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Methodology of evaluation of the national geodetic and cartographic resource

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Agenda

- Introduction
- Organizational structures of the national geodetic and cartographic resource
- Market value of the resource
- Value of the resource based on a cost formula
- Conclusions

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National Geodetic and Cartographic Resource

- The resource is a national collection of
  - maps
  - remote sensing materials
  - registers
  - computer databases
  - other materials….

  created as a result of geodetic and cartographic works
- Data collected in large period of time and in different formats
- Polish regulations
  - The resource is the property of the National Treasure
  - Value of components must be registered

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Organizational structure of the resource

Division of the national geodetic and cartographic resource		
Central resource (1)	**Regional (voivodship) resources (1-16)**	**District resources (1-378)**
Organizational units maintaining the resource		
Head Surveyor of the Country	**Marshalls of Voivodships**	**District Chief Officials**

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Research – I stage

Establishing of the market value of the resource

Methodology:

The value is calculated basing on the capitalized netto profit

$$D_j = \sum_i P_{i,j} - K_j$$

Dj – operational profit netto of the *j*-th type of resource (district, voivodship, central)
Pi,j – income of units maintaining the resource from distribution of the *i*-th type of materials collected in the *j*-th type of resource
Kj – operational costs of the *j*-th type of unit maintaining central, voivodship or district resource

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Results of the I-stage research

$$D_j \leq 0$$

Reasons:

- Prices of the materials distributed are government controlled (specified by the Ministry of Infrastructure)
- Costs of maintanance and running of the resource are higher than the incomes from their distribution

Result: **The market value cannot be established!**

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Research – II stage

Establishing of the resource value using a cost-based formula.

Procedure:

- identification of types of assortments of the national geodetic and cartographic resource,
- specification of number of units,
- evaluation of the cost of production of a single unit from the given assortment,
- establishing of a level of deterioration of the assortment's utilitary value.

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Computation of a value of j-th type of assortment

We use the following formula:

$$W_j = n \cdot C \cdot k_1 \cdot k_2$$

W_j – reconstruction value of j-th type of the resource assortments,
n – number of units of this assortment (points, hectares, kilometers, parcels, map sections, lists) established in the process of assortment identification,
C – cost of production of a unit using current technologies,
k_1 – coefficient denoting "technical deterioration" of materials of the j-th assortment due to the lack of updating on the date of valuation
k_2 – coefficient denoting "technical-technological deterioration" of existing materials (precision of elaborations, analog data, physical deterioration, etc.)

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Computation of the cost of production of a unit (C) established on the date of valuation

We use the following formula:

$$C_{DW} = C_p \cdot (1 + R \cdot t_1)$$

C_{DW} – cost of unit production on the date of valuation
C_p – initial costs of unit production adopted for calculations. The initial costs equal to:
- actual unit costs of production of the given assortment on the date of its production, or
- actual unit costs of production of the given assortment in the last years before valuation (e.g. 3-5 years).

R – coefficient of price change
t_1 – number of months between the date of valuation and the date established for the initial costs (C_p)

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Computation of the price change coefficient (R)

The coefficient is calculated using the following equation:

$$R = \frac{C_p - C_w}{C_w \cdot t_i}$$

R – coefficient of price change
C_p – mean unit prices obtained in tenders in a later year (closer to the date of resource valuation)
C_w – mean unit prices obtained in tenders in an earlier year (further off from the date of resource valuation)
t_i – time intervals expressed as a number of months between the moments of acquisition of prices from the geodetic works' market obtained in the later and in the earlier year

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Computation of price change (II)

Alternatively – change of the price in time can be modelled using linear trend:

$$f(t) = a \cdot t + b$$

Parameters a, b can be computed using multiple samples of production prices for different moments in time.

C_{DW} is than computed as an interpolation (extrapolation) using the trend line.

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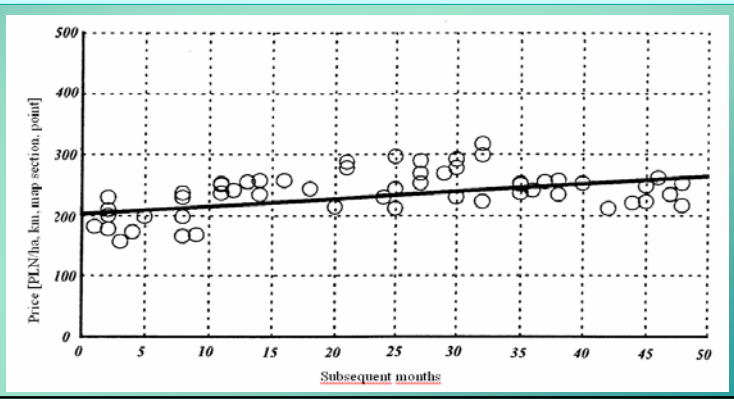
Computation of price change (II)

Linear trend computation using least-squares method:



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Technical deterioration of resource materials due to lack of updating on the date of valuation (k_1)

The level of outdatedness depends on:

- binding legal regulations enforcing maintenance of specific types of materials up-to-date,
- type of terrain that the materials collected in the resource refer to (city areas, urban-agricultural areas, agricultural and forest areas).

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Technical-technological deterioration of existing elaborations (k_2)

Criteria of evaluation of technical-technological deterioration:

- characterstics of precision of elaborations related to the current standards,
- form of data storage (analog, digital)

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Technical-technological deterioration of existing elaborations (k_2)

k_2 coefficient can be computed according to the following equation:

$$k_2 = \frac{C_1}{C_1 + C_2}$$

C1 – cost of production of a single unit of a given type of assortment e.g. the base map, the cadastral map in digital format, extrapolated to the date of valuation

C2 – costs of transformation form analog data into digital data and of production of the digital base map, the digital cadastral map etc.

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Establishing value of the unique geodetic documentation

Examples of unique geodetic documentation:

- documentation of establishment of the EUREF-POL and POLREF networks
- basic vertical class I control networks
- documentation of connectivity of the basic vertical class I control network with levelling lines of neighbouring countries
- the network of automatic tide gauges
- gravimetric control networks
- calibration bases
- documentations concerning absolute measurements of gravity force acceleration in absolute points
- documentations concerning magnetic control network, systems of central banks of horizontal and vertical control networks
- ……

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Establishing value of the unique geodetic documentation

The following equation is used:

$$W_i = (\sum_{r1} K_{Ni.r1} \cdot \frac{a_{kr.j}}{b_{kr.r1}} + \sum_{r2} K_{Ti.r2} \cdot \frac{a_{kr.j}}{c_{kr.r2}}) \cdot n$$

Wi – value of the i-th type of documentation
$K_{Ni.r1}$ – costs of analyses and research connected with the preparation of a project for producing i-th type of documentation in year r1 per unit (point, object, databank etc.)
$a_{kr.j}$ – coefficient of increase of goods' and services' prices in the j-th year of valuation according to the Central Statistical Office data
$b_{kr.r1}$ – coefficient of increase of goods and services prices in the r1-th year of performing analyses and research connected with preparation of the project
$K_{Ti.r2}$ – costs associated with the implementation of the project for producing i-th type of documentation in the r2-th year of technical execution per unit (point, object, databank, etc.)
$c_{kr.r2}$ – coefficient of increase of goods and services prices in the r2-th year of performing technical works connected with the project implementation
r_1 – years when the analyses and research connected with the preparation of a project were performed
r_2 – years when the project implementation (technical works) was performed
n – number of units (points, objects, data banks, etc.)

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Conclusions (1)

- There exists virtually no bibliographical reference to the valuation of this type of documentation
- The methodology of valuation of properties and their parts is well developed
- Our research revealed that:
  - capital (profit) - based resource valuation formula is not feasible under Polish legal regulations
  - cost – based formula is feasible, the method of replacement costs can be utilized

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Conclusions (2)

- Resource value can be estimated at **€5.2 billion**

  value is the result of valuations of several test objects

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Thank you for your attention