ECONOMICS
& Sociology

Hogeforster, M., & Ginevičius, R. (2024). Implementation of the work-based learning model in SMEs: Ranking the indicators of feasibility based on transitivity. *Economics and Sociology*, *17*(3), 291-302. doi:10.14254/2071-789X.2024/17-3/15

IMPLEMENTATION OF THE WORK-BASED LEARNING MODEL IN SMES: RANKING THE INDICATORS OF FEASIBILITY BASED ON TRANSITIVITY

Max Hogeforster
Baltic Sea Academy,
Hamburg, Germany
E-mail:
mhogeforster@hanse-parlament.eu
ORCID 0009-0007-0753-6608

Romualdas Ginevičius
Vilnius Gediminas Technical university,
Vilnius, Lithuania
E-mail:
romualdas.ginevicius@vilniustech.lt
ORCID 0000-0003-2067-4398

Received: October, 2023
1st Revision: July, 2024
Accepted: September, 2024

DOI: 10.14254/2071-789X.2024/17-3/15

JEL Classification: I25, J24, C38

ABSTRACT. Work-based learning models have been applied to varying extent across countries. This raises questions about the factors that determine the feasibility of their implementation in small and medium-sized enterprises (SMEs). The multifaceted impact of these factors and the indicators reflecting them varies significantly, which makes it necessary to rank them appropriately. This study uses a pairwise comparison of the indicators' importance based on their transitivity to determine such ranking. This new methodology is superior to existing approaches in that it allows the researcher to determine the importance rankings of a virtually unlimited number of indicators without compromising the adequacy of the assessment. It also significantly reduces the scope of expert judgement. The methodology also accounts for interactions between indicators, further improving the relevance of the rankings. Finally, the proposed methodology is versatile as it can be applied to rank the importance of any type of indicators reflecting the state of socio-economic systems.

Keywords: multi-criteria evaluations, transitivity of indicators, importance ranking of indicators, work-based learning

Introduction

Small and medium-sized enterprises (SMEs) play an important role in the economic development of countries. Their distinctive feature is the dynamism of their activities. SMEs are faster at innovating and creating jobs. Despite the challenges of recent years, such as job losses due to the coronavirus pandemic and increased energy prices, SMEs have shown great resilience, which suggests that they will have strategic advantages in defending themselves against unforeseen negative developments in the future (Zighan, Ruel, 2023; Juergensen et al., 2020; Di Bella et al., 2023). This strengthens their competitive position in the market. It is no coincidence that SMEs have been and continue to be a key factor in European competitiveness (Floyd, McManus, 2005). On the other hand, the experience of SMEs shows that the main challenge they face in their activities is the lack of skilled labour (Andrews, Higson, 2008; Moore, Morton, 2017). In particular, the need for staff is driven by the rapidly changing business environment as human capital directly influences a company's ability to adapt to constant market fluctuations, technological change, etc. SMEs are at a disadvantage compared to large companies because they do not have separate HR departments, as latter's functions include recruitment. In addition, due to their limited financial capacity, SMEs cannot allocate sufficient resources to recruiting the skilled workers or to upskilling their existing employees and providing them with the knowledge they need to be productive and innovative (Froy et al., 2012).

This shortage of skilled labour could be solved by recruiting from schools with graduates who have been appropriately trained, i.e., those who have undergone work-based learning (WBL). At its core, WBL consists of a range of educational strategies and programmes that enable the practical application of academic knowledge in a work environment (Perusso, Wagenaar, 2021; Cunningham, Dawes, 2016; Hogeforster, Alexander, 2018). This model allows traditional learning in education and training institutions to be combined with practical experience through internships, apprenticeships and collaborative work. The aim of WBL is to improve learners' understanding of the workplace, develop their vocational skills and prepare them for a successful professional career. It bridges the gap between theoretical knowledge and its practical application, creating a smooth transition from the academic environment to the workplace. In particular for SMEs, such an entrepreneurial education with a high level of practical training fosters the understanding of market dynamics, customer needs, and effective business planning (Bauman & Lucy, 2021). The WBL model has an important place in the training of a skilled workforce in many European countries (Brunet Icart, Rodríguez-Soler, 2017; Gibb, 1994; Grooters et al., 2023). In areas such as services and medicine, they play a crucial role (Morris, Blaney, 2013). However, experience indicates that the implementation of this model is complex. Its success is largely contingent upon several factors, including employers' awareness of the content of work-based learning programs, the potential for integration, particularly at the higher education level, and the administrative challenges inherent within vocational education and training institutions. It is essential that companies are ready and able to implement partnerships with schools (Andrews, Higson, 2008; Asmah, Ariffin, 2009).

The aim of this paper is to rank the indicators reflecting the capabilities of SMEs in the WBL model implementation country in order to calculate an index reflecting these capabilities based on these ranks.

Literature review

Amid the dynamics of the global economy, marked by escalating competition and accelerated technological progress, firms are compelled to engage in ongoing development and adaptive strategies to maintain their competitive edge. The traditional paradigm of competitiveness based primarily on labor cost advantages has become increasingly untenable, particularly for firms operating in developed economies (Herzog-Stein et al., 2013). This shift is largely attributed to the emergence of global value chains and the integration of developing economies into the world market, which has dramatically altered the landscape of international competition. The globalization of production processes has led to a significant disparity in labor costs between developed and developing nations. Consequently, European companies, along with their counterparts in other high-wage economies, find themselves at a distinct disadvantage when competing solely on the basis of labor expenses. This economic reality has necessitated a strategic pivot towards alternative sources of competitive advantage.

These are provided by the knowledge society, which on the one hand creates demand and on the other hand creates the conditions for a focus on innovation, technological progress and, in particular, a highly skilled workforce. This enables companies to differentiate themselves through the quality of their products and services, their innovative features, etc. The knowledge society implies, above all, the need for continuous learning and improvement in order to keep up with the constant changes in the market and thus be competitive. Education is considered to play a crucial role in this situation (Salavou et al., 2004). In this context, for SMEs it is not education in general, but education based on vocational training and a high level of practical learning. It becomes a key factor for the success and competitiveness of SMEs (Brunet Icart, Rodríguez-Soler, 2017; Gibb, 1994). Thanks to such training, the employees of the enterprise acquire the skills and competences necessary to make the right decisions, to solve problems constructively, to develop entrepreneurship and thus to successfully adapt to the constantly changing industrial situation. Meanwhile, the current situation shows that the shortage of skilled labour is a major problem for the further development of SMEs. Due to their specific characteristics, in particular their limited financial capacity, SMEs are unable to devote sufficient resources and effort either to finding and recruiting skilled workers or to upgrading the skills of their employees (Froy et al., 2012). The problem is not solved by graduates coming to work. Their fundamental disadvantage is that they are practically unprepared for professional work, as they do not have the necessary competences (Moore, Morton, 2017; Andrews, Higson, 2008). This underscores the urgent necessity to more closely align current curricula with the demands of the labor market. The analysis of the literature makes it possible to identify various combinations of vocational and practical training (Table 1).

Table 1. Variants of vocational skills formation in industrial societies

Professional specificities of countries' education systems	Involving enterprises in skills development processes	
	superficial	deep
Low	Developing a generic skills framework (US, UK)	At the heart of the Skills Framework is a company (Japan)
High	Skills development system limited to the school (France, Sweden, Poland)	Vocational skills are developed in the workplace (Germany, Austria, Netherlands)

Source: *compiled by the authors on the basis of Busemeyer, 2009*

Table 1 shows that it is strategically important to build on a model of vocational training that is characterised by a high degree of vocational specificity and a strong involvement of the enterprise, i.e. the development of vocational skills in the workplace. Traditional, school-based approaches do not provide such opportunities and therefore do not adequately prepare individuals for the specific needs of SMEs. This is because pure school-based education takes place in a closed, artificial environment (Hamilton, S.F.; Hamilton, M.A., 1994; Wolter, Ryan, 2011; Bosch, Charest, 2008). This approach fails to address the specific requirements of SMEs, as it lacks an emphasis on practical learning and the acquisition of specialized knowledge. Empirical evidence suggests that European SMEs that successfully integrate theoretical instruction with practical on-the-job training demonstrate higher levels of success. The effectiveness of this combined training is further validated by the positive outcomes observed in apprenticeship programs, underscoring the advantages of an integrated approach that aligns theoretical knowledge with its practical application.

Work-based learning manifests itself in various forms. It is interpreted differently across countries. The most common is blended learning, which combines classroom training with practical experience in a professional environment. Theoretical training at school can either precede or follow a traineeship/internship in the company, or alternate between time spent at school and time spent in the company. The German model of work-based learning is the most developed, and is widely known as the dual training system (Pilz, 2009; Hogeforster, Alexander, 2018; Attwell, Rauner, 2002; Casey, 1991; Deissinger, Hellwig, 2005; Rooney-Kron, Dymond, 2023; Ekert, Grebe, 2016; Hogeforster, Priedule, 2014). On the other hand, despite the advantages of this model, the extent to which it has been applied varies considerably across countries. An analysis of the literature suggests that this is due to a number of reasons: there is little research on the state of implementation of the model in SMEs, there is a lack of awareness of the benefits of WBL among employers as well as educational and scientific institutions, etc. In this situation, research is needed to shed light on the current situation and to increase the potential of the WBL model in SMEs.

Research methodology

In order to adequately assess the ability of SMEs to implement the WBL model in their operations, it is first necessary to identify the factors on which they depend. This can be done either through an analysis of literature sources or a survey of experts. The information gathered is combined to form a final list of factors. It is presented in Table 2.
The literature analysis highlighted the factors that determine the feasibility of implementing the WBL model in a country's SMEs (Table 2).

Table 2. Factors reflecting the feasibility of the WBL model for SMEs in the country

Factor No.	Name of the factor
1.	Professional background of person assessing the relevance of the WBL model
2.	Number of employees in the company
3.	Experience of working in a WBL system
4.	Experience in training company staff in WBL
5.	Content with participation in a WBL system
6.	Recommendation for other companies to implement the WBL model
7.	Professional background of person assessing the relevance of the WBL model
8.	Number of employees in the company
9.	Experience of working in a WBL system
10.	Experience in training company staff in WBL
11.	Content with participation in a WBL system
12.	Recommendation for other companies to implement the WBL model
13.	Awareness of the benefits of information on the WBL model

Source: *authors' compilation*

In order to establish an index reflecting the feasibility of the WBL model for SMEs in a country, the importance of the factors listed in Table 2 must be determined. This can be assessed in several ways – subjective, objective and mixed (Ustinovičius et al., 2007; Fan et al., 1977). Today, the first approach, where the importance of the indicators is determined by experts, is predominant. The literature shows that the adequacy of the assessment depends to a large extent on the number of indicators (Rakauskienė, 2013). If the number of indicators is small, i.e. the number of indicators does not exceed 10–12, it makes sense to directly determine the importance of the indicators, where the experts assess it immediately in unit fractions, subject to the condition that $\sum_{i=1}^{n} \omega_i > 1$ (here ω_i - the importance of the i-th indicator; n – the number of indicators (Podvezko, 2008); Oželienė, 2019; Ginevičius, 2009). When the number of indicators is large, this method is not suitable, as experts cannot adequately assess the importance relationships between all indicators in their minds. The higher the number, the less the consistency of the experts' opinions. In search of a solution, a pairwise comparison of the importance of the indicators in relation to the phenomenon under consideration (NR) has been proposed (Saaty, 1980). This method only partially solved the problem, since the expert has to weigh in his mind not only the importance of two indicators, but also the importance of this pair of indicators in relation to all other pairs of indicators. If there are many such pairs, it is practically impossible to complete a harmonised pairwise comparison matrix. For this reason, the methodology foresees a second assessment phase, in which the experts search for a consensus on the assessment. This is time-consuming. In addition, this methodology has other shortcomings (Tutygin, Korobov, 2010). Thus, the problem of the relevance of indicators remains largely unresolved. It can be alleviated if the evaluation is carried out in stages. The first stage involves determining the importance ranks of the indicators and the second stage involves indicating their importance on the basis of these ranks. This considerably increases the adequacy of the assessment, since an expert, seeing the importance ranks, will not give more weight to an indicator with a lower rank.

Given the shortcomings of the methodologies for determining the relevance of indicators, it is scientifically and practically important to propose new ways of avoiding these shortcomings, i.e. an unlimited number of indicators can be assessed without compromising the adequacy of the assessment, at a relatively low cost of expertise and, most importantly, by taking into account the interplay between the indicators as elements of a single system. In essence, the importance ranking of an indicator would be the result of its interaction with all other indicators in the system. The transitivity of these interactions makes this possible (Cherchye et al., 2018; Devi, Mangang, 2020; Yang, Dimitrov, 2021; Fishburn, 1979; Carpentiere et al., 2022; Muñoz, 2022; Khurana, Nielsen, 2022). A graphical representation of this looks like this (Figure 1).

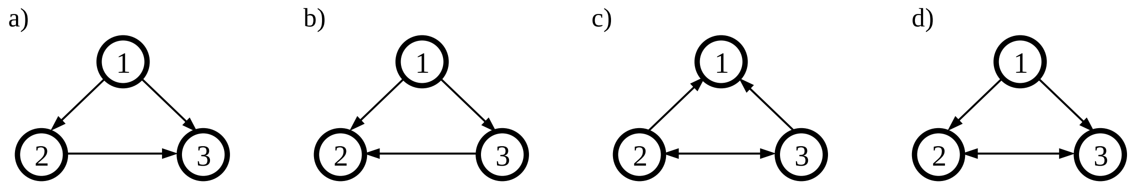

Figure 1. Transitivity and non-transitivity of sizes
Source: *compiled by authors*

Figure 1 shows that in case *a* the interaction is transitive, as the first magnitude of the effect on NR is larger compared to the second and the second to the third. Hence, the interaction of the first magnitude will also be larger compared to the third. Similarly, in case *b*, the effect of the first magnitude on NR is greater than that of the third, and the effect of the third magnitude on NR is greater than that of the second. Hence, the effect of the first magnitude will also be larger than the effect of the second magnitude. In cases *c* and *d*, the effect of the first magnitude is smaller (larger) than both the effect of the second and the effect of the third. The interaction is non-transparent, since the interaction between the second and third magnitudes cannot be determined.

Applying the transitivity property to pairwise comparisons opens up new possibilities for ranking the importance of indicators, as ranks can be derived from much smaller amounts of expert information. The rest can be obtained analytically thanks to the transitivity of the indicators. This methodology has been applied to the formation of hierarchical indicator systems for multi-criteria assessment, as well as to the determination of importance ranks for indicators of economic development in a country (Ginevičius, Podvezko, 2004; Ginevičius et al., 2023). It is primarily used to form a pairwise comparison matrix of indicator importance. We will use a specific example where six experts assess the importance ranks of six indicators for the phenomenon under consideration (Table 3).

Table 3. Pairwise comparison matrix of the importance of indicators for the phenomenon under consideration

Indicator numbers	Experts						Total estimates "+"	Total estimates "_"	The difference	Rank of importance
	1	2	3	4	5	6				
1 (basic)		–1	–1	+1	–1	+1	2	3	–1	5
2	+1		–1	+1	–1	+1	3	2	+1	4
3	+1	+1		+1	–1	+1	4	1	+3	2
4	–1	–1	–1		–1	+1	1	4	–3	3
5	+1	+1	+1	+1		+1	5	0	+5	1
6	–1	–1	–1	–1	–1		0	5	–5	6

Source: *authors' compilation*

Before completing the pairwise comparison matrix, each expert sets a baseline indicator, i.e. the indicator against which the importance of the impact of all other indicators on NR will be compared. A baseline indicator is an indicator whose impact is neither very high nor very low, i.e. it is around the average. The more precisely it is chosen, the less the scope for expert judgement.

The next step is to complete the first row of Table 3. The expert fills it in as follows: if the baseline indicator has a higher impact on NR than the one being compared, the intersection box is filled in with an estimate of "+1", if it has a lower impact, the intersection box is filled in with an estimate of "–1". All the cells in the first row of the matrix are filled in this way. Table 3 shows that the effect of the baseline indicator on NR is lower compared to indicators 2, 3 and 5 and stronger compared to indicators 4 and 6. In the corresponding column below the diagonal, estimates with opposite signs are shown. The first row shows that the following interactions are non-transitive: 1–2–3, 1–2–5, 1–3–5, 2–3–5, 1–4–6. This leads the expert to determine the nature of the interaction between pairs of indicators 2–3, 2–5, 3–5 and 4–6. All the cells to be filled in by the expert are highlighted in the matrix. There are eight of them. This means that all the other cells (almost 47%) are filled in analytically on the basis of the transitivity property of the indicators (Table 3).

Once all the cells in the matrix have been filled in, the estimates with a "+1" and a "–1" are summed up and the difference between them is determined. These are used to derive the importance ranks for the impact of the indicators on DR (Table 3). These are 'derived' from the interactions between indicators. A further advantage is that the number of indicators considered can be unlimited, as the interaction of each pair of indicators is assessed independently of the nature of the interaction of the other pair.

With the pairwise comparison matrices completed by all the experts, a summary table of the importance ranks of the indicators is produced (Table 4).

Table 4. Summary table for ranking the importance of indicators

Indicators	Experts							Amount of rangas	Average	Weight or rank of indicators
	1	2	3	...	j	...	r			
1	r_{11}	r_{21}	r_{31}	...	r_{j1}	...	r_{r1}	$\sum_{i=1}^{r} r_1$	$\tilde{r}_1$	ω_1
2	r_{12}	r_{22}	r_{32}	...	r_{j2}	...	r_{r2}	$\sum_{i=1}^{r} r_2$	$\tilde{r}_2$	ω_2
3	r_{13}	r_{23}	r_{33}	...	r_{j3}	...	r_{r3}	$\sum_{i=1}^{r} r_3$	$\tilde{r}_3$	ω_3
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
i	r_{1i}	r_{2i}	r_{3i}	...	r_{ji}	...	r_{ri}	$\sum_{i=1}^{r} r_i$	$\tilde{r}_i$	ω_i
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
m	r_{1m}	r_{2m}	r_{3m}	...	r_{jm}	...	r_{rm}	$\sum_{i=1}^{r} r_m$	$\tilde{r}_m$	ω_m
								$\sum_{i=1}^{m}\sum_{i=1}^{r} r_i$		

In order to determine the final importance ranks of the indicators, the consistency of the experts' opinions needs to be checked. Table 4 shows the actual value of the Pearson criterion χ^2:

$$\chi_f^2 = \frac{12S}{rm(m\leq 1)}; \tag{1}$$

$$S_f = (\sum_{i=1}^{r} r_i - \bar{r})^2; \tag{2}$$

$$\bar{r} = \frac{\sum_{i=1}^{m}\sum_{i=1}^{r} r_{ij}}{m}, \tag{3}$$

here r_{ij} – is the estimate of the j-th indicator by the i-th expert; r is the number of experts; m is the number of indicators; S_f – the cumulative deviation of the indicator importance horns from the mean $\bar{r}$.

If $\chi_f^2 \geq \chi_{K_2}^2$, the experts' opinions are in agreement. In this case, the final importance ranks of the indicators are determined (Table 4):

$$\omega_i = \frac{\sum_{j=1}^{r} r_i}{r}. \tag{4}$$

Based on the methodology outlined above, the importance ranks of the indicators reflecting the potential of the WBL model to be applied in the country's SMEs were determined.

Empirical study

To determine the importance rankings of the indicators reflecting the potential of the WBL model for SMEs in the country, a group of experts was formed, consisting of three representatives from SME enterprises, training institutions and administering organisations. Each of them identified a baseline indicator and filled in the first row of the matrix on that basis, as well as indicating the nature of the interactions between the indicators with equivalent impact in this row. The results of one of the experts' assessments are given in Table 5.

Table 5. Pairwise comparison matrix of indicators reflecting the WBL model’s applicability to SMEs in the country

Indicators	Indicators													Total Estimates “+1”	Total Estimates “–1”	The Difference	Indicator weights or ranks	
	4 baseline	1	2	3	5	6	7	8	9	10	11	12	13				taking into account the interaction of indicators	direct assessment
4 baseline		–1	+1	–1	+1	+1	+1	+1	+1	–1	–1	–1	–1	6	6	0	8	7
1	+1		+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	–1	11	1	+10	1	2
2	+1	–1		–1	–1	–1	–1	–1	–1	–1	–1	–1	–1	0	12	–12	13	13
3	+1	+1	+1	-1	+1	+1	+1	+1	+1	+1	+1	+1	–1	11	1	+10	2	3
5	–1	–1	+1	–1		–1	+1	+1	+1	–1	–1	–1	–1	4	8	–4	10	9
6	–1	–1	+1	–1	+1		+1	+1	+1	–1	–1	–1	–1	5	7	–2	9	8
7	–1	–1	+1	–1	+1	–1		+1	+1	+1	+1	+1	+1	8	4	+4	4	10
8	–1	–1	+1	–1	+1	–1	–1		–1	–1	–1	–1	–1	2	10	–8	12	12
9	–1	–1	+1	–1	+1	–1	–1	+1		–1	–1	–1	–1	3	9	–6	11	11
10	+1	–1	+1	–1		+1	–1	+1	+1		+1	+1	+1	9	3	+6	3	4
11	+1	–1	+1	–1		+1	–1	+1	+1	–1		+1	–1	7	5	–2	5	5
12	+1	–1	+1	–1		+1	–1	+1	+1	–1	–1		–1	6	6	0	7	6
13	+1	–1	+1	–1		+1	–1	+1	+1	–1	+1	+1		8	4	+4	5	1

Source: *authors’ compilation*

Table 5 shows that 42 cells, i.e. 54%, were filled in by experts, while 36 cells, i.e. 46%, were filled in on the basis of the transitivity of indicators. The sum of the difference in the importance of the indicators ranked with opposite signs in each row of the matrix indicates the rank of their importance. Table 6 shows the importance ranks for comparison, as reported directly by the expert, i.e. without taking into account the interaction of the indicators. They do not differ that much, except for indicators 7 and 9. This is because the importance of these indicators may have been incorrectly stated.

With all the matrices fully completed, a summary table of indicator importance ranks was produced (Table 6).

Table 6. Summary table of the importance ranks of indicators reflecting the feasibility of WBL in domestic SMEs

Indicators	Experts									Total	Average	Rank of importance
	1	2	3	4	5	6	7	8	9			
1	7	6	8	8	4	4	9	7	8	61	6.8	7
2	13	11	12	1	12	9	12	13	10	102	11.3	12
3	4	10	3	13	5	7	6	5	7	60	6.7	6
4	6	12	11	2	10	11	13	10	13	88	9.8	10
5	12	9	13	10	13	13	10	11	12	103	11.4	3
6	8	7	4	9	9	10	8	9	11	75	8.3	9
7	9	8	5	4	3	6	3	3	5	46	5.1	4
8	1	3	6	12	8	2	4	6	6	47	5.2	5
9	10	4	7	11	7	8	7	4	4	62	6.9	8
10	2	5	9	3	6	5	5	8	2	45	5.0	3
11	11	13	10	6	11	12	11	12	9	95	10.6	11
12	5	2	2	7	1	1	2	2	3	25	2.8	2
13	3	1	1	5	2	3	1	1	1	18	2.0	1

Source: *authors’ compilation*

Based on Table 6 and (1)–(3) formulas, the consistency of the experts’ opinions was checked. The results are that χ_f^2 = 50.3 > χ_{kr}^2 = 21.03, i.e. the opinions are consistent. This allows us to establish the final importance ranks for the indicators ω_i (Table 4). These rankings serve as a foundation for accurately weighting the indicators and highlight the key priority areas that must be addressed to enhance the feasibility of implementing work-based learning models in SMEs.

Conclusions

Today, multi-criteria evaluation methodologies for determining the importance of indicators have shortcomings that reduce the adequacy of the evaluation. Firstly, it is determined directly by unit fractions. This approach only makes sense when the number of indicators to be assessed is small. As the number of indicators grows, the accuracy of the assessment decreases, as the expert is unable to capture in his mind all the interrelationships between the importance of indicators. To a large extent, this can be avoided by carrying out the assessment in stages. The first stage involves determining the importance ranks of the indicators and the second stage involves determining the weights based on these ranks. Another disadvantage of the weighting of indicators is that both ranks and weights are determined without taking into account the nature of the interactions between the indicators, which are inherent to them as elements of the same system.

Conversely, when the number of indicators under evaluation is substantial, experts encounter challenges in accurately determining both their relative weights and ranks of importance. This difficulty arises from the need to simultaneously account for the complex interrelationships among the importance of all indicators. As a solution, it has been proposed to assess the importance of the indicators in relation to the phenomenon under consideration on the basis of a pairwise comparison - the AHP method. A deeper analysis of this method shows that it is difficult to apply, as the expert has to take into account all the other pairwise evaluations when assessing the situation of one pair of indicators. In the case of a large number of indicators, it is rarely possible to construct a pairwise comparison matrix. It is no coincidence that the methodology provides for a second step, which seeks to change the opinion of some experts.

The proposed methodology for ranking the importance of indicators reflecting the feasibility of implementing the WBL model in domestic SMEs avoids all these shortcomings. Firstly, an unlimited number of indicators can be evaluated without compromising the adequacy of the evaluation, as the importance of one indicator does not need to be taken into account in the evaluation of the relative importance of other pairs of indicators. Secondly, the cost of expert judgement is significantly reduced by almost half, as the other information needed to determine the importance ranks of indicators is found analytically, on the basis of the transitivity property of the indicators. Thirdly, the importance ranks of indicators are not determined directly, but on the basis of the nature of the interaction between their importance. Fourthly, it increases the adequacy of the importance ranking of indicators.

Understanding the importance ranks of indicators enables experts to assign weights with greater precision, as it prevents the misallocation of excessive weight to indicators with lower ranks.

The proposed methodology is versatile and can be applied to rank the importance of any type of indicators reflecting the state of socio-economic systems. Further research is needed to find ways of combining the first and second stages of indicator weighting, i.e. ranking the importance of indicators with their weighting, into a single methodology. This will depend to a large extent on the appropriate identification of a baseline indicator against which the importance of all other indicators is compared in relation to the phenomenon under consideration.

References

Andrews, J., & Higson, H. (2008). Graduate Employability, 'Soft Skills' Versus 'Hard' Business Knowledge: A European Study. *Higher Education in Europe, 33*(4), 411-422. https://doi.org/10.1080/03797720802522627

Asmah, A., & Ariffin, T. (2009). *Innovative practices in TVET towards education for sustainable development: Work-based learning diploma programmes at community college in Malaysia.* Retrieved from https://unevoc.unesco.org/up/Malaysia_Country_Paper.pdf

Attwell, G., & Rauner, F. (2002). Training and development in Germany. *International Journal of Training and Development, 3*(3), 227-233. doi:10.1111/1468-2419.00080

Bauman, A., & Lucy, C. (2021). Enhancing entrepreneurial education: Developing competencies for success. *The International Journal of Management Education*, 19(1), 100293. https://doi.org/10.1016/J.IJME.2019.03.005

Bosch, G., & Charest, J. (2008). Vocational training and the labour market in liberal and coordinated economies. *Industrial Relations Journal, 39*(5), 428-447. https://doi.org/10.1111/j.1468-2338.2008.00497.x

Brunet Icart, I., & Rodríguez-Soler, J. (2017). The VET system and industrial SMEs: the role of employees with VET qualifications in innovation processes. *Journal of Vocational Education & Training, 69*(4), 596-616. https://doi.org/10.1080/13636820.2017.1322130

Busemeyer, M. (2009). Asset specificity, institutional complementarities and the variety of skill regimes in coordinated market economies. *Socio-Economic Review, 7*(3), 375-406. https://doi.org/10.1093/ser/mwp009

Carpentiere, D., Giarlotta, A., & Watson, S. (2022). The interplay between transitivity and completeness: Generalized NaP-preferences. *Journal of Mathematical Psychology, 108*(1), 102667. https://doi.org/10.1016/j.jmp.2022.102667

Casey, B. (1991). Recent Developments in the German Apprenticeship System. *British Journal of Industrial Relations, 29*(2). https://doi.org/10.1111/j.1467-8543.1991.tb00237.x

Cherchye, L., Demuynck, L.T., & De Rock, B. (2018). Transitivity of preferences: When does it matter? *Theoretical Economics, 13*(3), 1043-1076. https://doi.org/10.3982/TE2733

Cunningham, I., & Dawes, G. (2016). *The Handbook of Work Based Learning.* Taylor and Francis. doi:https:// doi.org/10.4324/9781315557342

Deissinger, T., & Hellwig, S. (2005). Apprenticeship in Germany: modernising the Dual System. *Education and Training, 47*(4/5), 312-324. https://doi.org/10.1108/00400910510601896

Devi, T.T., & Mangang, K.B. (2020). On Equicontinuity, Transitivity and Distality of Iterated Function Systems. *Journal of Dynamical Systems and Geometric Theories, 18*(2), 223-239. https://doi.org/10.1080/1726037X.2020.1847766

Di Bella, L., Katsinis, A., Lagüera-González, J., Odenthal, L., Hell, M., & Lozar, B. (2023). *Annual Report on European SMEs 2022/2023.* doi:https://single-market-economy.ec.europa.eu/smes/sme-strategy/sme-performance-review_en

Ekert, S., & Grebe, T. (2016). The Training Module Concept: A Way Towards Quality Improvement and Inclusion in German Vocational Education and Training (VET)? *Technical and Vocational Education and Training, 24,* 369-387. https://doi.org/10.1007/978-3-319-47856-2_20

Fan, Z., Ma, J., & Tian, P. (1977). A Subjective and Objective Inte grated Approach for The Determination of Attribute Weights. *Materials of 4th Conference of the Interna tional Society for Decision Support Systems*.

Fishburn, P. (1979). Transitivity. *The Review of Economic Studies*, *46*(1), 163-173. https://doi.org/10.2307/2297179

Floyd, D., & McManus, J. (2005). The role of SMEs in improving the competitive position of the European Union. *European Business Review, 17*(2), 144-150. doi:10.1108/09555340510588011

Froy, F., Giguère, S., & Meghnagi, M. (2012). *Skills for Competitiveness: A Synthesis Report* . OECD Local Economic and Employment Development (LEED). OECD Publishing. Retrieved from https://www.oecd.org/cfe/leed/skills_for_competitiveness_synthesis_final.pdf

Gibb, A. (1994). Do we really teach (approach) small business the way we should? *Journal of Small Business & Entrepreneurship, 11*(2), 11-27. https://doi.org/10.1080/08276331.1994.10600453

Ginevičius, R. (2009). Some Problems of Quantitative Evaluation of the State of Social-Economic Systems. *Business: Theory and Practic*, *10*(2), 69-83. doi:10.3846/1648-0627.2009.10.69-83

Ginevičius, R., Nazarko, J., Gedvilaite, D., & Petraskevicius, V. (2023). Ranking the importance of multi-criteria evaluation indicators based on their transitivity. *Economics and Sociology, 16*(4), 309-320. doi:10.14254/2071-789X.2023/16-4/15

Ginevičius, R.; Podvezko, V. (2004). Hierarchical structuring of elements based on their transitivity. *Business: Theory and Practice, 5*(3), 85-89.

Grooters, S., Zaal, E., & Gerkema, M. (2023). Beyond entrepreneurship, raising broad academicprofessionals: Work-based learning in science from the employer's perspective. *Industry and Higher Education, 37*(4), 512-523. https://doi.org/10.1177/09504222221140077

Hamilton, S.F., & Hamilton, M.A. (1994). Schools and workplaces: Partners in the transition. *Theory Into Practice, 33*(4), 242-248. https://doi.org/10.1080/00405849409543646

Herzog-Stein, A., Joebges, H., Stein, U., & Zwiener, R. (2013). *Labour cost trends and international competitiveness in Europe. IMK Report, 88e.* doi:https://www.econstor.eu/handle/10419/106112

Hogeforster, M., & Alexander, M. (2018). Dual training schemes promoting entrepreneurship and business transfers – experiences from Lithuania 2018. *10th International Scientific Conference "Business and Management 2018"* (pp. 391-399). Vilnius: Technika. https://doi.org/10.3846/bm.2018.43

Hogeforster, M.A., & Priedulena, E. (2014). The Significance and Impact of Innovation Networks of Academia and Business with a Special Emphasis on Work-Based Learning. *Baltic Journal of European Studies*, *4*(2), 69-82. https://doi.org/10.2478/BJES-2014-0016

Juergensen, J., Guimón, J., & Narula, R. (2020). European SMEs amidst the COVID-19 crisis: assessing impact and policy responses. *Journal of Industrial and Business Economics, 47*(3), 499-510. https://doi.org/10.1007/S40812-020-00169-4/

Khurana, D., & Nielsen, P.P. (2022). Transitivity of Perspective. *Algebras and Representation Theory, 25*, 281-287. https://doi.org/10.1007/s10468-020-10020-y

Moore, T., & Morton, J. (2017). The myth of job readiness? Written communication, employability, and the 'skills gap' in higher education. *Studies in Higher Education, 42*(3), 591-609. https://doi.org/10.1080/03075079.2015.1067602

Morris, C., & Blaney, D. (2013). *Work-based learning.* https://doi.org/10.1002/9781118472361.ch7

Muñoz, D. (2022). Sources of transitivity. *Economics & Philosophy*, 1-22. doi:10.1017/S0266267122000074

Oželienė, D. (2019). *Modelling the factors of a company's sustainable development. Doctoral dissertation.* Vilnius.

Perusso, A., & Wagenaar, R. (2021). The state of work-based learning development in EU higher education: learnings from the WEXHE project. *Studies in Higher Education, 47*(7), 1423-1439. https://doi.org/10.1080/03075079.2021.1904233

Pilz, M. (2009). Initial Vocational Training from a Company Perspective: a Comparison of British and German In-House Training Cultures. *Vocations and Learning, 2*, 57-74. https://doi.org/10.1007/s12186-008-9018-x

Podvezko, V. (2008). Comprehensive evaluation of Complex quantities. *Business: Theory and Practice, 9*(3), 160-168.

Rakauskienė, G. (2013). *The increase of validity of National Competitiveness' Promotion Decisions. Doctoral dissertation.* Vilnius: Technika.

Rooney-Kron, M., & Dymond, S.K. (2023). Work-Based Learning Experiences and Students With Intellectual Disability. *Inclusion, 11*(2), 84-99. https://doi.org/10.1352/2326-6988-11.2.84

Saaty, T.L. (1980). *The Analytic Hierarchy Process.* New York: McGraw-Hill. https://doi.org/10.1002/0470011815.b2a4a002

Salavou, H., Baltas, G., & Lioukas, S. (2004). Organisational innovation in SMEs: The importance of strategic orientation and competitive structure. *European Journal of Marketing, 38*(9), 1091-1112. https://doi.org/10.1108/03090560410548889/

Tutygin, A., & Korobov, V. (2010). Advantages and disadvantages of the analytic hierarchy process. *Ekonomika [Economics]*, 108-115.

Ustinovičius, L., Zavadskas, E.K., & Podvezko, V. (2007). Application of a quantitative multiple ceriteria decission making (MCDM-1) approach to the analysis of investments in construction. *Control and Cybernetics, 1*, 251-269.

Wolter, S.C., & Ryan, P. (2011). *Handbook of the Economics of Education. Chapter 11 - Apprenticeship* (Vol. 3). https://doi.org/10.1016/B978-0-444-53429-3.00011-9

Yang, Y., & Dimitrov, D. (2021). Weak transitivity and agenda control for extended stepladder tournaments. *Economic Theory Bulletin, 9*, 27-37. https://doi.org/10.1007/s40505-020-00190-9

Zighan, S., & Ruel, S. (2023). SMEs' resilience from continuous improvement lenses. *Journal of Entrepreneurship in Emerging Economies, 15*(2), 233-253. https://doi.org/10.1108/JEEE-06-2021-0235