Multiple Criteria Decision Analysis of EU Project Implementation Benefits for the Impacted Micro-region

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Abstract—The objective of this contribution is to analyze, by means of a case study, any potential benefits of a project financed from the European Union - European Regional Development Fund implementation on the selected Czech Republic micro region. The contribution of the project can be assessed according to multiple sustainable development criteria. These criteria cover the following areas: economic, environmental and social. The solved problem is formulated as a problem of multiple criteria decision analysis. The three level method analytic hierarchy process is used. The algorithm has been implemented in MATLAB. The decision tree analysis was applied for this problem, too.

Keywords—Economic cohesion, European regional development fund, multiple criteria decision analysis, decision tree analysis, analytic hierarchy process, Saaty matrix.

I. INTRODUCTION

THE European Union (EU) in the framework of its economic and social policy finances activities that contribute to reducing uneven developments in individual regions. To meet this end the EU utilizes its structural funds. The most important funds are the European Regional Development Fund (ERDF), and the European Social Fund [1]. The assistance implemented via provision of financial funds from the ERDF is targeted to investments to local potential developments in the form of support to small and medium enterprises (SMEs) to create new job positions or to keep the existing ones. Further the Fund is used to finance infrastructure improvements, such as roads and railways constructions, replacement of old ecology burdens, investments targeted to environment etc.

The Czech Republic (CR) as a member state of the EU, in the current programming period 2007 – 2013, draws financial funds from the above mentioned structural funds. The funds are drawn via 26 approved Operational Programes (OPs) [2]–[7]. The analyzed project has been financed by the OP Enterprise and Innovations that is managed by the Ministry of Industry and Trade CR. The global objective of this OP is to increase the CR competitiveness and to bring the sector of industry and services performance closer to the level of leading industrial European countries.

This program has the following Priority Axes: Establishment of Firms, Development of Firms, Effective Energy, Innovation, Environment for Enterprise and Innovation, Business Development Services and Technical Assistance. Enterprise Flídr plast s.r.o., the owner of the analyzed project – the analysis was done to analyze the benefits of the project for the local and the regional economy – has received a grant (subsidy) from the Priority Axes "Development of Firms" of the above mentioned OP. The objective of this priority axes is to improve competiveness of SMEs by means of introducing progressive technologies. This project can be implemented only in regions with concentrated state aid for period 2007 – 2013. Such regions are defined by the Ministry of Regional Development CR [8].

The economic performance and competitiveness of any region is influenced by a whole range of factors (indicators) [9]–[17]. Among the most observed macroeconomic indicators are the Gross Domestic Product (GDP) and the Productivity Indicator expressed as GDP calculated as per one inhabitant (GDP per inhabitant). Unemployment and Unemployment rate are, next to GDP per inhabitant, the second most observed macroeconomic indicators on the regional level. The regional level is to a certain extent dependent on the GDP but it is also influenced by the development of the total labour productivity, total employment, population age and education level, and transport infrastructure conditions. Another accompanying indicator is the rate of investments or the amount of direct foreign investments and the export performance of the region. To this mentioned set of indicators we can also include indicators with relevance to the standard of living – average wage and households disposable income in the regions.

Another set of economic performance factors are the quality of human potential and the region innovative activity. The

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innovation activity performance can be assessed by the human resources quality (e.g. based on the achieved education level), research and development expenditures in regions, employment in research and development, level of foreign investment as a carrier of innovation changes and the value added in the more technology extensive sectors.

Indicators that can rate the quality of life are, for instance, population migration, the environment, crime rate, population health conditions, medium life expectancy, sports and culture life opportunities.

The objective of this case study was to analyze, from the sustainable development point of view, the contribution of the development project financed by the ERDF to the selected CR region and to decide on the biggest contribution of the existing project implementation year on the micro region "Poličsko" (Polička micro region).

II. Problem Formulation

The economy of any region is influenced also by the allocation and the structure of business entities (determined for instance by the share individual sectors have in employment or by the sector structure specification). Here SMEs play a very important role since they are the most frequent type of a business entity. They play a very important role in the creation of job opportunities; they are a social stability factor and an economy development factor. The number of SMEs in a given area signals, among other things, regional differences in the willingness to undertake independent business activities.

Business activities influence the most the region inhabitants, income and expense sides of municipal budgets, and last but not least, the entire population. Any region's inhabitants represent potential enterprise employees. A concrete economy situation in a region is thus illustrated by the regional employment level, number of inhabitants dependent on unemployment benefits and on other types of social transfers. Any enterprise has also its share in the effective demand and in the inhabitants´ living standard since it influences the level of wages and salaries paid to its employees. Further taxes paid by the enterprise increase municipal budgets. Tax yields go to municipal budgets as trusted/own or shared taxes according to the tax allocation rules. On the other hand, social transfer expenditures, new jobs creation expenditures, requalification of unemployed expenditures or business activities state aid are financed from the public budgets. Business entities contribute to the financing of transportation services, to improvement in the transport system and to ecological behavior.

A. The Micro Region Characteristics

"Poličsko" micro region belongs, from the point of view of the area/regional division, to the Pardubice region. The Pardubice region is a part of the cohesion region NUTS II North East. Poličsko micro region is situated in the Pardubice region on the south border of the Svitavy district as it is illustrated in Fig. 1 [18]. The micro region administration

district consists of 20 municipalities with 29 cadastre areas.

Inside the Pardubice region the micro region has borders with municipalities belonging to the administration district Litomyšl on the north side and with Svitava region on the east side. On the south side it borders with the "Vysočina" region and with the South Moravia region. From the catchment area point of view, the employment opportunities and the number of inhabitants point of view the key role in the region play primarily two cities, Polička city and Bystré city. Important is the catchment ability towards Brno, the capital city of the South Moravia region which is more significant than the catchment to Pardubice.

The Poličsko micro region inhabitants fall into two districts – they represent 19 % of the inhabitants of Svitavy district and 3.9 % inhabitants of the Pardubice region. More than 20 000 inhabitants live in the micro region territory (20 093 inhabitants as of December 31, 2009). The highest number of inhabitants has the Policka city (8 877 inhabitants), in which 44 % of the total micro region inhabitants live. The micro region population density is significantly below the average level of population compared to the Pardubice region and nearly half of the population density average of the entire CR (Table 1) [19].

Fig. 1 The Pardubice region division and the Micro region "Poličsko" division

Table 1 Population density of the given area of the CR in year 2009

The area	Population density (inhabitants per square kilometre)
Mikro region "Poličsko"	71.1
Svitavy district	76.3
Pardubice region	114
CR	133

Regarding the age structure of inhabitants living in all of the micro region member municipalities the highest share of inhabitants, as of December 12, 2009, are persons in productive age, that is persons between 15 – 64 years of age. The share of inhabitants in the pre-productive age (0 – 14 years of age) in the micro region was higher that the Svitavy district average and the Pardubice region average. Opposite to that, the share of inhabitants in the productive age (15 – 64)

was the lowest in the micro region (the average for the micro region) compared to Svitavy district and to the Pardubice region. The share of inhabitants in the post productive age (65 and more years of age) was higher that in Svitavy district and in the Pardubice region (Table 2) [19].

Based on the analysis of statistical data from years 1991 to 2001 [18] it is obvious that the level of education inside the micro region is rising. Number of inhabitants with basic/elementary education declined by 11.6 %, number of inhabitants with secondary education without school leaving exams increased and it is higher that the CR average. Share of inhabitants with secondary education with school leaving exams also increased, however not over the CR average. In the group of inhabitants with university education men have the majority. In the group of inhabitants with secondary education with school leaving exams and higher education women have the majority.

Table 2 Representation of persons by age structure in the given territory in year 2009 (in percentages)

Inhabitants age structure	Micro region "Poličsko"	District Svitavy	Pardubice region
0 – 14 years	15.5	15.0	14.6
15 – 64 years	68.4	70.1	69.9
65 and more years	16.1	14.9	15.5

As of December 31, 2009 the rate of unemployment in the Poličsko micro region was 11.1 % (that is the average for the member municipalities) which is under the Svitavy district average level (12.3 %) but higher that is the Pardubice region average (6.4 %). Regarding the economy structure - as of the end of year 2009, there were 109 449 business companies with official seat registered in Pardubice region. The majority of the registered companies are physical entities/sole traders (80.0 %) (in concrete sole traders not registered in the register of companies). Based on the CZ-NACE information (from French Nomenclature générale des activités économiques dans les Communautés Européennes) the prevailing trade activities, more than 25 %, of the registered sole traders are "Trade" and "Repair of motor vehicles", 14.5 % sole traders are active in "Industry" activities, and 13.3 % sole traders are active in construction activities. In year 2009 there were 150 industry business entities with more than 100 employees registered in the Pardubice region.

In the micro region, data showing the share of the individual employers, according to the classification of economic activities CZ-NACE, in the micro region employment are not observed. We state here data on the share which individual sectors have in the Pardubice region employment as provided by the Czech Statistical Office – see (Table 3) [20, Annex E, page 82]. We compare this data with the data acquired from [18], [19]. Each unit has a code under NACE assigned. The code is assigned by its main/predominant business activity (that is the activity which contributes most to the business unit value added). Units that are active in the same business activities are sorted into the

same NACE categories, regardless the type of ownership of the statistical unit (that is if it concerns a physical entity/sole sole trader, limited company or a joint stock company, and similar).

Manufacturing is the sector with the highest share of employees in the Pardubice region in all observed years. In Manufacturing works on average 37 % of all region employees. More than 10 % of the region employees are employed in the sector Wholesale and Retail trade, Repair of Motor vehicles and Motorcycles. These two sectors are the region's characteristic sectors.

Table 3 Share of individual sectors in the level of employment in Pardubice region between years 2007 – 2009 (in percentages)

Sector, Code, Title of Economic activities by CZ-NACE	Pardubice region		
	2007	2008	2009
Primary sector	4.91	4.87	4.97
A / Agriculture, Forestry and Fishing	4.91	4.58	4.71
B / Mining and Quarrying	-	0.29	0.26
Secondary sector	44.99	45.67	45.31
C / Manufacturing	33.27	34.06	32.85
D / Electricity, Gas, Steam and Air conditioning supply	0.93	1.11	1.32
E / Water supply, Sewerage, Waste management	1.31	1.09	1.80
F / Construction	9.49	9.41	9.33
Tertiary sector	49.68	49.46	49.55
G / Wholesale and Retail trade, Repair of Motor vehicles and Motorcycles	12.58	11.79	11.32
H / Transportation and Storage	6.27	6.08	6.73
I / Accommodation and Food service activities	2.44	3.13	2.68
J / Information and Communication activities	2.09	1.83	1.75
K / Financial and Insurance activities	1.90	2.18	1.84
L / Real estate activities	-	0.41	0.44
M / Professional scientific and Technical activities	2.68	2.96	3.55
N / Administrative and Support service activities	1.94	1.60	1.29
O / Public administration and Defence, Compulsory social security	5.65	4.95	5.21
P / Education	4.97	5.43	6.16
Q / Human health and Social work activities	7.10	6.57	6.28
R / Arts, Entertainment and Recreation	0.73	1.08	1.23
S / Other service activities (stated without activities of households, without activities of extraterritorial organizations and bodies)	1.33	1.46	1.27

In the Poličsko micro region there were 3 069 entities with the seat registered in the micro region as of September 30, 2010 (that is 2.8 % from the Pardubice region). They are entities with the seat in the relevant member municipality. Out of the total number nearly half (45 %) is in the category "without employees". In the territory of the micro region there is active 11 key employers with more than 100 employees (the enterprise Flídr plast, s.r.o. with the seat in munucipality "Široký Důl" is one of those companies). Manufacturing plays the key role in the micro region economicy. The dominant manufacturing sectors in the micro region are food

manufacturing (meat processing, beverages production), machinery (e.g. production of cars for technical and ecology intervention) wood manufacturing (production of wood products, joinery, floors manufacturing) and other. The second dominant sector providing micro region employment is the service sector. Health and social care facilities are the largest employees in the tertiary (service) sector. Agriculture remains to be an important element of the micro region economy base. In the micro region municipalities there can also be found petty services and handicrafts. Based on the data acquired from [18], [19], it can be stated that the micro region economy structure measured by the individual sectors' share in employment is similar to that of the Pardubice region.

B. Characteristics of the Enterprise

The main business activity of the enterprise Flídr plast s.r.o. (hereinafter "the enterprise") is the production of plastic products with focus on the shape and size precise pressed parts [21], [22]. The enterprise has the status of a "protected workshop", that means it employs people with health handicap. As it has been already stated, it belongs among eleven most important employers in the micro region. Its leading customer is the car industry. The enterprise is a member of the Technical Plastic Materials Cluster – Plasticor, it has intensive cooperation with the Technical University in Liberec in the area of metal substance metallurgy and in the area of thermoplastics and elastomers injection moulding. The enterprise submitted a grant application for project "The Extension of Production Equipment Capacity for the Increase of Process Efficiency and Employee Efficiency", hereinafter The Extension of Process Efficiency and Employee Efficiency (EPE3). The main goal of the project is the utilization of the existing production spaces for the extension of production capacity and efficiency increase via acquisition of new technology in the estimated value of the Czech crown (CZK) 16.7 million. The enterprise submitted a grant application for the EU funds grant for this project in year 2007 and in the same year it was decided that the enterprise would receive the grant in the total amount of CZK 9.2 million. This amount of grant was paid out to the enterprise in year 2009. The company would create, by the implementation of this project, eight new job positions and the acquisition of new technologies shall decrease amount of waste produced during production.

The proposed model of the analysis of the project EPE3 on the micro region Poličsko can be illustrated by a general hierarchic structure where the input in the model are real data characterizing the micro region and the enterprise. The output of this model is the selection of a given year (2007, 2008 and 2009) of the project implementation in which it is possible to observe, based on the criteria, the biggest impact on the region development. The structure of the model includes 3 sub models. There are sub-model SM_1 Poličsko micro region development evaluation, SM_2 enterprise development evaluation and SM_3 the enterprise contribution to the micro region development evaluation. The problem is formulated as a multiple criteria decision analysis (MCDA) problem. The criteria concern the region sustainable development area [23].

The use of traditional MCDA process P, is determined by the set of decision alternatives $A = \{a_1, a_2, …, a_n\}$ and by the set of criteria $C = \{c_1, c_2, …, c_m\}$, according to which the desirability of an alternative is to be evaluated. It can be expressed in a decision matrix $\mathbf{R}$. Process P can be expressed by the following way

$$P = \{A, C, \mathbf{R}(n \times m)\}, \tag{1}$$

where a matrix element r_{ij} of $\mathbf{R}$ indicates the performance rating of the i-th alternative a_i with respect to the j-th criterion c_j.

For all sub models the alternatives are the development years 2007, 2008 a 2009. The criteria from the sustainable development area are always defined with respect to the sub models specifics.

The set of criteria for the first sub model SM_1 was constructed based on internal information provided by the Municipal Office of Polička and it characterizes the economic, social and environmental pillars of sustainable development [18], [19]. The set includes: GDP per inhabitant for the entire Pardubice region (this data is not observed for the micro region) (in Ths. CZK), Number of economic subjects, Average monthly wage (in Ths. CZK), Monthly household housing costs (in Ths. CZK), Household housing burden (linguistic expression), Unemployment Rate (in percentage points), Number of inhabitants, Number of inhabitants in productive age (from 15 to 64 years of age), Number of students in elementary schools, Number of students in secondary schools, Land area, Ecology stability co-efficient, Waste production (in tons), the Share of hazardous waste in the total waste production (in percentage points), and the Costs of waste replacement (in Ths. CZK). The criterion Households housing burden was created in order to compare the households incomes with households housing costs. This variable acquires linguistic values "acceptable" and "higher".

The set of criteria for sub model SM_2 was selected on the basis of internal enterprise information provided by the enterprise. The selected criteria reflect the development of the enterprise in the individual years and are oriented into the areas of the enterprise economic development, the enterprise market position development and on production export countries and to the waste production area. They are the following: Revenues (in Ths. CZK), Average number of employees, Average gross monthly wage (in Ths. CZK), Number of main customers, Position on the car market, Position on the electronics market, Position in the machine building market, Position in other markets, Exports to country Switzerland, Exports to country Great Britain, Exports to country Belgium, Exports to country Hungary, Exports to country Germany, Production of waste (in tons), Share of hazardous waste in the total production of waste (in percentage points), Share of other waste production in the total waste production (in percentage points) and Cost of

waste removal (in Ths. CZK).

The selected criteria for sub model SM_3 reflect primarily the share of the enterprise in the given area in the development of the region Poličsko and criteria essentials for the macroeconomic development of the micro-region. These criteria are: GDP per inhabitant for the Pardubice region (in Ths. CZK), Difference in gross monthly wages (in Ths. CZK), Share of the enterprise employees in the total number of productive inhabitants (in percentage points), Monthly household housing costs (in Ths. CZK), Household housing burden, Rate of Unemployment (in percentage points), Position in the car market, Export position of the micro region compared to previous years, Number of inhabitants in the productive age (15 – 64 years), Share in the total waste production in the micro region (in percentage points), Share of waste removal costs in the total costs. The criterion Position on the car market is defined due to the dominant position of the enterprise in the production of the selected product (car seats head restraints frame) and the implementation of the project.

The MCDA problem can be solved by means of analytic hierarchy process (AHP). The AHP method points out to an effective decision under difficult situations. It is the method of analysis of difficult unstructured situation which separates the hierarchical problem into several different groups (also called levels, clusters, stratums) with easy elements so called hierarchy structure. Hierarchy is a particular type of system, which is based on the assumption that the entities, which we have identified, can be grouped into disjoint sets, with the entities of one group influencing the entities of only one other group and being influenced by the entities of only one other group [24, pages 19-28]. The AHP [25], [26] is possible applied to the easiest type of hierarchy structure of decision making. We wish to find their weights of influence: the vector

$$\mathbf{w} = [w_1, w_2, \ldots, w_m] \qquad (2)$$

and the matrix

$$\mathbf{V} = [v_{11}, v_{12}, \ldots, v_{1n};$$
$$v_{21}, v_{22}, \ldots, v_{2n}; \qquad (3)$$
$$\ldots;$$
$$v_{m1}, v_{m2}, \ldots, w_{mn}]$$

on some A and C. Basic problems of the method are [24]–[28] subjective evaluation of the pair wise comparison of the criteria and determine the judgment, it means evaluation E alternatives.

Subjective evaluation of the pair wise comparison of the criteria, which assigns to individual components a numerical value. It expresses relative importance individual criteria by weights w_j and v_{ij}, where $i = 1,2, \ldots, n$ and $j = 1, 2, \ldots, m$. Determine the judgment of the selection of alternative a_i with the highest priority on the basis of the multiplication i-row of the matrix $\mathbf{V}$ and the transposed vector $\mathbf{w}$. It means

$$E = [v_{1i}, v_{2i}, \ldots, v_{mi}] \cdot [w_1, w_2, \ldots, w_m]^{\mathrm{T}}. \qquad (4)$$

III. PROBLEM SOLUTION

The MCDA issues can be dealt with by means of using decision making method for/under certainty, risk or uncertainty [29, page 60].

A. Model of Analytic Hierarchy Process

The general structure of the formulated problem is worked out into a project's impact on the micro region model (Fig. 2) [30]. For the solving of the MCDA issue in the model the method AHP has been used. Real data matrixes have been obtained from the Czech Statistical Office, Polička Municipal Office and from the enterprise itself.
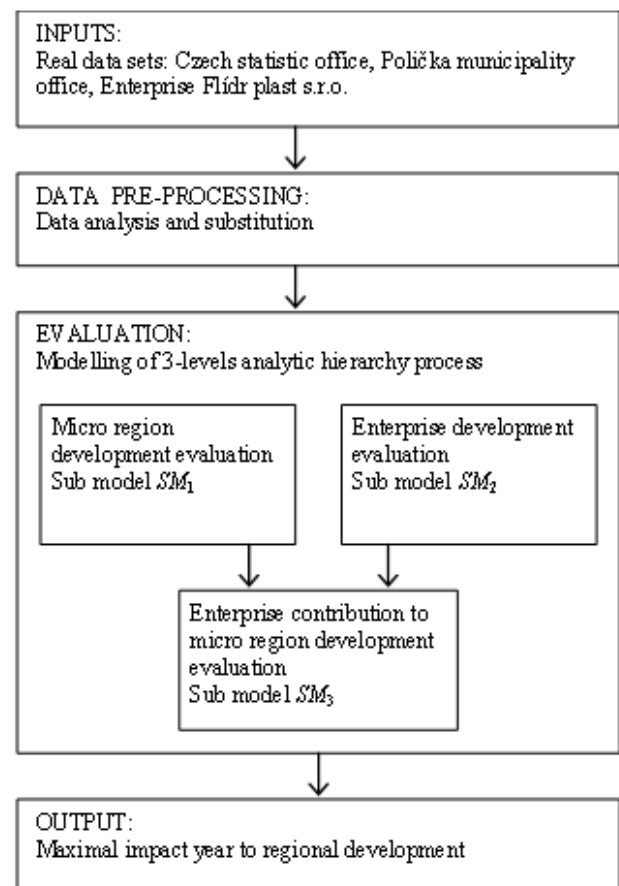

Fig. 2 Project's impact on the micro region model

When pre-processing input data the redundant criteria have been eliminated and the linguistic criteria have been transformed into numeric values. Redundant criteria are in this case such criteria that in all alternatives return very similar or totally identical values. It is the criteria Ecological stability coefficient and the criteria Position in the market for SM_1 – other, Exports to country Switzerland, Exports to country Belgium, Exports to country Hungary in the framework of sub model SM_2.

The criterion Households housing burden has been substituted by values "acceptable" and "increased" for SM_1.

The value "acceptable" is in the decision making process a desirable phenomenon and it has the value 1. Value 0 is assigned to the value "increased" which expresses an undesirable phenomenon. Adjusted data for sub model SM_1 are stated in Table 4.

Substitution concerns the criteria Position in the car, in the electronics and in the machine building markets for SM_2. The values "increased" and "majority" get the value 1 and the "minority" gets the value 0. For the criteria Exports to Great Britain and to Germany is the value "yes" substituted to the value 1 and "no" to the value 0. The adjusted data for the sub model SM_2 are stated in Table 5.

Table 4 Adjusted data of sub model SM_1

Criteria	Alternatives (years)		
	2007	2008	2009
GDP per inhabitant *, **	286.630	294.153	286.518
Number of economic subjects	3687	3751	3545
Average gross monthly wage **	18.11	19.39	19.54
Monthly households housing costs **	2.340	2.603	3.810
Households housing burden	1	1	0
Unemployment rate	5.380	4.420	7.150
Number of inhabitants	19445	19407	19528
Number of inhabitants in productive age	13554	13522	13546
Number of students elementary schools	1633	1371	1330
Number of students secondary school	714	609	571
Land area	27264.1	27264.2	27265.6
Waste production [tons]	62776.9	31002.7	32954.8
Share of hazardous Waste [%]	5.390	2.980	3.350
Share of other waste [%]	94.610	97.020	96.650
Costs of waste replacement **	33481	16534	17575

where * the data are stated in Ths. CZK per an inhabitant of the Pardubice region, this data is not observed for the micro region level; and ** means [Ths. CZK]

With the sub model SM_3 there have been the values "acceptable", "yes" and "increased" for the criteria Households housing burden, Position on the car market and the Export importance of the micro region substituted to value 1 and the values "increased", "no" and "constant" to value 0. Adjusted data for sub model SM_3 are stated in Table 6.

For the sub models SM_1 and SM_2 are the alternatives the years of development 2007, 2008 and 2009. Alternatives for the sub model SM_3 are only those years that represent the choice of the best alternative from SM_1 and SM_2.

Based on Saaty matrix $\mathbf{S}_{SM1}(15\times15)$ for the sub model SM_1 is defined standardized weight vector of criteria $\mathbf{w}_{SM1}$ in the following way

$\mathbf{w}_{SM1}$ = [0.1866, 0.1273, 0.0867, 0.0568, 0.0568, 0.1273, 0.1866, 0.0363, 0.0110, 0.0110, 0.0363,   (5)

0.0231, 0.0155, 0.0155, 0.0231],

where maximal eigenvalue λ_{max} is 15.6297, consistency index CI is 0.0450 and consistency ratio CR [34] is 0.0283 for $\mathbf{S}_{SM1}$.

Table 5 Adjusted data of sub model SM_2

Criteria	Alternatives (years)		
	2007	2008	2009
Revenues *	55983	50801	36737
Average number of employees	38.460	38.260	35.450
Average gross monthly wage *	46.270	48.520	40.180
Number of major clients	10	10	12
Position in the car market	0	0	1
Position in the electro technology market	0	0	1
Position in the machine building market	0	0	1
Exports to country Great Britain	1	1	0
Exports to country Germany	0	0	1
Waste production [tons]	46.130	48.070	39.790
Share of hazardous waste [%]	4.890	5.490	7.060
Share of other waste [%]	95.110	94.510	92.930
Costs of waste replacement *	16	35	21

where * means [Ths. CZK]

Table 6 Adjusted data of sub model SM_3

Criteria	Alternatives (years)		
	2007	2008	2009
GDP per inhabitant *, **	286.63	294.15	286.52
Difference in gross monthly wages **	28.160	29.130	20.640
Share of employees in the number of productive population [%]	0.284	0.283	0.262
Monthly households housing costs **	2.340	2.603	3.810
Households housing burden	1	1	0
Unemployment rate	5.380	4.420	7.150
Position in car market	0	0	1
Micro-region export importance (compared to previous years)	0	0	1
Number of inhabitants in productive age	13554	13522	13546
Share in waste production [tons]	0.073	0.155	0.121
Share of costs of waste replacement [%]	0.048	0.212	0.120

where * the data are stated in Ths. CZK per an inhabitant of the Pardubice region, this data is not observed for the micro region level; and ** means [Ths. CZK]

Based on Saaty matrix $\mathbf{S}_{SM2}(13\times13)$ for the sub model SM_2 is defined standardized weight vector of criteria $\mathbf{w}_{SM2}$ in the

following way

$\mathbf{w}_{SM2}$ = [0.2502, 0.1102, 0.1102, 0.1693, 0.0665,
0.0665, 0.0665, 0.0394, 0.0394, 0.0247, 0.0162,   (6)
0.0162, 0.0247],

where λ_{max} is 13.2927, *CI* is 0.0244 and *CR* is 0.0156 for $\mathbf{S}_{SM2}$.

Based on Saaty matrix $\mathbf{S}_{SM3}$(11×11) for the sub model SM_3 is defined standardized weight vector of criteria $\mathbf{w}_{SM3}$ in the following way

$\mathbf{w}_{SM3}$ = [0.2610, 0.0610, 0.1049, 0.0610,
0.0610, 0.1666, 0.0359, 0.0359, 0.1666,   (7)
0.0230, 0.0230],

where λ_{max} is 11.1534, *CI* is 0.0153 and *CR* is 0.01 for $\mathbf{S}_{SM3}$.

Saaty matrixes for the calculation of evaluation of all alternatives for individual criteria have been designed in a similar way. There are matrixes $\mathbf{V}_{SM1}$(15×3), $\mathbf{V}_{SM2}$(13×3) and $\mathbf{V}_{SM3}$(11×2) for individual sub models SM_1, SM_2 and SM_3. The resulting evaluation of alternatives is stated in Table 7.

Table 7 Total evaluation of alternatives

Evaluation of alternatives for sub models	Alternatives (years)		
	2007	2008	2009
E_{SM1}	0.2658	0.3933	0.3409
E_{SM2}	0.3421	0.2884	0.3694
E_{SM3}	cut out	0.5827	0.4173

With sub model SM_3 only two alternatives are used. These are specified as the selected best alternatives from the sub models SM_1 and SM_2. For the SM_1 the best alternative is year 2008, for the SM_2 year 2009 and for the SM_3 it is the year 2008. Calculated CR values for the constructed Saaty matrixes demonstrate their suitable construction. Based on the results of the model we may state that the project had the biggest benefits for the micro-region in year 2008.

The three-level structure of AHP algorithms for the individual sub models has been executed in MATLAB, ver. 7.1, Service Pack 3.

B. Model of Deterministic Decision Tree

When applying the above mentioned method (AHP) we based our assumption on the expectation that the project is co-financed from EU funds. If the management of the enterprise (Flídr plast s.r.o.) must implement the goals of the project EPE3 without the EU program funds then it is possible to utilize the method for decision making under risk, it means decision tree analysis [23, page 741], [24, page 205], [32].

Deterministic decision tree, composed of decision and chance (event) nodes, branches and probability estimation, has been applied for the solution of this problem. Branches that come out from these nodes represent the individual alternatives of the given decision making problem.

We assume that the problem is solved for years 2007, 2008 and 2009. Decision making alternatives are extended also for the first and the second half of the given year (that is 6 alternatives). The goal is to always create 8 job positions.

In the decision node, the equation of number of micro region's inhabitants registered at the unemployment office/job center is used like conditioned expected value in the following way

$E(X \mid A_j) = \sum_i x(S_i, A_j) \, P(S_i),$ (8)

where X is the selected criteria under risk situation S_i; A_j is j-th decision alternative; $x(S_i, A_j)$ is the value of X and A_j for each j = 1, 2, …, 6; $P(S_i)$ is the probability of the risk situation S_i.

We consider to be the optimal alternative the alternative whose conditioned expected value is the highest. For this problem it means that the number of registered unemployed inhabitants is minimal.

For the chance nodes – we have consulted and defined with the Unemployment Office in Svitavy the number of unemployed inhabitants registered at the Office $x(S_i, A_j)$ for the individual alternatives (Table 8). Based on expert evaluations the enterprise Flídr plast s.r.o. defined the probabilities for the project implementation in the second half of the year for the given years $P(S_i)$ (Table 9). Situation knots are defined for the implementation options "YES" and "NO".

Table 8 Number of unemployed inhabitants registered at the employment office Svitavy

Year	Half year	No. of Unemployed
2007	First	608
	Second	553
2008	First	447
	Second	441
2009	First	668
	Second	719

Table 9 Probability of implementing the project in the second half of the year

Year	Probability
2007	0.6
2008	0.8
2009	0.3

When using the decision tree as the best alternative was selected the second half of the year 2008 alternative when the number of registered unemployed was assumed to be 434.

IV. CONCLUSION

The objective of this case study was the analysis of the benefits of the project EPE3 funded from EU funds for the micro region Poličsko, CZ. The micro region Poličsko is a peripheral area of the Pardubice region, it is a part of the Svitavy district. The Svitavy district was declared by the CR government to be an Economically weak region in the time period 2007 – 2013 (Economically weak regions are characterized by low economy performance accompanied by low wages/salaries, low economic activity, high

unemployment rate, unfavorable geographic position and by underdeveloped technical infrastructure [33]). The state aid to support business activities and innovation for SMEs and aid to support employment is in accord also with the Poličsko micro region strategic development plan [18].

Impacts were analyzed by means of selected indicators. Among these indicators, the most important indicator is the impact on the level of unemployment in the micro region.

Direct creation of eight job positions, from the point of view of the micro-region rate of unemployment reduction, is not very significant. However it is important for the inhabitants of the municipality Široký Důl, in which the enterprise Flídr plast, s.r.o has its seat. In the observed years the number of inhabitants in the municipality was 372, 383 and 386 [34] and the rate of unemployment in the municipality was in year 2007 – 3.2 %, in year 2008 – 4.5 % and in year 2009 – 8.9 % [19]. Creation of 8 new job positions may represent a significant reduction of unemployment for the municipality of this size (if we assume that based on the data showed in Chart 2 there is 68.4 % inhabitants in the productive age, that is 254, 262 and 264 inhabitants respectively). Under certain simplified assumptions (e.g. all 8 new job opportunities are filled by the municipality inhabitants), the level of unemployment in the municipality would decline to nearly zero in year 2007, to 1.4 % in year 2008 and to 5.9 % in year 2009. When eliminating the extraordinary impact of the economic crisis in year 2009 it can be assumed that implementation of more such similar projects in the region would have more important impact on the reduction of the number of unemployed. From the long-term perspective it contributes to the stabilization of employment opportunities for the micro region inhabitants. Other benefits represent in particular the indirect impacts of the implemented project – increase of purchasing power for the enterprise employee who live in the micro region, increase in highly qualified industrial production and export opportunities which leads to increasing potential of region [35] and to the increase in the total GDP of the Pardubice region and thus also of the micro region.

Other important benefits are also the environmental criteria related to the reduction of waste production and to the reduction of environmental burdens.

The analysis has shown that the most important benefits of the project were realized in year 2008.

In case of the decision tree implementation of the project the second half of year 2008 was selected as the optimal alternative. Based on the defined probability the number of registered unemployed inhabitants in the micro region Poličsko declines to 434.

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