Determination of a European Standard for Key Performance Indicators (KPIs) in Vocational Training Models of Construction Industry (KPIsVTMCon PROJECT)

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KPIsVTMCon PROJECT – 4th MEETING, 28th-29th April 2016, Vilnius

Project Aim & Methodology

AIM:

Determination of The KPIs of Vocational Training of Construction Industry

METHODOLOGY:

√ Comprehensive literature survey >>> Determination of KPIs

√ Data Collection: Workshops (Germany, Netherlands, Turkey and Lithuania) >>> Rating of determined KPIs

√ Data Analyzes : Fuzzy AHP (FAHP) model

Outline

- KPIs for vocational education and training (VET) institutions
  - Financial perspective
  - Trainee perspective (Customer)
  - Internal process perspective
  - Learning and growth perspective

- Research Methodology (FAHP)

- Data Collection

- Analyzes

- Related Comments

KPIs for vocational education and training (VET) institutions

Financial perspective	Description
Turnover volume	Total amount of income per year
Cost control	Efforts for decreasing direct cost of products and services
Budget control	Efforts for controlling the budget usage
Productivity	Ratio of inputs (total investment such as salary, overheads, utility) and outputs (total revenue such as trainee fee income)
Investment strategies	Efforts for developing strategies for new courses and projects via industry-academia cooperation
Non-founded income	Ratio of non-founded income and total income
Net income	Turnover volume minus all costs related to the training
Return on investment (ROI)	Operating profit (net income) / operating capital (total capital)
Advertising cost	Costs for advertising and promotion

Financial Perspective - Trainee Perspective - Internal Process Perspective - Learning And Growth Perspective

KPIs for vocational education and training (VET) institutions

Trainee perspective (Customer)	Explanation
Trainee satisfaction	The satisfaction of trainee to training and education
Continuation of trainee	Rates of maintaining or contact relationship with trainee
Trainee relationship	Efforts for developing good relationship with the trainees
Expanding of new trainees	Efforts for increasing number of new trainees
Market share	Ratio of vocational training and education to total market demand
Learning environment	Appropriateness of facilities and equipment for teaching/ learning for construction industry
Range of products and services	Availability of courses about all skills demanded by the construction companies
Flexibility of service system	Adaptability of the courses to the changes and trends in the construction industry
Image and reputation	Reputation of the institute and in the construction market
Trainees' trust	Trainees' confidence in the VET institute
Product quality	Availability of quality management in the institute
Opportunities for further education and training	Capability of the VET to create new opportunities and chances for students in terms of education

Financial Perspective - **Trainee Perspective** - Internal Process Perspective - Learning And Growth Perspective

KPIs for vocational education and training (VET) institutions

Internal process perspective	Explanation
Customized courses	If there are new courses or services that are developed according to the demands of potential trainees and construction companies
Operational business process	If there are periodic reviews of operational business processes for improvement in order to close to the construction market and trainees' demand
After-sales service	Availability of establishing relationship with the graduated trainees and their companies to improve the business process
Standard operating procedures	Availability of ISO certification for handling curriculum, service delivery, and forms
School of characteristics	Availability of facilities and resources for trainees
Setting up the major programs	Availability of core programs of VET institute.
Increasing administration efficiency	Availability of process for reviewing and improving the internal processes
Teaching quality evaluation	Availability of tools for teaching quality evaluation
Experience of teachers and trainers in teaching	Experience level of teachers and trainers in education
Experience of teachers and trainer in practice	Experience level of teachers and trainers in construction industry as a professional
Update frequency of course contents and course program	How frequently the course contents and course programs are updated according to the demand of the construction industry and trainees
Expenditure on staff development	Availability of resources for staff development
Development of multidisciplinary courses	Availability of courses developed by establishing coordination between different disciplines of construction industry
Information system capabilities	Availability of technology capabilities of the VET institution to access.
Encouraging methods	Implement of encouraging or reward systems

KPIs for vocational education and training (VET) institutions

Learning and Growth perspective	Explanation
Economic Growth	Improvement in economic incomes of construction industry
Employees` satisfaction	Satisfaction level of employees with the VET institution in terms of opportunities and training programs
Firm's performance	Improvement in performance of construction company
Employees` retention	Decreasing the rate of employee turnover
Employees' productivity	Rate of employees' resource intensive inputs and outputs.
Earnings	Increase of incomes of the trainees
Increasing quality of labor	Improvement in the quality of labor
Crime reduction	Decrease number of crimes in the society
Social cohesion	Decrease number of cohesion between different social groups
Intergenerational benefits	Decrease the problems between the generations
Inclusion of disadvantaged groups	Encouragement of disadvantaged groups to join the society
Mobility chance of the employees	Increase the chance of the employees of working abroad

Financial Perspective - Trainee Perspective - Internal Process Perspective - **Learning And Growth Perspective**

Fuzzy Analytic Hierarchy Process

AHP >>> *prioritization of considered criteria to choosing the best alternative*

- to convert qualitative judgements into quantitative judgements.

- easy decision making processes and ease of analysis

- hierarchical representation of problem

Fuzzy Analytic Hierarchy Process

Fuzzy Logic >>> the human judgement regarding preferences is often unclear and difficult to estimate with exact numerical values,

thus fuzzy logic is necessary for handling problems characterized by vagueness, ambiguity and imprecision.
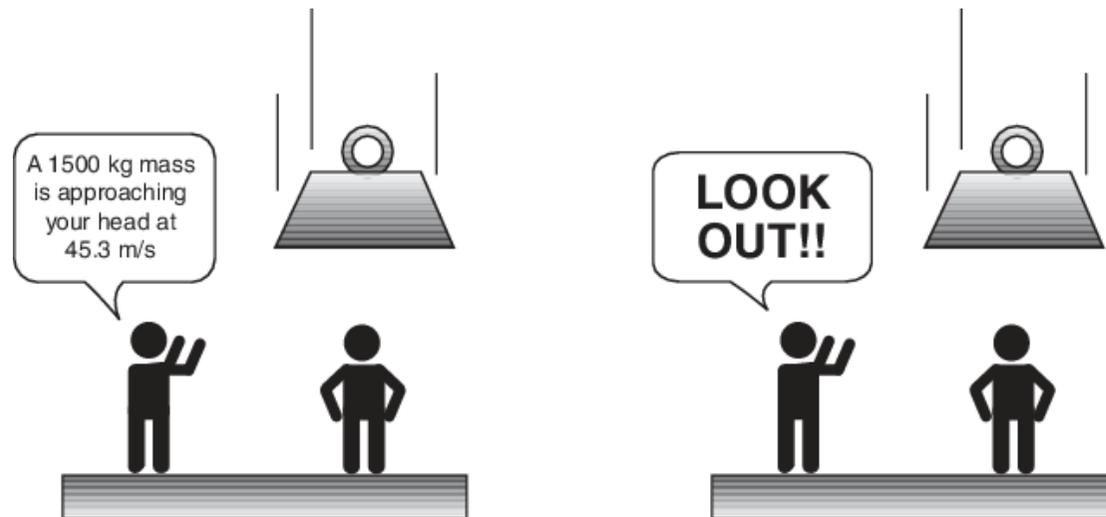
Data Collection

Different workshops were conducted in Germany, Netherlands, Turkey and Lithuania

The experts evaluated obtained KPIs by literature survey and performed brainstorming sessions to eliminate some of these KPIs and add new KPIs.

√Finally, in each workshop, the KPIs criteria were rated in the light of the fuzzy AHP model structure.

√Each expert evaluated the importance of each criterion by comparing this criterion with each criterion based on fuzzy AHP scale.

√The fuzzy AHP analyses were performed for each workshop and each criteria group separately.

√All of the data obtained at the end of the workshops were evaluated by using fuzzy AHP priorities, therefore the most important criteria and least important criteria could be obtained.

√The fuzzy AHP analyses were conducted by using Chang's extent analysis.

Intersection of two triangular fuzzy numbers

- A fuzzy number is denoted as $M_z = (l_z, m_z, u_z)$
"l" = minimum value of perception
"u" = maximum value of perception of decision-maker
belongs to measured problem respectively and
"m" = the nearest value in decision-maker's mind
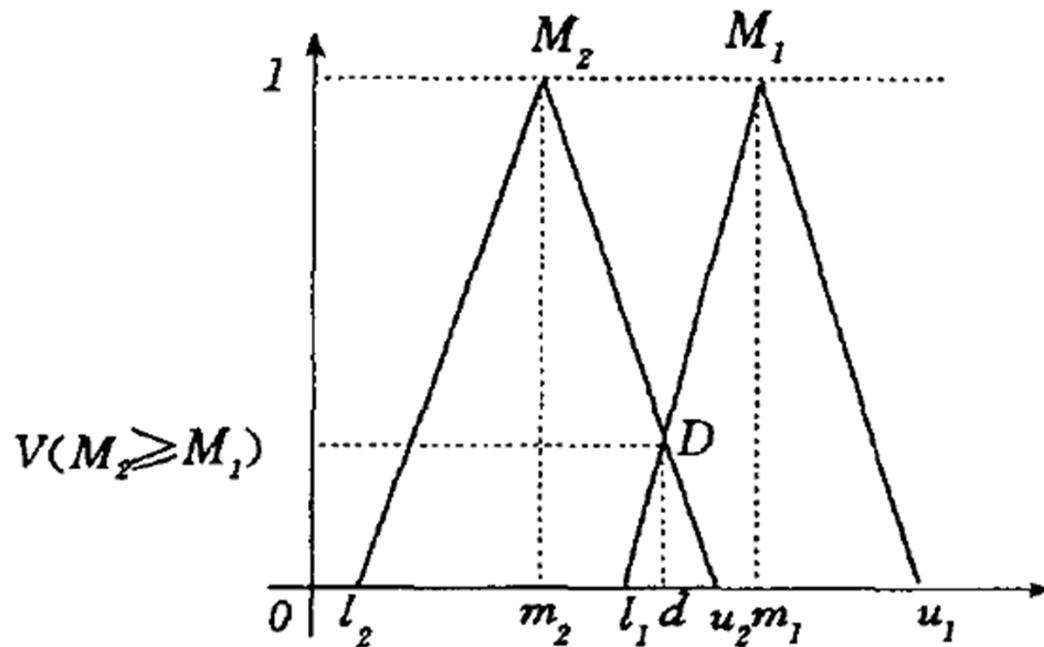
Triangle fuzzy scale

Preferences Expressed In Linguistic Variables	Numeric Variables	Triangle Fuzzy Scale	Triangle Fuzzy Reciprocal Scale
Equally Important/preferred	1	(1, 1, 1)	(1, 1, 1)
Intermediate	2	(1, 2, 3)	(1/3, 1/2, 1)
Weakly Important/preferred	3	(2, 3, 4)	(1/4, 1/3, 1/2)
Intermediate	4	(3, 4, 5)	(1/5, 1/4, 1/3)
Essentially Important/preferred	5	(4, 5, 6)	(1/6, 1/5, 1/4)
Intermediate	6	(5, 6, 7)	(1/7, 1/6, 1/5)
Very Strong Important/preferred	7	(6, 7, 8)	(1/8, 1/7, 1/6)
Intermediate	8	(7, 8, 9)	(1/9, 1/8, 1/7)
Absolutely Important/preferred	9	(9, 9, 9)	(1/9, 1/9, 1/9)

Chang's Extent Analysis

An example for pairwise comparison matrices that were collected as result of workshop is presented.

|	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C_1	(1,1,1)	(1,2,3)	(1,2,3)	(2,3,4)	(1,2,3)	(1,2,3)	(1/3,1/2,1)	(1,1,1)	(3,4,5)
C_2	(1/3,1/2,1)	(1,1,1)	(1,1,1)	(1,2,3)	(1/3,1/2,1)	(1,2,3)	(1/4,1/3,1/2)	(1/3,1/2,1)	(1,1,1)
C_3	(1/3,1/2,1)	(1,1,1)	(1,1,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1/4,1/3,1/2)	(1/3,1/2,1)	(1,1,1)
C_4	(1/4,1/3,1/2)	(1/3,1/2,1)	(1,2,3)	(1,1,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1,2,3)
C_5	(1/3,1/2,1)	(1,2,3)	(1,2,3)	(1,2,3)	(1,1,1)	(1,1,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1,2,3)
C_6	(1/3,1/2,1)	(1/3,1/2,1)	(1,2,3)	(1,2,3)	(1,1,1)	(1,1,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1,1,1)
C_7	(1,2,3)	(2,3,4)	(2,3,4)	(1,2,3)	(1,2,3)	(1,2,3)	(1,1,1)	(1,1,1)	(3,4,5)
C_8	(1,1,1)	(1,2,3)	(1,2,3)	(1,2,3)	(1,2,3)	(1,2,3)	(1,1,1)	(1,1,1)	(3,4,5)
C_9	(1/5,1/4,1/3)	(1,1,1)	(1,1,1)	(1/3,1/2,1)	(1/3,1/2,1)	(1,1,1)	(1/5,1/4,1/3)	(1/5,1/4,1/3)	(1,1,1)

Chang's Extent Analysis

1. Value of fuzzy synthetic extent

2. The degree possibility

3. Minimum value of degree of possibility

4. Via normalization, the normalized weight vectors -where W is a non-fuzzy number- were calculated

Chang's Extent Analysis

Fuzzy Logic

1. $S_i = \sum_{j=1}^{m} M_{gi}^j \times \left[\sum_{j=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right]^{-1}$

2. $\sum_{j=1}^{m} M_{gi}^j = \left(\sum_{j}^{m} l_j , \sum_{j=1}^{m} m_j , \sum_{j=1}^{m} u_j \right)$

3. $\left[\sum_{j=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right] = \left(\sum_{j}^{m} l_j , \sum_{j=1}^{m} m_j , \sum_{j=1}^{m} u_j \right)$

4. $\left[\sum_{j=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right]^{-1} = \left(\dfrac{1}{\sum_{j=1}^{n} u_i} , \dfrac{1}{\sum_{j=1}^{n} um_i} , \dfrac{1}{\sum_{j=1}^{n} l_i} \right)$

5. $V(M_1 \geq M_2) = \sup \left[\min (\mu_{M1}(x), \mu_{M2}(y)) \right]$

6. $V(M_1 \geq M_2) = 1,\ if\ m1 \geq m2\ V(M_2 \geq M_1) = hgt\ M_1 \cap M_2 = \mu_{M2}$

7. $V(M2 \geq M1) = hgt\ M_1 \cap M_2 = \dfrac{l1 - u2}{(m2 - u2) - (m1 - l1)}$

8. $V(M \geq M_1, M_2, .., M_k) = V[(M \geq M_1)\ and\ (M \geq M_2)\ and ... and\ (M \geq M_k)] = \min V(M \geq M_i)$

9. $W' = (d'(A_1), (A_2), ... , d'(A_n))^{\mathsf{T}}$
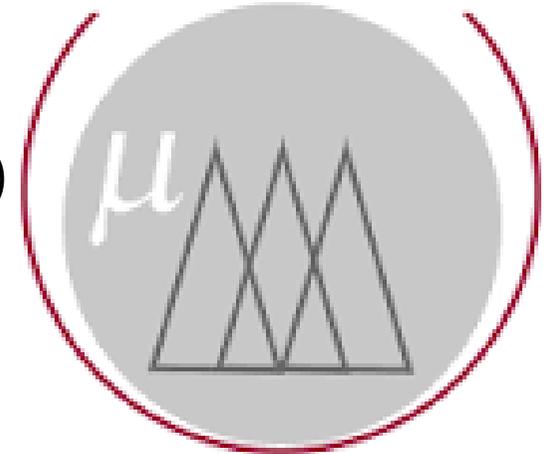
Data Analyzes

Financial	Germany	Lithuania	Holland	Turkey
F1 Turnover volume	0.1603891	0.3891037	0.401409	0.180338071
F2 Cost control	0.170961	0.1076675	0.17371	0.088966383
F3 Budget control	0.2202189	0.1431662	0.096333	0.036833883
F4 Productivity	0.0627708	0.043679	0.167577	0.084791684
F5 Investment strategies	0.1020277	0.043679	0.035591	0.128430571
F6 Non-founded income	0.0277858	0.0962091	0.038607	0.093512673
F7 Net income	0.1836291	0.043679	0.036353	0.197610081
F8 Return on investment (ROI)	0.064755	0.1301329	0.014828	0.176152491
F9 Advertising cost	0.0074626	0.0026835	0.035591	0.013364163

Related Comments

According to the FAHP analysis results among financial indicators;

- **"Turnover volume (F1)"** has the highest importance relatively in all four countries in comparison with other financial indicators.

- **"Advertising cost (F9)"** has the least importance in all four countries in comparison with other financial indicators.

Data Analyzes

Trainee perspective (Customer)	Germany	Lithuania	Holland	Turkey
TS1 Trainee satisfaction	0.1940187	0.4909276	0.291413	0.233782
TS2 Continuation of trainee	0.0287984	0.0910171	0.068903	0.020583
TS3 Trainee relationship	0.1781455	0.0483259	0.062901	0.134761
TS4 Expanding of new trainees	0.0696379	0.0474783	0.19078	0.062367
TS5 Market share	0.0251325	0.0406146	0.009824	0.061155
TS6 Learning environment	0.0732692	0.0474783	0.042097	0.139027
TS7 Range of products and services	0.0135954	0.034485	0.042889	0.003529
TS8 Flexibility of service system	0.0115913	0.0002637	0.037708	0.017725
TS9 Image and reputation	0.0881769	0.000259	0.178116	0.107848
TS10 Trainees' trust	0.2080034	0.0002544	0.042097	0.193328
TS11 Product quality	0.0704287	0.1486202	0.031122	0.006066
TS12 Opportunities for further education and training	0.0392022	0.0502759	0.002151	0.019829

Related Comments

According to the FAHP analysis results among trainee satisfaction (customer) cluster;

- **"Trainee satisfaction (TS1)"** has the highest importance relatively in all four countries in comparison with other indicators in trainee satisfaction (customer) cluster.

Data Analyzes

Internal Process	Germany	Lithuania	Holland	Turkey
IP1 Customized courses	0.1362665	0.2687165	0.051259	0.003946
IP2 Operational business process	0.0175952	0.1286775	0.108537	0.029508
IP3 After-sales service	0.0881057	0.0765698	0.09362	0.007171
IP4 Standard operating procedures	0.0489426	0.0786748	0.10071	0.090891
IP5 School of characteristics	0.158802	0.0833217	0.039655	0.0887
IP6 Setting up the major programs	0.0851458	0.0875071	0.052147	0.111957
IP7 Increasing administration efficiency	0.0720185	0.0359446	0.037982	0.071567
IP8 Teaching quality evaluation	0.0581368	0.0813833	0.025264	0.141412
IP9 Experience of teachers and trainers in teaching	0.0881763	0.0560465	0.022571	0.1754
IP10 Experience of teachers and trainer in practice	0.04878	0.027323	0.152325	0.142276
IP11 Frequency of course contents and course program update date	0.0612319	0.047264	0.157519	0.021723
IP12 Expenditure on staff development	0.0078993	0.0070771	0.021741	0.032114
IP13 Development of multidisciplinary courses	0.0161069	0.0075037	0.088643	0.028534
IP14 Information system capabilities	0.1060181	0.0070771	0.022493	0.030975
IP15 Encouraging Methods	0.0067744	0.0069133	0.025533	0.023825

Related Comments

According to the FAHP analysis results among internal process cluster;

- Germany and Lithuania reported that "**customized courses (IP1)**" has the highest importance in comparison with other indicators.

- Turkey reported that "**experience of teachers and trainers in teaching (IP9)**" and "**experience of teachers and trainers in practice (IP10)**" have the highest importance respectively

- Netherlands reported that "**frequency of course contents and course program update date (IP11)**" and "**experience of teachers and trainers in practice (IP10)**" have much more importance in comparison with other indicators.

Data Analyzes

Learning and Growth	Germany	Lithuania	Holland	Turkey
LG1 Economic Growth	0.0871335	0.2777488	0.044629	0.026463
LG2 Employees' satisfaction	0.0755456	0.1193005	0.107828	0.050949
LG3 Firm's performance	0.149193	0.1400212	0.129153	0.045745
LG4 Employees' retention	0.0645857	0.1313487	0.102198	0.100578
LG5 Employees' productivity	0.1325601	0.0681476	0.109916	0.132166
LG6 Earnings	0.1883847	0.0479192	0.158881	0.09816
LG7 Increasing quality of labor	0.1946299	0.0571504	0.107924	0.137946
LG8 Crime reduction	0.019366	0.0164278	0.034721	0.219565
LG9 Social cohesion	0.0508303	0.0093273	0.083801	0.013948
LG10 Intergenerational benefits	0.0080042	0.0751651	0.076569	0.036559
LG11 Inclusion of disadvantaged groups	0.0130955	0.0169612	0.027032	0.044264
LG12 Mobility chance of the employees	0.0166715	0.0404823	0.017347	0.093657

Related Comments

According to the FAHP analysis results among learning and growth cluster;

- Lithuania reported that **"economic growth (LG1)"** has the highest importance in comparison with other indicators and also **"economic growth (LG1)"** has a huge variety in rankings in comparison with other countries' results.

- **"Crime Reduction (LG8)"** has the highest importance in comparison with other indicators in learning and growth cluster for Turkey.