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Urban Planning

ECONOMIC VALUATION OF HOUSING ESTATE TRANSFORMATION

ONDŘEJ CHUDÝ

Czech Technical University in Prague, Faculty of Architecture, Department of Building Sciences, Thákurova 9, 160 00 Prague 6, Czech Republic
Tutor: doc. Ing. arch. David Tichý, Ph.D.
ORCiD: 0000-0002-2499-5992
E-mail: ondrej.chudy@fa.cvut.cz

ABSTRACT: Housing estate areas usually have around a 70% share of public space. A considerable amount of money is spent on the maintenance of these non-building areas. When maintenance efforts decrease, technical and visual aspects of the living environment also decrease. This paper presents a survey conducted in the Modřany housing estate in Prague evaluating current non-building areas and proposing three examples of model transformations. The costs used in the survey were taken from the Catalogue of Interventions in Housing Estates. Benefits presented in the survey are taken from a questionnaire determining residents' preferences. The goal is to find the correct valuation of the money spent on development and management of public areas of housing estates and show it can bring great benefits for residents.

KEY WORDS: Housing estates, public space, transformation, valuation, costs, benefits

Introduction

Modernist housing estates in the Czech Republic were built from the 1950s to the beginning of the 1990s. The original population of housing estates corresponded to the demographic average composition of the Czech population and this situation has still not really changed. However, now some housing estates have a negative reputation and the wealthier population is starting to leave. Views on the shortcomings and quality of this urban structure and public space differ, but there is agreement that the quality of public space should be improved (Maier, 2003). This paper wants to examine the suitability of

housing estate transformation for improving the quality of the residential environment, and to compare it with the current state. The open space of housing estates is also a public space. The open space is a free space between houses (Wittmann, 2015) and occupies approximately 70% of this urban structure. Considerable funds from the public budget are spent on public space management. (Hudeček, 2018).

The regeneration of housing estates is one of the priority programmes of the Ministry for Regional Development of the Czech Republic, providing subsidy programmes in their "Housing Regeneration and Panel 2013+" (SFPI, 2020). These subsidy programmes do not evaluate the benefits and effectiveness of the investments made in terms of improving the quality of the environment. For this reason, I wanted to introduce a procedure that compares the current state with the transformation plan of the urban structure of the housing estate, primarily in the organisation of undeveloped public space. My goal is to find the housing estate transformation costs and benefits and set the Benefits to Costs Ratio (BCR).

Method

This is a method that is based on Cost Benefit analysis and expresses the final effects of the measures by BCR. (Zapletalová, 2019) If we want to compare the current state and the possible transformation of the undeveloped space of a housing estate, it is necessary to define the costs and benefits of the individual elements that make up the space. In order to determine the costs of the transformation of the housing estate and to price the built current structure, we compiled a Catalogue of Interventions on Housing Estates. (Chudý, Molnárová 2020) The catalogue shows the research of foreign approaches and presents "top-down" and "bottom-up" interventions together with the investment costs of individual elements.

After compiling the catalogue, it was necessary to find out whether the mentioned interventions are in demand among the residents of housing estates in the Czech Republic and what their value is. For this, we used a questionnaire survey, in which we showed housing estate residents the proposed changes and asked them for their preferences. We were interested, firstly, whether the residents would welcome the given change and secondly, whether they would hypothetically be willing to pay for it. The inspiration for this procedure was economic valuation methods from the Stated Preference Method category, which are based on the creation of a hypothetical market, expressing people's willingness to pay for a certain product and willingness to accept compensation for a given arrangement , intervention, change. These are the Choice Experiment method and the Contingent Valuation Method. (Melichar, 2010)

For the questionnaire survey, we chose the Modřany housing estate in Prague that was also used for the "Housing Estate, What Next?" (Kohout, 2016) research. This

area was also used for a case study proposing housing estate refurbishment.

Three locations, "blocks", were selected for which costs and benefits were calculated. The BCR was determined for both conditions, current state and transformation. The higher BCR means higher benefits for society. Any projects with BCR of less than 1 should theoretically not be implemented, as the costs exceed the benefits. However, in the case of public projects, this may not be entirely the case, as not all the benefits can always be monetised. (Zapletalová, 2019) Therefore, it is possible to compare the benefits of individual plans.

Block 1 - current state	
area of block	34 560 m²
non-builded space	27 780 m²
construction costs	873 153 CZK/year
public maintenance costs	466 937 CZK/year
total public cost	1 340 090 CZK/year
benefits	178 284 CZK/year
BCR - Benefits to Cost Ratio	**0,133**
	-1 161 806 CZK/year
other:	
number of parking spaces	82

Block 1 - transformation	
area of block	34 560 m²
non-builded space	27 594 m²
construction costs	1 552 669 CZK/year
public maintenance costs	380 420 CZK/year
total public cost	1 933 090 CZK/year
benefits	1 356 105 CZK/year
BCR - Benefits to Cost Ratio	**0,702**
	-576 984 CZK/year
other:	
number of parking spaces	185
profit from the sale of land (3600 CZK/m²)	7 661 m²

Figure 1. Block 1 – Comparison of the BCR (Chudý, 2020)

Cost analysis

Basic dimensions were calculated for each of the three blocks. In the case of the current state, I have valued modifications leading to the restoration and maintenance of this state, which reflects the service life. The proposed modifications were assessed in the same way. Prices per 1 m² were set using the catalogue. Furthermore, the costs of the expected earthworks were included. Investment costs were budgeted for the condition and execution based on the lifetime of the elements for the annual investment costs (year/m²). Maintenance costs were taken from the "Hustota a ekonomika měst"[1](Hudeček, 2016) research and converted to (year/m²).

The intervention catalogue contains 17 elements: modification of public space; new development; shared gardens; private gardens; reserved open parking; reserved parking with shelter; communal garages; private garages; active parterre; building entrance modification; individual entrances to apartments; outbuildings on the ground floor; outbuildings on the upper floors; balconies and loggias; front gardens; shared inner blocks; technical infrastructure networks.

Within this paper, the individual elements of the catalogue of interventions in housing estates are not described in more detail. It is published in more detail elsewhere (Chudý, Molnárová, 2020). Elements and prices are used in the described cost calculation. The prices were determined in the URS 2020 price system. Figure 2 shows the calculation of Total Costs. Costs for the current state were similarly calculated.

BLOCK 1 current state - costs	Nuber of units		Unit price (UP)		Total cost (TC)	Total price of earthworks (EARTHW)	Investment costs (TP+EARTHW)
surface treatment					**18 221 810 CZK**		
roadway - main	3526	m2	1650	CZK/m2	5 817 900 CZK	2 086 511 CZK	7 904 411 CZK
roadway - additional	0	m2	1200	CZK/m2	0 CZK	0 CZK	0 CZK
sidewalks	5489	m2	900	CZK/m2	4 940 100 CZK	1 804 509 CZK	6 744 609 CZK
paved area - shared	0	m2	1200	CZK/m2	0 CZK	0 CZK	0 CZK
paved area - entrances	0	m2	3000	CZK/m2	0 CZK	0 CZK	0 CZK
paved area - parking	913	m2	1650	CZK/m2	1 506 450 CZK	420 208 CZK	1 926 658 CZK
parking - shed		m2			0 CZK		0 CZK
parking - inner block					0 CZK		0 CZK
parking - garage					0 CZK		0 CZK
playground	450	m2	1500	CZK/m2	675 000 CZK	177 525 CZK	852 525 CZK
workout		m2	4400	CZK/m2	0 CZK		0 CZK
public greenery	14740	m2	200	CZK/m2	2 948 000 CZK		2 948 000 CZK
semi-public green	2779	m2	840	CZK/m2	2 334 360 CZK		2 334 360 CZK
semi-private green (shared)	0	m2	840	CZK/m2	0 CZK		0 CZK
private green	0	m2	1990	CZK/m2	0 CZK		0 CZK
land for sale							
networks					**18 355 250 CZK**		
public lighting	37	ks	58250	CZK/piece	2 155 250 CZK		2 155 250 CZK
electricity line	900	m	1500	CZK/m	1 350 000 CZK		1 350 000 CZK
water supply	750	m	5000	CZK/m	3 750 000 CZK		3 750 000 CZK
sewerage	750	m	10000	CZK/m	7 500 000 CZK		7 500 000 CZK
gas pipe	900	m	4000	CZK/m	3 600 000 CZK		3 600 000 CZK
trees					**1 320 000 CZK**		
number of trees after treatment							
number of existing trees preserved	120	pcs	11000	CZK/ks	1 320 000 CZK		1 320 000 CZK
number of newly planted trees							
fence	0				**0 CZK**		
Total price					**37 897 060 CZK**	**4 488 753 CZK**	**42 385 813 CZK**
price of modifications of undeveloped area (CZK/m2)					1365		

Figure 2. Block 1 current state – costs part 1 (Chudý, 2020)

BLOCK 1 transformation - costs	Nuber of units		Unit price (UP)		Total cost (TC)	Total price of earthworks (EARTHW)	Investment costs (TP+EARTHW)
surface treatment					**35 074 020 CZK**		
roadway - main	2644	m2	1650	CZK/m2	4 362 600 CZK	1 564 587 CZK	5 927 187 CZK
roadway - additional	2606	m2	1200	CZK/m2	3 127 200 CZK	1 542 101 CZK	4 669 301 CZK
sidewalks	6140	m2	900	CZK/m2	5 526 000 CZK	2 018 525 CZK	7 544 525 CZK
paved area - shared	783	m2	1200	CZK/m2	939 600 CZK	257 411 CZK	1 197 011 CZK
paved area - entrances	1265	m2	3000	CZK/m2	3 795 000 CZK	415 869 CZK	4 210 869 CZK
paved area - parking	2037	m2	1200	CZK/m2	2 444 400 CZK	937 529 CZK	3 381 929 CZK
parking - shed	300	m2	3300	CZK/m2	990 000 CZK	138 075 CZK	1 128 075 CZK
parking - inner block							0 CZK
parking - garage							0 CZK
playground	278	m2	1500	CZK/m2	417 000 CZK	109 671 CZK	526 671 CZK
workout	78	m2	4400	CZK/m2	343 200 CZK		343 200 CZK
public greenery	762	m2	200	CZK/m2	152 400 CZK		152 400 CZK
semi-public green	2867	m2	840	CZK/m2	2 408 280 CZK		2 408 280 CZK
semi-private green (shared)	4067	m2	840	CZK/m2	3 416 280 CZK		3 416 280 CZK
private green	3594	m2	1990	CZK/m2	7 152 060 CZK		7 152 060 CZK
land for sale	7661						
networks					**18 355 250 CZK**		
public lighting	37	ks	58250	CZK/piece	2 155 250 CZK		2 155 250 CZK
electricity line	900	m	1500	CZK/m	1 350 000 CZK		1 350 000 CZK
water supply	750	m	5000	CZK/m	3 750 000 CZK		3 750 000 CZK
sewerage	750	m	10000	CZK/m	7 500 000 CZK		7 500 000 CZK
gas pipe	900	m	4000	CZK/m	3 600 000 CZK		3 600 000 CZK
trees					**1 331 000 CZK**		
number of trees after treatment	145	pcs					0 CZK
number of existing trees preserved	24	pcs					0 CZK
							0 CZK
number of newly planted trees	121	pcs	11000	CZK/piece	1 331 000 CZK		1 331 000 CZK
fence	1735	m			**8 572 350 CZK**		
walls	569	m	10250	CZK/m	5 832 250 CZK		5 832 250 CZK
wooden							0 CZK
hedge	1166	m	650	CZK/m	757 900 CZK		757 900 CZK
mesh	1166	m	1700	CZK/m	1 982 200 CZK		1 982 200 CZK
Total price					**63 332 620 CZK**	**6 983 768 CZK**	**70 316 388 CZK**
price of modifications of undeveloped area (CZK/m2)					2306		

Figure 3. Block 1 transformation – costs part 1 (Chudý, 2020)

After the first part of Total Costs (TC) calculation, the costs taking into account the lifetime of the elements were calculated. All costs were calculated on an annual basis.

Total maintenance costs per year determine the costs associated with the maintenance of all surfaces. Total public maintenance costs per year determine the maintenance costs financed from the public budget. Total costs per year determine total investment costs as well as costs and maintenance budgeted for one year. Total public costs per year show the annual costs paid from the public budget.

BLOCK 1 current state - costs	Service life	Investment costs per year (ICY)	Maintenance costs (1m2/year)	Total maintenance costs per year (TMCY)	Total public maintenance costs per year (TPMCY)
surface treatment					
roadway - main	30	263 480 CZK	17,19	60 612 CZK	
roadway - additional	30	0 CZK	17,19	0 CZK	
sidewalks	30	224 820 CZK	18,55	101 821 CZK	
paved area - shared	30	0 CZK	18,55	0 CZK	
paved area - entrances	30	0 CZK	18,55	0 CZK	
paved area - parking	30	64 222 CZK	17,19	15 694 CZK	
parking - shed	50	0 CZK		0 CZK	
parking - inner block	100	0 CZK		0 CZK	
parking - garage	100	0 CZK		0 CZK	
playground	30	28 418 CZK	11,59	5 216 CZK	
workout	30	0 CZK	11,59	0 CZK	
public greenery	50	58 960 CZK	11,59	170 837 CZK	
semi-public green	50	46 687 CZK	11,59	32 209 CZK	
semi-private green (shared)	50	0 CZK	11,59	0 CZK	
private green	50	0 CZK	11,59	0 CZK	
land for sale					
networks					
public lighting	80	26 941 CZK	2177	80 549 CZK	
electricity line	80	16 875 CZK			
water supply	120	31 250 CZK			
sewerage	150	50 000 CZK			
gas pipe	80	45 000 CZK			
trees					
number of trees after treatment					
number of existing trees preserved	80	16 500 CZK			
number of newly planted trees					
fence					
Total price		**873 153 CZK**		**466 937 CZK**	**1 340 090 CZK**
price of modifications of undeveloped area (CZK/m2)					
Total costs per year (TCY)=(ICY+TMCY)					**1 340 090 CZK**
Total public costs per year (TPCY)=(ICY+TPMCY)					**2 213 243 CZK**

Figure 4. Block 1 current state – costs part 2 (Chudý, 2020)

Benefits and preferences

Based on a questionnaire survey and people's willingness to participate (Chudý, 2020), the benefits of changes were calculated per inhabitant per month. Based on the effect on a certain circle of people, the total annual benefits (year/m²) were calculated. The circle of people was defined according to the number of users. Therefore, both the status and the proposal were valuated under the same conditions and benefits. Some benefits were expressed in terms of payment per housing unit, as the hypothetical payment, the expressed benefit, is normally related to the apartment. This is, for example, a front yard, front of a house, a shared garden, or a parking space. It was easier to determine the approximate number of apartments per entrance than the average occupancy of apartments. Both methods are

comparable, but this procedure was chosen for valuation. It is therefore possible that the expressed benefits may be even higher, but the same is true of the assessed current state.

BLOCK 1 transformation - costs	Service life	Investment costs per year (ICY)	Maintenance costs (1m2/year)	Total maintenance costs per year (TMCY)	Total public maintenance costs per year (TPMCY)
surface treatment					
roadway - main	30	197 573 CZK	17,19	45 450 CZK	45 450 CZK
roadway - additional	30	155 643 CZK	17,19	44 797 CZK	44 797 CZK
sidewalks	30	251 484 CZK	18,55	113 897 CZK	113 897 CZK
paved area - shared	30	39 900 CZK	18,55	14 525 CZK	14 525 CZK
paved area - entrances	30	140 362 CZK	18,55	23 466 CZK	
paved area - parking	30	112 731 CZK	17,19	35 016 CZK	35 016 CZK
parking - shed	50	22 562 CZK		0 CZK	0 CZK
parking - inner block	100	0 CZK		0 CZK	0 CZK
parking - garage	100	0 CZK		0 CZK	0 CZK
playground	30	17 556 CZK	11,59	3 222 CZK	3 222 CZK
workout	30	11 440 CZK	11,59	904 CZK	904 CZK
public greenery	50	3 048 CZK	11,59	8 832 CZK	8 832 CZK
semi-public green	50	48 166 CZK	11,59	33 229 CZK	33 229 CZK
semi-private green (shared)	50	68 326 CZK	11,59	47 137 CZK	
private green	50	143 041 CZK	11,59	41 654 CZK	
land for sale					
networks					
public lighting	80	26 941 CZK	2177	80 549 CZK	80 549 CZK
electricity line	80	16 875 CZK			
water supply	120	31 250 CZK			
sewerage	150	50 000 CZK			
gas pipe	80	45 000 CZK			
trees					
number of trees after treatment					
number of existing trees preserved					
number of newly planted trees	80	16 638 CZK			
fence					
walls	80	72 903 CZK			
wooden	30				
hedge	50	15 158 CZK			
mesh	30	66 073 CZK			
Total price		**1 552 669 CZK**		**492 677 CZK**	**380 420 CZK**
price of modifications of undeveloped area (CZK/m2)					

Total costs per year (TCY)=(ICY+TMCY)	**2 045 346 CZK**
Total public costs per year (TPCY)=(ICY+TPMCY)	**1 933 090 CZK**

Figure 5. Block 1 transformation – costs part 2 (Chudý, 2020)

BLOCK 1 current state - benefits	benefit of element for 1 person (apartment)/month		benefit for 1 person (apartment)/month/1m2		benefit of 1m2 for 1person (apartment)/year	Total benefit per year	Benefit-to-Cost Ratio (BCR)	Posit. pref. before price (%)	Posit. Pref. after price (%)
roadway - main									
roadway - additional									
sidewalks									
paved area - shared	55	for 910 inhabitants of block	0,0604	for inhabitant per 1m2	0,725	0 CZK		77	60
paved area - entrances	30	for apartment per 30m2	1	for apartment per 1m2	12	0 CZK		74	61
paved area - parking	200	for apartment per 12,5m2	16	for apartment per 1m2	192	175 296 CZK		52	47
parking - shed	400	for apartment per 12,5m2	32	for apartment per 1m2	384	0 CZK		55	41
parking - inner block	1000	for apartment per 20m2	50	for apartment per 1m2	600	0 CZK		46	18
parking - garage	1700	for apartment per 28m2	60,7	for apartment per 1m2	728,5714286	0 CZK		49	21
playground						0 CZK			
workout						0 CZK			
						0 CZK			
public greenery	55	for 180 inhabitants per ha	0,0055	for inhabitant per 1m2	0,066	973 CZK		77	60
semi-public green	55	for 910 inhabitants of block	0,0604	for inhabitant per 1m2	0,725	2 015 CZK		77	60
semi-private green	60	for 20 apartments per 200m2	6	for apartment per 1m2	72	0 CZK		37	18
private green	500	for 1 apartments per 40m2	12,5	for apartment per 1m2	150	0 CZK		52	39
land for sale									
						178 284 CZK	0,1330		

Figure 6 Block 1 current state - benefits (Chudý, 2020)

BLOCK 1 transformation - benefits	benefit of element for 1 person (apartment)/month		benefit for 1 person (apartment)/month/1m2		benefit of 1m2 for 1person (apartment)/year	Total benefit per year	Benefit-to-Cost Ratio (BCR)	Posit. pref. before price (%)	Posit. Pref. after price (%)
roadway - main									
roadway - additional									
sidewalks									
paved area - shared	55	for 910 inhabitants of block	0,0604	for inhabitant per 1m2	0,725	568 CZK		77	60
paved area - entrances	30	for apartment per 30m2	1	for apartment per 1m2	12	15 180 CZK		74	61
paved area - parking	200	for apartment per 12,5m2	16	for apartment per 1m2	192	391 104 CZK		52	47
parking - shed	400	for apartment per 12,5m2	32	for apartment per 1m2	384	115 200 CZK		55	41
parking - inner block	1000	for apartment per 20m2	50	for apartment per 1m2	600	0 CZK		46	18
parking - garage	1700	for apartment per 28m2	60,7	for apartment per 1m2	728,6	0 CZK		49	21
playground						0 CZK			
workout						0 CZK			
						0 CZK			
public greenery	55	for 180 inhabitants per ha	0,0055	for inhabitant per 1m2	0,066	50 CZK		77	60
semi-public green	55	for 910 inhabitants of block	0,0604	for inhabitant per 1m2	0,725	2 079 CZK		77	60
semi-private green	60	for 20 apartments per 200m2	6	for apartment per 1m2	72	292 824 CZK		37	18
private green	500	for 1 apartments per 40m2	12,5	for apartment per 1m2	150	539 100 CZK		52	39
land for sale									
						1 356 105 CZK	**0,7015**		

Figure 7. Block 1 transformation - benefits (Chudý, 2020)

Conclusions

BCR shows better results for the new, transformed structure. New housing estate transformation is a better choice compared to the total costs of maintaining the current state.

The presented benefits are not the limit price for which people are hypothetically willing to pay. It is a price that people are willing to pay and that is needed for the new changes to be made.

It is important to mention that profits from the sale or transfer of land to apartment buildings or users of private gardens are not included. In the case of a new development, the profits from the sale of land or apartments is not taken into account. Only the quality benefits of the new environment are assessed. I also try to find the monetary value of these benefits.

Block 2 - current state

area of block	17 491 m²
non-builded space	14 331 m²
construction costs	458 423 CZK/year
public maintenance costs	248 972 CZK/year
total public cost	707 394 CZK/year
benefits	196 960 CZK/year
BCR - Benefits to Cost Ratio	**0,278**
	-510 434 CZK/year
other:	
number of parking spaces	74

Block 2 - transformation

area of block	17 491 m²
non-builded space	14 331 m²
construction costs	832 810 CZK/year
public maintenance costs	253 296 CZK/year
total public cost	1 086 107 CZK/year
benefits	663 012 CZK/year
BCR - Benefits to Cost Ratio	**0,610**
	-423 094 CZK/year
other:	
number of parking spaces	84
profit from the sale of land (3600 CZK/m²)	3 369 m²

Figure 8. Block 2 – Comparation of the BCR (Chudý, 2020)

Block 3 - current state

area of block	33 135 m²
non-builded space	31 393 m²
construction costs	1 520 011CZK/year
public maintenance costs	595 825 CZK/year
total public cost	2 115 836 CZK/year
benefits	990 235 CZK/year
BCR - Benefits to Cost Ratio	**0,468**
	-1 125 601 CZK/year
other:	
number of parking spaces	211 (+17)
number of guarded parking spaces	177
(1 park. place 800 CZK/month)	to 1 699 000 CZK/year

Block 3 - transformation

area of block	33 135 m²
non-builded space	26 110 m²
construction costs	1 631 607 CZK/year
public maintenance costs	437 462 CZK/year
total public cost	2 069 068 CZK/year
benefits	1 761 906 CZK/year
BCR - Benefits to Cost Ratio	**0,852**
	-307 162 CZK/year
other:	
number of parking spaces	137
num. of under. parking spaces	295
gross flore area	17 498 m²
profit from the sale of land (3600 CZK/m²)	7 325 m²

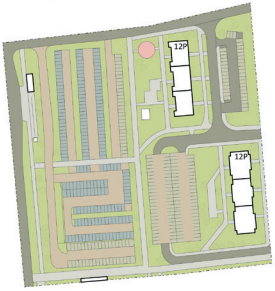

Figure 9. Block 3 – Comparation of the BCR (Chudý, 2020)

Footnotes

[1] "Hustota a ekonomika měst" – translated into English: "Density and Economy of the City"

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