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Application of multicriteria decision aid for evaluation of ICT usage in business

Dalė Dzemydienė[1] · **Giedrė Dzemydaitė**[2] · **Dinesh Gopisetti**[3,4]

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Abstract
The different types of business management systems provide the functionality for management of business enterprises by enabling the maintaining of data about the management of all types of resources used in business. The statistical data helps us in revealing of information about the functioning of enterprises and the implementation of information communication technologies (ICT). Our research area concerns the methods for evaluation of ICT access and usage in businesses and possibilities to evaluate a variety of different types of used systems. The access and usage of ICT by business enterprises have differences and is quite complex for evaluation. Countries provide statistical data about the level of ICT usage. An approach presented by this research include some methods for multi-criteria decision support by applying the TOPSIS, AHP and SAW methods. As the case study we demonstrate the evaluation of ICT usage in small and medium enterprises of business of Lithuania in comparison with other countries. The TOPSIS method provides the structure of decision making which help to evaluate the distance between the level of ICT usage in business of some countries of EU. Empirical research results show disparities of evaluation of countries by ICT usage in business according to the dynamic perspective.

Keywords Information communication technology (ICT) · Decision support · Business management systems · Multi-criteria decision making methods

1 Introduction

In the recent decade extraordinary changes were achieved in numerous business areas, including manufacturing industry, retail sector and other sectors. It is seen that information technology (IT) assets are being renovated and re-engineered on regular basis in the areas of bookkeeping, marketing and sales, finance planning, supply chain management, production and human resources planning. This move

✉ Dalė Dzemydienė
dale.dzemydiene@mif.vu.lt

Extended author information available on the last page of the article

could be explained by business willingness to reduce the costs and to create higher benefits for clients that leads to higher efficiency rates and profits.

The IT usage in businesses enterprises is differentiated between different size and types of the companies. Business use IT in different intensity and it could create differentiated opportunities to seek for efficiency. Even though countries have general statistical data about the level of IT usage, more analytical techniques seems to be required to evaluate differentiations between companies and countries in IT usage in achieving outputs from IT usage.

There are different studies that tried to evaluate a level of usage of information and communication technology (ICT) in business (Premkumar 2003; Ceric 2015). Z. Mastilo and others evaluate the impact of digital growth in modern business (Mastilo 2017). The ICT usage was comparatively high, despite the fact that there were no conceivable outcomes of e-business (Bocij et al. 2015). The study points were to mirror the usage of ICT as an interface between the private and open area. It is likewise proposed to portray the current ICT implementation and benefits in the business uncovering up to what degree they address with the organizations' issues for further business advancement.

Bedeley et al. (2018) contend that manageability of this area focuses can be improved impressively on the off chance that taxpayer supported organizations are implanted. In any case, for the ICT implementation to be converted into beneficial returns, the organization must embrace a learning focused ICT framework. This is substantiated by information sharing, between hierarchical connections, and the commitment to the goals of the certain contention among maintainability and monetary development.

The aim of this research is to analyze differentiations of ICT usage in small and medium enterprises (SME) by enabling the evaluation of sustainable development of business. Special view is paid for business management systems and ICT usage differentiation in business and their benefit. For achieving this aim the main objectives of research are as follows: to analyze the possibilities of application of multi-criteria decision making methods for evaluation of ICT usage in business development; to analyze the methods for recognition of different alternatives of decision making in the ICT implementation area of business enterprises. We demonstrate the results of the evaluation of ICT usage in SME of business in Lithuania in comparison with other countries (Latvia, France, United Kingdom, and Greece). It supported the idea that multi-criteria decisions making methods could be applied to compare ICT usage between different countries in dynamic time perspective.

2 Benefits of implementation of ICT and BMS in business

The different types of ICT are used for managing and optimizing various tasks in business organizations (Wier et al. 2007; Dzemydiene and Baltrusaitis 2015; Bazaras et al. 2010). The attention of the scholars is put on finding solutions for the problems of business process management and organization while focusing on the following aspects:

- What are the conceptual models of collaboration and interoperability of separate business segments and organizations;
- When is the organization mature and ready to install the business management processes, ICT and e-services;
- How to classify the e-services and ICT dedicated to the business processes;
- How to estimate and determine the efficiency of the innovative activities of business, and its changes.

A particular emphasis can be analyzed by paying more attention on the issues of intangibility and multiplicity of the innovative activity assessment. The analyzed problems and offered solutions are related to the largest business entities, thus either ignoring the small and medium-sized business sector or assessing it by applying only the methods and indicators of measuring its productivity.

We are trying to found the indicators and methods of measuring the efficiency of business process infrastructure, which would meet the requirements of the SMEs by implementing innovative ICT.

The problematic research field of the effective organization of business process infrastructure support is topical, especially with the emphasis on the context of a scarcely analyzed particularity of SME, with regards to both theoretical and practical approaches analysis of the application of the e-services in the business process infrastructure (Arsanjani et al. 2015; Ceric 2015). Multiplicity of the evaluation possibilities led to the conclusion that the concept of a value chain can be reasonably applied as a platform for organization of evaluation activities (Saha 2011; Bedeley et al. 2018). Despite of grouping into the traditional quality control, business principles and ICT application based on the classification of value chain evaluation methods, it might be claimed that utilization of ICT measures and tools in the infrastructure process has an immediate influence on the levelling of the relative distribution boundaries. We would like to provide the classification of evaluation criteria on the basis of multi-criteria compromise approach by grouping the analyzed criteria into three categories (quality, price, performance), following the M. Porter's value chain model and other recommendations provided by (Saha 2011). The criteria system is based on the concept of value chain creation, evaluation of its separate elements and developing of the basis of the combination of parameters of price, quality and performance. Such a system of criteria becomes a universal tool that allows SMEs to evaluate the effectiveness of their activities and their compliance with the needs of consumers (Fig. 1).

Number of minimization parameter of SME entity's value creation chain constituent elements should be emphasized as it improves its activity efficiency characteristics.

The choice of ICT for improving the processes of business has been a challenging task for SME (Kale et al. 2010). By analyzing the layers of information infrastructure, as ICT support of business organizations, we can divide it in 7 layers. Even though they are connected with each other, they have different types of system support possibilities (Fig. 2). The common information infrastructure of business organization contains different layers: a layer of law and legal systems, a layer of management and control, a layer of technical equipment (hardware), a

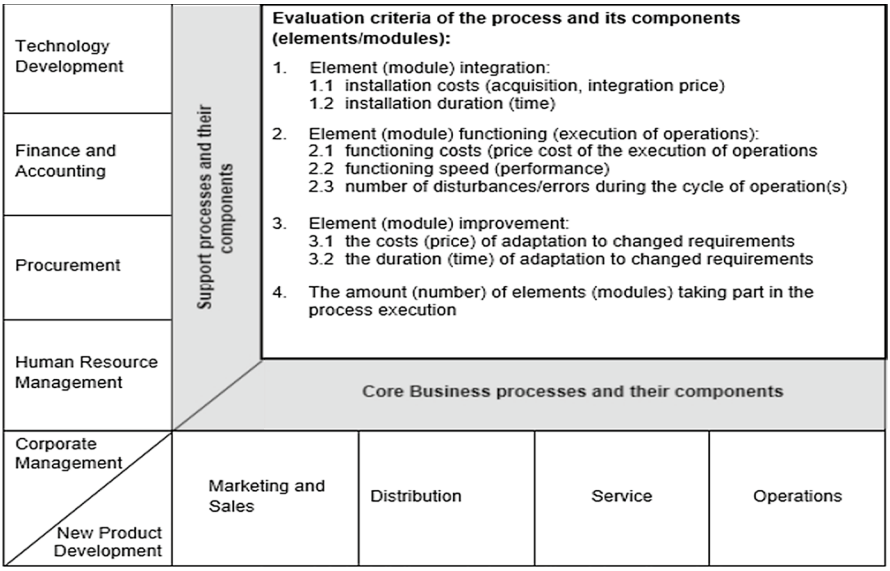

Fig. 1 The components of evaluation of business process infrastructure by following M. Porter's value chain model. *Source*: Prepared by following M. Porter's value chain model, and Saha (2011)

layer of software, a layer of databases, a layer of information systems, and a layer of decision support systems that could be related with different types of ICT. There are different types of management information systems (MIS) and business management system (BMS) that vary from the type of enterprise resource planning (ERP) systems, such as provided by IT corporations, for example as SAP, Microsoft versions of BMS as Axapta, Navision, Dynamics, Green plain, by Oracle Business Suite, or open source ERP and CRM systems as ODOO, Sugar CRM and etc. (Kale et al. 2010; Karimi et al. 2007; Møller 2005; Shaul and Tauber 2012; Law and Ngai 2007), until Business Intelligence Systems (BIS) (Marjanovic 2007; Sun 2016). Expert systems are used as well, and are helpful for knowledge management in business and for improvement of their functionality (Dzemydiene et al. 2019).

A business can attain the following advantages with the implementation of management information systems (MIS) (Taticchi et al. 2010), such as: an economy of scales; a balancing conflicting requirements; a flexibility and a responsiveness, and many others. With the help of MIS all operations of the business can be combined and information can be supplied at a very fast rate from one department to another. The volume of advanced developments and the effect on current business is more prominent than can be seen from the present point of view. It ought to be noticed that extensive organizations in their look for the likelihood of business enhancement have perceived ICT as a factor to raise issues related with prohibited actions. Governments and administrations of global organizations are attempting to empower the advancement of inventive exercises in hardware and interchanges of ICT (Ceric 2015).

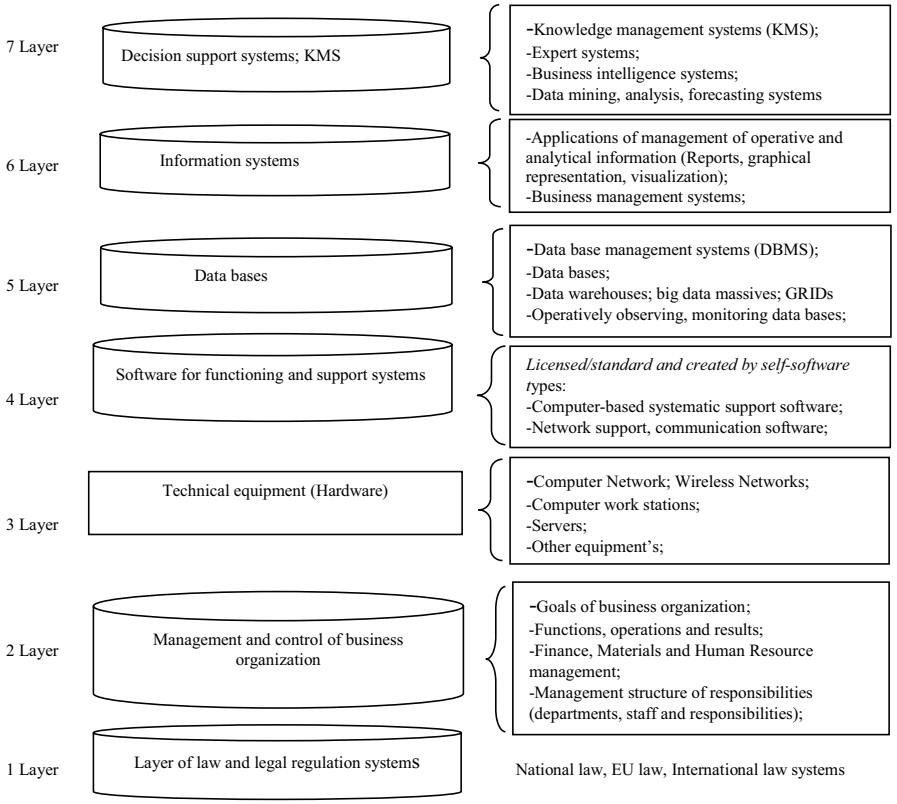

Fig. 2 Layers of information infrastructure in a business organization

While various innovations are applied to help in e-commerce, including e-information trade (EDI) and e-finance exchange (EFT), a standout amongst the most conspicuous advances for business supposed to be the internet and its usage possibilities (Lee et al. 2010; Shiels et al. 2003).

The comparison of methods for evaluation of business performance and ICT implementation we would like to provide by describing the spectrum of proposals of approaches and methods for developing of quality management of business during the historical point of view (Table 1). Some evaluation possibilities by implementing the framework which help us to overview the main approaches provided for business management in the world, and which help us to summarize all provided possibilities of ICT means for business.

The PMM, i.e. Performance Measurement and Management framework is provided by summarizing of such approaches described in works of (Taticchi et al. 2010; Shaul and Tauber 2012; Arsanjani et al. 2015). The methods of influencing business quality and management have be evaluated in parallel with developing processes of innovative ICT which support infrastructure components of business processes and re-engineering (Table 1).

Table 1 Overview of approaches provided for business activities, quality management and ICT support by historical periods. *Source*: This overview developed by works of Taticchi et al. (2010), Saha (2011), etc.

Period	Approaches for quality control of business activities	Approaches for evaluation of business management	ICT support and computer-based business management structures
1980–1990	*American Society for Quality* (ASQ); *Total Quality Management* (TQM); *Return On Investment* (ROI) *Return On Assets* (ROA); *Return On Capital Employed* (ROCE); *Activity Based Costing* (ABC); *Activity Based Management* (ABM)	*M. Porter's Value Chain;* *Rummler-Brashe Performance Improvement structure;* *Economic Value Added Model* (EVA)	*Soft Systems Methodology* (SSM) IT architecture development approaches: *-Business Process Management Initiative* (BPMI); Provided methods *of Workflow Management Coalition* (WfMC); *Object Management Group* (OMG); *International Institute of Business Analysis* (IIBA)
1990–2000	*Strategic Measurement Analysis and Reporting Technique* (SMART); *Return on Quality Approach* (ROQ) *LEAN methodology;* *Six Sigma method;* *International Society of Six Sigma Professionals* (ISSSP)	*Business Process Re-engineering* (BPR); *Customer Value Analysis* (CVA); *Performance Measurement Questionnaire* (PMQ); *Supportive Performance Measures* (SPA); *Service-Profit Chain* (SPC); *Results and Determinants Framework* (RDF)	*Computer-Aided Software Engineering* (CASE); IT *software packages*: *Customer Relationship Management* (CRM); Business Process Re-engineering Tools (BPRT); *Expert systems* (ES); *Computer Integrated Manufacturing* (CIM); *Rational Unified Process description methods (RUP)*
2000–2010	*Capability Maturity Model Integration* (CMMI); Joint Lean Six Sigma method; ISO 9000 Quality management standards I*SO 9000 Standards Series*	*Balanced Scorecard System* (BSS); *Business Process Management* (BPM); *Process Frameworks*: SCOR, CIBIT, eTOM; *Cambridge Performance Measurement Framework* (CPMF); *Consistent Performance Measurement System* (CPMS); *Integrated Performance Measurement System* (IPMS); *Business Excellence Model* (BEM); *Dynamic Performance Measurement System* (DPMS); *Comparative Scorecard System* (CBS); *Integrated Performance Measurement Framework* (IPMF)	*Business Process Architecture* (BPA); *Business Process Modeling Tools* (BPMT): *Unified Modeling Language* (UML) *- Business Process Model and Notation*) (BPMN); *- Business Process Management Software* (BPMS); *Federal Enterprise Architecture Framework* (FEAF); *Enterprise Application Integration*) (EAI) *Workflow models;* *Business Rules;* *Business Intelligence* (BI)

Table 1 (continued)

Period	Approaches for quality control of business activities	Approaches for evaluation of business management	ICT support and computer-based business management structures
2010–2015	*European Foundation for Quality Management* (EFQM); *SERVice QUALity model* (SERVQUAL); *Perceived e-Service Quality)* (PeSQ)	*Action-Profit Linkage Model* (APL); *Manufacturing System Design Decomposition* (MSDD); *Performance Prism* (PP); *Performance Planning Value Chain* (PPVC); CEVITA®—*Capability Economic Value of Intangible and Tangible Assets Model;* *Performance, Development, Growth Benchmarking System* (PDGBS); *Unused Capacity Decomposition Framework* (UCDF)	Analysis of *Good, Average, Poor* (GAP); *Value Network Mapping* (VNM); *Value Stream Mapping* (VSM)l *Information Technology Infrastructure Library* (ITIL); *IBM IT Process Model*);
2015-until now	*Production Planning and Control* (PPC); Model Quality Assurance (MQA)	*Green Manufacturing* *Shareholder Value as a Strategy;* *Sustainable Management*; *Business Networking Models* (BNM)	*Online Analytical Processing* (OLAP; MOLAP; HOLAP); *Data Mining* *Local and Global Information System* (LIS; GIS); Geographical information systems (GIS); ERP II; Integrated mobile and e-services; *Knowledge Management*: *Groupware;* *e-Learning;* *Integrated Project Management* (IPM); *Cloud computing;* *IaaS- Infrastructure as a Service;* etc.

3 An approach for evaluation of differentiation of ICT usage in SMEs

A lot of multi-criteria decision-making (MCA) methods have been created and proposed in literature. The MCA methods have been adjusted and connected to tackle refined functional and logical issues. We can found a variety of strategies dependent on multi-criteria utility hypothesis and different decision making methods provided as the Simple Additive Weighting method (SAW) (Memariania et al. 2009), the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) (Krohling and Pacheco 2015), COPRAS (Zavadskas et al. 2016), and review of different decision making strategies provided by (Zavadskas et al. 2009). The multi-criteria basic leadership could be connected to survey diverse choices of future exercises. Following by Zavadskas et al. (2016) "the multiple criteria analysis (MCA) gives a structure to breaking an issue into its constituent parts. MCA gives a way to examine various options in light of clashing needs".

Some of multi-criteria decision-making methods were compared in order to select the most suitable for ICT assessment opportunities in terms of the value chain for SMEs. Based on the nature of primary data (the level of evaluation criteria system) and characteristics of the data availability, some methods are analyzed such as: the Analytic Hierarchy Process (AHP), the SAW, and the TOPSIS. The structure is developed for evaluation of ICT usage by implementing of AHP and SAW methods and is presented in (Fig. 3). For the application of the TOPSIS method the implementation structure can be very similar.

Given the examples of best practice when several methods are combined, a conceptual method for business process infrastructures adjustment was developed on the basis of the concept of a value creation chain. The application of multi-criteria evaluation principles in the activities of value creation evaluation enables optimization of activities at minimal cost by maximizing compatibility of different value creation chain elements with one another as well as with consumer expectations. The scientific literature of 2004–2018 mostly focuses on four models of value creation chain evaluation as Balanced Scorecard (BS), Supply Chain Operations Reference model (SCOR), Data Envelopment Analysis model (DEA) and Analytic Hierarchy Process (AHP). That establish DEA and AHP principles, which are widely used for solution evaluation of engineering, mathematical, social problems (Zavadskas et al. 2016).

For this research two methods (the TOPSIS and the SAW) have preference as more applicable for needs of evaluation of ICT access and usage in SMEs.

3.1 Explanation of application of TOPSIS method

The TOPSIS method, developed by Hwang and Yoon in 1981 and applied in many other works, can be treated as a technique to judge the performance of alternatives through the similarity with the best solution. Following by the work of (Krohling and Pacheco 2015) in which "the simplest different would be one that's nearest to the positive-ideal solution and farthest from the negative-ideal

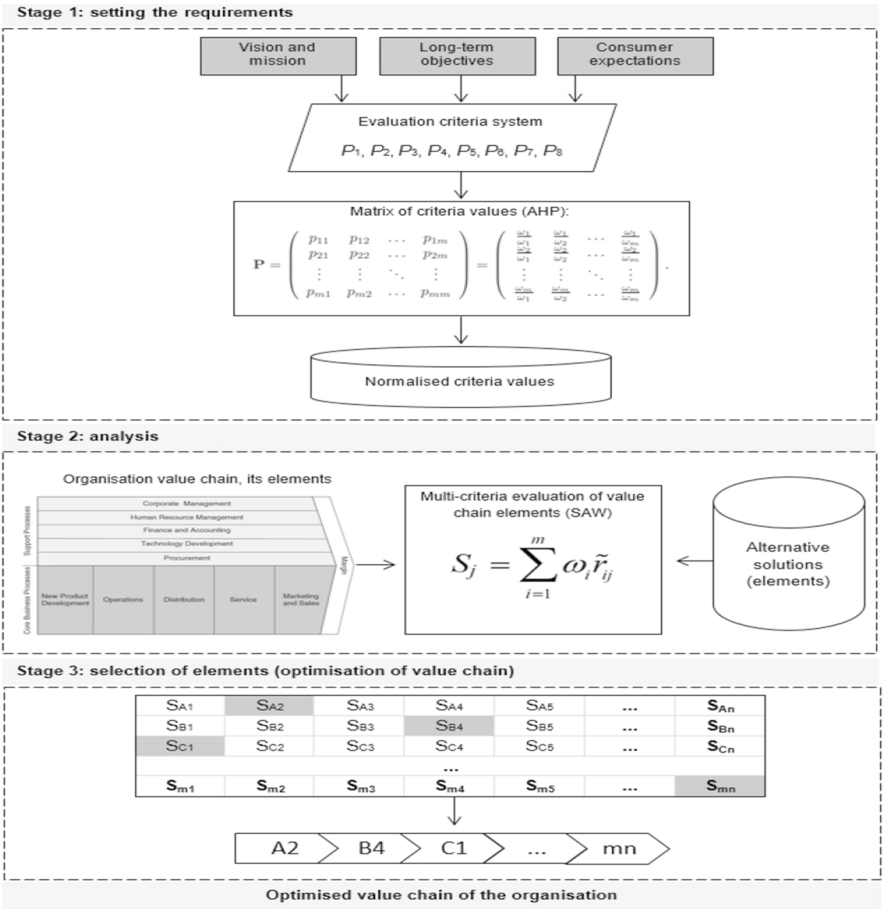

Fig. 3 Process of evaluation of infrastructure of ICT implementation in SME by using AHP and SAW methods

solution. The positive-ideal solution is one that maximizes the benefit criteria and minimizes the price criteria. The negative-ideal solution maximizes the price criteria and minimizes the profit criteria. In summary, the positive-ideal solution consists of all best values possible of criteria and also the negative-ideal solution consists of all the worst values possible of criteria."

We would like to follow the recommendations of the TOPSIS application process (Krohling and Pacheco 2015), as applicable steps of algorithm, which is carried out as follows:

Step 1 Construct the decision matrix and determine the weights of criteria. (The sum of all the weights should be equal to 1).

Step 2 Calculate the normalized decision matrix:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{1}$$

where n_{ij} normalized decision matrix.
Step 3 Calculate the weighted normalized decision matrix.

$$v_{ij} = w_j n_{ij} \text{ for } i = 1, \ldots, m; \quad j = 1, \ldots, n.$$

where v_{ij} weighted normalized decision matrix.
w_j the weight of the j-th criterion.
Step 4 Determine the positive ideal and negative ideal solutions.

$$V^+ = \left(v_1^+, v_2^+, \ldots, v_n^+\right) = \left(\left(\max_i v_{ij} \middle| j \in I\right), \left(\min_i v_{ij} \middle| j \in J\right)\right) \tag{2}$$

$$V^- = \left(v_1^-, v_2^-, \ldots, v_n^-\right) = \left(\left(\min_i v_{ij} \middle| j \in I\right), \left(\max_i v_{ij} \middle| j \in J\right)\right) \tag{3}$$

where I is associated with benefit criteria and J with the cost criteria, $i = 1, \ldots, m$; $j = 1, \ldots, n$; and V^+ positive ideal solution; V^- negative ideal solution.
Step 5 Calculate the separation measures from the positive ideal solution and the negative ideal solution.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_i^+\right)^2}, \quad i = 1, 2, \ldots, m. \tag{4}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_i^-\right)^2}, \quad i = 1, 2, \ldots, m. \tag{5}$$

where S_i^+ separation measure from positive ideal solution and, S_i^- separation measure from negative ideal solution.
Step 6 Calculate the relative closeness to the positive ideal solution.

$$P_i = \frac{S_i^-}{S_i^- + S_i^+} \tag{6}$$

where P_i positive ideal solution.
Step 7 Rank the preference order.

3.2 Possibilities of application of the SAW method

The SAW method is often also known as weighted summing method in which the main aspect is to find the weighted sum of performance ratings on each alternative on all attributes. The SAW method requires the process of normalizing the decision

matrix to a scale comparable to all existing alternative ratings. By following of recommendations how the SAW method is carried out, we follow such steps (Memariania et al. 2009):
Step 1 Construct the decision matrix and determine the weight of criteria. (The sum of all the weights should be equal to 1).
Step 2 Calculate the normalized decision matrix.

$$\text{For minimum criteria } \bar{r}_{ij} = \frac{\min_j r_{ij}}{r_{ij}} \tag{7}$$

r_{ij} i-th criterion's value for j-th alternative.
$\min_j r_{ij}$ the smallest i-th criterion's value for all the alternatives compared.
$\bar{r}_{ij}$ denotes the converted values.

$$\text{For maximum criteria } \bar{r}_{ij} = \frac{r_{ij}}{\max\limits_j r_{ij}} \tag{8}$$

$\max\limits_j r_{ij}$ the largest i-th criterion's value of all alternatives.
Step 3 Calculate the weighted normalized decision matrix.

$$w_i * \bar{r}_{ij}$$

w_i weight of the i-th criterion, $\bar{r}_{ij}$ normalized i-th criterion's value for j-th object; $i = 1, \ldots, m; \quad j = 1, \ldots, n$, m the number of the criteria used, n is the number of the objects (alternatives) compared.
Step 4 Calculate the sum.

$$S_j = \sum_{i=1}^{m} w_i \bar{r}_{ij} \tag{9}$$

Step 5 Rank the preference order.

The one of the limitations of the SAW method is all the criteria must be positive so if we have the negative values they should be transferred to the positive values. The transformation can be done as follow:

$$\bar{r}_{ij} = r_{ij} + \left|\min_j r_{ij}\right| + 1 \tag{10}$$

4 Results of evaluation of ICT access and usage by business of SMEs

For the evaluation situations of ICT access and usage by business we choose the primary statistical data of small and medium enterprises in Lithuania and provide the comparison with other countries (Latvia, Greece, United Kingdom, and France) by implementing the Official statistical data (https://stats.oecd.org). The percentage evaluation of ICT access and usage by businesses in such countries can help us

Table 2 Dynamics of access and usage of ICT in business enterprises (expressed by percentage per year). *Source*: Official statistical data (https://stats.oecd.org)

Weights	0.2	0.2	0.2	0.2	0.2
Country	Year				
	2013	2014	2015	2016	2017
Lithuania	75.2	74.53	77.28	77.03	78.03
France	65.3	63.59	66.82	68.5	66.53
United Kingdom	81.98	79.69	80.76	82.99	88.63
Greece	60.59	61.85	60.95	65.89	64.77
Latvia	55.66	55.86	58.95	63.49	62.93

Table 3 Results of normalized decision matrix after applying the Step 2 of TOPSIS method

	2013	2014	2015	2016	2017
Lithuania	0.491503	0.492565	0.497296	0.478773	0.479104
France	0.426797	0.420263	0.429986	0.425756	0.408494
United Kingdom	0.535817	0.526668	0.51969	0.515817	0.544188
Greece	0.396013	0.408764	0.392213	0.409534	0.397687
Latvia	0.363791	0.369176	0.379343	0.394617	0.38639

to reveal more common evaluation of situations of this complex phenomenon for reviewing of advancements during the period of 2013–2017 years. The structure of more detailed information about such statistical data include the indicators which represent the data about businesses with website or home page, businesses using ERP, CRM systems, electronic data interchange (EDI), systems for receiving orders over computer networks, usage of supply chain management systems (SCM), RFID functionality, etc.

4.1 Evaluation of main statistical data on ICT usage in business by using TOPSIS method

The results of Step 1 by following the TOPSIS method, demonstrate the construction of matrix by using data from the Official statistics (https://stats.oecd.org) by representing the access and usage of ICT (in percentage) by businesses of five countries of EU during the period from 2013 until 2017 years (Table 2). The weights are chosen as 0,2 and performed as equal for all cases of 5 year periods by giving the same weights in dynamic perspective, because the assessment of year periods have the same starting positions, and Sum of weights have to be equal to 1.

The results of Step 2 of TOPSIS method are provided in Table 3. The numbers in the table represents the results of that particular year for a particular country after calculating the normalized decision matrix (Table 2).

The results of Step 3 are provided in Table 4 by representing the data of that particular year for the particular country after the calculation of the weighted normalized decision matrix.

Results after determination of the positive ideal and negative ideal solutions are presented in Table 5.

The separation of measures from the positive ideal solution and the negative ideal solution are calculated by the Step 5 of the algorithm of TOPSIS method and the results of ranking are obtained during Step 6 and 7 of TOPSIS method (Table 6).

4.2 The example of evaluation of ICT access and usage in businesses by using SAW and AHP methods

We are trying to use another MCA method as SAW for the same purposes by applying the same statistical data. The starting decision matrix is presented in Table 7. The weights are taken as maximum and equal for all countries, because the access and usage of ICT in SME businesses are of the same starting position of analyzing of 5 countries, and the sum of weights should be more, but not less than $Sum = 1$.

Results of normalized matrix by implementing maximized criteria are demonstrated in Table 8.

The results of Step 3, Step 4, and Step 5 of SAW method are presented in Table 9 in which the sums and ranks of each country according to the usage of ICT in businesses during 2013 to 2017 years are calculated.

Table 4 Results after applying the Step 3 of TOPSIS method

	2013	2014	2015	2016	2017
Lithuania	0.098301	0.098513	0.099459	0.095755	0.095821
France	0.085359	0.084053	0.085997	0.085151	0.081699
United Kingdom	0.107163	0.105334	0.103938	0.103163	0.108838
Greece	0.079203	0.081753	0.078443	0.081907	0.079537
Latvia	0.072758	0.073835	0.075869	0.078923	0.077278

Table 5 Results of Step 4 determination of the positive ideal and the negative ideal solutions

V+	0.107163	0.105334	0.103938	0.103163	0.108838
V−	0.072758	0.073835	0.075869	0.078923	0.077278

Table 6 The ranks with ideal positive and negative solutions for each country according to the usage of ICT in businesses during 2013 to 2017 year period

Country	si+	si−	pi	Rank
Lithuania	0.019221	0.049448	0.720089	2
France	0.048074	0.020594	0.299906	3
United Kingdom	0	0.067434	1	1
Greece	0.05743	0.011174	0.162872	4
Latvia	0.067434	0	0	5

Table 7 Results of Step 1 of SAW method

	Weight	Lithuania	France	United Kingdom	Greece	Latvia
2013	0.20	75.2	65.3	81.98	60.59	55.66
2014	0.20	74.53	63.59	79.69	61.85	55.86
2015	0.20	77.28	66.82	80.76	60.95	58.95
2016	0.20	77.03	68.5	82.99	65.89	63.49
2017	0.20	78.03	66.53	83.63	64.77	62.93

Table 8 Normalized decision matrix

		Weight	Lithuania	France	United Kingdom	Greece	Latvia
2013	MAX CRITERIA	0.20	0.9172969	0.796536	1	0.739083	0.678946
2014	MAX CRITERIA	0.20	0.9352491	0.797967	1	0.776133	0.700966
2015	MAX CRITERIA	0.20	0.9569094	0.82739	1	0.754705	0.729941
2016	MAX CRITERIA	0.20	0.9281841	0.825401	1	0.793951	0.765032
2017	MAX CRITERIA	0.20	0.9330384	0.795528	1	0.774483	0.752481

Table 9 Results after applying the Steps 3–5 of SAW method, by ranking the countries by ICT access and usage

	Weight	Lithuania	France	United Kingdom	Greece	Latvia
2013	0.20	0.1834594	0.159307	0.2	0.147817	0.135789
2014	0.20	0.1870498	0.159593	0.2	0.155227	0.140193
2015	0.20	0.1913819	0.165478	0.2	0.150941	0.145988
2016	0.20	0.1856368	0.16508	0.2	0.15879	0.153006
2017	0.20	0.1866077	0.159106	0.2	0.154897	0.150496
Sum		0.9341356	0.808564	1	0.767671	0.725473
Rank		2	3	1	4	5

The provided methods allow to show which country ranks first in ICT usage. By the evaluation of ICT usage in Lithuania in comparison with the other countries we can know how Lithuania has a sustainable development in business by implementing ICT.

Anyhow there are some limitations of using SAW method, such as we cannot use the negative values and if there are negative values in the statistics, they should be converted into positive values and because of this there is a chance of losing some important data and the evaluation may have some errors and one more limitation of this method is all the criteria in the data should be maximum and not minimum which results in errors in the evaluation. However, in this analysis we have used the SAW method as there are no negative values in the statistics and the criteria of

using the ICT is always maximum and the results obtained by using the TOPSIS and SAW methods were comparatively similar. The provided methods allow to reveal which country ranks first in the ICT usage and the level of differentiation between countries.

For more detailed evaluation of ICT access and usage in businesses, the questionnaire for specialists—experts was developed with respect to find out the preferences of criteria. The method applied there is related with the specific of AHP method. Specialists-experts are from the management field of ICT implementation in different SME's, and they were asking about the preferences of using of innovative ICT tools. All questions form factors which are representing in the Table 10 by same number:

1. How the inter branch and inter-market communication is affected by ICT? (Such question forms 1 Factor in the Table 10 naming it as "Communication").
2. To what extents the business data collection are effected and utilized by the ICT?
3. If the data collection method is not 100% compatibility with the business, how much it affects business growth?
4. Is it necessary to hire the skilled employee or employee skill must be developed at the more grounding level?
5. Data management methods and data collection method are not available at low cost, is it necessary to reduce the expenditure on them or new methods are required?
6. Every employee has to know the data is safe or data access has to be open to every employee?
7. If information sharing is very important at what level it shows the effect on the business model?
8. What are the odds and evens of ICT on business profit growth?

By taking the above questionnaire, experts provide the weights as follows by presenting them in Table 10, and by showing the preference level of such criteria in business, and how this factors affect the value chain of business (Tables 11, 12).

In the market, every organization is trying to protect the employee information, at the same time employee has to understand the necessity of the ICT. Practically the entirety of the respondents has concurred that there are a constraint experienced IT experts with the capacities to plan and actualize the precise custom-fitted frameworks in accordance with the overall conditions exceptional to the nation just as the particular organization.

5 Conclusions

The phenomenon of ICT access and usage in businesses is very complex and corresponds to the implementation of vide spectrum of technologies and systems provided for business. The proposed methods for quality management of business varied and became more complex with application of novel methods proposed in time

Table 10 Expert's opinions on various factors which are affected SMEs by implementation the innovative ICT

	Factors	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Maximum values of each factor
1	Communication	2.5	3.5	3.8	4.0	6.0	6.0
2	Company's awareness of need for change in data collection	5.0	3.4	3.0	5.1	6.5	6.5
3	Compatibility	5.0	5.0	5.8	6.0	7.0	7.0
4	Knowledgeable employee's attitude toward data sharing	7.0	6.8	4.0	5.6	5.6	7.0
5	Data management cost	3.0	4.7	6.2	5.2	6.6	6.2
6	Data sharing and protection	2.0	3.8	5.0	4.0	4.0	5.0
7	Security concerns	1.0	3.9	4.3	2.8	3.4	4.3
8	Intra and inter connection between various departments and information sharing	6.5	6.9	3.8	6.5	6.8	6.9

Table 11 Weights of various factors

	Factors	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Weights
1	Communication	3	2	3	3	4	0.083333
2	Company's awareness of need for change in data collection	5	2	1	4	6	0.1
3	Compatibility	6	6	7	7	8	0.188889
4	Knowledgeable employee's attitude toward data sharing	8	7	4	6	3	0.155556
5	Data management cost	4	5	8	5	5	0.15
6	Data sharing and protection	2	3	6	3	2	0.088889
7	Security concerns	1	4	5	1	1	0.066667
8	Intra and inter connection between various departments and information sharing	7	8	3	8	7	0.183333

Table 12 Normalized values of various factors

	Factors	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
1	Communication	0.034722	0.048194	0.052778	0.055556	0.083333
2	Company's awareness of need for change in data collection	0.076923	0.053385	0.046154	0.078462	0.1
3	Compatibility	0.148413	0.134921	0.156508	0.161905	0.188889
4	Knowledgeable employee's attitude toward data sharing	0.155556	0.151111	0.088889	0.124444	0.125556
5	Data management cost according to business law	0.084	0.1128	0.1488	0.12672	0.15
6	Data sharing and protection	0.035556	0.067556	0.088889	0.071111	0.071111
7	Security concerns	0.027907	0.060465	0.066667	0.043411	0.052713
8	Intra and inter connection between various departments and information sharing	0.172705	0.183333	0.100966	0.172705	0.181208
	Sum	0.735781 5	0.811765 3	0.74965 4	0.834314 2	0.95281 1

perspective. The problems of choosing the well-grounded and reasoned solutions are important in the organizations of business and influence the processes of the infrastructure changes. Making the most appropriate decision in a given situation turns into a multi-criteria challenge that can affect the business organization's in the operational prospects. Comprehensive assessment of business organization for preparedness to ICT innovations are influenced by parameters and criteria of preferences of using informative and objective indicators, which help to reduce the likelihood of possible wrong decisions and avoid the negative consequences of performance.

The versatility of the evaluation criteria allows the comparison and evaluation of the many alternatives offered for SMEs on the market, which are treated as separate infrastructure elements and can help to increase the efficiency of the value chain. The SME entity have possibility to evaluate the value chain processes (their constituent elements) using a common set of valuation criteria (combinations of values) and replace the non-compliant elements with one of the many alternatives on the market. Multiple Criteria Decision Making (MCDM) can be used to evaluate alternatives in a timely manner based on a combination of criteria. They are used to find the optimal solution and are divided into two groups: multi-objective and multi-objective.

Despite the wide range of applications, all problems solved by the multi-criteria decision-making method have some common features: alternatives are evaluated against several indicators; the evaluation criteria may conflict with one another; the measurement indicators may have different units of measurement.

The expediency of applying the principles of multi-criteria evaluation in the field of management is also determined by the tendency that single-criteria evaluation methods cannot solve problems in complex technology or marketing systems.

For evaluation of ICT usage in small and medium enterprises of business some methods were choose. For evaluation of ICT usage in SME of Lithuania in comparison with the other countries we can evaluate Lithuanian case and distance from the other countries. The spectral use of IT as business management systems (BMS) and some of their benefits is revealed in a paper. The limitations of this research that five countries were involved and two multi-criteria decision making methods were used (TOPSIS and SAW). In future we would like to expand this research by getting the expert's evaluations of statistical data by using other multi-criteria decision making methods such as Kendell coefficient of concordance and analytic hierarchy process (AHP).

According to the scientific literature, the choice of the most appropriate method for solving the problem is usually determined by the nature of the information available. After evaluating the application of the methods in practical tasks, the number and different dimensions of the evaluated criteria and their possible alternatives, the level of competence of the potential users of the method and the resources managed are analyzed and the SAW, TOPSIS and AHP method combination are applied. One of the features of the presented conceptual model is its simplicity, considering the limited resources of the SME entities. Many quantitative multi-criteria methods directly or indirectly apply the idea of the SAW method, only the methods of dominant alternatives use values of specially selected functions (priorities, consensus, and disagreement) instead of criteria normalized values. The validity of the

method is also determined by the justification of the data required for the task based solely on quantitative measurements. The rules of the method can be summarized: these are the input data—the decision matrix and the significance of values of the indicators.

The choice of the AHP method was determined by its versatility and popularity, its ability to combine with TOPSIS and SAW (both methods belong to the group of combined methods, the main feature of which is the use of expert competence) evaluated by structured sequence of actions of using mathematical analysis methods.

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Affiliations

Dalė Dzemydienė[1] · Giedrė Dzemydaitė[2] · Dinesh Gopisetti[3,4]

Giedrė Dzemydaitė
giedre.dzemydaite@evaf.vu.lt

Dinesh Gopisetti
dinesh.gopisetti@stud.vgtu.lt

[1] Institute of Data Science and Digital Technologies, Faculty of Mathematics and Informatics, Vilnius University, Akademijos Str. 4, Vilnius, Lithuania

[2] Department of Economic Policy, Faculty of Economics and Business Administration, Vilnius University, Saulėtekio Av. 9, Vilnius, Lithuania

[3] Department of Business Technologies and Entrepreneurship, Faculty of Business Management, Vilnius Gediminas Technical University, Saulėtekio Av. 11, Vilnius, Lithuania

[4] V. R. Siddhartha Engineering College, NH-9, Kanuru, AP, India