Shelter

Sustainable Historic Environments hoListic reconstruction through Technological Enhancement & community-based Resilience

T 3.4 CBA Tool Manual

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Content

Important notes regarding the testing version (+ known issues) 3
Overall logic of the tool 4
1 Import function 4
1.1 Import macro 4
2 Cultural heritage information 5
2.1 Basic data 5
2.2 Financial data 5
3 Hazard information 6
3.1 Basic data 6
3.2 Financial data 6
4 Solutions filter 7
4.1 Basic logic 8
4.2 Main parameters 8
4.3 Additional parameters 9
4.4 Filtered list 9
5 Solution information 9
5.1 Basic data 10
5.2 Financial data 10
6 CBA report 12
7 Export 14
7.1 The .pdf print 14
7.2 Export sheet 14

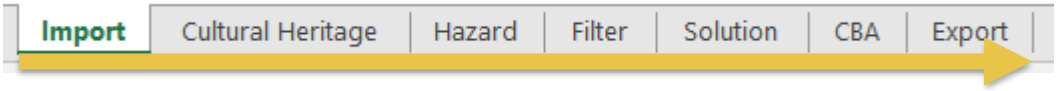
Important notes regarding the testing version (+ known issues)

- **The VBA** (macros for MS Office) **must be allowed**; it is an essential part of the design; if you are not familiar with VBA allowance, contact your IT support.
- The sheets and the workbook are protected by a password; no unsupported changes are allowed.
- The source data are taken from the file "*PORTFOLIO of solutions and strategies_NBK_final_EHU_PRIORITIZATION*" released on 17/05/2021. Some of the Solutions are corrupted in the source file, and hence the *CBA Tool* does not work with them flawlessly:
    - *CLIMBER GREEN WALL*
    - *Temporary flood protection systems*
    - *Reinforced perforations made with steel bars*
    - *Application of composite materials strips to vaults and arches*
    - *Straw mulches*

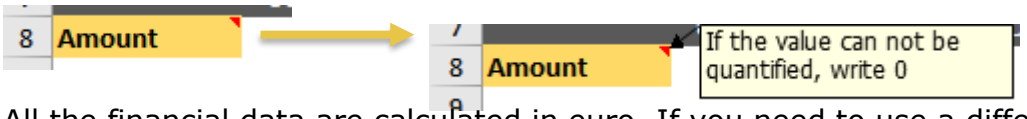
Overall logic of the tool

The use of the tool should be done in these basic steps:

1. Fill in data about the protected cultural heritage in sheet *Cultural Heritage*; these data should remain unchanged during the analysis of possible solutions
2. Fill in data about the hazard in sheet *Hazard* affecting the cultural heritage; these can be adjusted during the analysis of possible solutions
3. Use the sheet *Filter* to go through all the available solutions and find the ones used for the analysed problem
4. Select one analysed solution in sheet *Solution* and fill in its financial data
5. Check the CBA results on sheet *CBA*
6. Export CBA results for further use to sheet *Export*



If not sure about the items, use the red marking signalising an explanatory commentary.



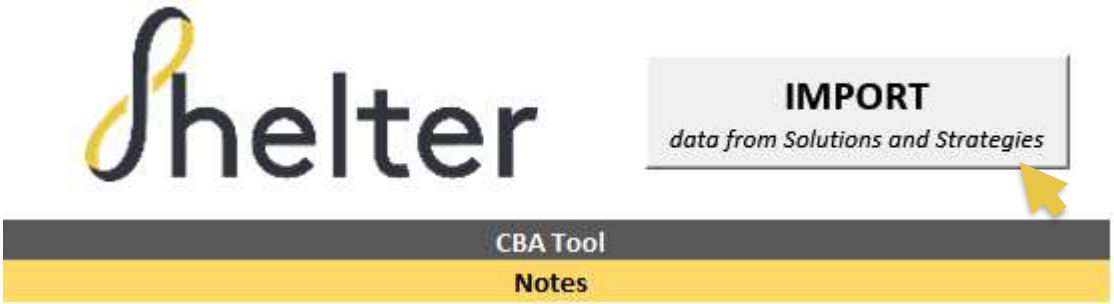
All the financial data are calculated in euro. If you need to use a different currency, you can use the tool, just ignore the € unit.

1 Import function

If there is an updated version of the "Solutions and strategies" database workbook, you can import the actual data into the *CBA Tool.*

1.1 Import macro

1.1.1 Prepare the actual "Solutions and strategies" file and rename it to this exact name: "PORTFOLIO of solutions and strategies.xlsx".
1.1.2 Open the "Solutions and strategies" file, let it be opened.
1.1.3 Click on the *IMPORT* button and wait for a while (it can take even a few minutes depending on the speed of your device).
1.1.4 In case of any malfunction, you can still use the *CBA Tool* with obsolete data.



2 Cultural heritage information

Fill in data in the sheet *Cultural Heritage.*

2.1 Basic data

2.1.1 Fill in the basic information about analysed cultural heritage. This information is just qualitative and has no impact on calculations.

3	**Name**	*The main train station in Brno*
4	**Location**	*Nádražní, Brno, Czechia*
5	**Type**	*Building*

2.2 Financial data

2.2.1 Fill in the estimated financial value of the cultural heritage. If the value is unknown or cannot be assessed, write *0 €*.

7	CULTURAL HERITAGE VALUE	
8	**Amount**	*1 000 000 €*

2.2.2 Fill in the financial benefits resulting from the cultural heritage operation. If you miss the detailed items, write the summary in the field *Other*. Use the field *Other* if there are any benefits not fitting in the offered fields. You can use the sum in the header for data control. All the data are calculated per one fiscal year.

10	CURRENT BENEFITS	*21 000 €*
11	**Benefit**	**Amount per year**
12	Contributions from private sources	*1 000 €*
13	Contributions from public sources	*3 000 €*
14	Admittance fees	*5 000 €*
15	Revenues	*2 000 €*
16	Other	*10 000 €*

2.2.3 Fill in the financial costs resulting from the cultural heritage operation. If you miss the detailed items, write the summary in the field *Other*. Use the field *Other* if there are any costs not fitting in the offered fields. You can use the sum in the header for data control. All the data are calculated per one fiscal year.

18	CURRENT COSTS	29 000 €
19	Cost	Amount per year
20	Own production costs	4 000 €
21	Costs of goods and services	2 000 €
22	Energies	2 000 €
23	Personnel costs	20 000 €
24	Other	1 000 €

3 Hazard information

Fill in data in sheet *Hazard.*

3.1 Basic data

3.1.1 Select one of the basic hazard *Types* and use *Description* and *Severity – description* for any additional information and overview. These data are not used in any calculation.

3.1.2 Fill in the hazard occurrence. You can use the frequency in months or years. The point is to express how often does the hazard occur, resp. how many time does it affect the cultural heritage during the solution lifespan (see part 5.1). Choose if the hazard affects the cultural heritage just once (*Unique)* or repeatedly (*Recurring*). The *Unique* choice is used mainly in such cases if the hazard causes so many damages that the next affections are irrelevant, i.e. they bring no additional costs. The *Recurring* choice is used mainly in such cases when every other effect of the hazard brings additional damages and costs, which are cumulated with the previous ones.

3	Type	Storm	Description	Heavy hailstorm
4	Severity - description	Damaged roof and facade, leakage in main hall		
5	The hazard occurs once every...		6	months
6	The effects of the threat are...		Unique	Recurring

3.2 Financial data

3.2.1 Fill in the effect of the hazard on the cultural heritage. The point is to assess the financial extent of the damages done, and activities realised to eliminate the hazard consequences. These losses mean the irreversible reduction of the cultural heritage value. You can fill in the monetary amount or percentage of the cultural heritage value that is lost. Choose just one possibility; do not fill in both fields. The previously filled (2.2.1) cultural heritage value is displayed for your information.

8	Impact on cultural heritige value (fill one)	
9	Current cultural heritage value	1 000 000 €
10	Loss in currency	- €
11	Loss in percentage	50%

3.2.2 Fill in the effects of hazard occurrence on the cultural heritage benefits. The *Expected change* is the new annual value after the hazard strikes. The previously filled (2.2.2) cultural heritage benefits are displayed for your information. If there is no change, write the same amount as displayed in *Current.*

15	Benefits after implementation		9 000 €
16	Benefit	Current	New amount
17	Contributions from private sources	1 000 €	1 000 €
18	Contributions from public sources	3 000 €	2 000 €
19	Admittance fees	5 000 €	4 000 €
20	Revenues	2 000 €	- €
21	Other	10 000 €	2 000 €

3.2.3 Fill in the effects of hazard occurrence on the cultural heritage costs. The *Expected change* is the new annual value after the hazard strikes. The previously filled (2.2.3) cultural heritage costs are displayed for your information. If there is no change, write the same amount as shown in *Current.*

23	Costs after implementation		37 000 €
24	Cost	Current	New amount
25	Own production costs	4 000 €	3 000 €
26	Costs of goods and services	2 000 €	1 000 €
27	Energies	2 000 €	10 000 €
28	Personnel costs	20 000 €	22 000 €
29	Other	1 000 €	1 000 €

3.2.4 Fill in additional costs caused by the hazard occurrence. The *Amount* is one-off expenditure used to solve the damages caused by the hazard. If the hazard repeatedly occurs, fill in just the amount for one occurrence. Use the field *Description* for any information needed for your overview.

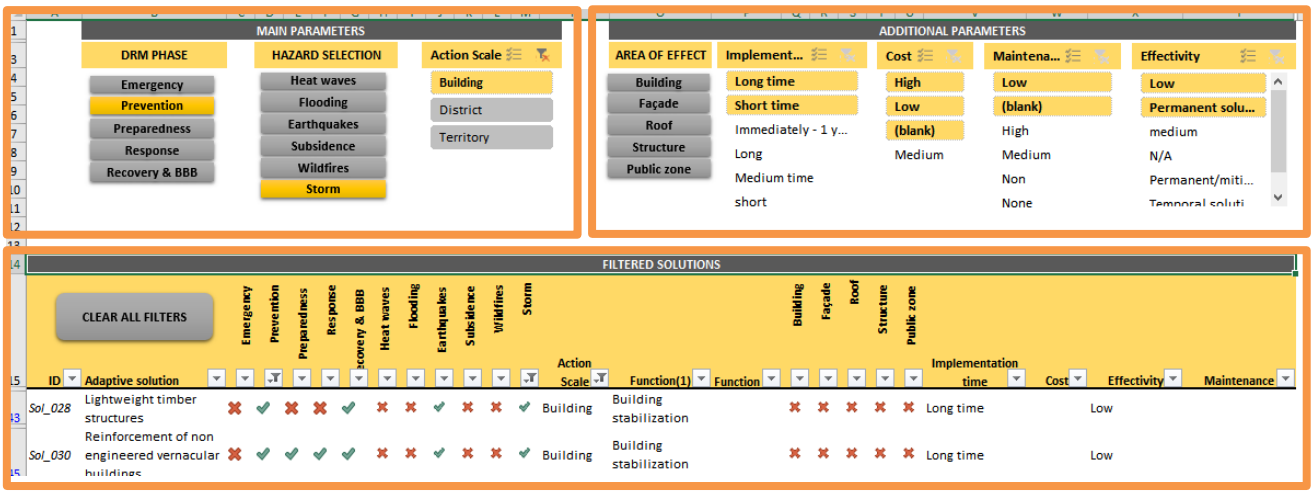
31	Additional costs		300 000 €
32	Cost	Description	Amount
33	Repairs	...	200 000 €
34	Cleaning	...	50 000 €
35	Other	...	50 000 €

4 Solutions filter

Use the sheet *Filter* to find all the possible solutions.

4.1 Basic logic

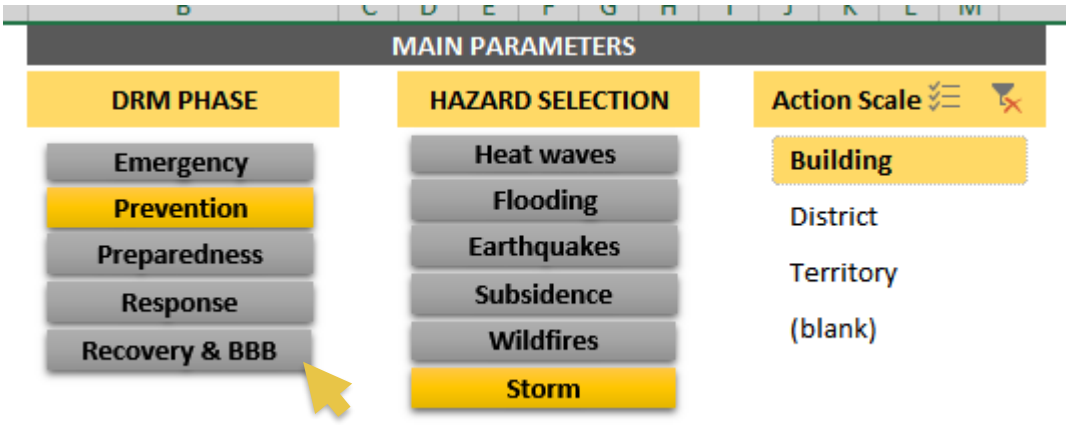
4.1.1 The sheet uses many filters to go through all the available solutions processed in the file "*Solutions and Strategies*". First, use the filters in section *Main parameters*, then use the filters in the section *Additional parameters* if necessary. The solutions meeting the specified criteria are shown in the lower part in *Filtered Solutions*.



4.1.2 Some filtering tools use on/off buttons, and some are multiple-choice slicers (MS Excel tool). They operate in a slightly different way. Already selected filters condition the slicers, i.e. they offer only available options.

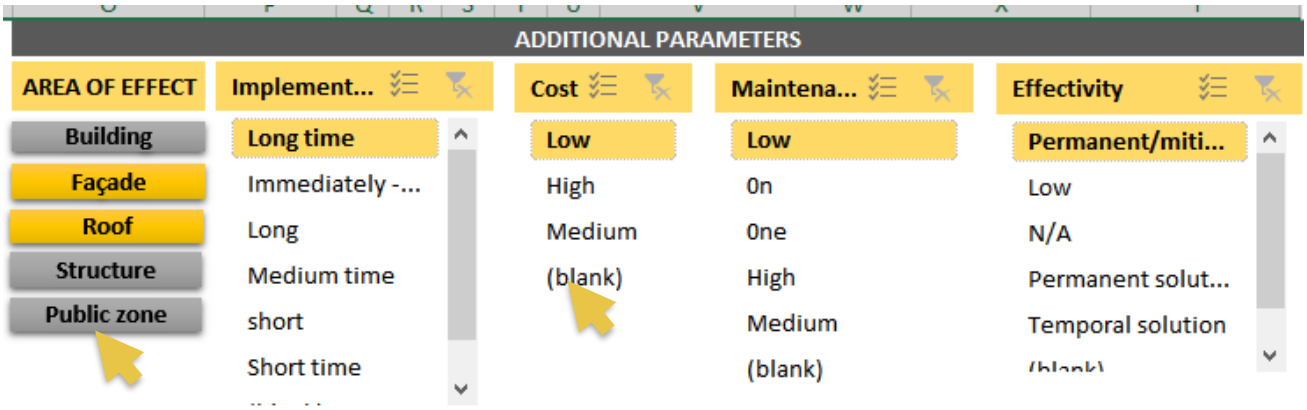
4.2 Main parameters

4.2.1 Use the main filters to choose the *DRM Phase*, *Hazard* and *Action Scale*. The *Hazard* filter is independent of the hazard filled previously in 3.1.1. All the filters use the logic *"and"*, which means that the solutions must meet all the filtered criteria simultaneously.



4.3 Additional parameters

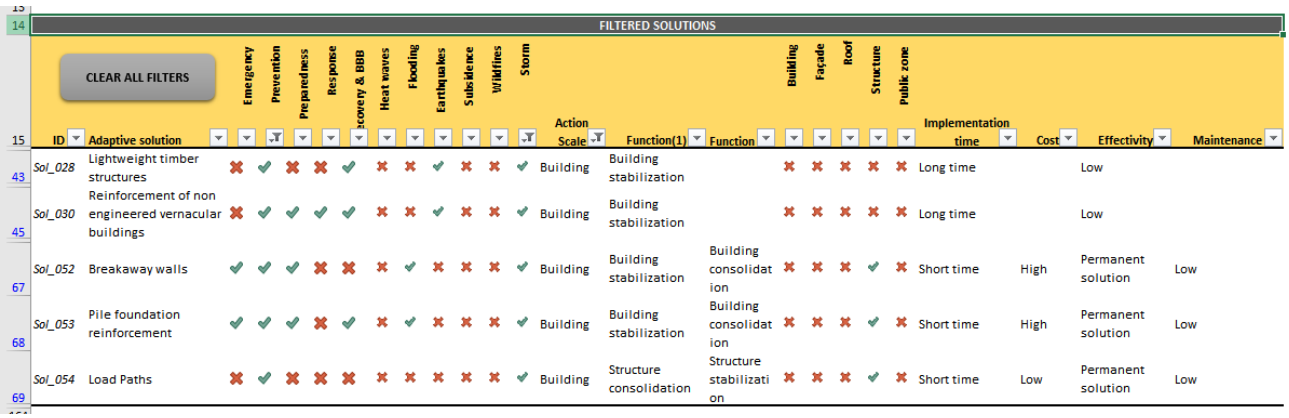
4.3.1 Use the additional filters to choose the solution *Area of effect*, *Implementation time*, *Cost, Maintenance and Effectivity*. The filters are based on the information from the source file *"Solutions and Strategies"* and are independent of the data filled in this tool. The choices in the slicers are dependent on the source data. All the filters use the logic *"and",* which means that the solutions must meet all the filtered criteria simultaneously.



4.4 Filtered list

4.4.1 This table shows all the solutions meeting all the selected criteria. In some fields, the mark ✔ means that the solution meets these criteria, the mark ✖ means that the solution does not meet these criteria. The filtered solutions are here for your information, and one analysed solution is chosen in the next step 5.1.

4.4.2 The button *Clear all filters* allows you to put all the filters away at once.



FILTERED SOLUTIONS

CLEAR ALL FILTERS

	ID	Adaptive solution	Emergency	Prevention	Preparedness	Response	Recovery & BBB	Heat waves	Flooding	Earthquakes	Subsidence	Wildfires	Storm	Action Scale	Function(1)	Function	Building	Façade	Roof	Structure	Public zone	Implementation time	Cost	Effectivity	Maintenance
43	Sol_028	Lightweight timber structures	✖	✔	✖	✖	✔	✖	✖	✔	✖	✖	✔	Building	Building stabilization		✖	✖	✖	✖	✖	Long time		Low	
45	Sol_030	Reinforcement of non engineered vernacular buildings	✖	✔	✔	✔	✔	✖	✖	✔	✖	✖	✔	Building	Building stabilization		✖	✖	✖	✖	✖	Long time		Low	
67	Sol_052	Breakaway walls	✔	✔	✔	✖	✖	✖	✔	✖	✖	✖	✔	Building	Building stabilization	Building consolidation	✖	✖	✖	✔	✖	Short time	High	Permanent solution	Low
68	Sol_053	Pile foundation reinforcement	✔	✔	✔	✖	✔	✖	✔	✖	✖	✖	✔	Building	Building stabilization	Building consolidation	✖	✖	✖	✔	✖	Short time	High	Permanent solution	Low
69	Sol_054	Load Paths	✖	✔	✖	✖	✖	✖	✖	✖	✖	✖	✔	Building	Structure consolidation	Structure stabilization	✖	✖	✖	✔	✖	Short time	Low	Permanent solution	Low

5 Solution information

Fill in data in sheet *Solution.*

5.1 Basic data

5.1.1 First, choose one solution for further analysis using a drop-down list. The *Solution ID and name* are offered from the list of solutions filtered in step 4.4.1. If there are any filters set in the previous step, you will see all the existing solutions in the drop-down list.

5.1.2 Fill in the *Impact on hazard* of the solution. This expresses the degree of protection against damages caused by the hazard. If the solution negates the damages completely, write *100%. I*f it does not protect against the hazard at all, white *0%.*

5.1.3 Fill in the *Lifespan* of the solution in years. This is the length of rational use of the solution, i.e. the number of years for which the solution protects against the hazard and its damages. The lifespan is assumed to be at least one year.

3	**Solution ID and name**	*Sol_084 - Expansion of foundation system*		
4				
5	**Impact on hazard**	*50%*	**Lifespan (years)**	*10*

5.2 Financial data

Some of the solution data elaborated in the file *"Solutions and Strategies"* are shown here by the corresponding financial items. These shown data are not used in CBA calculation and serve only for better overview and clarity. Some of these data are not shown. They are missing in the source file.

11	Positive aspects: [1] FEMA. 2005.Hurricane Mitigation: A handbook for public facilities		
12	**Benefits after implementation**		***25 000 €***
13	**Benefit**	**Current**	**New amount**

5.2.1 Fill in the effects of solution implementation on the cultural heritage benefits. The *Expected change* is the new annual value after the solution is implemented and functioning. The previously filled (2.2.2) cultural heritage benefits are displayed for your information. If there is no change, write the same amount as displayed in *Current.*

11	Positive aspects: [1] FEMA. 2005.Hurricane Mitigation: A handbook for public facilities		
12	**Benefits after implementation**		***25 000 €***
13	**Benefit**	**Current**	**New amount**
14	Contributions from private sources	1 000 €	*1 000 €*
15	Contributions from public sources	3 000 €	*3 000 €*
16	Admittance fees	5 000 €	*6 000 €*
17	Revenues	2 000 €	*3 000 €*
18	Other	10 000 €	*12 000 €*

5.2.2 Fill in the effects of solution implementation on the cultural heritage costs. The *Expected change* is the new annual value after the solution is implemented and

functioning. The previously filled (2.2.3) cultural heritage costs are displayed for your information. If there is no change, write the same amount as displayed in *Current.*

20	Negative aspects:		
21	**Costs after implementation**		***23 000 €***
22	**Cost**	**Current**	**New amount**
23	Own production costs	4 000 €	*4 000 €*
24	Costs of goods and services	2 000 €	*2 000 €*
25	Energies	2 000 €	*1 000 €*
26	Personnel costs	20 000 €	*15 000 €*
27	Other	1 000 €	*1 000 €*

5.2.3 Fill in the additional costs of solution implementation. This "project" is divided into three steps: *Preparation, Realization* and *Operating costs*. All these steps include only direct costs caused by the solution itself and cover the whole solution costs with no exception.

5.2.4 Fill in the possible solution benefits other than those mentioned above.

31	**BENEFITS**		***2 000 €***
32	**Benefit**	**Description**	**Amount**
33	Other	...	*2 000 €*

5.2.5 Fill in the *Preparation* phase that includes all the costs, which occur before the solution installation begins. *External supplier costs* include all the money, which are spent on external parties. *Internal costs* include money consumed by the organisation covering the analysed cultural heritage. All the costs are expressed as o one-time expense.

40	**Preparation**		***47 000 €***
41	**Cost**	**Description**	**Amount**
42	External supplier costs	...	*30 000 €*
43		**Internal costs**	
44	Preparation work	...	*2 000 €*
45	Training	...	*3 000 €*
46	Project documentation	...	*1 000 €*
47	Administration	...	*2 000 €*
48	Marketing	...	*5 000 €*
49	Other	...	*4 000 €*

5.2.6 Fill in the *Realisation* phase, which includes all the money spent on the solution installation. It covers mainly the solution price (value) included in *External supplier costs*. *Internal costs* include cash consumed by the organisation protecting the analysed cultural heritage. All the costs are expressed as o one-time expense.

52	Realization		15 000 €
53	Cost	Description	Amount
54	External supplier costs	...	2 000 €
55		Internal costs	
56	Internal implementation costs	...	4 000 €
57	Training	...	5 000 €
58	Other	...	6 000 €
59			

5.2.7 Fill in the *Operating costs*. Be aware that this section represents the annual expenses on the solution service.

62	Operating costs		33 000 €
63	Cost	Description	Amount
64	Maintenance	...	10 000 €
65	Energies	...	9 000 €
66	Administration	...	8 000 €
67	Other	...	6 000 €

Now all the data are filled in.

6 CBA report

The sheet *CBA* includes all the calculated values and analysis outputs. There are no additional data inputs on this sheet. All eventual changes must be done on their respective sheets.

6.1.1 The general output summarises the information about the cultural heritage, hazard and solution. These are the main pieces of information for future orientation.

3	**Cultural heritage**	The main train station in Brno located in Nádražní, Brno, Czechia
4	**Hazard**	Storm which occurs every 6 months and decreses cultural heritage value by 5%
5	**Solution**	Pile foundation reinforcement with lifespan 10 years and 90 % impact on hazard

6.1.2 The next part includes the comparison of cultural heritage value loss and cumulated costs of scenario without and with the selected solution. All the amounts are calculated for the length of the solution lifespan.

6.1.3 The difference between *Cultural heritage value in case of hazard occurrence and solution effect* and *Cultural heritage value in case of hazard occurrence* represents the direct value conservation gained by the solution implementation, i.e. it is the field *Value of protected cultural heritage*. The difference between *Cultural heritage value in case of hazard occurrence* and *Cumulated impact of the solution on Cost/Benefits of the object* represents the saved (or increased) expenses caused by the solution implementation.

6.1.4 The button *Export CBA and PRINT PDF* is used for data print and export into the next sheet. See chapter 7.

7	**Current cultural heritage value**	1 000 000 €
8	**Cultural heritage value in case of hazard occurance**	358 486 €
9	**Cultural heritage value in case of hazard occurance and solution effect**	904 610 €
10		
11	**Value of protected cultural heritage**	546 125 €
12	**Cumulated impact of the solution on Costs/Benefits of the object**	274 000 €
13	**Cumulated costs of solving hazard consequences**	6 200 000 €

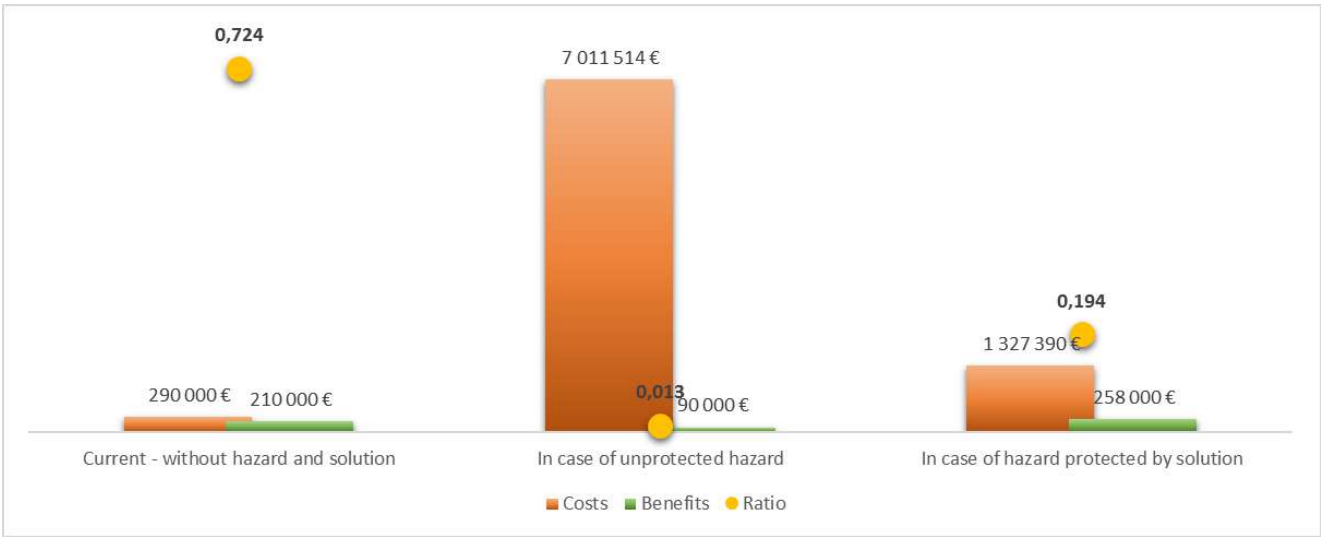
6.1.5 The next part of the output shows the cumulative sum of costs and benefits, *excluding* or *including* the changes in the cultural heritage value. The *Ratio* is calculated as the *Benefits/Costs* ratio. If the *Ratio In case of hazard protected by solution* increased compared to *Ratio In case of unprotected hazard*, the solution implementation could be considered effective.

	Excluding cultural heritage value	**Benefits**	**Costs**	**Ratio**
18	Current - without hazard and solution	210 000 €	290 000 €	0,724
19	In case of unprotected hazard	90 000 €	6 370 000 €	0,014
20	In case of hazard protected by solution	338 000 €	1 230 000 €	0,275
21				
22	**Including cultural heritage value**	**Benefits**	**Costs**	**Ratio**
23	Current - without hazard and solution	210 000 €	290 000 €	0,724
24	In case of unprotected hazard	90 000 €	7 011 514 €	0,013
25	In case of hazard protected by solution	338 000 €	1 325 390 €	0,255

6.1.6 The overall evaluation of the calculation of the selected combination of the cultural value, hazard and solution is stated below. This is only a generalisation based on the change of the CBA ratio, no other aspects are included, and a complex approach should be used to assess further decision making.

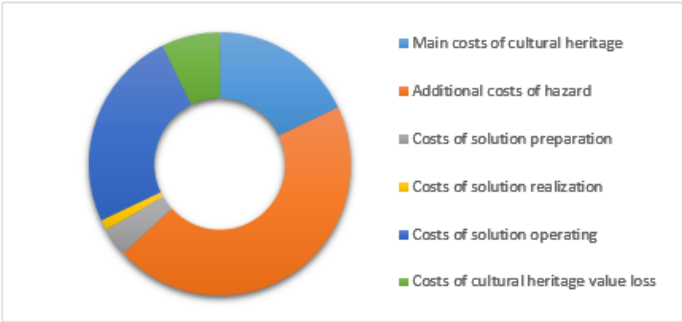
26	**RESULT: The ratio in case of hazard protected by solution has higher value than ratio in case of unprotected hazard, and**
27	**therefore, the solution implementation can be considered EFFECTIVE.**

6.1.7 The values "*Including cultural heritage value*" are displayed in the chart below. If the yellow dot (*Ratio*) is higher in the third column than in the second column, the solution implementation can be considered effective, but see 6.1.6.



6.1.8 The *Benefits and costs breakdown* summarises the cumulated sums of the most important partial items. It mainly displays the structure of expenses during the solution lifespan, which is also displayed in the chart on the right.

47	Item	Amount
48	Main benefits of cultural heritage	238 000 €
49	Addinitonal benefits of solution	20 000 €
50	Main costs of cultural heritage	238 000 €
51	Additional costs of hazard	600 000 €
52	Costs of solution preparation	47 000 €
53	Costs of solution realization	17 000 €
54	Costs of solution operating	330 000 €
55	Costs of cultural heritage value loss	95 390 €
56	Solution effectivness	1514%



7 Export

The button *Export CBA and PRINT PDF* on the sheet *CBA* (see 6.1.4) is used for two purposes: 1) A new .pdf file with the complete CBA is created, which allows modifying the inserted data and financial values without losing the complete analysis (see 7.1). 2) The main CBA data are stored in the *Export* sheet, where further comparison of different setting is possible (see 7.2).

7.1 The .pdf print

7.1.1 After the *export* button is clicked, a new *.pdf* file is to be printed. The file's name can be modified; the default folder is the same where the *CBA Tool* is located. The *.pdf* export can be cancelled in a standard way.

7.2 Export sheet

7.2.1 The export sheet consists of two main parts. The upper part contains all the information independent of the selected solution. The lower part contains the

exported CBA results of each calculated solution. In such a way, a comparison of different solution effects is possible. All the data on the sheet are shown previously somewhere in the workbook – there is no new information here.

1	CBA VARIANTS EXPORT				
2					
3	Cultural heritage	The main train station in Brno located in Nádražní, Brno, Czechia			CLEAR EXPORT
4	Hazard	Storm which occurs every 6 months and decreses cultural heritage value by 5%			
5					
6	Current cultural heritage value			1 000 000 €	
7	Cultural heritage value in case of hazard occurance			358 486 €	
8					
9	Including cultural heritage value	Benefits	Costs	Ratio	
10	Current - without hazard and solution	210 000 €	290 000 €	0,724	
11	In case of unprotected hazard	90 000 €	7 011 514 €	0,013	

13	Solution	Cultural heritage value in case of hazard occurance and solution effect	Value of protected cultural heritage	Cumulated impact of the solution on Costs/Benefits of the object	Cumulated costs of solving hazard consequences	Benefits Including cultural heritage value In case of hazard protected by solution	Costs Including cultural heritage value In case of hazard protected by solution	Ratio In case of hazard protected by solution
14	Pile foundation reinforcement with lifespan 10 years and 90 % impact on hazard	904 610 €	546 125 €	274 000 €	6 200 000 €	258 000 €	1 327 390 €	0,194
15	Pile foundation reinforcement with lifespan 10 years and 90 % impact on hazard	904 610 €	546 125 €	274 000 €	6 200 000 €	258 000 €	1 327 390 €	0,194

7.2.2 The *Clear export* button is used to clear the lower table with the solutions.

7.2.3 If there is a need to compare situations, which change the upper part of the *Export* sheet (for instance, the parameters of the hazard), it is necessary to work in a copy of the *CBA Tool* file.