,8953 | 2,932 | 0,0001 | 0,9672 | 0,033 |
| Transaction date | 0,0407 | 0,9285 | 1,930 | 0,0144 | 0,9809 | 0,019 |

Resource: Own study

Wilks' lambda statistics shows that all the features are important, although in varying degrees, they have the statistical power. On the basis of the partial Wilks can determine the order of the variables that have the greatest impact on the discrimination of different districts. They are, in order of transaction price, location / surroundings, Usable area, technical condition, the right to land, access communication Floor, Functionality, room belonging, date of the transaction. The values of F-statistic confirms that the greatest impact of discrimination are the first four variables.

Discriminant functions are based on the canonical analysis. A crucial step inference is to determine whether subsequent discriminant functions are statistically significant. Due to the ill-conditioned matrix, calculate the eigenvalues performed by copyright numerical algorithms presented in (PREWEDA, 2013). Using discrete regularization, allowing solution to the problem.

The basis for the regularization of discrete distribution with respect to a specific value. Due to the ill-condition matrix, traditional methods of calculation generate errors. The error that occurred in the package Statisctica, is illustrated in Fig 23.
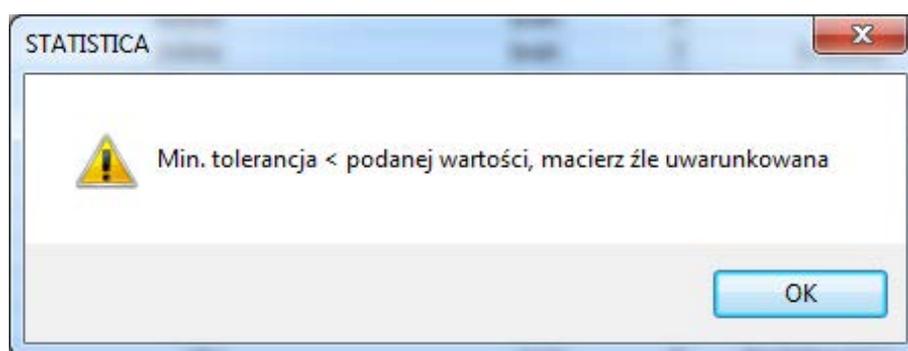


Fig. 23. Screenshot when creating a discriminant function-polish version of software
Resource: Own study.

The essence of the problem is to determine whether the eigenvalues close to zero due to the specifics of the analyzes or for purely numerical. Pay special attention to the fact that the discriminant functions are very sensitive to disturbance input. Problems with the numerical solution tasks appear frequently when analyzed based on the property there is a significant group of properties with similar characteristics. In the case under consideration the cardinality of the base 475 of real estate, it was inevitable. Conditioning matrix, the authors studied with the

help of indicators Turing $M(\mathbf{A})\,i\,N(\mathbf{A})$, Von Neuman'a-Goldstin $P(\mathbf{A})$ and the determinant of a standardized system of equations, where $\mathbf{A}$

is a matrix classification. The values of each indicator is determined from the relation:

$$M(\mathbf{A}) = n \cdot \max_{ij}\left|a_{ij}\right| \cdot \max_{ij}\left|\alpha_{ij}\right|$$

$$N(\mathbf{A}) = n^{-1} \cdot \left\|\mathbf{A}\right\| \cdot \left\|\mathbf{A}^{-1}\right\|$$

where:

$$\left\|\mathbf{A}\right\| = \left(\sum_{ij} a_{ij}^{2}\right)^{\frac{1}{2}}$$

$$P(\mathbf{A}) = \left|\frac{\lambda_{max}}{\lambda_{min}}\right|$$

wherein:

$\lambda_{max}, \lambda_{min}$ - largest and smallest eigenvalue of the matrix $\mathbf{A}$.

$$W(\mathbf{A}) = \det \breve{\mathbf{A}}$$

where:

$\breve{\mathbf{A}}$ - normalized matrix, subsequent rows of the matrix $\mathbf{A}$ were divided by the $\left(\sum_{j=1}^{n} a_{ij}^{2}\right)^{\frac{1}{2}}$.

For a well-conditioned matrix, relevant indicators should be of the order (Preweda, 1995)

$$M(\mathbf{A}) = \sqrt{n}\log n$$

$$N(\mathbf{A}) = \sqrt{n}$$

$$P(\mathbf{A}) = n$$

$$\left|W(\mathbf{A})\right| > 1$$

Between the first three indicators overlap relations:

$$\frac{M(\mathbf{A})}{n^2} \le N(\mathbf{A}) \le M(\mathbf{A}) \quad (\text{ dla } n \ge 10)$$

$$\frac{M(\mathbf{A})}{n} \le P(\mathbf{A}) \le nM(\mathbf{A})$$

The relationships between indicators of conditions for the matrix $\breve{\mathbf{A}}^{\mathrm{T}}\mathbf{A}\,i\,\mathbf{A}$ can not be precisely specified, but you can give estimates in the form of:

$$P\left(\mathbf{A}^{\mathrm{T}}\mathbf{A}\right) \gtrless P\left(\breve{\mathbf{A}}\right)$$

$$N\left(\mathbf{A}^{\mathrm{T}}\mathbf{A}\right) \gtrless N\left(\breve{\mathbf{A}}\right)$$

Indicators $M\left(\mathbf{A}^{\mathrm{T}}\mathbf{A}\right)i\,W\left(\mathbf{A}^{\mathrm{T}}\mathbf{A}\right)$ give a view on the issue of determinants of this matrix in terms of the designation of its inverse. In this example the base of the real estate premises, all indicators point to the poor conditioning of the matrix, which is the basis for the designation of the discriminant function. This is confirmed by numerical analyzes carried out. Estimator disturbed system $\left(\mathbf{A}+\mathbf{dA}\right)\breve{\mathbf{x}} = \mathbf{w}+\mathbf{dw}$, which can be solved with the help of matrix pseudo – diversion is given by (Preweda, 1995)

$$\mathbf{ds} = \left(\mathbf{A}+\mathbf{dA}\right)^{+}\mathbf{w} + \left(\mathbf{A}+\mathbf{dA}\right)^{+}\mathbf{dw}$$

Impaired coefficient matrix can be written as:

$$\mathbf{A}+\mathbf{dA} = \mathbf{U}\left(\mathbf{S}+\mathbf{dS}\right)\mathbf{V}^{\mathrm{T}}$$

hence the disorder determined by $\mathbf{dA} = \mathbf{U}\,\mathbf{dS}\,\mathbf{V}^{\mathrm{T}}$.

A key problem to be solved is whether or disorder **dS** increases, whether or not **S** array row. If it does not grow in a row, then change the pseudo-inverse are continuous in the sense Lipshitz. In this case, you can give the upper estimate for the change pseudoodwrotności. If, however, the **S** matrix disorder enlarges its range, then these changes are discontinuous and endless. In practice, this means that we can not have virtually no confidence in more robust estimate of the accuracy of estimated parameters.

In the case of the test set, which are characteristics of Krakow premises real estate market, the last value own, though not zero, due to both the failure of the system as well as with numerical factors. In fact, there is a defect of the matrix, hence in the light of the arguments presented above, the statement established her as equal to 0.

Table 20 shows the eigenvalues of canonical roots, the coefficients of determination R, Wilks' Lambda statistics and the results of the chi-square test. In the first line of the table shows the significance test for all ten elements, the second for nine after removal of the first element, the penultimate included only the relevance of the ninth element. Tenth case was not considered, because of its zero value.

Table 20. Eigenvalues, coefficients of determination and significance tests of canonical roots

| The number of deleted elements | Eigenvalues | R canonical | Wilks' Lambda statistics | Chi-sqr | Df | P |
|---|---|---|---|---|---|---|
| 0 | 3,266 | 0,875 | 0,038 | 1435 | 170 | 0,000 |
| 1 | 1,001 | 0,707 | 0,161 | 800 | 144 | 0,000 |
| 2 | 0,543 | 0,593 | 0,322 | 496 | 120 | 0,000 |
| 3 | 0,233 | 0,435 | 0,497 | 306 | 98 | 0,000 |
| 4 | 0,203 | 0,411 | 0,613 | 214 | 78 | 0,000 |
| 5 | 0,137 | 0,347 | 0,738 | 133 | 60 | 0,000 |
| 6 | 0,066 | 0,248 | 0,838 | 77 | 44 | 0,001 |
| 7 | 0,057 | 0,231 | 0,894 | 49 | 30 | 0,015 |
| 8 | 0,034 | 0,181 | 0,944 | 25 | 18 | 0,119 |
| 9 | 0 | 0 | - | - | - | - |

Resource: Own study

Based on the determination of coefficients can be seen that the first three most important elements are canonical. Another three, though important, explain much less variance overall variability. Other discriminant functions have practical significance. At this point it is worth paying attention to the standardized discriminant function coefficients for each canonical roots. Table 21 shows the values for the first four elements of an element of the ninth. Omitted when the feature "Transaction Date", which in the case of the present database is not critical.

Table 21. Standardized coefficients for canonical variables (elements)

| Variable | Pierw. 1 | Pierw. 2 | Pierw. 3 | Pierw. 4 | Pierw. 9 |
|---|---|---|---|---|---|
| Location | 0,6526 | -0,4674 | 0,8374 | -0,0520 | 0,0615 |
| Law to ground | 0,3438 | -0,4519 | -0,4653 | -0,1492 | 0,1512 |
| Technical standard | -0,6687 | -0,6016 | -0,3577 | 0,3679 | 0,2362 |
| Transport access | -0,0949 | 0,0568 | -0,1589 | -0,8483 | 0,2483 |
| Transaction price | 2,1334 | 2,3487 | -1,4608 | 0,6888 | -0,1117 |
| Usable area | -1,9258 | -2,6161 | 1,0902 | -0,8930 | -0,9863 |
| Floor | -0,1711 | 0,2041 | 0,3835 | -0,1743 | -0,0793 |
| Funkcjonality | 0,0529 | 0,0545 | 0,3802 | -0,1106 | 0,6664 |
| Associated rooms | 0,0988 | 0,0171 | 0,2057 | 0,2627 | 0,1180 |

| | | Eigenvalue | | | 3,2658 | 1,0008 | 0,5431 | 0,2331 | 0,0245 |

Resource: Own study

In the first discriminant function has the greatest influence the transaction price, usable area, technical condition and location. The second function is determined mainly by the usable area, the transaction price, to a lesser extent by technical condition. The third function again dominates the transaction price, usable and location. Further features also take into account other characteristics, but the significance of these features is of no practical significance.

An important step in discriminant function analysis is the classification of a particular property to the concerned districts. The classification in the multidimensional space defined by the variables in the model are in this case the Mahalanobis distances (Fig. 23).

| Przyp | Obserw. Klasyf. | Podgórze p=,07064 | Nowa Huta p=,11921 | Podgórze - Duchackie p=,04636 | Stare Miasto p=,06623 | Swoszowice p=,04636 | Bieńczyce p=,04194 | Bronowice p=,04857 |
|---|---|---|---|---|---|---|---|---|
| | Nowa Huta | 13,2924 | 6,6813 | 17,6888 | 46,01228 | 25,9755 | 9,2814 | 21,7178 |
| | Nowa Huta | 18,9042 | 7,3094 | 17,1231 | 52,42801 | 22,8206 | 10,7202 | 20,8399 |
| | Nowa Huta | 17,7217 | 8,1148 | 20,6166 | 53,64652 | 24,4126 | 10,4114 | 21,8370 |
| * | Prądnik Czerwony | 15,7893 | 18,7755 | 18,6402 | 32,50241 | 14,7239 | 13,8227 | 19,3376 |
| | Nowa Huta | 17,0450 | 7,1022 | 16,6830 | 52,74355 | 22,3492 | 12,6711 | 22,0961 |
| | Nowa Huta | 12,1396 | 6,3928 | 15,9737 | 50,09983 | 17,5331 | 8,7990 | 15,3436 |
| * | Bieńczyce | 13,1579 | 10,7064 | 12,9066 | 44,81995 | 12,8170 | 15,0039 | 13,8524 |
| * | Krowodrza | 25,5392 | 32,7360 | 24,2194 | 65,75453 | 18,0298 | 27,3544 | 17,0436 |
| | Nowa Huta | 15,8107 | 4,7089 | 14,0382 | 58,63907 | 21,4317 | 11,2340 | 20,0553 |
| * | Bieńczyce | 24,4496 | 11,2694 | 22,1263 | 56,16533 | 23,2589 | 15,7520 | 23,6529 |
| | Nowa Huta | 15,3965 | 4,3205 | 16,8035 | 57,26738 | 23,0629 | 7,5268 | 19,0034 |
| * | Czyżyny | 24,0909 | 22,0678 | 17,7828 | 43,84733 | 23,7949 | 16,8103 | 20,1869 |
| | Nowa Huta | 24,7211 | 11,0696 | 20,6952 | 72,37046 | 19,6613 | 16,3767 | 20,3427 |
| * | Krowodrza | 20,9656 | 26,6861 | 18,1276 | 70,54282 | 20,9549 | 23,8120 | 16,6047 |
| * | Bieńczyce | 12,7718 | 15,7529 | 19,1622 | 39,28714 | 14,7401 | 13,9482 | 15,8114 |
| | Nowa Huta | 22,7963 | 9,8601 | 21,5303 | 64,78703 | 25,5182 | 19,5609 | 28,1978 |
| | Prądnik Czerwony | 23,8709 | 28,2791 | 24,6284 | 40,36389 | 18,4420 | 18,5695 | 19,2579 |
| * | Czyżyny | 24,3882 | 35,8435 | 25,1689 | 35,91289 | 26,0368 | 22,4270 | 21,4841 |
| | Nowa Huta | 17,3632 | 4,7231 | 14,3967 | 62,77405 | 16,8261 | 11,2707 | 16,9444 |
| | Bieńczyce | 20,6625 | 11,7703 | 23,7189 | 38,00599 | 28,4395 | 8,9931 | 26,0750 |
| * | Prądnik Czerwony | 21,7888 | 41,5852 | 26,0087 | 41,06846 | 15,0450 | 32,3601 | 17,9918 |
| * | Bieńczyce | 19,9771 | 9,9490 | 18,7596 | 37,57359 | 22,8300 | 9,1018 | 22,7318 |
| * | Krowodrza | 25,5627 | 29,1538 | 21,2565 | 73,96813 | 22,3919 | 25,2718 | 17,5269 |
| | Nowa Huta | 16,8746 | 4,7122 | 18,1036 | 59,67417 | 22,6983 | 9,1949 | 19,9978 |

Kwadraty odległości Mahalanobisa od centroidów (Kraków_ lokale-bez Stare Miato)
Błędne klasyfikacje są oznaczone *

Fig. 23. A fragment containing sheet squares Mahalanobis distances from centroid-polish software version
Resource: Own study

Classification matrix shown in Table 22. In the lines the observed real estate are given, while in columns sorted in the result analysis. Fragment of a sheet showing the classification of the property to neighborhoods is posted in Fig. 24.

Klasyfikacja przypadków (Kraków_ lokale-bez Stare Miato)
Błędne klasyfikacje są oznaczone *

| Przyp | Obserw. Klasyf. | 1 p=,07064 | 2 p=,11921 | 3 p=,04636 | 4 p=,06623 |
|---|---|---|---|---|---|
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Bieżanów - Prokocim |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Mistrzejowice |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Bieżanów - Prokocim |
| * | Prądnik Czerwony | Wzgórza Krzesławickie | Prądnik Czerwony | Bieńczyce | Bieżanów - Prokocim |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Mistrzejowice |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Bieżanów - Prokocim |
| * | Bieńczyce | Nowa Huta | Mistrzejowice | Wzgórza Krzesławickie | Bieżanów - Prokocim |
| * | Krowodrza | Czyżyny | Bronowice | Prądnik Biały | Swoszowice |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Bieńczyce | Mistrzejowice |
| * | Bieńczyce | Nowa Huta | Wzgórza Krzesławickie | Mistrzejowice | Bieńczyce |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Mistrzejowice |
| * | Czyżyny | Prądnik Czerwony | Łagiewniki | Bieńczyce | Bieżanów - Prokocim |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Mistrzejowice | Bieńczyce |
| * | Krowodrza | Czyżyny | Wzgórza Krzesławickie | Prądnik Biały | Łagiewniki |
| * | Bieńczyce | Wzgórza Krzesławickie | Bieżanów - Prokocim | Nowa Huta | Bieńczyce |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Bieńczyce | Mistrzejowice |
|  | Prądnik Czerwony | Prądnik Czerwony | Czyżyny | Krowodrza | Swoszowice |
| * | Czyżyny | Prądnik Czerwony | Krowodrza | Czyżyny | Prądnik Biały |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Mistrzejowice | Bieńczyce |
|  | Bieńczyce | Bieńczyce | Nowa Huta | Wzgórza Krzesławickie | Bieżanów - Prokocim |
| * | Prądnik Czerwony | Swoszowice | Czyżyny | Prądnik Biały | Bronowice |
| * | Bieńczyce | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Mistrzejowice |
| * | Krowodrza | Czyżyny | Prądnik Biały | Bronowice | Wzgórza Krzesławickie |
|  | Nowa Huta | Nowa Huta | Bieńczyce | Wzgórza Krzesławickie | Mistrzejowice |
| * | Prądnik Czerwony | Łagiewniki | Prądnik Czerwony | Prądnik Biały | Krowodrza |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Mistrzejowice | Bieńczyce |
|  | Krowodrza | Krowodrza | Prądnik Czerwony | Czyżyny | Grzegórzki |
|  | Prądnik Czerwony | Prądnik Czerwony | Czyżyny | Prądnik Biały | Bronowice |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Bieńczyce | Mistrzejowice |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Mistrzejowice | Bieńczyce |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Bieńczyce | Mistrzejowice |
|  | Nowa Huta | Nowa Huta | Wzgórza Krzesławickie | Bieńczyce | Mistrzejowice |
| * | Prądnik Czerwony | Bronowice | Prądnik Biały | Swoszowice | Podgórze |

Klasyfikacja przypadków (Kraków_ lokale-bez Stare Miato)

Fig. 24. A fragment containing sheet classification of the property to the districts.
Resource: Own study

Table 22. Summary of the classification matrix property.

| | Percentage of correct | Podgórze | Nowa Huta | Podgórze D. | Swoszowice | Bieńczyce | Bronowice | Dębniki | Łagiewniki | Grzegórzki | Krowodrza | Prądnik Czerwony | Wzgórza Krzesławoickie | Prądnik Biały | Mistrzejowice | Zwierzyniec | Czyżyny | Bieżanów – Prokocim |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Podgórze | 37,5 | 12 | 3 | 3 | 1 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 0 | 5 | 1 | 0 | 0 | 2 |
| Nowa Huta | 92,5 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 1 |
| Podgórze D. | 42,9 | 1 | 0 | 9 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 1 |
| Swoszowice | 71,4 | 1 | 1 | 0 | 15 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 |
| Bieńczyce | 47,4 | 0 | 8 | 0 | 0 | 9 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Bronowice | 18,2 | 4 | 1 | 0 | 1 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 10 | 1 | 0 | 0 | 0 |
| Dębniki | 78,1 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| Łagiewniki | 61,1 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 11 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| Grzegórzki | 67,7 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 21 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Krowodrza | 25,0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 4 | 6 | 0 | 0 | 1 | 0 | 0 | 4 | 0 |
| Prądnik Cz. | 55,6 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 10 | 1 | 1 | 0 | 0 | 0 | 0 |
| Wzgórza Krzesławickie | 47,1 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 0 | 2 | 0 |
| Prądnik Biały | 16,3 | 6 | 0 | 3 | 5 | 2 | 2 | 3 | 5 | 1 | 3 | 2 | 3 | 7 | 0 | 0 | 1 | 0 |
| Mistrzejowice | 47,4 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 9 | 0 | 0 | 2 |
| Zwierzyniec | 80,0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 |
| Czyżyny | 40,0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 0 | 6 | 0 |
| Bieżanów – Prokocim | 47,1 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 8 |
| Razem | 55,8 | 30 | 72 | 17 | 26 | 16 | 10 | 42 | 21 | 36 | 16 | 19 | 16 | 39 | 14 | 20 | 13 | 14 |

Resource: Own study

## 2.2.4. Discussion of the results and conclusions

The aim of the study was the use of experimental methods discrimination and classification, in order to verify the usefulness of discriminant analysis to better understand the complex real estate market. The subject of the study was the Krakow real estate market premises, database numbered 475 property for which, in addition to the explanatory variables are known transaction prices. Consideration was given to how the real estate housing, both in terms of features as well as market values vary from city neighborhoods. In a comparative approach, this attribute are backed by some appraisers often the selection of the property similar to valued. Grouping variable in the discriminant function analysis was therefore large, as much as 18-element variable quality. Based on the analysis stepwise established order of variables that have the greatest impact on discrimination. Detailed results are presented in section 4 based inference was Wilks' lambda statistic. Based on the canonical analysis, discriminant functions were determined. One of the steps in the calculation is to determine the eigenvalues of the matrix. Drew attention to the difficulties experienced during their calculation in the case of a weak matrix condition. It was found that the discriminant functions arise mainly from transaction prices, usable, condition and location / ambient property. As a result of the classification of a particular property, which were based on Mahalanobis distances, it was found that the City Districts administratively determined correctly classify about 56% of the property. Most of correctly classified cases took place in the district of Nowa Huta (92.5%), at least in the District Prądnik White (only 16.3%).

The analyzes show that the discriminatory methods can be successfully applied in the real estate market research, for example to verify the correct selection of the real estate underlying the so-called real estate similar to valued. The advantage of this method is able to verify and classify, at the level of the probability of each property for a specific group.

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*This work is financed from funds for science realized at AGH University of Science and Technology, allocated for the year 2014*

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