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Value Impairment of Contaminated Real Estate

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RESEARCH ARTICLE

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Abstract

Market actors have already recognised the effects of different pollution sources on the surrounding real estate; however, in the Central European environment, both appraisers and non-professionals are highly unsure of how to determine the value of the deterioration caused. In this article we are to classify the available methods described in international literature and to introduce the preconditions for their utilisation. Many options and methods are available to specialists; it is advised to avail of them as soon as possible, in the interest of estimating the economic effects as well as ensuring a solution to any subsequent disputes.

Keywords

property · valuation · sustainability · open market value · contaminated land

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1 Introduction

Environmental awareness has become part of everyday life: both ordinary people and science are more sensitive to pollution. Related disciplines examine in detail the effects of different damage caused by particular pollution sources on the population, the environment and the economy. However, scientific attention has not yet turned towards the real estate sector. The effects of pollution sources on the market value of surrounding real estate have not yet been explored. Presently, no suitable set of methods is available for experts in Central Europe to obtain reliable estimates of the effects of a given pollution on real estate value. Unfortunately, land value impairment factors are excluded in environmental impact studies on the remediation of pollution sources, while, contradictory, and more often, excessive valuations are published in ensuing legal disputes.

The matter is not only topical because of the enforcement of environmental awareness; not only because new developments are necessarily established in already damaged environments, but also because real estate owners have realised the negative influence of different pollution sources on its market value, and have many of them have claimed for indemnity or compensation[1]. Quantifying the amount of impairment of real estate is an important task even at the national economic level, as without such information there is no basis for making responsible decisions.

International real estate practice provides numerous methods for the valuation of contaminated or impacted real estate. These methods are to be chosen and applied according to such factors as the form and site of the pollution, as well as available data and other factors. In their article, Throupe and his co-writers believe that a general real estate appraiser is a professional akin to a general medical practitioner, while ascertaining the value of contaminated property is like brain surgery (Throupe et al, 2007).

1 In the newest edition of the game of Monopoly, residential houses lose their value because of poisonous land improvements built on neighbouring properties, which models the spread of the problem into public awareness.

Our aim is to summarise the suitable methodology for Central European circumstances, based on the literature of the past twenty years and our own experience, and to give an insight on the mentioned special appraisal activity.

2 'The Polluter Pays'

Before describing the possible methods for calculating value impairment, it is necessary to ascertain who is suffering as a result of the damage caused. Csák, in her article, (Csák, 2011) says that damage to and pollution of the environment and the usage of natural resources have an increasing price with a high influence on economic output. Transforming the above to present problem, owners of developments that pollute the land have to face the fact that their planned financial results might be significantly modified by the effects of value impairment on the built environment.

According to the European Union directive of 2004 (Directive 2004/35/CE), the prevention and remediation of environmental damage should be implemented through the furtherance of the 'polluter pays' principle. According to this directive, the polluter is the operator who directly or indirectly damages the environment or establishes any circumstances that lead to such damages. Experts, though, try to construe the meanings of "contamination" and "polluter" more widely but even do not take into consideration the processes that can be or might be initiated in the real estate market by pollution sources. However, the above directive is available to link the value impairment caused to real estate to the operators of the pollution sources. The relating Hungarian Act on environmental protection makes one step forward and defines the meaning of damage to the environment (1995. LIII. Act). Stating: 'environmental damage is a change in or pollution of the environment or a component thereof, direct or indirect, measurable, significantly unfavourable change or direct or indirect, measurable and significant deterioration of any service provided by an environmental component'[2].

According to the Act, the built, artificial environment is also an environmental component, and so the meaning of environmental damage is also interpreted with regard to buildings.

The only open question in the quoted definition of the Actis whether the given effect is measurable and, if yes, if it can cause significant disadvantageous changes. The owners of the pollution sources might escape from any payment obligation if they dispute the quantification in general or, they prove that the change of state caused is not significant. It is essential therefore, to review and develop, for local practice, the method for quantifying changes in the value of real estate to avoid the risk of evasion.

3 Stigmatised properties and their value impairment

In appraisal practice, stigma means all kinds of burdens and negative presumptions. In the narrow sense, stigma also means environmental pollution or its presumption. What are these contaminations or stigmas that generally cause value impairment among neighbouring buildings? Examples are the spreading stink of a neighbouring tannery, the route of high voltage transmission lines, an airport's noise belt, a dumping ground and polluted ground-water. Among these types of different pollutions there are some that are perceived by the senses and some that are indicated only by instruments, while there is a third group of pollution sources of which the effects are undetectable or the measured results are controversial. For example, if there is a research nuclear plant in the neighbourhood, and there is no doubt that the operator had done everything to keep emissions under the limit, the fear of atomic energy pervades the population; as such, no-one would move next to an operating nuclear plant, no matter how safe it was. Such stigmatised buildings can be classified according to the type of pollution or according to perceptibility, and thirdly, according to chronology. Sometimes the pollution occurs only once (e.g. an accident to a tanker vehicle transporting hazardous waste); sometimes the pollution is continuous (the permanent noise pollution of a rail overpass). Moreover, we have to differentiate those cases where the pollution has not occurred but the fear has been in existence e.g. fear of the hazardous impacts of the mentioned nuclear plant). The thoughts of the quantity of certain pollutions can also change as time passes by. While the methods of measurement and technologies are being modernised and pollution limit values, parallel to the development of science, become more precise, the tolerance level of the population is changing.

It would be easy if the value impairment of stigmatized buildings was laid only on measurable and scientifically explainable facts. However, the most important factor of value impairment is society, with changing judgements over time and from place to place. The American movie 'Erin Brockovich,' shot in 2000, highlighted the problem of the damaging effects on health of high voltage transmission lines. Meanwhile, fears over cellular telephone transmission stations cause panic among the members of smaller communities only periodically. The stigma lasting after a neutralised spillage - for instance, an accident to a tanker vehicle and recovery of the hazardous materials that poured out -, can be considered as time factor, meaning that the fear is gradually waning. This is how the scientifically proven facts are feeding back to the real estate market through a special social filter and cause changes in market value judgements.

All the above are interesting as to how market value is defined by the real estate industry, for example the guidelines

2 Act LIII of 1995 on the general rules of environmental protection (Kvt.), Section 4. 13

from TEGOVA[3] or RICS[4]. Any of the definitions model the forming of the market bargain among the parties, meaning that the human factor is responsible for the value judgement. The market value modified by the value impairment of stigmatised real estate can therefore only partly be explained by 'hard' facts; the 'soft' factors being analysed also appear in the mediating social media. Hajnal (Hajnal, 2013) has classified the factors of value impairment into three groups that need to be examined together. These are:

- Those significant for polluted real estate;
- Those significant for pollution sources;
- The interaction of the two above.

Interaction means, for example, the distance, the visibility and all other land improvements between the polluting and the polluted buildings, as well as their common effects. It is important to involve the polluted real estate itself into the research as the very same pollution effects might be different when considered for a hotel, or on an industrial unit.

We can find strongholds for the valuation of polluted real estate in international appraisal publications. RICS continuously upgrades its guide for real estate valuation and appraisal and gives general principles; moreover, it provides methodical amendments in separate brochures, and also published one relating to our topic (RICS, 1995). Beyond these, research sponsored by RICS (Kinnard & Worzala, 1996) states that the disturbing establishments and pollution put 'stigma' on the neighbouring real estate properties and therefore cause value impairment. Kinnard, in one of his subsequent essays, (Kinnard, 1998) summarises, as a result of work by previous researchers, the main methodical options for the valuation of polluted real estate. He enlists methods of cost-correction, paired quantification and an approach based on the obsolescence of the capability of income production as well as the hedonic price model. Similar to this, in the United States the appraisal rulebook (the USPAP[5]) has been completed by special guidance (Advisory Opinion 9) for the appraisal of polluted or supposedly polluted real estates.

Many authors, for example Chan (Chan, 2000) or Syms (Syms & Weber, 2003), synthesised the British and American methods, including the principles laying down the experts' basic principals. Mundy (Mundy, 1992) gives a graphic of the chronological process of pollution's value impairment effect. In his publication, he divides the value impairment into the following phases: - occurrence of pollution with its uncertain effects – scientifically precise statement of pollution with the risks decreasing – removal of hazard – remaining stigma or continuous disappearance. In the above phases, the significances of risk are different and therefore the judgement and quantity of value impairment is consequently different.

In the following chapters we wish to introduce the ranges and sphere of operations as well as the opportunities to use the various valuation methods. The collocation of different methods quoted in literature was adjusted to Central European opportunities and requirements.

4 Valuation Methods

4.1 With Comparisons

Real estate appraisers mostly prefer to estimate market values by direct comparisons, especially for real estate that are traded in numbers on the market, for example residential apartments, building plots or resort properties. Using a general formula, the value will be dependent on the location and on other attributes of the property:

$$V = f(Loc,Att), \text{ where} \quad (1)$$

V: Property value based on comparisons,
Loc: Location factor,
Att: Property attributes factors.

For contaminated property, there is stigma in the formula, with its „soft" and „hard" format:

$$Vcont = f(Loc,Att, St), \text{ where} \quad (2)$$

Vcont: Contaminated property value based on comparisons,
St: Stigma factor.

However, such a valuation approach is less suitable for polluted buildings because it is quite rare that stigmatised real estate is part of a transaction – moreover, especially in the event that the 'stigma' itself, and the real estate are comparable. It is unquestionable that such market transactions are rare, and the related data are not available. In some cases, however, the total neighbourhood is exposed to the same hazard, for instance, in the noise belt of an airport. In this situation there is a wide range of eligible properties upon which to practice the usual method of comparative analysis of transactions.

The simple comparative method had been developed for cases with no available comparison data (Syms & Weber, 2003). In the comparison of a sample area, the appraiser assumes that the local real estate turnover, relating trends and specific prices etc. had been diverted by only one single factor, the pollution (the *St* factor) itself. This means that, if it is possible to obtain detailed turnover information for a similar, unpolluted area, it is enough to take only this single factor into consideration. The location, the built environment, the compound of users and foremost, the indices of real estate turnover are to be considered when choosing a sample area. The examined area itself can also act as control space using its results from a period before the pollution. In the latter case, the method for combining the

3 TEGOVA: The European Group of Valuers
4 RICS: Royal Institution of Chartered Surveyors
5 USPAP: Uniform Standards of Professional Appraisal Practice

two-type sample space approach is to be used. This practically means that only the time correction is deducted from the sample area. Other significant turnover factors are enlisted by surveying the available data of the examined area before the pollution. In the sample area method, the pollution factor is described by the difference of the two turnover traits (according to Mundy: the 'value of stigma' (Mundy, 1992)), as:

$$V - Vcont = St. \quad (3)$$

In some cases the expected measure of value impairment caused by a specific pollution source is known from a feasibility study or research. The case of the mobile transmitter tower is similar to this, when various research was made to explore the value impairment effect on neighbouring real estates (vide (Hajnal, 2013)). If the appraiser has well-certified variables from the past in his possession, analysis of turnover of the sample area might be enough, as the market value of the stigmatized real estate can be deduced from the difference of the comparative data of sample area and the value impairment argument.

The most quoted and examined form of comparison models is the regression model. The principle of the multiple regression approach, in the literature called the hedonic method,was applied in the Hungarian real estate market by Horváth (Horváth & Székely, 2007). The approach is that the value of real estate is divided into value elements. Different multipliers are ordered to the different value elements that are to explain the weight of the various coefficients in the final value as a 'shadow price'.

The general formula of the model is as follows:

$$V = \alpha + \beta x + \varepsilon, \text{ where} \quad (4)$$

V: Property value;
α: constant;
β = (β1, β2, …, βn): vector of coefficients (shadow price);
X: internal and external variables vector;
ε: error.

The hedonic model was tested to determine the value impairment of different pollution sources ((Benson et al, 1998), (Chan & Cin, 2002), (Chuti, 2011) and others). Hajnal, in his case study (Hajnal, 2012), analysed a 69-element sample on mobile telephone transmitter towers and found that, among the coefficients, the time of the transaction, the area and quality of the real estate and among the pollution factors, the visibility of the tower, are significant. The hedonistic model is suitable only if the sample is quite large and homogenous and therefore this mathematical toolbar is utilised only in pollution cases affecting a wide area.

By evaluating the applications of the comparison method it can be seen that the primary question is the existence, suitability and analysability of the transaction data. If the appraiser finds detailed lists of data on the turnover of the neighbourhood of the polluted real estate, or the turnover of a similar environment (sample area), he has a huge resource for determining the value impairment of the polluted real estate. In the absence of real transactions, the appraiser has to resort to another approach from among the possibilities described in the following chapters.

4.2 On Cost-Base

The simplest – at least according to an engineering mind-set the simplest – appraisal approach is the cost approach. To apply this, it is essential that the pollution and its negative effects are to be terminated by investments or technical equipment, at least partially. In some cases, remediation can be fully carried out (e.g. disinfection, removal of spilled hazard). In other cases, damage control is only partial (for instance noise pollution is only reduced, but not neutralised by building soundproof walls). The cost-base method is practical for cases where there are technical solutions with calculable costs to stop or to decrease pollution. Even the literature (e.g. (Syms & Weber, 2003)) quotes it as the 'Cost to Correct' or 'Cost to Cure' method. The principal of value impairment calculations is that all costs of the related neutralisation to the affected real estate as value impairment are set against the market value of the real estate without pollution effects.

It is important to remark that the complete elimination covers not only the technical intervention but also the related risk management, monitoring, authority fees and penalties and lost income or lost development opportunities as well as non-physical fears. All these cost-elements are therefore to be taken into account. Different cost elements of the complete elimination are to be corroborated by quotations using market data (or similar), competitive prices and data from previous elimination works. According to the recommendations of USPAP (IAOO Standard, 2001), all the above factors are to be summarised and compared in an Environmental Balance. Another factor also to be taken into consideration is that elimination costs are always estimated, and usually underestimated. Throupe in (Throupe et al, 2007), therefore suggest doubling this element, since the potential buyer also believes that the damage remediation would cost twice as much as first estimated.

Time deceleration and the value change effect of pollution are also important with the cost-based approach. The figure prepared by the statements of Mundy (Mundy, 1992) presents the change of value in time (Figure No. 1)

If the intervention or deactivation is only partial, meaning it is not complete, we receive only a proportion of the value impairment by estimation. For instance, if a block of flats is located in the close neighbourhood of an airport and the chosen method of minimising noise pollution is changing all windows to soundproof ones, the noise level decreases as specified in the standards. However, the apartments remain value-depreciated as the take-off of jets is still noticeable within the building and, in the garden, the 'stigmatised' conditions are still unchanged. The appraiser in such cases can correct the market value with further expenses and regard the 'disturbed' conditions as the

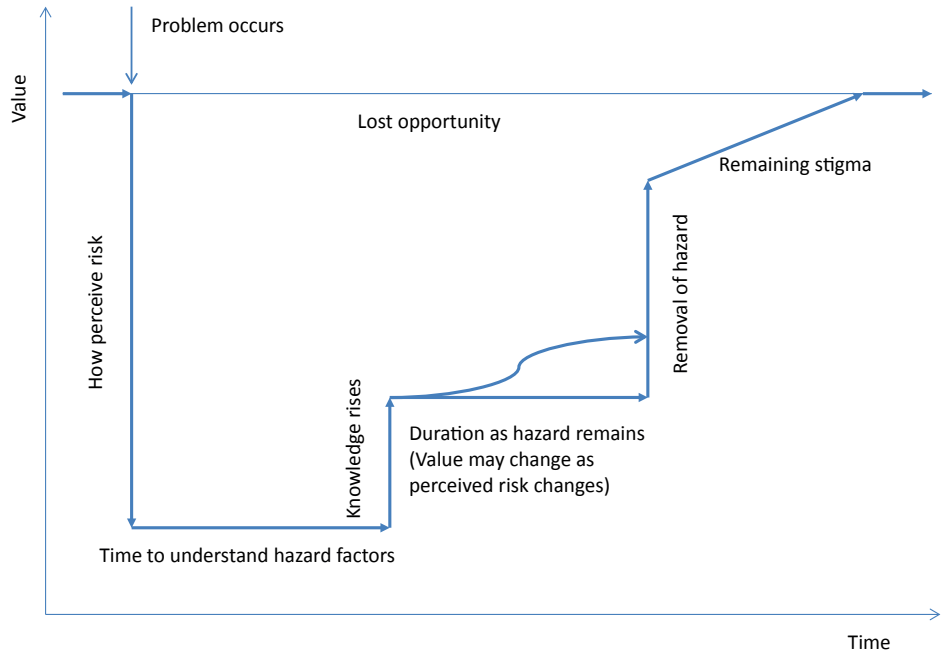

Fig. 1. The change of value in time

base, meaning he applies the comparison data gained from the apartments supplied with the soundproof windows and corrects it with further elements of costs (settlement of soundproof walls, soundproof protection of building structure etc.) The above example presents the situation when there is a comparative market database available which can reflect the market situation after the partially and completely fulfilled neutralisation.

The cost approach mirrors the market situation in certain cases only. If neutralisation can be easily and completely achieved, and its costs are significantly lower than the value of the real estate, then, according to experience, all market players calculate the same way. If the pollution is difficult to remove, or its extent is disputed, the cost-base method brings misleading results.

4.3 Income Approach

The Income Approach to market value statements is based on their investors' believes and the economic principle that states that the value of a property equals the net present value (NPV) of its net revenue, using the formula:

$$V = \sum_{t=0}^{n} F_t \frac{1}{(1+i)^t}, \text{ where} \tag{5}$$

n: number of investigated periods,
i: applicable market yield, and
Ft : net revenue realised in 't' period.

If the polluted real estate is investment property(for example the property is utilised by renting it out), the best value impairment calculation model is to be built on the revenue decrease. If an apartment is extremely noisy, we are to examine how the market rental price decreases in comparison to an average apartment rent. The result of the income stream (the net present value) of polluted real estate shows the market value of the stigmatized real estate.

$$V_{cont} = \sum_{t=0}^{n} F_t' \frac{1}{(1+i)^t}, \text{where} \tag{6}$$

F'$_t$ net revenue realised on the polluted property in 't' period.

To estimate value impairment (the stigma), an incremental discounted cash-flow model might also help us. According to the model, the net present value of the difference between the available income in the average market and the realised income stream of the polluted real estate gives the estimate range of value impairment, using the formula:

$$St = V - V_{cont} = \sum_{t=0}^{n} (F_t - F_t') \frac{1}{(1+i)^t} \tag{7}$$

The incremental model also has the advantage that there is no need to clarify the exact income and expenditure; it is enough to establish the difference in income stream (F_t-F_t') only in order to find the value of the income impairment.

Polluted real estate is usually accompanied by higher investment risks, and therefore the applied capitalisation rate grows. The rate is a market variable reflecting the yield expectations of investors. It is obvious that if the investment is riskier, the yield expectations are higher. While it is relatively easy to estimate the reduction in rental fees for polluted real estate by comparisons and market examinations, there is no suitable database for modelling the expansion of investors' risks. As such, this appraisal method contains heavily subjective, even experimental, estimation elements.

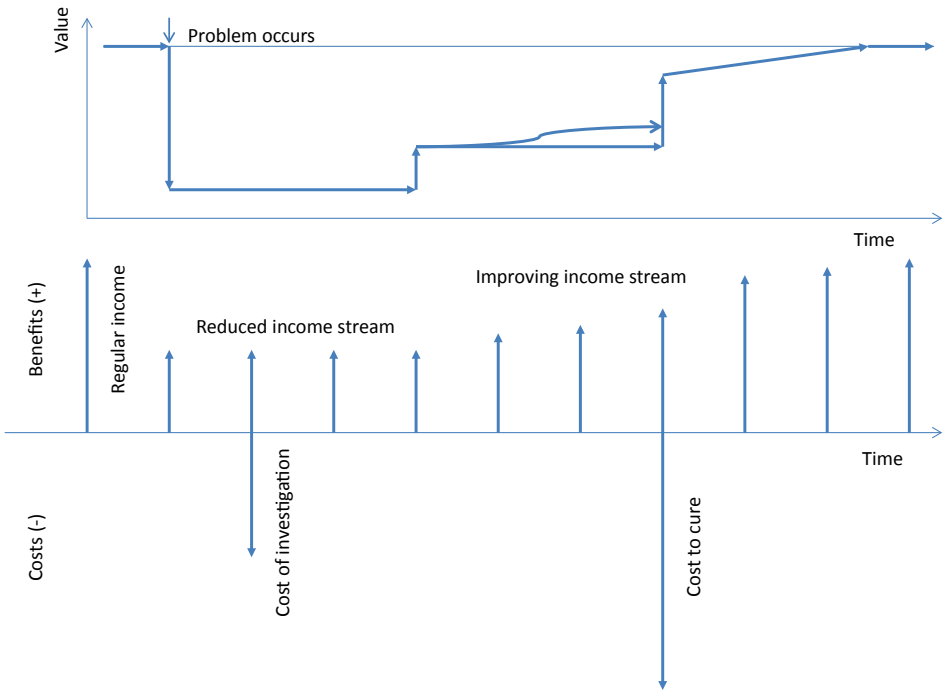

Fig. 2. Restoration of income stream after the pollution

The residual value method is a standard form of yield calculation with regard to real estate developments, within which the expected income stream is compared to the costs of investment activities (planning, construction, tenant acquisition). This is how the cost of cleaning up the polluted real estate can approach the value deprecation of income-productive real estate. In the mixed model, the stream of the previously described costs of cure and the stream of decreased income are placed in the same income stream model, taking into consideration the income production ability that can be modified by intervention, or even be restored to its original level. Figure 1 in the previous sub-chapter displayed the change of value in time. Using this schema, we can introduce the conceptual diagram of the income stream for income-productive real estate (Figure No. 2).

Many outcomes can be linked to different variables by applying stochastic models. For example, if the possibility of neutralising a pollution source is only 30 percent, both outcomes are to be taken into consideration to estimate the value of the polluted real estate. If only one variable is there, the value is to be calculated by weighting the expected value of the two outcomes. Sometimes the calculations using multivariate models are not easy. In such cases, the experts may use the Monte Carlo method. The point of the method is that the discrete outcomes of the stochastic models, along with the frequency of their occurrence, are recorded in a table, and we model the results many times using a random number generator, (as with throwing dice). The arithmetic mean of the results will be a fair approximation of the expected value of the project outcome.

Any of the above-described versions of the yield calculation approach might provide good results for determining the market value of polluted real estate for investment, especially when the appraiser knows the interest rates based on transactions and can map the increase of risks. However, for real estate not bought by institutional investors, the result does not take into consideration the presence of the stigma.

4.4 In a Non-Standard Way: By Opinion Survey Research

In the previous three chapters, we utilised the three main methods of real estate appraisal (market comparison, based on costs, income calculations) to solve the problem. As we could see, the various methods are suitable only in particular cases, informed by reliable and relevant data. This is why the literature and international practice list non-standard practices, including survey-based approaches, as an option. Opinion Survey Research has two main versions: expert opinion and end-users' evaluation.

The expert opinion method is typically used as a practical method; moreover, some authors have themselves used it. It is to be expected that a group of experts will be familiar with the attribution of the pollution as well as its effects on real estate turnover. At the same time, they cannot be expected to know all aspects of a certain case and its topography. Jackson, in his summary publication, analyses the opinions of creditors about the credit worthiness of stigmatised real estate (Jackson, 2001). One of his important observations is that it is unproductive to put the questions on a questionnaire and also provide possible answers with some space for experts' additional opinions, if they so wish. Jackson's article also points out that the questionnaire is to be asked from several directions in order of the common plank. Dorin and his colleagues in Richmond,

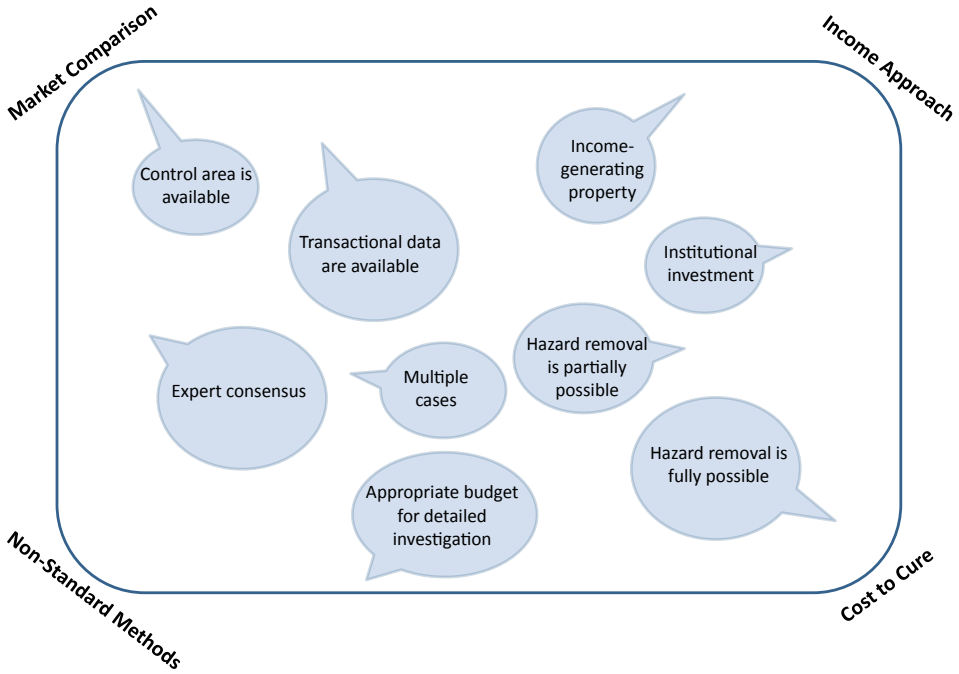

Fig. 3. Assistance chart to choose proper method

USA (Dorin & Smith, 1999) examined the area of 77 communication towers in respect of the value loss of newly-built residential property, partly using the method of expert evaluation. As a result, they found that the towers had no significant effect on sale price of real estate. Hajnal followed the same method in his essay, in which he asked his expert colleagues about the value impairment effect of mobile transmitter towers (Hajnal, 2012b). In this survey, he found that the expected rate of the value impairment is between 2 and 3 percent only. The Risk Assessment model, used within the experts' evaluation method, is a previously prepared form of questionnaire, where the experts are to choose possibilities of already determined categories among the rates grouped into five. In this case, the probability rates are previously worked out by a group of experts, while the respondents are to choose among already provided parameters of a specific case (Syms & Weber, 2003).

End-user evaluations lead us to the field of sociological surveys. In this case, the users of the real estate involved; for example, a broad sample of inhabitants are questioned about their expectations and opinions of value. The questionnaires are edited by experts also to test the consistency of their answers. As the market value is finally formed by the users or market players, by using a well-built questionnaire we can see which coefficients determine the final market price of a stigmatized property better than ever. Unfortunately, the above method can be used only in case of a huge pollution, as the wide sample questionnaire is highly expensive.

5 Choosing the suitable valuation method

We have already referred to application bans in the analysis of the discussed valuation methods for establishing the value impairment of polluted real estate. Basically, choosing the suitable method depends on three factors: the availability of data, the type of real estate and the type of pollution. Additionally, we have to make decisions depending on the budget of the project, as certain methods, for example users' evaluations, are expensive. The following questions help experts to choose the right method or solution.

- Does the pollution affect one or more properties?
- Have earlier examinations been prepared on the value impairment effect?
- Has expert consensus already been formed on the value impairment effect?
- Is there any useful transaction data on polluted properties?
- Is it possible to assign a sample sphere relating to unpolluted, comparable, real estate?
- Is the property an income producer?
- Is the real estate an industrial investment property?
- Are there any technical solutions for neutralisation?
- Would neutralisation be complete or partial?
- Is there an appropriate budget to estimate the value impairment with precision?

Figure No. 3 contains the positive answers to the above questions, aligned with the four groups of methods, to indicate which solution would be the best in a given situation.

6 Summary

There is a versatile methodical toolkit for determining the value and value impairment of polluted properties that can also be used in Central Europe. It is obvious that if there is a precise analysis of market then these methods work with greater efficiency. It is for sure that sometimes the estimation of value is a longer process than is the case with traditional real estate appraisal. Nevertheless, for the reasons mentioned

in the introduction, it is essential for the appraisers to know and to employ such a toolkit. As part of the preparation work for social investments, it is essential that feasibility studies present not only the direct effects of pollution but also the weight of value impairment appearing in the value of the properties, to those making decisions on investments.

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