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# Flood Protection Measures Evaluation using CBA Approach – Case Study

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# Introduction

## **Main goal of the paper**

- Presentation of the possibilities of the usage of Cost-Benefit Analysis approach in the economic evaluation of projects in the area of the flood protection measures realization

## **Schedule of presentation**

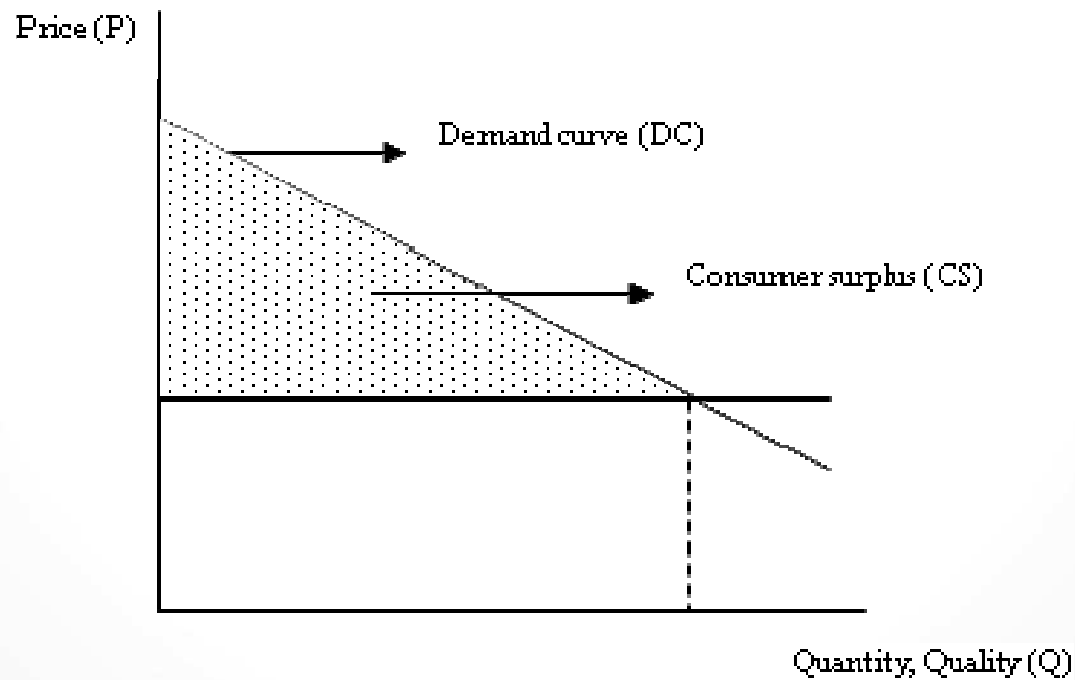
- CBA approach – basic principles
- Non-market valuation
- Impacts of flood protection measures realization
- Case study
- Conclusions

# CBA – Basic Principle

- Methodological approach solving benefits and costs of beneficiaries within the non-profit investment project
- The CBA – chapters
  - The definition of the essence of the project
  - The determination of the structure of beneficiaries
  - Description of zero and investment option
  - Determination, quantification and classification of all relevant costs and benefits for all phases of the project
  - Specification and separation of non-appreciable costs and benefits and their description
  - The transfer of appreciable costs and benefits into cash-flows
  - The determination of the discount rate
  - The calculation of crucial indexes
  - The sensitivity analysis
  - The valuation of the project based on calculated crucial indexes
  - The decision about acceptability and financing of the investment

$$NPV_E = \sum_{i=1}^n \frac{B-C}{(1+r)^i}$$

# Valuation Approaches



# Impacts of Flood Protection Measures Realization

- Non-financial benefits and costs of the projects based on the analysis of 29 project intentions:
  - Impacts on population
  - Impacts on air and climate
  - Impacts on noise situation
  - Impacts on water
  - Impacts on soil
  - Impacts on natural resources
  - Impacts on green, animals and ecosystems
  - Impacts on protected parts of the nature
  - Impacts on landscape

# Case Study

- Simplified economic analysis of the project of the realization of flood protection measures
- The project consists in the realization of following measures:
  - The reconstruction and the extension of three existing ponds,
  - The realization of new polder



# Input Data

Investment costs of the project

Investment costs	Pond upper	Pond middle	Pond bottom	Polder	Totally
Basic budgetary costs (1,000 CZK)	2 174	3 230	2 835	2 400	<b>10 639</b>
Construction site accessories (1,000 CZK)	12	22	18	14	<b>66</b>
Costs totally (1,000 CZK)	2 186	3 252	2 853	2 414	<b>428,2 th. EUR</b>

Expected **operation costs** are 5 % from determined investment costs

**Parameters** of expected flood :

- the duration of the flood 1 day,
- the deepness of water 0,5 m,
- the frequency of the flood 0,1 appear. per a year

# Input Data

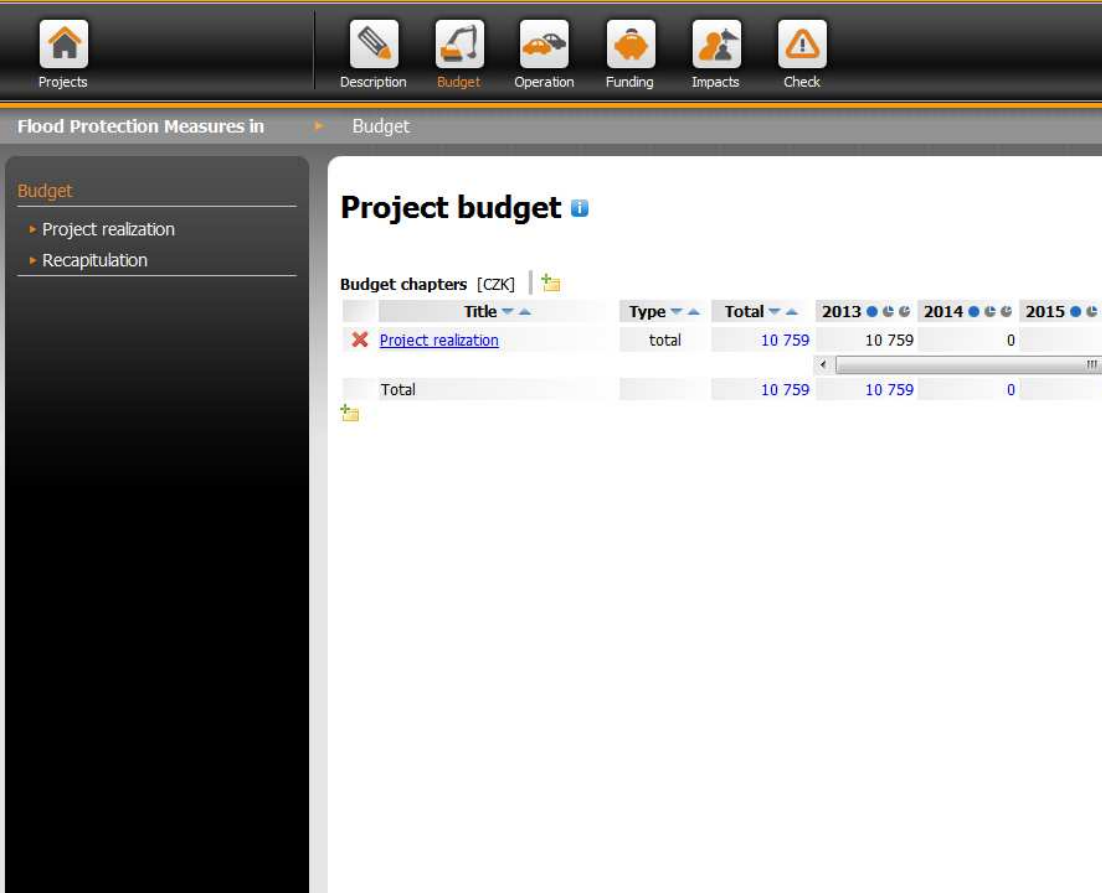
The **loss on the property** in protected territory

Name of representative	Damage (%)	Reproduction price (1000 CZK)	Loss totally (1000 CZK)
Apartment buildings till 4 floor	5,26	41 560	2 186
Apartment buildings over 4 floor	do not occur	0	0
family houses	7,67	63 190	4 847
Buildings for health care and services	6,77	7 820	529
Buildings for municipal services and hygiene	do not occur	0	0
Buildings for education and training	6,77	24 420	1 653
Buildings for science, culture and education	do not occur	0	0
Buildings for physical education	6,77	18 110	1 226
Buildings for administration	6,77	16 770	1 135
Buildings for commerce and public catering	6,77	9 480	642
Buildings social care	do not occur	0	0
Buildings manufacturing industry, special	do not occur	0	0
Areas for Physical Education uncovered	8,27	3 350	277
Additional objects	do not occur	0	0
Objects of technical equipment	9,14	980	90
<b>Totally</b>			<b>503,4 th. EUR</b>



# Case Study – eCBA Outputs

Basic overview of investment costs



The screenshot displays the eCBA software interface. At the top, there is a navigation bar with icons for Projects, Description, Budget, Operation, Funding, Impacts, and Check. Below this, the breadcrumb path is 'Flood Protection Measures in > Budget'. The main content area is titled 'Project budget' and shows a table of budget chapters. The table has columns for Title, Type, Total, and years 2013, 2014, and 2015. The data shows a total budget of 10,759 CZK for 2013, with 0 CZK for 2014 and 2015.

Title	Type	Total	2013	2014	2015
Project realization	total	10 759	10 759	0	0
Total		10 759	10 759	0	0

# Case Study – eCBA Outputs

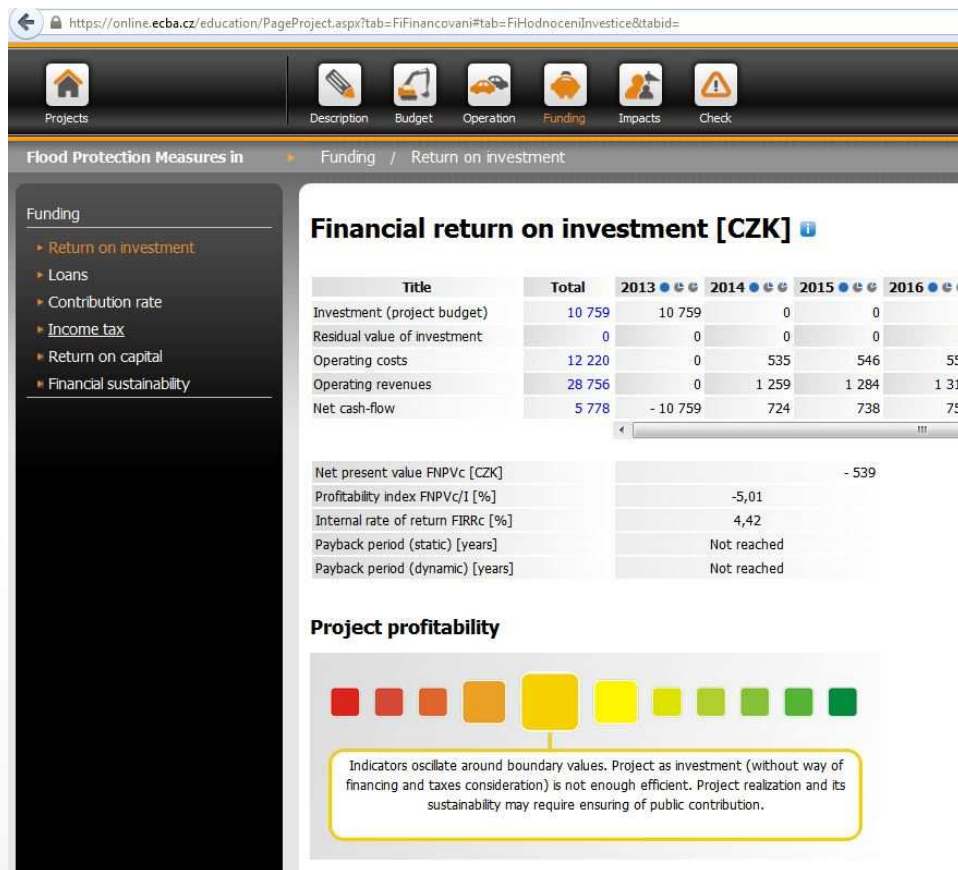
Operation costs and revenues

The screenshot displays a software interface for 'Flood Protection Measures in Operation'. The top navigation bar includes icons for Projects, Description, Budget, Operation (selected), Funding, Impacts, and Check. The left sidebar shows a tree view with 'Operation' expanded, containing 'Operating costs', 'Operating revenues', and 'Residual value of investment'. The main content area is titled 'Operating cash-flow [CZK]' and contains a table with columns for Title, Total, 2014, 2015, and 2016. The table is divided into 'Operating costs' and 'Operating revenues' sections, with a final row for 'Operating cash-flow'.

Title	Total	2014	2015	2016
<b>Operating costs</b>				
Operating costs	12 220	535	546	557
Total operating costs	12 220	535	546	557
<b>Operating revenues</b>				
Operating revenues	28 756	1 259	1 284	1 310
Total operating revenues	28 756	1 259	1 284	1 310
Operating cash-flow	16 537	724	738	753

# Case Study – eCBA Outputs

Results of the financial analysis with main indexes  
( $NPV_F = -21\ 560\ \text{EUR}$ ,  $IRR = 4,42\ \%$ )



# Case Study – eCBA Outputs

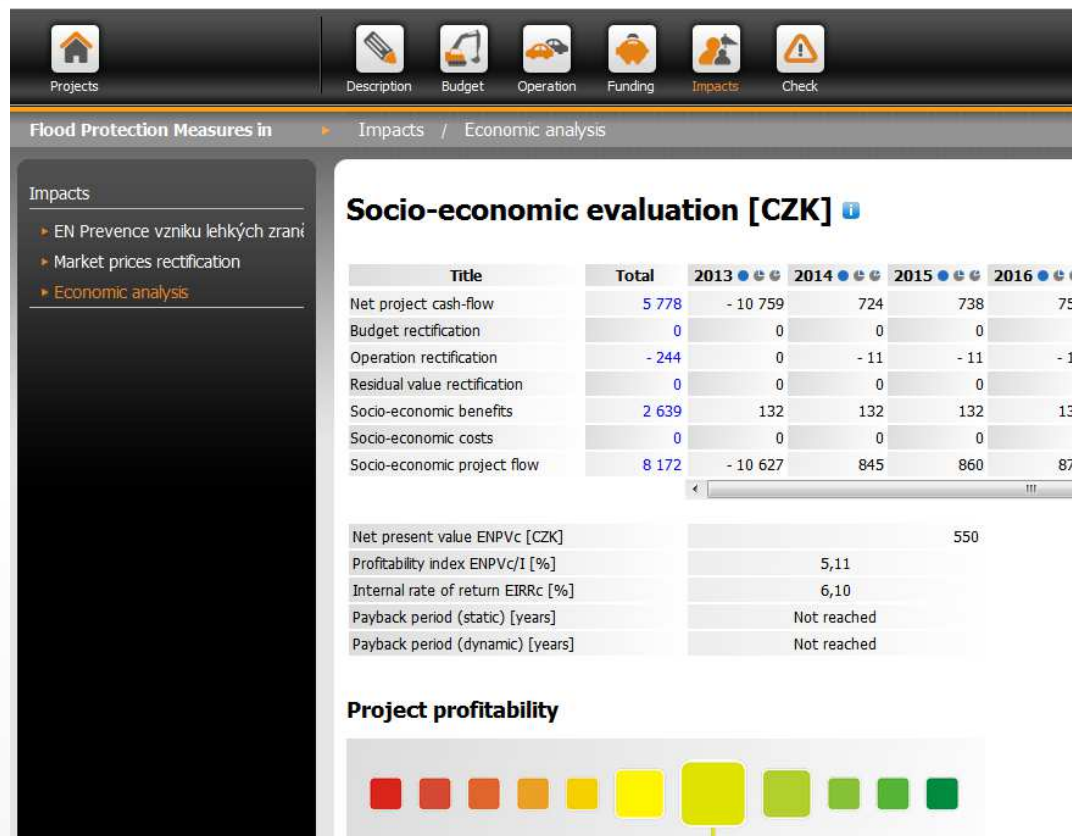
Identification of the social benefit in the form of the prevention against minor injury (prevention of 2 minor injuries during the flood)

The screenshot displays the eCBA software interface. At the top, there is a navigation bar with icons for Projects, Description, Budget, Operation, Funding, Impacts, and Check. Below this, the breadcrumb path is 'Flood Protection Measures in > Impacts / EN Prevence vzniku lehkých zranění'. On the left, a sidebar lists 'Impacts' with sub-items: 'EN Prevence vzniku lehkých zranění', 'Market prices rectification', and 'Economic analysis'. The main content area is titled 'Impact 'EN Prevence vzniku lehkých zranění''. It includes fields for 'Impact type' (benefit selected), 'Impact specification - English' (EN Prevence vzniku lehkých zranění), 'Unit of impact' (prevention of minor injury), and 'Impact unit price' (659,82 CZK/prevention of minor injury). Below these fields, it states 'No impact extent is defined' and provides an 'Add impact extent' button. A table titled 'Impact value' shows data for years 2013, 2014, 2015, and 2016, along with a 'Total' column. The table has two rows: 'prevention of minor injuries [count]' and 'impact value [CZK]'. At the bottom, there is a 'Comment - English' field with a character limit of 1100 and a rich text editor toolbar.

Year	Total	2013	2014	2015	2016
prevention of minor injuries [count]	4	0,2	0,2	0,2	0,2
impact value [CZK]	2 639	132	132	132	132

# Case Study – eCBA Outputs

Total results of the economic valuation  
( $NPV_E = 22\ 000\ \text{EUR}$ ,  $IRR = 6,1\ \%$ )



# Conclusions

Basic problems to solve

- Prediction of flood characteristics and flood frequency
- Possibilities of correct determination of the flood protection measure effect
- Identification of all relevant costs and benefits
- Possibility to evaluate major part of important non-financial impacts – suitable methods and approaches

Recommendations ???