PROMOTING OF THE GEOSPATIAL SKILLS: FIRST RESULTS OF THE GEOSKILLS PLUS PROJECT OF THE LEONARDO DA VINCI PROGRAMME

P. Dijkstra[1], J. Pirlot[2], D. Velichkov[3], E. Parseliunas[4], M. Wijngaarde[5], K. Donert[6], D. Frigne[7],
H. Westerbeek[8], K. Levoleger[1], D. Popovas[4], R. Obuchovski[4], D. Slikas[4], A. Buga[4]

[1] Dutch Cadastre, Land Registry and Mapping Agency (NETHERLANDS); [2] Belgian Order of Surveyors (BELGIUM); [3] Geodesy, Cartography and Cadastre Agency (BULGARIA); [4] Vilnius Gediminas Technical University (LITHUANIA);
[5] Council of European Geodetic Surveyors (BELGIUM); [6] European Association of Geographers (BELGIUM); [7] Flemish Association for Geographic Information (BELGIUM); [8] GEO Employment Market (NETHERLANDS)

paula.dijkstra@kadaster.nl, jean-yves.pirlot@landmeter-expert.org, velichkov.d@cadastre.bg, eimis@vgtu.lt, mrwijngaarde@cs.com, kdonert@yahoo.com, dirk.frigne@geosparc.com,
hendrik.westerbeek@kadaster.nl, karen.levoleger@kadaster.nl, darius.popovas@vgtu.lt, romuald.obuchovski@vgtu.lt, dominykas.slikas@vgtu.lt, arunas.buga@vgtu.lt

@GeoSkills_Plus   Geo Skills +

ABSTRACT

"Exchange of best practices for transfer of innovation of GEO VET education to meet changing labour market needs in Europe following EU GEO policies" (GeoSkills Plus) is a European Commission funded project under DG Education and Culture, Leonardo da Vinci programme (Project No 2013-1-NL1-LEO05-12278). It began in October 2013 and will run until October 2015. Initiated by the Dutch Cadastre, Land Registry and Mapping Agency and the Geo Employment Market Foundation (SAGEO), the GeoSkills Plus Project is an ambitious project aiming to match labour market needs with geo education offer in Europe.

The aim of this two-year project is to enable European countries to exchange best practices and innovation with each other regarding the gap between Europe's geospatial vocational education and training and the geospatial labour market. There is a growing need for well-trained students at all levels – vocational, bachelors, masters – in the field of geospatial technologies. This is because there a growing number of jobs available in land surveying, mapping data collection, data processing, data delivery and turning data into information.

In order to analyse the gap and to find out the reasons and factors, which have an influence on gap occurrence, and creates the mismatch between European geospatial education community and geospatial labour market, the hierarchy of the gap structure was developed. Suggested structure was adopted for questionnaire of respondents by method of pairwise comparison and processing of obtained judgements by multi-criteria method – Analytic Hierarchy Process (AHP).

The test AHP computations were made and expected digital values of gap factors importance was determined for some European countries (Belgium, Bulgaria, Lithuania, the Netherlands). Based on these results the optimal ways to Raise Awareness of geospatial studies and increase student enrolment were set up. GeoSkills Plus also identified the gaps between the supply of geospatial jobs and the demand for qualified graduates in different European countries, and set up ways to bridge the gap. Ultimately a Cooperation Model is created that identifies all stakeholders and offers them the steps necessary to improve Europe's position in the global geospatial market.

Keywords: geospatial education, vocational training, best practice, AHP method.

1. INTRODUCTION

We will analyse the gap as the difference between labour market demand imposed by industry and the supply enabled by education and training. The gap could be defined as a combination of some mismatches:

- Imbalance of the number of students and demand of the labour market,
- Discrepancy between expectations of job market (employers) and student's professional abilities (qualification, knowledge, practical skills etc.), (lack of motivation for life learning)
- Variance between the fast technological development and delayed improvement of study curriculums,
- Dissonance between narrow geo-specialized study programmes and multi-disciplinary needs of market
- Inadequacy between locally educated students and internationally widening market (internationalization of the geo-market).

The gap between GEO (VET) students and employers is a complex phenomenon, therefore plenty of theories about how it occurs have been created [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11]. Though they all have elements to offer, therefore until now there is no single acceptable approach to deal with labour markets gaps. We understand the GEO (students, market) as fields of science and economy, which deal with geodesy, cartography, geophysics, geographic information systems (GIS) and other geo- and geospatial-related subjects – Earth sciences.

We propose to employ the multi-criteria methods to enable conceptual studies of gap factors. One of the suggested multi-criteria methods is the Analytic Hierarchy Process developed by T. L. Saaty [15], [16], [17], [18], [19], [20], [21], [22]. First of all the hierarchy of the gap structure was developed in order to analyse the gap and to find out the reasons and factors, which have an influence on gap occurrence and creates the mismatch between European geospatial education community and geospatial labour market [23]. By using the Analytic Hierarchy Process (AHP) this hierarchy was used to identify most important factors of gap occurrence. It aims at quantifying relative priorities for a given set of factors on a ratio scale, based on the judgment of the decision-maker, and stresses the importance of the intuitive judgments of a decision-maker as well as the consistency of the comparison of alternatives in the decision-making process.

Goal of this publication is to analyse some results of the research on factors influencing the gap occurrence between Europe's geospatial vocational education and training and the geospatial labour market and to suggest the measures for it decreasing.

2. ANALYSIS OF FACTORS INFLUENCING THE GAP OCCURRENCE

The factors of the gap occurrence were divided into three main components: factors dependent from GEO market, external factors and factors dependent from education system. Later these three components were split into 4 levels. All factors interacting are creating impact on gap occurrence and existence. After comprehensive theoretic research and summarized collected information [4], [5], [6], [7], [8], [9], [10], [26], the gap factors hierarchy was suggested [23]. On the basis of the hierarchy the special kind of questionnaire was developed [23]. Fragment of the questionnaire containing evaluations is presented in Fig. 1.

The AHP computations were made and the digital values of gap factors importance were determined for some European countries. The preliminary analysis of gap estimation in European countries was presented in [23]. It could be seen that majority of the analysed countries faces the lack of the geo educated specialists. Some countries like Lithuania or Switzerland have misbalance between highly skilled and technical staff. i.e. there are more than enough technical workers, but there is demand for skilled geo specialists. There are several countries experiencing overproduction of geo students. Only few countries reported that gap is non-existent.

The challenge was to reach agreement among the participating experts on value judgments of the factors importance. Finally, the weights developed at each level of the hierarchy were aggregated into an overall ranking for an alternative, and the alternative with the highest score was considered dominate. In identifying the value creation content of gaps in research countries, the following results were obtained: Belgium (Fig. 2–5), Bulgaria (Fig. 6–9), Lithuania (Fig. 10-13) and Netherlands (Fig. 14–17).

The results state that in Belgium the most important factors dependent from GEO market are (Fig. 2): Low salary (0.221), No promotion system for quality of work (0.074) and No promotion for professionalism (0.074), following by such factors as Non-transparent salary system (0.044), Non-adequate working flow (0.044) and No comfortable working/leisure regime (0.044). Other factors are of less importance.

The ranking of scores show that the most important external factors are (Fig. 3): GEO companies do not support GEO students studies (0.194), Universities and high schools have their own interest due to financial reasons (0.194) and Weak or not-existing trade unions (0.084). Other factors are not so important.

It reveals that the most important factors dependent from education system are (Fig. 4): GEO companies do not participate in development of curriculums (0.116), No unification of curriculums in different countries (0.098) and factors dependent from VET system (0.046). Other factors received less weight.

Finally, the Belgium experts ended up that the most important gap factors are (Fig. 5): GEO companies do not support GEO students studies (0.105), Universities and high schools have their own interest due to financial reasons (0.105), Low salary (0.045), Weak or not-existing trade unions (0.045), Countries do not have GEO governance bodies (0.031), GEO companies do not participate in development of curriculums (0.030). Other factors are of less importance.

The results state that in Bulgaria the most important factors dependent from GEO market are (Fig. 6): Low salary (0.345), Non-transparent salary system (0.115) and No promotion for professionalism (0.049), No payments for studies, training courses (0.047), No promotion system for quality of work (0.042) following by such factors as No inputs to pensions, insurance funds (0.034), No additional payments for child or in the case of death of family member (0.031) and Leader is not respecting workers (0.028). Other factors are of less importance.

The ranking of scores show that the most important external factors are (Fig. 7): Universities and high schools have their own interest due to financial reasons (0.194), GEO industry/fields/specialities are not among governmental priorities (0.144), GEO companies do not support GEO students studies (0.102) and Governmental regulation is not effective (0.077). Other factors are not so important.

It reveals that the most important factors dependent from education system are (Fig. 8): IVET does not help to further career development (0.129), IVET does not reduce the unemployment and inequality (0.090), GEO technologies are updated faster than curriculums (0.077), and No relation with the primary education schools (0.077). Other factors received less weights.

Finally, the Bulgarian experts ended up that the most important gap factors are (Fig. 9): Universities and high schools have their own interest due to financial reasons (0.090), GEO industry/fields/specialities are not among governmental priorities (0.084), Low salary (0.060), GEO companies do not support GEO students studies (0.059), Governmental regulation is not effective (0.045), Preparation of GEO specialists is expensive (0.045), IVET does not help to further career development (0.031). Other factors are of less importance.

The results state that in Lithuania the most important factors dependent from GEO market are (Fig. 10): Low salary (0.266), Non-transparent salary system (0.266) and No (sufficient) daily allowance (0.061), No payments for working equipment and its amortization (0.042), No promotion for professionalism (0.038), No promotion system for quality of work (0.035) following by such factors as No prestige of duty (0.032), No means to improve the working safety (0.029), No payments for studies, training courses (0.020). Other factors are of less importance.

The ranking of scores show that the most important external factors are (Fig. 11): Universities and high schools have their own interest due to financial reasons (0.239), Governmental regulation is not effective (0.095), Countries do not have GEO governance bodies of highest level (0.080), Preparation of GEO specialists is expensive (0.075), GEO industry/fields/specialities are not among governmental priorities (0.062), Private/public(governmental) partnership is not effective (0.045). Other factors are not so important.

It reveals that the most important factors dependent from education system are (Fig. 12): GEO technologies are updated faster than curriculums (0.151), GEO companies do not participate in development of curriculums (0.128), Some GEO subjects related to space-born and air-born fields are difficult to teach (0.090), Theoretical knowledge is not so easily applicable in occupational activities (0.069), and Methodological methods are too old (0.051). Other factors received less weight.

Finally, the Lithuanian experts ended up that the most important gap factors are (Fig. 13): Universities and high schools have their own interest due to financial reasons (0.115), Low salary (0.052), Non-transparent salary system (0.052), GEO technologies are updated faster than curriculums (0.048), Governmental regulation is not effective (0.046), GEO companies do not participate in development of curriculums (0.041), Countries do not have the GEO governance bodies of highest level (0.038), Education system oriented towards the number students instead of education quality (0.038). Other factors are of less importance.

The results state that in Lithuania the most important factors dependent from GEO market are (Fig. 14): Low salary (0.266), Non-transparent salary system (0.266), No payments for studies, training courses (0.059), No leader's trust and no transfer of responsibility to workers (0.056) and No creative vacations (0.049), following by such factors as No support to family institution (0.041), No inputs to pensions, insurance funds (0.037) and Working climate with different tensions (0.032), No team work (0.032), No respect and recognition from colleagues (0.032), No trust in colleagues (0.032). Other factors are of less importance.

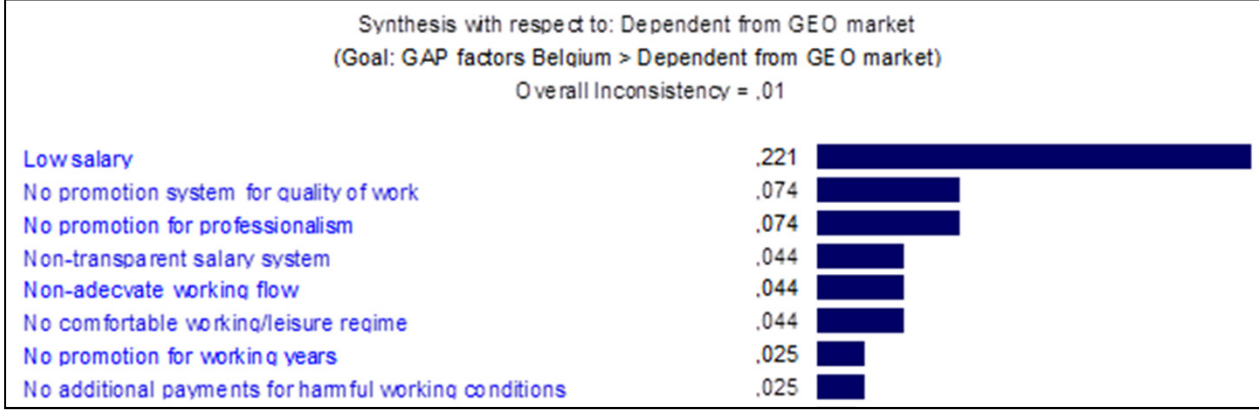Fig. 1. The fragment of questionnaire containing estimations

Fig. 2. The digital values of the most important factors dependent from GEO market (Belgium)
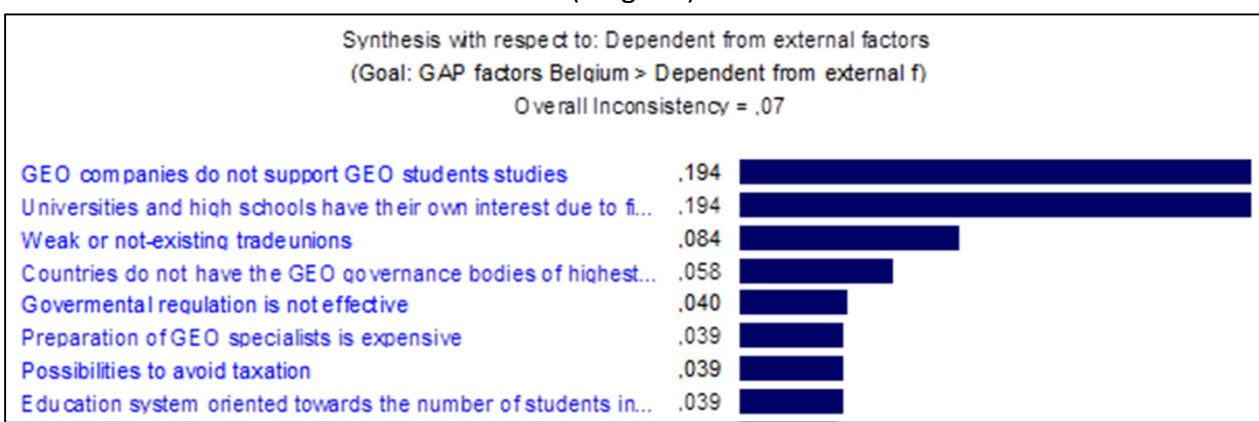

Fig. 3. The digital values of the most important external factors (Belgium)

Fig. 4. The digital values of the important factors dependent from education system (Belgium)

Fig. 5. The digital values of the most important factors (Belgium)
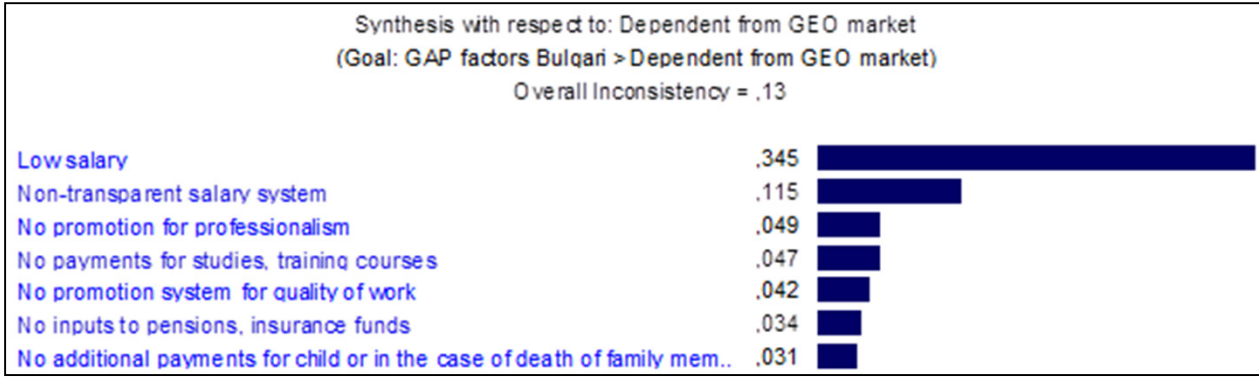

Fig. 6. The digital values of the most important factors dependent from GEO market (Bulgaria)
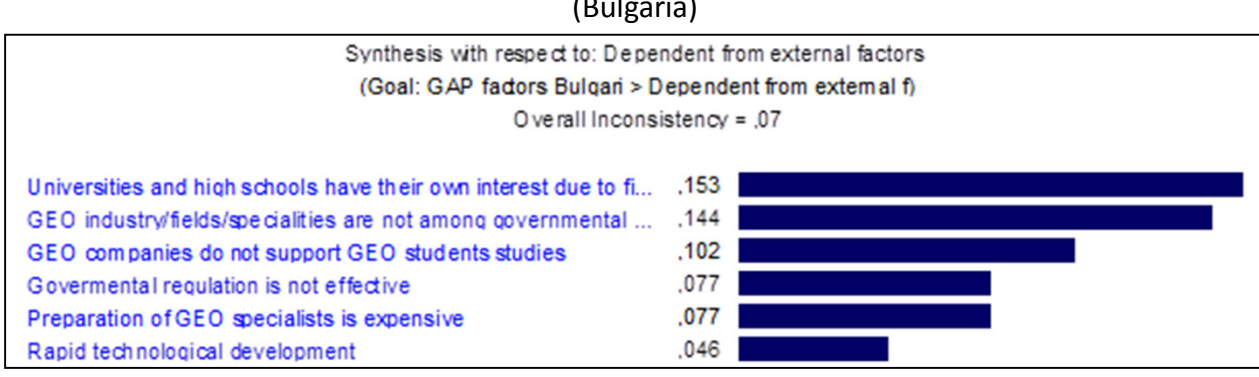

Fig. 7. The digital values of the most important external factors (Bulgaria)
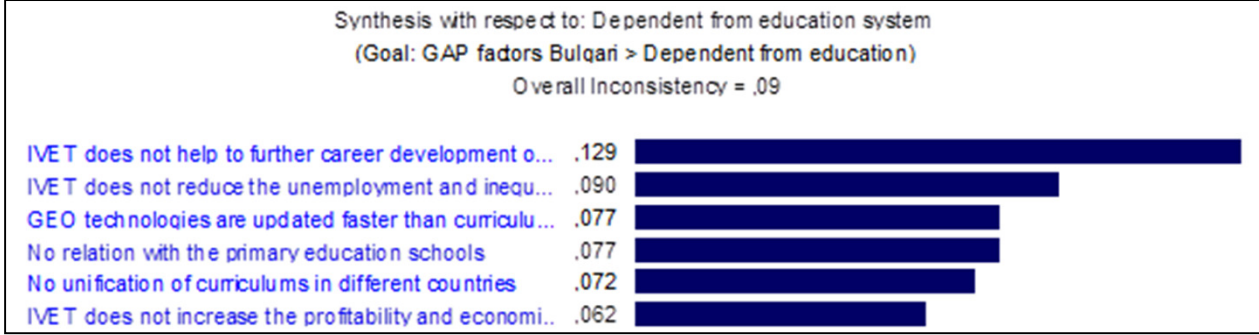

Fig. 8. The digital values of the important factors dependent from education system (Bulgaria)
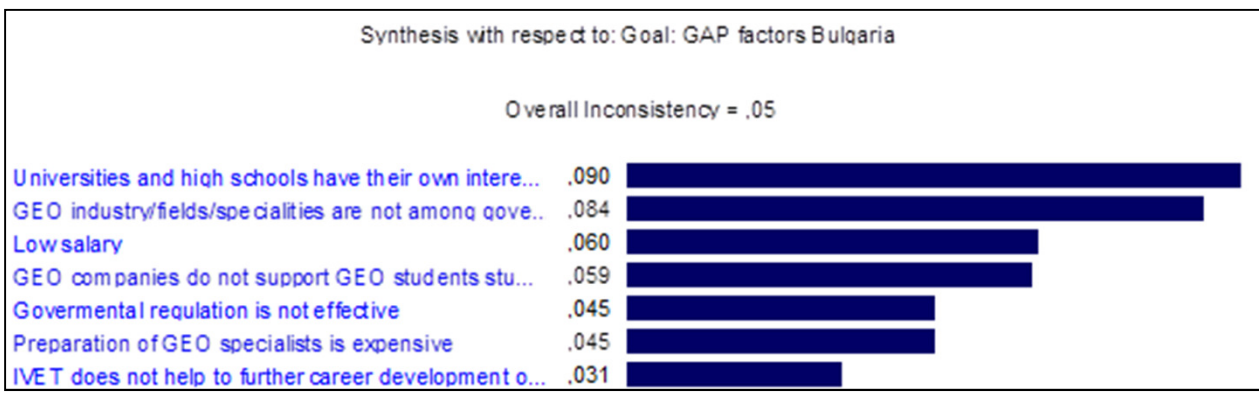

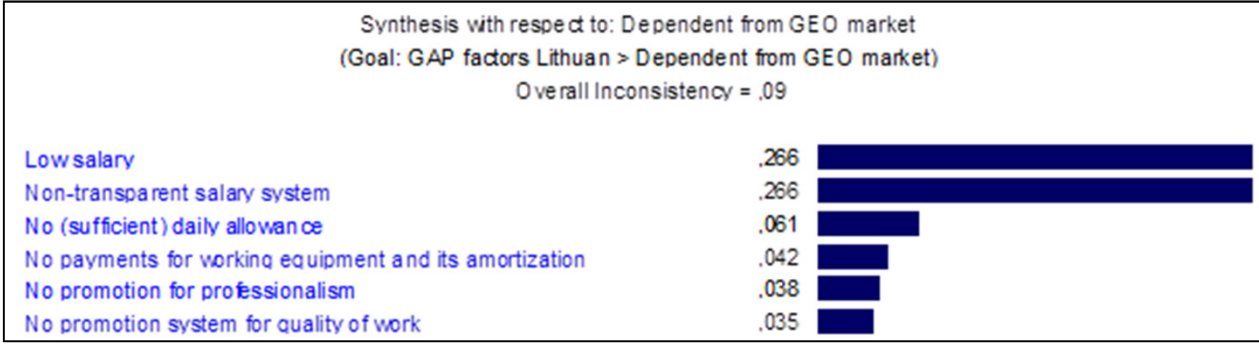Fig. 9. The digital values of the most important factors (Bulgaria)

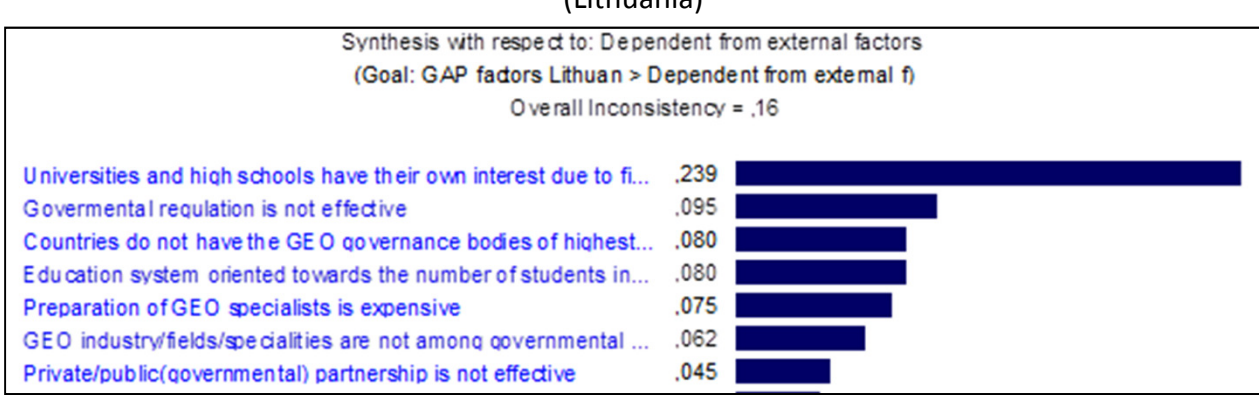Fig. 10. The digital values of the most important factors dependent from GEO market (Lithuania)

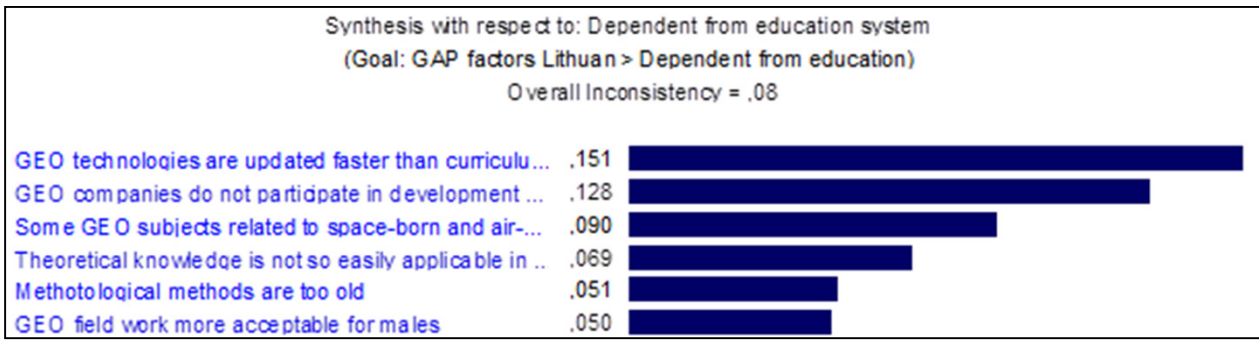Fig. 11. The digital values of the most important external factors (Lithuania)

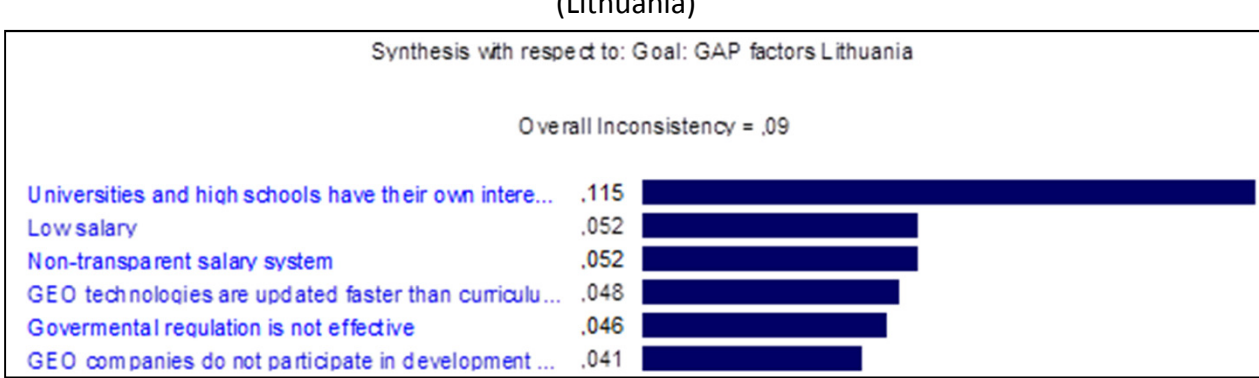Fig. 12. The digital values of the important factors dependent from education system (Lithuania)

Fig. 13. The digital values of the most important factors (Lithuania)
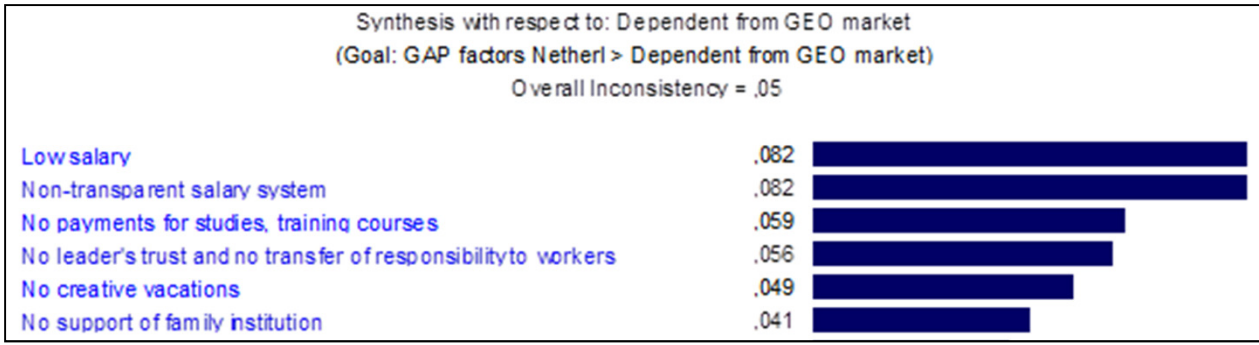

Fig. 14. The digital values of the most important factors dependent from GEO market (Netherlands)

The ranking of scores show that the most important external factors are (Fig. 15): Global/Regional GEO needs international cooperation (0.116), Importance of international professional bodies is not significant (0.116), Private/public(governmental) partnership is not effective (0.078), Importance of local professional bodies is not significant (0.078) and There are no Global/Regional scientific programmes on GEO fields (0.039), Militaries do GEO separately from civilians (0.039). Other factors are not so important.

It reveals that the most important factors dependent from education system are (Fig. 16): GEO companies do not participate in development of curriculums (0.132), No unification of curriculums in different countries (0.132), Life long learning system is not popular (0.073) and factors dependent from CVET system (0.073). Other factors received less weight.

Finally, the Netherlands' experts ended up that the most important gap factors are (Fig. 17): Global/Regional GEO needs international cooperation (0.060), Importance of international professional bodies is not significant (0.060), Private/public(governmental) partnership is not effective (0.040), Importance of local professional bodies is not significant (0.040), GEO companies do not support GEO students studies (0.034), No unification of curriculums in different countries (0.034). Other factors are of less importance.

3. ANALYSIS OF MEASURES TO BRIDGE THE GAP

By summing-up we could state that under the Dependent from GEO market not surprisingly the factors Low salary, Non-transparent salary system, No payments for studies, training courses and No promotion for professionalism received the highest priorities. Under the Dependent from external factors the experts of all countries agree that most important factors are Universities and high schools have their own interest due to financial reasons and GEO companies do not support GEO students studies and Governmental regulation is not effective. It was found that under Dependent from education system such factors as GEO companies do not participate in development of curriculums, No unification of curriculums in different countries and factors, related to VET system are extremely important.

The synthesis with respect to ranking of all factors showed that the factors Universities and high schools have their own interest due to financial reasons, Low salary and GEO companies do not support GEO students studies received the highest priorities.

Based on these results the optimal ways to Raise Awareness of geospatial studies and increase student enrolment were set up. Geo Skills Plus also identified the gaps between the supply of geospatial jobs and the demand for qualified graduates in different European countries, and set up ways to bridge the gap. Ultimately a Cooperation Model is created that identifies all stakeholders and offers them the steps necessary to improve Europe's position in the global geospatial market.

In general the Implementation plan consists of 6 steps:
- To create a hierarchy of gap factors and questionnaire, which applying AHP method will statistically reliably determine the main factors of the gap occurrence in investigating country.
- Depending on the results, the responsible chain in the cooperation model should be identified.
- To develop a manifesto according to the results achieved in steps 1 and 2.
- To trigger the suitable best practices and other measures to reduce the gap between GEO market and GEO education.
- To develop the measuring system to evaluate the success of the implementation plan (applied measures).
- To execute the impact analysis of implementation plan progress for short and long term.

An example of the indicators system of the implementation plan progress for long term (about 3-5 years) is presented in Table 1.

Table 1. An example of the indicators of implementation plan progress for long term

Implementation Indicators	How executer will implement the plan	Lead Staff	Monitoring Tool(s)	Achievement Measures
If gap depends on education system factors				
To adopt the best practices of GEO VET education	Analyse the structures of education systems of most advance countries	Heads of Departments	Suggested innovation in education system	Number of implemented innovations
To improve curriculums of GEO disciplines	Analyse the curriculums of best universities	Heads of Departments	Improved curriculum	Number of improved curriculums
If gap depends on external factors				
Regulate number of GEO branch students by possibilities of profession guides	Preparation of the profession guiding means list	GEO branch experts and teachers	Means for implementation	Number of means
Disseminate GEO branch	Organize public relation activities	GEO branch scientists	Event	Number of events
If gap depends on GEO market factors				
To adopt the best practices of GEO market structuring	Analyse the GEO markets of most advance countries	GEO Expert	Suggested innovation in GEO market structure	Number of implemented innovations
Suggest actions for transparent salary implementation	1. Analysis of payments to employees	Expert of economy	Report	Number of interviewed employees
	2. Organise seminar on consequences due to payment of non-transparent salaries	Expert of personnel	Seminar	Number of seminars

4. CONCLUSIONS

1. In order to analyse the gap and to find out the reasons and factors, which have an influence on gap occurrence, and creates the mismatch between European geospatial education community and geospatial labour market, the hierarchy of the gap structure was developed. Suggested structure was adopted for questionnaire of experts by method of pairwise comparison and processing of obtained judgements by multi-criteria method – Analytic Hierarchy Process (AHP)

2. The AHP computations were made and expected digital values of gap factors importance were determined for some European countries (Belgium, Bulgaria, Lithuania, the Netherlands). It was detected that the factors Universities and high schools have their own interest due to financial reasons, Low salary and GEO companies do not support GEO students studies received the highest priorities.

3. Based on research results the optimal ways to Raise Awareness of geospatial studies and increase student enrolment were set up and example of the implementation plan was suggested.

5. ACKNOWLEDGMENTS

REFERENCES

[1] Pascarella, Ernest T., Terenzini, Patrick T. (2005). How college affects students: a third decade of research, 2nd ed. Jossey-Bass, 848 p.

[2] Wan Salmuni Wan Mustaffa; Hariri Kamis. (2007). Prioritizing Academic Staff Performance Criteria in Higher Education Institutions to Global Standards. Proceedings of the 13th Asia Pacific Management Conference, Melbourne, Australia, 1281–1288.

[3] Geister, S., Konradt, U., Hertel, G. (2006). Effects of Process Feedback on Motivation, Satisfaction, and Performance in Virtual Teams. Small Group Research, Volume 37 Number 5 October 2006, p.p. 459–489

[4] Olivetti, C., Petrongolo, B. Unequal pay or unequal employment? A cross-country analysis of gender gaps. Draft, 34 p.

[5] Li, Y., Devine, F., Heath, A. (2008). Equality group inequalities in education, employment and earnings: A research review and analysis of trends over time. 159 p.

[6] The Knowledge Economy Workforce and Higher Education in Western New York: A Match Gap Analysis. University at Buffalo Regional Institute, 2008, 37 p.

[7] Barton, Paul E., Coley, Richard J. (2010). The Black-White Achievement Gap. 42 p.

[8] Report on the Gender Initiative: Gender Equality in Education, Employment and Entrepreneurship. OECD, 2011, 78 p.

[9] An Analysis of Reasons for the Disparity in Wages Between Men and Women. A Report by CONSAD Research Corp, U.S. Department of Labour Employment Standards Administration, 2009, 95 p.

[10] Gap Analysis Report for the League of Vocational Education and Training Association. Palestine (VET-NGO League), April 2011, 102 p.

[11] Soutar, G., McNeil, M. Measuring service quality in a tertiary institution. Journal of Educational Administration 34, 1, p.p. 72–82

[12] Zavadskas, E.K.; Kaplinski, O.; Kaklauskas, A.; Brzezinski, J. (1995). Expert systems in construction industry. Vilnius: Technika. 180 p.

[13] Vaidya, O. S.; Kumar, S. (2006). Analytic Hierarchy process: An overview of applications. European journal of Operational Research, 169(1): 1–29.

[14] Forman, E. H.; Selly, M.A. (2001). Decision by Objectives. World Scientific. 402 p.

[15] Saaty, T.L.; Forman, E. H (1992) The Hierarchon: A Dictionary of Hierarchies. Vol V, AHP Series, RWS Publications, 496 p.

[16] Saaty, T.L. (1992). Multicriteria Decision Making - The Analytical Hierarchy Process. RWS Publications, Pittsburg, Pa.

[17] Saaty, T.L. (1990). Ratio Scales Derived From Perturbations Of Consistent Judgments. Behaviometrika, 18, p.p. 1–21.

[18] Saaty, T.L. (1991). Some Mathematical Concepts Of The Analytic Hierarchy Process. Behaviometrika, 29, p.p. 1–9.

[19] Saaty, T.L.; Vargas, L.G. (2001). Models, Methods, Concepts & Applications of the Analytic Hierarchy Process. Springer. 333 p.

[20] Saaty, T.L. (2006). Rank from comparisons and from ratings in the analytic hierarchy/network processes. European Journal of Operational Research, 168(2), p.p. 557–570.

[21] Saaty, T.L. (2008a). Decision making with the analytic hierarchy process. Int. J. Services Sciences, 1(1), p.p. 83–98.

[22] Saaty, T.L. (2008b). Making decisions in hierarchic and network systems. Int. J. Applied Decision Sciences, 1(1), p.p. 24–79.

[23] Dijkstra, P.; Pirlot, J.Y.; Penkov, V.; Paršeliūnas, E.; Wijngaarde, M.; Donert, K.; Frigne, D.; Westerbeek, H.; Levoleger, K.; Popovas, D.; Obuchovski, R.; Slikas, D.; Būga, A. (2014) Promoting of the geospatial skills: introduction into geoskills plus project of the Leonardo da Vinci programme. EDULEARN 14: 6th International conference on education and new learning technologies, Barcelona, Spain, 7-9 July, 2014 : conference proceedings [CD] / International Association of Technology, Education and Development (IATED). Valencia : IATED, 2014. ISSN 2340-1117, ISBN 9788461705573. p.p. 7587–7596.

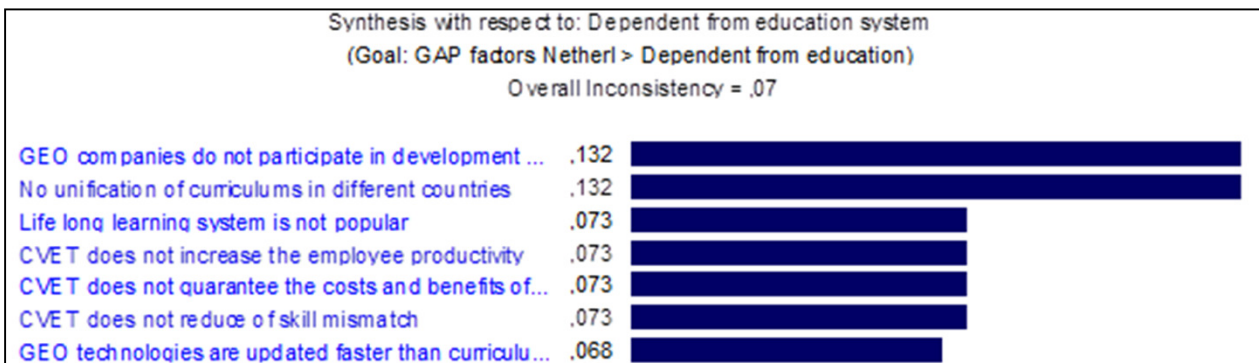Fig. 15. The digital values of the most important external factors (Netherlands)

Fig. 16. The digital values of the important factors dependent from education system (Netherlands)

Fig. 17. The digital values of the most important factors (Netherlands)