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## **Information System for Real Estate Valuation**

### **1. Introduction**

Real estate valuers are certified to conduct real estate valuations, which means that they are licensed to perform legal actions related to the appraisal of real property value [7]. End result of the value appraisal procedure is the so-called valuation survey, whose form and possible valuation methods have been defined in the ordinance of the Council of Ministers on real estate valuation and preparation of a valuation survey [6] and national valuation standards issued by the Polish federation of associations of real estate valuers [8].

At the moment, a real estate valuer is in the possession of a number of data from the real estate market. Their analysis precedes the preparation of a valuation survey for all types of real estate properties. Development of a real estate valuer profession in the nearest future will necessitate a modification of existing appraisal methods (they currently reveal significant faults). The modified valuation methods should to a larger extent objectify the established property value by means of algorithms. A traditional approach to real estate valuation (without the use of dedicated computer systems) does not yield reliable results even with the use of existing valuation algorithms.

The tasks performed by real estate valuers are particularly difficult because they have to conduct an insightful analysis at every stage of the valuation procedure. The comprehensive analysis results in the establishment of property value. The need to analyse carefully a large amount of incomplete and uncertain data confirms that a dedicated computer system that would assist a real estate valuer at every stage of work is indispensable. The use of a computer system completely changes the valuation procedure because the valuer does not have to concentrate on correct calculations but focuses on the right choice of market parameters which can be freely corrected.

Value appraisal is significantly influenced by subjectivity in the process of real estate market analysis and real estate valuation. Development of a computer system assisting particular stages of valuer's work will provide an expert with a tool enabling the objectification

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of market parameters. Such a system takes the evaluation procedure off the valuer's shoulders and lets the person concentrate on real estate market analysis, which consequently objectifies the market and real estate value. The system should maximally automate all processes, whose course is clearly defined by binding legal regulations. Most significantly, the system must be flexible and leave the valuers enough space to use their experience at every stage of the valuation process. The valuer should be able to influence the conducted procedure at every stage.

It needs to be highlighted that the market of computer systems does not currently offer professional software that would assist a real estate valuer. The existing systems only enable the storage of information in the database, yet they do not possess implemented algorithms complying with the law and real estate market analysis modules useful for the valuer.

Creation of a real system requires both knowledge of information systems as well as theoretical and practical experience in real estate valuation. The most difficult challenge here is obtaining practical experience in real estate valuation because most certified valuers do not wish to engage in the creation of computer systems. A system created solely on the basis of theoretical knowledge would not be useful in practice. This is actually the most significant reason why there are no professional computer systems for real estate valuation.

The aim of the article is to present a concept created by co-author of an information system assisting property valuers in the process of property value assessment. Creation of such a system was possible since the co-author has worked for many years in a family-owned real estate valuer's office and currently cooperates with a large number of certified valuers.

The article presents the proposed architecture of the system, which has been divided into three parts: real estate database, valuation survey database and analytical part using the algorithms of real estate valuation.

National valuation standards [8] define the term valuation survey in such a way: *Valuation survey – a document which constitutes a written personal opinion of a real estate valuer on the value of the subject of valuation, taking into consideration assumptions and conclusions, upon which the valuation is based, and including significant information obtained in the valuation procedure.*

A valuation survey should contain such an amount of data on the valued property, the market, and valuation grounds and methods that its contents should be clear and sufficient for third persons. Thus, a valuation survey should be a relatively extensive document because it is usually analysed and checked in the valuer's absence. Hence it should speak by itself.

## **2. Real estate valuation methodology**

A real estate valuer may determine many types of property value by means of a valuation procedure, for example, market value and replacement value. Market value is the most often determined value type. The term is defined as the most probable price a property

would bring if offered in the market, established with the help of transaction process [7]. Thus market value is the predicted price that can be obtained in the sales transaction. It is determined after a thorough observation of a large group of real estate property transactions. Real estate valuation is conducted with the use of the following fundamental approaches: comparative approach, income (rental) approach, cost approach, or mixed approach which includes elements of all the previous ones [7]. Comparative approach is the most popular valuation procedure. It encompasses two following methods: average price correction method and pairwise comparison method. Comparative approach helps to establish market value of a property.

The concept system predicts several real estate valuation algorithms. This article will present two of them: the average price correction method and pairwise comparison method. They both include a common part which is analysis of the real estate market.

## 2.1. Analysis of the real estate market

The first stage of the valuation procedure in the comparative approach is analysis of the real estate market. It is the most important part of the valuation procedure because data collected at this stage and conclusions will form the grounds for further valuation. A summary of the market analysis should be also included in the valuation survey. The description of market analysis should indicate market type, the scope of the described market and the period of price analysis. Real estate market analysis can be divided into a few basic parts: selection of the properties being the basis for the assessment, update of transaction prices, calculation of the basic parameters related to the properties being the basis for the assessment, selection of market prices differentiating property prices, comparison of minimum and maximum property prices in the light of their market features.

The first part of the market analysis is the selection of properties which would form the basis of the assessment procedure. Then, it is necessary to calculate individual prices which form the base of the entire comparative approach algorithm. Selected properties need to be similar to the valuated one. The act on real estate management [7] defines the term similar property in the following way:

*Similar property is a property comparable to the one being the subject of the valuation procedure in terms of location, legal status, purpose, usage and other factors influencing its value.*

According to national valuation standards [8] valuation procedure should take into consideration only properties, "...which were the subject of the sales transaction on the date preceding the valuation date but no earlier than two years before the valuation date. Application of prices from other periods requires detailed justification".

Real estate market is relatively fluid and using data from previous periods while establishing the current property value would make the established value unreliable.

Using properties from earlier periods may be justifiable when the researched market segment is not well-developed, which means that sales transactions of particular property types are infrequent.

### Price change trends

All transaction prices assumed for market analysis need to be updated with a market trend of property price change in the analysed period for the valuation date.

There is a few algorithms calculating price change trends, for example, the interval method. Monthly price change trend calculated with the interval method requires the choice of two properties which differ by only one feature – date of transaction, whilst in other terms they should be identical. Monthly price change trend for one pair is determined in the following way:

$$zC = \frac{C_B - C_A}{C_A \cdot (T_B - T_A)} \cdot 30 \text{ days} \cdot 100\% \quad (1)$$

where:

- $zC$  – price change trend expressed in % per month,
- $C_A, C_B$  – price of earlier and later transaction respectively,
- $T_A, T_B$  – date of earlier and later transaction respectively.

The monthly price change trend, according to the interval method, can be determined most reliably by calculating the arithmetic mean of the largest possible number of pairs, which objectifies the obtained number. This procedure establishes both the price change trend as well as the relevant price change trend period. Afterwards, it is necessary to update all real estate prices for the valuation date.

Out of the set of properties being the basis for the assessment, it is necessary to select a property of minimum price  $C_{\min}$  and property of maximum price  $C_{\max}$ , calculate basic parameters, that is arithmetic mean out of all property prices and  $\Delta C$ .

$$\Delta C = C_{\max} - C_{\min} \quad (2)$$

The “delta” should not be understood solely as a difference between property features: maximum and minimum. It should be also regarded as difference in the condition of these properties because it influences the difference in price. Maximum and minimum real estate prices are reflections of market features of these real estates.

### Market features

The next step in the analysis of the real estate market is the selection of market features which significantly affect differences between real estate prices in a given market. These features constitute the difference between the state of real estate of minimal price and maximum price, defined by “delta”. The features, which significantly affect the differences between real estate prices, depend on the local real estate market and its characteristics 0.

There is no mention of a specific number of market features that should affect the variability of real estate prices. Preferably, their number should be insignificant because this means that real estates selected for analysis do not differ significantly.

Another significant aspect here is that the influence of market features on real estate prices usually varies. The role of the real estate valuer is to determine how much particular market features influence the value, that is to determine the weights of market features.

It is possible to determine clearly why the value of property “A” is higher than that of property “B” only by characterizing market features ascribed to particular properties. Each real estate should be described in terms of its market features and these should be given specific weights. In the case of market features, verbal descriptions are used for particular features.

Thus, for example for the feature “neighbourhood” the following weights can be given: very good, good, average. Each weight possesses an index which is a consecutive number of the assessment. The indexes are in the range from 0 to  $n$  for  $n-1$  weights of a given market feature. Usually, the index 0 is given to the worst weight and index  $n$  to the best one.

It is an incredibly clear method of real estate description, yet a very subjective one, which intensifies the probability of erroneous judgement and inconsistency with the factual state. The number and naming of market features is up to the valuer to decide. Best solution is establishing such a scale which would reflect differences between real estates. The higher the number of weights the more detailed the description is. A small number of weights results in a very vague and general assessment. Hence, it might be the case that two real estates significantly different in terms of their price and condition seem similar in terms of market features.

The evaluation of the real estate market in terms of market features is conducted with the help of two principles: interpolation and extrapolation.

The principle of interpolation is referred to when the valuated property and the property of minimal price share the same weight for a given market feature or the weight for the valuated property is higher. At the same time the weight needs to be worse or the same as for the property of maximum value. On the other hand, when the weight of the valuated property is higher than property of the maximum price or worse than property of the minimum price we speak about the principle of extrapolation.

The last stage of the real estate market analysis is the summary of weights of properties with minimum and maximum value in the context of selected market features. Such a summary aims at determining the scope of the given market feature in “delta” and establishing the size of one range between neighbouring weights of the market feature. The mentioned range refers to the part of “delta” which is a result of the weight of a given market feature, that is 100%.

$$W_p = \frac{100\%}{I_{\max} - I_{\min}} \quad (3)$$

where:

- $W_p$  – size of the range [%],
- $I_{\min}$  – market feature weight index of the maximum price property,
- $I_{\max}$  – market feature weight index of the minimum price property.

After establishing the market value with the help of a selected valuation method within the comparative approach, we can additionally apply expert's coefficient  $K$ , which remains in the range [0.90; 1.10]. Normally, the coefficient assumes the value of 1. It can be taken into consideration only in exceptional circumstances, for example, if the valuated property has faults that go beyond market features ( $K < 1$ ) or if it possesses advantages that go beyond market features ( $K > 1$ ). Each use of the coefficient  $K \neq 1$  should be justified by the valuer by an appropriate note in the valuation survey. After including the expert's coefficient the market value of the property is defined as:

$$W_{rn} = W_r \cdot K \quad (4)$$

where  $W_r$  – property market value before correction.

## 2.2. Pairwise comparison method

The ordinance of the Council of Ministers on real estate valuation and preparation of a valuation survey [6] defines the pairwise comparison method in such a way:

*In the case of the pairwise comparison method, a property which is the object of the valuation procedure and whose features are known is compared with properties which have been the object of market transactions and whose features, transaction prices and transaction conditions are known.*

In the method, the valuated property is compared with a selection of 3–5<sup>1</sup> properties out of all properties which are the basis of the valuation procedure. A higher number of properties taken for comparison increases reliability of the obtained result.

The rule is that compared properties are corrected against the valuated one and not the other way round. The compared properties are adjusted to the valuated one in order to calculate what prices (for the valuation day) they would obtain if they possessed the same features as the valuated property.

Nominal correction values for particular market features of a given pair are calculated with this formula:

$$P_{x_i} = (I_w - I_x) \cdot W_p \cdot w_i \cdot \Delta C \quad (5)$$

where:

- $P_{x_i}$  – nominal correction of  $i$  feature in the pair number  $x$ ,
- $I_w$  – market feature weight index of the valuated property,
- $I_x$  – market feature weight index of the compared property,
- $W_p$  – size of the range calculated with formula (3),
- $w_i$  – weight of  $i$  market feature,
- $\Delta C$  – delta calculated with formula (2).

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<sup>1</sup> According to national valuation standards [8].

The corrected property value is the sum of transaction price and calculated correction value  $P_x$ .

When adjusting transaction prices to the prices of the compared property, it is necessary to calculate (assuming that all pairs can be treated with the same trust) arithmetic mean of all the pairs. Yet it may be the case that some pairs are treated with greater trust than the others. In such a case, real estate value is calculated with weighted mean.

### 2.3. Mean price correction method

Mean price correction method defines value based on average prices observed in the real estate market. The crucial thing here is that in order to obtain the market value we need to make a correction of the mean price calculated by means of a representational sample, which should include at least several<sup>2</sup> properties which have been the subject of market transactions. The most significant stage here is a detailed description of properties with minimal and maximum price.

When defining the value with the help of mean price correction method, it is also necessary to determine:

- mean transaction price
- ranges of correction coefficients, as

$$W_d = \frac{C_{\min}}{C_{sr}} \quad (6)$$

$$W_g = \frac{C_{\max}}{C_{sr}} \quad (7)$$

where:

$W_d$  – bottom coefficient,

$W_g$  – top coefficient.

The range of correction coefficient ascribed to particular features is described as:

$$[w_i \cdot W_d; w_i \cdot W_g] \quad (8)$$

where  $w_i$  – weight of  $i$  market feature.

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<sup>2</sup> According to the ordinance of the Council of Ministers on real estate valuation and preparation of a valuation survey [6].

Based on assessments of features of minimum, maximum and evaluated property, it is necessary to establish the value of the correction coefficient for a particular market value for the valuated property in accordance with the formula below:

$$\Delta W_i = w_{g_i} - w_{d_i} \quad (9)$$

$$u_i = w_{d_i} + \Delta W_i \cdot (I_w - I_{\min}) \cdot W_p \quad (10)$$

where:

- $\Delta W_i$  – the size of the range of coefficients correcting for  $i$  market feature,
- $w_{d_i}, w_{g_i}$  – bottom and top coefficient for  $i$  market feature,
- $u_i$  – correction coefficients for  $i$  market feature,
- $I_w$  – market feature weight index of the valuated property,
- $I_{\min}$  – market feature weight index of the minimum price property.

In this method, property value is defined as a product of the mean price and the sum of correcting coefficients for all market features.

$$W_r = C_{sr} \cdot \sum_{i=0}^n u_i \quad (11)$$

where  $W_r$  – market value for 1 m<sup>2</sup> of the property.

## 2.4. Example of property valuation mean price correction method

The subject of the valuation is dwelling with the surface 45.70 m<sup>2</sup>. As a result of local market research selected 11 most similar properties to the property being valued (Tab. 1–4).

**Table 1**  
Market features and their weight

Item	Market features	Weights of the market feature
1	Location of detailed	25.0%
2	The area of usable a flat	10.0%
3	Location on the floor	10.0%
4	Technical condition of housing	40.0%
5	Standard interior of an apartment	15.0%
	SUM:	100.0%

**Table 2**  
Assessment of market features

Item	Market features	Assessment of market features
1	Location of detailed	(bad, good, very good)
2	The area of usable a flat	(unfavorable, moderately favorable, favorable)
3	Location on the floor	(worst, average, best)
4	Technical condition of housing	(average, satisfactory, very good)
5	Standard interior of an apartment	(low, intermediate, medium)

**Table 3**  
Assessment of real property

Item	Market features	Property valued	Property of the minimum price	Property of the maximum price
1	Location of detailed	very good	bad	very good
2	The area of usable a flat	favorable	unfavorable	favorable
3	Location on the floor	average	worst	best
4	Technical condition of housing	satisfactory	average	satisfactory
5	Standard interior of an apartment	intermediate	low	medium

From the collection of sales adopted for the analysis determined the arithmetic mean of price, minimum price and maximum price.

$$C_{avg} = 2\,863.84 \text{ zł/m}^2$$

$$C_{min} = 2\,212.35 \text{ zł/m}^2$$

$$C_{max} = 3\,170.08 \text{ zł/m}^2$$

Calculation of the total range of weightings [ $W_d$ ,  $W_g$ ]:

- lower limit of the weightings  $W_d$ :  $C_{min} / C_{sr} = 0.773$
- upper limit of the weightings  $W_g$ :  $C_{max} / C_{sr} = 1.107$

**Table 4**  
Correction coefficients

Item	Market features	Range of weightings		Correction coefficients
1	Location of detailed	0.193	0.277	0.277
2	The area of usable a flat	0.077	0.111	0.111
3	Location on the floor	0.077	0.111	0.094
4	Technical condition of housing	0.309	0.443	0,443
5	Standard interior of an apartment	0.116	0.166	0.141
		SUM [U]:		1.066

The market value of property [ $1 \text{ m}^2$ ] ( $C_{avg} \cdot U$ ):  $2\,863.84 \text{ zł/m}^2 \cdot 1.066 = 3\,052.85 \text{ zł/m}^2$

The market value of property:  $45.70 \text{ m}^2 \cdot 3\,052.85 \text{ zł/m}^2 = 139\,515 \text{ zł}$

### 3. Structure of the dedicated system

Basic parts of the proposed system include the following: real estate database, valuation survey database and analytical part using the algorithms of real estate valuation.

#### 3.1. Real estate database

The main role of the real estate database is to collect information on real estate transactions. The system should make it possible to view data included in the real estate database, add new information on real estates and export data to other formats. System configuration also allows the user to modify the form, which is filled in when new property is entered into the database – the user may define what information will be stored in the database.

Table 5 includes a list of functions (together with short characteristics), which will the real estate database include.

**Table 5**  
Real estate database

Item	Name / Description
1	<p><b>Adding a real estate to the database</b></p> <p>This functionality enables adding information about real estate transactions. Basic information needs to be entered obligatorily, whilst some data is not indispensable and does not need to be added. A significant element here is a function which makes it impossible to enter the same real estate twice – in the course of entry creation, the system verifies whether a given real estate already exists in the database</p>
2	<p><b>Exporting real estate data to external files</b></p> <p>Data is exported to the RTF format and to the encoded database format which can be opened only in the described system. The user makes a choice which real estate data will be exported. This functionality makes it possible to search a real estate in the database</p>
3	<p><b>Importing real estate data from a file to the database</b></p> <p>The system can automatically import real estate data from other systems. A significant feature here is the possibility to import data from the same system but installed by another user. This function makes it possible to select which properties should be added and review real estate data before adding them to the database</p>
4	<p><b>Searching real estates in the database</b></p> <p>It is possible to search real estates in the database by all parameters which have been filled in when the data was entered to the database</p>
5	<p><b>Reviewing real estates</b></p> <p>Reviewing real estates is possible in two modes: Table – real estates search in the database are presented in the form of a table whose columns include basic data about the real estate: location, transaction date, area, transaction and unit price is a basic method of reviewing the database contents. Detailed view – presents detailed data on selected real estates</p>
6	<p><b>Sorting the real estate database</b></p> <p>Sorting data by columns of the table</p>
7	<p><b>Removing real estates from the database</b></p> <p>The system allows for permanent deletion of data from the database. It is possible to remove individual real estates as well as select a particular group</p>

### 3.2. Valuation survey database

The main role of valuation survey database is the storage of completed valuation surveys in the system. Each survey stored in the database may be opened in the analytical part of the system. The data is stored in such a way that a particular survey can be found very quickly. The database is divided by real estate types: building parcel, commercial/apartment premises, agricultural property, developed property.

Table 6 includes a list of functions (together with short characteristics), which the valuation survey database will include.

**Table 6**  
Valuation survey database

Item	Name / Description
1	Collecting valuation surveys in folders
	Valuation surveys are stored in folders where they were saved by the user. Folders may be freely created and removed; their names may be modified. Folders may be nested, which enables the creation of a very comfortable structure of valuation surveys
2	Automatic sorting by creation date
	Valuation surveys stored in the valuation survey database are automatically sorted into folders according to the date of survey creation. Folders are created for particular years when valuation surveys were conducted. Additionally each year folder consists of month sub-folders
3	Copying a valuation survey
	A selected valuation survey from the database may be copied and used as a template for a new survey. While copying, we can select survey elements that will be copied
4	Removing a valuation survey
	Each valuation survey may be removed from the database
5	Change of survey name and location
	Names of all valuation surveys stored in the database may be changed at any time. Valuation surveys may be moved between folders
6	Adding folders
	It is possible to add any number of folders for the storage of valuation surveys. Folders may include sub-folders
7	Removing folders
	Folders may be removed. Removal of a folder results in a removal of all its valuation surveys
8	Changing folder names

### 3.3. Analytical part using the algorithms of real estate valuation

The analytical part constitutes the largest component of the system. It produces valuation surveys which can be saved in the RTF format. The system enables valuation of four real estate types: building parcel, commercial / apartment premises, agricultural property, and developed property.

A valuation survey has an extended form. It may include a valuation of several properties of different kind, which may be valued with the help of various methods. The following list presents possible evaluation methods:

- valuation of a few real estate of the same type based on one real estate market analysis,
- valuation of a few real estates of the same type with the help of different valuation methods,
- valuation of a few real estates of different types with the help of different valuation methods.

Properties may be valued by means of, for example, the comparative approach (methods: pairwise comparison method and average price correction method).

At the same time, we can open any number of valuation surveys and copy analytical parts between valuation surveys.

Table 7 includes a list of functions (together with short characteristics), which the analytical part will include.

**Table 7**  
Analytical part using the algorithms of real estate valuation

Item	Name / Description
1	Creation of a valuation survey (without the analytical and calculation part) The structure of a valuation survey complies with relevant legal regulations. The system enables unlimited description size at every point of the survey and allows basic text formatting, for example, italics, bold, underline and numbering
2	Functions of the analytical and calculation part (valuation methods):
2.1	Comparative approach The comparative approach procedure makes it possible to review real estate data from the database. The price change trend may be calculated with the following methods: linear approximation, interval method or define one's own price change trend on the basis of market data. The system requires dates for the price change trend. Market features and their weights may be retrieved from configurable dictionaries or entered into the valuation survey aside the dictionary as non-standard features. Non-standard features are visible only in the valuation survey into which they have been introduced. In the comparative approach, real estates may be valued with the following methods: pairwise comparison method and average price correction method. What is important, each action of the system user results in an automatic calculation of real estate value by the system. There is no need to click the buttons calculate, yet it is necessary to change, for example, a market feature weight which is selected from a drop down menu. This results in an automatic calculation of all parameters, consequently we have a new property value. In the eyes of the real estate valuer, this is one of the most important features of the system
3	Saving a valuation survey It is possible to save completed valuation surveys in the survey database. They are saved in a very similar way to text editor applications, that is firstly, the system asks for name and location in the database. Every next time, the system saves changes automatically

## 4. System architecture

The system has been designed in accordance with the MVC<sup>3</sup> paradigm. It differentiates the following layers:

- layer of presentation,
- layer of business logic,
- layer of data access.

MVC is one of the most popular software architecture patterns. It enables independent implementation of particular layers. As a result, modifications of one layer insignificantly affect the others. Basic advantages of the MVC model include:

- all layers may be created independently,
- the presentation layer is separated from business logic,
- the system code is easy to maintain and modernize,
- data access and presentation layers are easy to modify,
- scalability.

Data access layer helps to collect records from the database. Thanks to this layer, the remaining part of the application does not depend on data source type and collection method. When creating application business logic we only refer to model methods; consequently we receive data ready for processing. Also, system development may require changes in database structure. Isolating data the access layer from the remaining part of the application does not result in significant changes in other layers, only in the model. Data access layer is the only layer that communicates with the database.

The designed system of communication between the data model and the database uses JDBC<sup>4</sup>. It is an interface for databases of applications created in *Java* language.

The system contains its own data model which optimally reflects database structures. At the same time, models are logical objects from the point of view of the system.

Business logic layer is the most important logical unit of the system. It includes contains the code fragments which are crucial for system operations. It is responsible for:

- processing data collected from the “lower” layer (data access layer),
- presenting processed data to the user (presentation layer),
- entering the data to the database by the user – with the help of data access layer, which is the only one able to modify database contents.

Major part of the system business logic is placed in the analytical part. It includes all analytical algorithms which are the point of reference for the valuation survey. The remaining parts of the system contain an insignificant fragment of the code belonging to this layer.

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<sup>3</sup> Model-View-Controller.

<sup>4</sup> Java DataBase Connectivity.

Business logic is based upon an object model, where the subject field mainly rests upon cooperating objects. Each of these is characterised by a particular state and specific behaviour. Application project required such an organisation of the application logic so that the state of objects in the database and the user interface could be easily reflected. At the same time, it was important that the business logic fulfils all the requirements set out by the user. The analytical part of the system includes a large number of elementary operations which only together realize a certain algorithm. Hence, creation of a very good problem model was of great importance here.

Business logic of the analytical part was additionally divided into smaller parts. Its major fragment is responsible for the structure of the valuation survey as a whole. Irrespective of this structure, models reflecting particular real estate valuation algorithms were created. It was possible to isolate a set of common processes, which are used by all algorithms. A separate functions set, realizing elementary processes, was created to ensure flexibility of the system logic. The created function sets may be used at any valuation algorithm; consequently when developing the application it is not necessary to repeat the code realizing the same process in different valuation algorithms.

The basic role of the presentation layer (view) is displaying data to the end user. The presentation layer displays data directly collected from the data access layer. There is no possibility of modifying data in this layer, the data are visible in the read-only mode. This layer includes such elements as user windows and widgets. The Project of the system predicts realization of the presentation layer with the help of SWT<sup>5</sup> graphics library for *Java*. SWT library object which represents a window is called *Shell*. It is a container for all the remaining basic and user widgets.

When creating the presentation layer, which is the most important part of the application from the point of view of end user, particular attention was paid to the number of pop-ups. The aim was to minimize the number of open windows to 3–4. A larger number of open windows would hinder system operation and control of it by the user. An average person using computer systems forgets long sequences of events that result in particular actions. The realized application needs to be easily navigable because many of its target users are not computer-fluent.

Application view was developed in such a way that each window contains a minimum number of buttons. The name of each button clearly points to functionality it realizes. Functionalities conducted by all the buttons of a given form are mutually exclusive. Thus, the user finds it easy to select the right button which would activate the result he or she desires. Moreover, the presentation layer was designed in such a way that the system leads the user towards the realization of particular actions and the user does not need to wonder where to

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<sup>5</sup> Standard Widget Toolkit.

click in order to perform a particular action. Close analysis of real estate valuer's work enabled the creation of groups of functions that the system needs at a particular moment. Also, functions from a given group are seen by the user in one window. The user performing a given action does not need to search the most useful functions for the moment in various parts of the system.

The project predicts that the application will operate in the standalone mode. The idea of creating a web application was given up as the majority of valuers work in one-person offices and use one computer. A web-based version of the system would be implemented in a small number of offices where the total number of computers is also small. It is very rarely the case that a certified valuer works with various computers.

## 5. Conclusions

The article presents a concept of a computer software designed to assist property valuers. It needs to be stated that there is currently no professional computer software that can be used for property valuation. The reason for that is probably the difficulty to formalize knowledge and experience presented by real estate valuers in an efficient computer system. The article capitalizes on the experience of one of the authors who has cooperated with a real valuer's office for a number of years. The article analyses the work of a real estate valuer and describes a valuation survey which is a report on real estate valuation procedure. Also, the most basic stages of real estate market analysis have been presented. The article includes information about two most popular methods of real estate valuation: pairwise comparison methods and mean price correction method. The described valuation algorithms help to establish market value of a property. The article presents the structure of a designed system and characterizes its basic functionalities. It describes architecture of the system which has been designed in accordance with the MVC paradigm. The project assumes that the application will be developed in Java programming languagesince there is a significant number of free Java libraries which can be filled up by new applications. The use of several additional libraries is indispensable to implement the system. The project predicts that the application will operate in the standalone mode.

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