G-AUDI FRAMEWORK: EVALUATION OF ICT INDUSTRY IN LATVIA TO DEVELOP STRATEGIES

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Abstract

Purpose: to create a synthesised conceptual framework for evaluating the information and communication technology (ICT) industry and to illustrate application of the framework by identifying existing situations and tendencies in the ICT industry in Latvia in order to suggest development strategies for ICT enterprises and ICT policymakers.

Approach: adopted a systematic literature review method and, through the content analysis technique, analysed 158 scientific papers (only papers mentioned directly in the article are included in the references), book chapters and proceedings focused on the ICT industry. The period of the literature review: January 2000 – March 2016. Based on the analyses, a conceptual framework is developed. The main data sources for ICT industry evaluation in Latvia 2014/2015 within the created framework: public government organisation reviews and studies – Global Information Technology Report 2015 (World Economic Forum, 2015), The PREDICT 2015 Report: An Analysis of ICT R&D – the EU and Beyond (European Commission, 2015), Digital Agenda for Europe. Unlocking the ICT growth potential in Europe: Enabling people and businesses (European Union, 2013), and World Bank and Eurostat statistics about the ICT industry.

Findings: the results of the literature research revealed that the main research gap is that there are no academic, focused and holistic studies on the ICT industry in Latvia that evaluate not only the situation in the industry but also tendencies and possible development strategies for ICT enterprises and policymakers. This is a highly relevant topic and the authors have developed a wide range of possible future research directions, which shows that this topic has scientific potential. In the paper a synthesised G-AUDI framework consisting of 5 elements is proposed in order to analyse the industry, i.e., the performance level of its actors, usage, domain and impact, and the levels of these elements could also reveal the gaps in the industry's development. Evaluation of the ICT industry in Latvia shows that the levels are close and mostly at a medium-low level, but there are gaps to fill to improve the performance of the industry in Latvia. Several possible strategies are mentioned that should be validated by experts in detailed future studies.

Value: it is one of the few up-to-date studies that have compiled trends and challenges mentioned in the scientific literature. The conceptual ICT industry evaluation framework created in the study should be further tested empirically.

Paper type – conceptual paper.

Keywords – ICT industry, ICT industry evaluation, ICT industry in Latvia, SWOT matrix

INTRODUCTION

In the last 15 years ICT has driven global development in an unprecedented way and technological progress and infrastructure development have increased access to ICT and connectivity around the world (ITU, 2015). Between 2000 and 2015 there were serious changes in the ICT industry: (1) globally 3.2 billion people were using the Internet by the end of 2015, of which 2 billion were from developing countries; (2) in 2015 there were more than 7 billion mobile cellular subscriptions compared to only 738 million in 2000; (3) global Internet penetration increased from 6.5% in 2000 to 43% in 2015; (4) the number of mobile broadband subscriptions has increased 12 times since 2007 and was used by 47% of the world's population in 2015; (5) household Internet access grew from 18% in 2005 to 46% in 2015; (6) the proportion of the population covered by a 2G mobile-cellular network grew from 58% in 2001 to 95% in 2015 (ITU, 2015). These data show that the ICT industry is growing fast globally – but what is the situation in Latvia? According to research conducted in 6 databases, there are only two

scientific papers about the ICT industry in Latvia. One of them describes the quantitative characteristics of information society and the ICT industry in Latvia (Gulbe, 2015), and the other analyses the competitiveness of Latvia's ICT service sector, but these studies reveal only a few ICT industry indicators (Balina & Mickevica, 2012). The Central Statistical Bureau (CSB) has gathered some data about the ICT industry. Based on CSB data, the Investment and Development Agency of Latvia (2015) has concluded that the ICT industry itself comprises only 3.8% of the GDP of Latvia. But the ICT industry's importance goes well beyond that; it is vital to: (1) meeting globalization and social challenges; (2) delivering cutting-edge science; (3) making the public sector more efficient and modernizing sectors ranging from education to energy, etc. These are the reasons why it is vitally important to research this industry. There are also global business consultancy and public government organisation reviews and studies which research specific aspects of the ICT industry on a global or European level that also include Latvia, for example, the Global Information Technology Report 2015 (World Economic Forum, 2015), The PREDICT 2015 Report: An Analysis of ICT R&D – EU and Beyond (European Commission, 2015), Digital Agenda for Europe. Unlocking the ICT growth potential in Europe: Enabling people and businesses (European Union, 2013), and World Bank and Eurostat statistics about the ICT industry. All these studies could be divided into two groups: (1) studies that explore one specific ICT industry aspect and its tendencies; (2) studies that explore many aspects but not tendencies. There are no studies that develop possible development strategies for ICT enterprises and policymakers based on an evaluation of the situation. So there is a research gap. Every study uses different ICT industry evaluation indicators and methods, but the most frequently applied evaluation tools are Porter's 5 Forces Model and input-output analysis. This situation shows that there is a lack of tools to evaluate the ICT industry, so the aim of the authors is not only to research the ICT industry in Latvia, but also to create an evaluation framework for the ICT industry based on literature research that will not only describe the current situation but also evaluate tendencies with the aim of developing possible development strategies for ICT enterprises and policymakers.

Research aim: to create a synthesised conceptual framework for evaluating the information and communication technology (ICT) industry and to illustrate application of the framework by identifying existing situations and tendencies in the ICT industry in Latvia in order to suggest development strategies for ICT enterprises and ICT policymakers.

Research tasks: (1) determine the main dimensions for evaluating the ICT industry, create an ICT industry evaluation framework based on them; (2) illustrate application of the framework by evaluating the ICT industry in Latvia and developing possible strategies for ICT industry enterprise managers and policymakers.

Research design: (1) explore literature about the ICT industry in order to create an ICT industry evaluation framework; (2) evaluate the ICT industry in Latvia; (3) conclusions and suggestions for future research.

Research method: systematic literature review method and content analysis technique.

Research questions:

- RQ1 – What is the level of research on the ICT industry in Europe and Latvia based on the researched literature?
- RQ2 – What are the most researched trends and challenges?
- RQ3 – What are some future research ideas regarding the ICT industry in Latvia?
- By addressing different aspects of ICT industry research, the answers to these questions imply an answer to RQ4: What are the main dimensions for ICT industry evaluation (sub-elements and elements)?

Research basis: literature sources from 6 databases – *Scopus, ScienceDirect, Sage Journals, EBSCO Academic Search Complete, Emerald, and Web Science* – as well as business consultancy and public government organisation reviews and studies. In the research, mainly secondary sources (scientific papers, books, etc.) are used to create an ICT industry evaluation framework, while business consultancy and public government organisation reviews and studies are used to create an evaluation of the ICT industry in Latvia.

Theoretical aspects of the ICT industry

The ICT industry has become significant in the regional economic structure during the last two

decades through its increasing impact on other industries (Hudec & Sebova, 2012). Zoroja (2015) found that ICT plays an important role in the competitiveness of European countries on a global level, while Garcia-Muniz & Vicente (2014) maintain that the ICT industry is the key instrument for the development of an economy. Chand (2005) has even written that ICT is a survival tool in a social, economic, political and military sense. Mathur (2009) has asserted that the difference between information and communication technology reveals that information technology refers to computer software, computer services and hardware, while communication technology describes telecommunications equipment.

There are many definitions of the ICT industry but one of the elements that could provide the most accurate view are standards on industry classification. For example, the OECD stated that the "ICT industry is a combination of manufacturing and services industries that capture, transmit and display data and information electronically" (OECD, 2003:81). This definition of the ICT industry is also consistent with standard international classification of its activities (ISIC Rev. 3):

(1) "Manufacturing: 3000 - office, accounting and computing machinery; 3130 - insulated wire and cable; 3210 - electronic valves and tubes and other electronic components; 3220 - television and radio transmitters and apparatus for line telephony and line telegraphy; 3230 - television and radio receivers, sound or video recording or reproducing apparatus and associated goods; 3312 - instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process equipment; 3313 - industrial process equipment.
(2) Services: 5150 - wholesaling of machinery, equipment and supplies; 7123 - renting of office machinery and equipment (including computers); 6420 - telecommunications; 72 - computer and related activities" (OECD, 2003: 81).

This definition concentrates on the characteristics of the industry's products, but it was revised again in 2007. The new definition of the ICT sector is as follows: "the production (goods and services) of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display" (OECD, 2007: 15). The list of ICT industries (ISIC Rev. 4) that meet these conditions are as follows:

(1) "ICT manufacturing industries: 2610 - manufacture of electronic components and boards; 2620 - manufacture of computers and peripheral equipment; 2630 - manufacture of communication equipment; 2640 - manufacture of consumer electronics; 2680 - manufacture of magnetic and optical media.
(2) ICT trade industries: 4651 - wholesale of computers, computer peripheral equipment and software; 4652 - wholesale of electronic and telecommunications equipment and parts.
(3) ICT services industries: 5820 - software publishing; 61 - telecommunications; 6110 - wired telecommunications activities; 6120 - wireless telecommunications activities; 6130 - satellite telecommunications activities; 6190 - their telecommunications activities; 62 - computer programming, consultancy and related activities; 6201 - computer programming activities; 6202 - computer consultancy and computer facilities management activities; 6209 - other information technology and computer service activities; 631 - data processing, hosting and related activities; web portals; 6311 - data processing, hosting and related activities; 6312 - web portals; 951 - repair of computers and communication equipment; 9511 - repair of computers and peripheral equipment; 9512 - repair of communication equipment" (OECD, 2007:15).

The new view differs from the previous view in the following ways: (1) the scope of the ICT industry is narrowed down by excluding electronic processing to detect, measure and/or record physical phenomena or control a physical process; (2) some categories are more specific.

In this research the OECD (2007) definition will be used as it is the latest OECD ICT industry definition and is widely used by other organisations, for example, the European Commission. It should be noted that this definition provides only a general view for the authors on this industry and will be used in framework development.

Research methodology

The research is based on the theoretical research method – the adapted systematic literature review method – and the content analysis technique regarding scientific literature about the ICT industry in

order to create a holistic ICT industry evaluation. Based on the analyses a conceptual model is developed. Business consultancy and public government organisation overviews and studies on the ICT industry are applied to demonstrate how to apply this framework by evaluating the situation and perspectives in Latvia. The research design is shown in Figure 1.

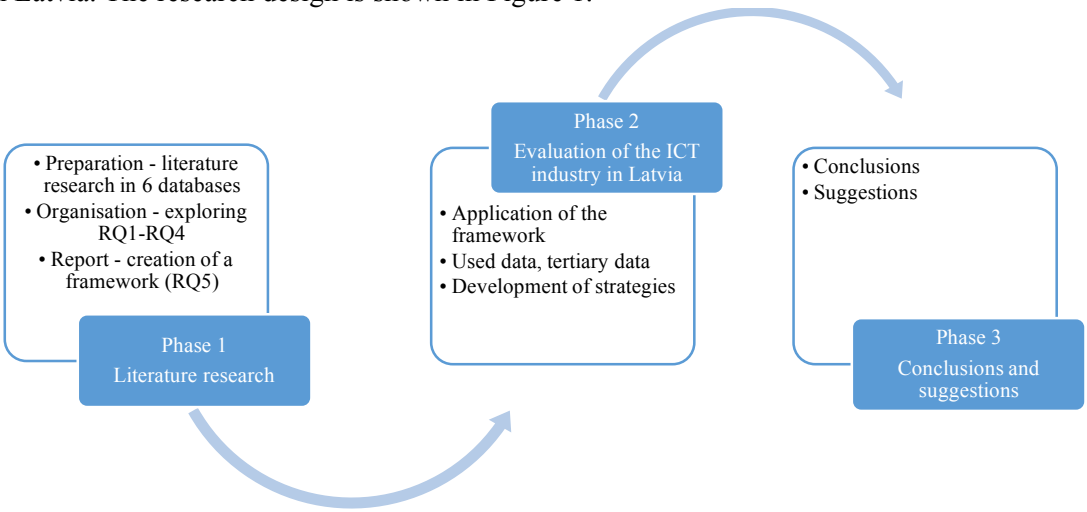


Figure 1. Logical schema of the research

Phase 1 – literature review divided into 5 research stages: (1) to research literature about the ICT industry; (2) to select literature specifically about the ICT industry; (3) to exclude duplicates; (4) to analyse selected papers; (5) to create an ICT industry evaluation framework.

The researched literature was written between January 2000 and March 2016. The first three research stages are shown in detail in Table 1.

Table 1

Literature Review (Step 1- Step 3)

	Stage 1 Sources in which "ICT industry" is mentioned (in the title and/or abstract)	**Stage 2 Sources specifically about the ICT industry**	**Stage 3 Unique sources**
Scopus	258	113	158
ScienceDirect	14568	37	
Sage Journals	4386	11	
EBSCO Academic Search Complete	37	20	
Emerald	4159	16	
Web of Science	1694	68	
Total:	25102	262	

Overall, 158 papers and proceedings were analysed, but only those mentioned in this article directly are referenced.

After Stage 3, selected sources were analysed in a systematic review using a 3-step approach (Boiral, 2012): (1) development of a review protocol; (2) data extraction; (3) information synthesis. The development of a protocol is important for collecting answers to RQ1-RQ3. In the review process the main factors for analysis were: (1) geographical perspective of the paper; (2) ICT industry trends and challenges included; (3) ICT industry sub-elements included; (4) research gaps described; (5) research aim and research results.

The fifth stage of the literature review is the creation of an ICT industry evaluation framework based on the main ICT industry indicators according to the researched literature using both deductive and inductive approaches (detailed in Section 1.2). In Phase 1 of this stage, RQ4 is answered: What are the main dimensions (elements) for ICT industry evaluation based on the main ICT industry indicators found in the literature review?

Phase 2: evaluation of the ICT industry in Latvia based on the evaluation framework created, applying data from Global Information Technology Report 2015 (World Economic Forum, 2015), The PREDICT 2015 Report: An Analysis of ICT R&D – the EU and Beyond (European Commission, 2015), Digital Agenda for Europe. Unlocking the ICT growth potential in Europe: Enabling people and businesses (European Union, 2013), and World Bank and Eurostat statistics about the ICT industry. At the end of Phase 2: creation of potential development strategies for ICT enterprises and policymakers in Latvia.

Phase 3: conclusions (on the situation and perspectives in the ICT industry in Latvia and on the level of research in this area) and suggestions for future research and development with regard to the ICT industry in Latvia.

1. RESULTS OF THE LITERATURE RESEARCH

1.1. ICT INDUSTRY LITERATURE

Based on the content analysis conducted, the paper provides an answer to RQ1 – what is the level of research on the ICT industry in Europe and Latvia based on the researched literature? According to the literature research it may be concluded that the level of research on the ICT industry in Europe is appropriate, since 69 of 158 researched literature sources were directly related to European countries, while only 24 sources (for example in Broeders & Hampshire, 2013; Misuraca, Broster & Centeno, 2012; Narulaa & Santangelob, 2009; Ballon & Van Heesveide, 2011; Dimelis & Papaioannou, 2011; Rohman, 2013; Jorgenson & Vu, 2016; Luhan & Novotna, 2015; Savulescu, 2015; Rohbeck, 2010) were about more than one European country. Only 2 research papers about the ICT industry in Latvia were found – Gulbe (2015), Baltina and Mickevica (2012). This situation shows that there is a lack of focused studies about the ICT industry in Latvia. It should be noted that studies mainly focus on exploring some specific aspects of the ICT industry, but there is a lack of scientific papers evaluating the ICT industry and creating new frameworks to evaluate it. The authors support the opinion that studies should not only explore something new but also provide contributions regarding possible practical implications. The authors consider that evaluation of the ICT industry should explore not only the overall situation and tendencies but also strategies for ICT industry enterprises and policymakers.

The literature review also provides an answer to RQ2 – what are the most researched trends and challenges? There are studies about different ICT industry trends and challenges, and to sum up, in the researched literature, the focus is mainly on different trends and challenges in the ICT industry. Additionally, there is a well-noted stream of research about the ICT industry's impact. A summary of the most frequently researched and described challenges and trends can be found in Table 2.

Table 2

Trends and challenges described in the researched literature

Challenges for the industry	Challenges related to external elements	Impact of the industry
Clustering and clusters (Wang, Lin & Li, 2010; Lucas, Sands & Wolfe, 2009; Koski, Rouvinen & Yla-Anttila, 2002), **alliances** (Kum, Chang & Atkinson, 2008; Chiaroni & Chiesa, 2008) **Innovation and innovation performance** (Wang, Lin & Li, 2010; Sun & Du, 2011; Lin et al., 2011; Gao, Guo & Guan, 2014; Figueiredo & Brito, 2012; Maurseth & Frank, 2009) **Networks and linkages** (Sun & Du, 2011; Liao & Wei, 2013; Wei, Liefner & Miao, 2011; Rohrbeck, 2010) **Convergence** (Hacklin, Marxt & Fahrni, 2009; Xing, Ye & Kui, 2011; Mancebon & Lopez-Pueyo, 2012) **Productivity growth, efficacy, employment performance** (Mathur, 2009; Green, Burgess &	**Sustainability and energy – impact on CO2** (Zhang & Liu, 2015), **electricity consumption** (Salahuddin & Alam, 2016), **green ICT** (Peng, 2013), **energy demand** (Schulte, Welsch & Rexhauser, 2016), **sustainability** (Arushanyan et al., 2015) **ICT industry globalization** (Chen & Lin, 2004) **ICT ecosystem**	**Impact on the economy**, **such as productivity** (Iammarino & Jona-Lasino, 2015; Dimelis & Papaioannou, 2011; Inklaar, O'Mahony & Timmer, 2005; O'Mahonu & Robinson, 2003), **impact on governance and policymaking** (Misuraca, Broster & Centeno, 2012), **contribution to**

Grant, 2004; Lopez-Pueyo & Mancebon, 2010) **The impact of knowledge management / sharing / transfer, learning, intellectual capital on ICT industry firm performance** (Shehata, 2015; Cheung, 2010; Calabrese, Costa & Menichini, 2013; Jang, Yang & Hong, 2014; Im & Yang, 2014) **Total quality management** (Khanam, Ztalib & Siddiqui, 2015; Talib, Rahman & Akhtar, 2013) **Business insolvency** (Yang et al., 2015), **growth capacity** (Li & Chen, 2013), **foreign investments in ICT** (Abbas-Kazmani & Manarvi, 2009), **resilience** (Holm & Ostergaard, 2015) **ICT security** (Chand, 2005), **labour standards in the industry** (Ferus-Comelo, 2008), **ethics** (Lucas & Mason, 2008) **Entry barriers and timing** (Yang, Lee & Lee, 2013; Villaverde, Ruiz-Ortega & Parra-Requena, 2012) **Gender-related aspects,** such **as female professionals' perceptions of working in the ICT industry** (Timms et al., 2008; Crump, Logan, McIlroy, 2007), **pay equity** (Byrnes & Staehr, 2011) **Forecasting** (Meade & Islam, 2015), **future skills in the ICT industry** (Leppimaki & Meristo, 2006) **Industry competitiveness** (Halkos & Tzeremes, 2007; Doucek et al., 2011; Balina & Mickevica, 2012)	(Hongburn, Dong-Hee & Deaho, 2015; Clark & Claffy, 2015; Rahul, Hyunwoo & Brandon, 2015) **Problems with ICT affordability, application** (Ayanso & Lertwachara, 2015; Luhan & Novotna, 2015; Costello, Chibelushi & Sloane, 2007; Peansuapp & Walker, 2006; Ziaie, 2013) **Effect of patents on the ICT industry** (Oh & Kim, 2007) **Impact of the crisis on the ICT industry** (Calopa, Kukec & Sestanj-Peric, 2011)	**economic performance / development** (Rohman, 2013; Maryska, Doucek & Kunstova, 2012; Savulescu, 2015; Lestariningati & Agusdian, 2014), **impact on competitiveness** (Martinovic, Pozega & Dalibor, 2014), **potential to combat the crisis** (Muntean et al., 2014) **Impact on the economy and vice versa** (Fischer, Novotny & Doucek, 2015), **impact on knowledge flow** (Kim & Park, 2009)

The research conducted revealed that there are many research gaps with regard to the ICT industry in Latvia, based on the conclusion that there are only two focused studies about the ICT industry in Latvia. Some possible objectives for future research (RQ3 – what are some future research ideas regarding the ICT industry in Latvia?):

- To research challenges in the ICT industry in Latvia directly, for example, to research challenges which are explored in the researched literature, such as (1) clustering and clusters in the ICT industry in Latvia, (2) innovation and innovation performance in the industry, (3) networks and linkages in the industry, (4) convergence in the industry, (5) productivity growth, efficacy, employment performance in the industry, (6) the impact of knowledge management / sharing / transfer, learning, intellectual capital on ICT industry firm performance, (7) business insolvency in the industry, (8) industry growth capacity, (9) foreign investments in ICT, (10) ICT security, (11) labour standards and ethics in the industry, (12) entry barriers in the industry, (13) gender-related aspects, such as female professionals' perceptions of working in the ICT industry, (14) industry competitiveness, (15) forecasting, etc.
- To research the ICT industry's impact: (1) social, (2) economic, etc.
- To research external challenges and tendencies, for example, (1) sustainability and energy consumption, (2) ICT industry globalization, (3) the ICT ecosystem, (4) problems with ICT affordability, application, (5) effect of patents on the ICT industry, (6) the impact of different business cycles on the ICT industry, etc.

The authors have concluded that even though there are many studies on the ICT industry related to management and business, there is a lack of studies that show how to evaluate the ICT industry overall

and even less recommendations on how to conceptualise evaluation results in strategies. This is a highly relevant topic and the wide range of possible future research directions proves that it has scientific potential.

1.2. THE ICT INDUSTRY EVALUATION FRAMEWORK G-AUDI

Based on analysis and synthesis of ICT industry research trends and characterisation of sub-elements in studies, the authors have compiled more than 50 different ICT sub-elements. In this section an answer is provided for RQ4: what are the main dimensions for ICT industry evaluation (sub-elements and elements)? The most recently mentioned sub-elements in literature according to the content analysis conducted are ICT use, ICT enterprises, ICT's impact, and different environmental factors, challenges and problems in the ICT industry. Development of the framework's main elements was part of the content analysis coding. It was not a linear process, since after basic code (sub-element) determination, pre-defined organisational code groups were selected (deductive approach), inspired by element from Porter's 5 Forces Model (supplier power, buyer power, competitive rivalry, threat of substitution, threat of new entry) as well as elements from the input-output analysis of the ICT industry in the reviewed literature (for example, ICT infrastructure, ICT adoption, impact on the economy, impact on society, etc.). Then all the basic codes were divided into organisational code groups, new code groups for the rest of the sub-elements were created, and the most similar groups were merged and redefined as necessary (inductive approach). The basic code grouping in organisational code groups was performed independently by two researchers to ensure inter-coder reliability (Duriau, Reger & Pfarrer, 2007). A few disagreements were resolved through a discursive alignment of interpretation and definition of organisational code groups. So the organisational code groups or main elements of the framework are: gaps, actors, usage, domain, impact of the industry and its products/services. It should also be noted that according to the authors' conception, there are connections between all the main framework elements – actors, usage, domain and impact – while gaps reveal if there are differences between the performance levels of these elements. See Figure 2.

Figure 2. G-AUDI – ICT industry evaluation framework

To use this framework, it is important to identify the level of element performance (through sub-element level evaluation). All elements and some optional sub-elements are described and explained in Table 3.

Table 3

Elements and sub-elements of the G-AUDI framework

	Explanation	Optional sub-elements	Some of the authors who mentioned the elements
Actors	Characterize actors and agents, their roles in the industry, and evaluate the level of actors' performance.	ICT firms – major "winners", number of businesses, size and types of firms, innovation and R&D, ICT clusters, ICT supply, sustainability, networks, strategic alliances, collaboration, suppliers, clients, image of the industry, etc.	Costello, Chibelushi & Sloane, 2007; Im & Yang, 2014; Jang, Yang & Hong, 2014; Neumann, 2006; Martinovic, Pozega & Pudic, 2014; Chaminade & Plechero, 2015; Lee, Kim & Park, 2009; Wang & Lin, 2008; Lida, 2016; Koski, Rouvinen & Yla-Anttila, 2002; Yu, et al., 2008; Narulaa & Santangelo, 2009
Usage	Characterize usage of ICT industry products and services. Evaluate the level of the usage.	ICT products/services, ICT use, adoption (individual, business, government), ICT spending, outsourcing, demand, ICT diffusion, ICT deployment barriers, etc.	Iammomarino & Jona-Lasino, 2015; Garcia-Muniz & Vicente, 2014; Costello, Chibelushi & Sloane, 2007; Acharya, 2016; Schulte, Welsch & Rexhauser, 2016; Zoroja, 2015; Mathur, 2007; Ting & Rui, 2008, Qin, 2009; Lee et al., 2014; Lee, Yang & Lee, 2015; Ziaie, 2013

Domain	Characterize the environment of the industry. Evaluate the support level of the domain. *Different sub-tools could be used, for example, PESTL or Porter's 5 Forces Model, etc.*	economic – export, import, ICT employees' average income, ICT competitiveness, value added, ICT sales, employment, labour productivity, growth capacity, financial performance; social – workforce, ICT skills, ICT professionals, education; political – ICT policy, country risk; technological – technology, convergence, availability, accessibility, number of broadband Internet connections, industrial background, infrastructure; legal – standards, patents, security, legal framework, etc.	Qin, 2009; Ting & Rui, 2008; Bei, 2008; Balina & Mickevica, 2012; Carayannis & Sagi, 2002; Fischer, Novotny & Doucek, 2015; Holm & Ostergaard, 2015; Strohmaier & Rainer, 2016; Li & Chen, 2013; Crump, Logan & McIlroy, 2007; Maryska, Doucek & Kunstova, 2012; Doucek et al., 2011; Leppimaki & Meristo, 2006; Kum, Chang & Atkinson, 2008; Iamratanakul, Anamtrattanachai & Chetthumrongchai, 2011; Cheng, 2005; Abbas-Kazmani & Manarvi, 2009; Li et al., 2014; Samkange, 2014; Martinovic, Pozega & Pudic, 2014; Kam, 2015; Heinrich, 2014; Gao, Guo & Guan, 2014; Yeh, Huang & Chen, 2014; Chand, 2005; Basole, Park & Barnett, 2015; Clark & Claffy, 2015; Kim, Shin & Lee, 2015; Yang, Lee & Lee, 2013
Impact	Characterize the level of the economy, social aspects, and the environment.	Impact on the economy – productivity, percentage of ICT in the GDP; impact on society, etc.	Fischer, Novotny & Doucek, 2015 Edward, Lestariningati & Agusdian, 2014; Gulbe, 2015; Harrigan et al., 2008
Gap	The levels of the elements and sub-elements and their tendencies reveal the gaps. After evaluation of the first 4 elements the main gaps and possible solutions could be revealed with the help of SWOT analysis.		

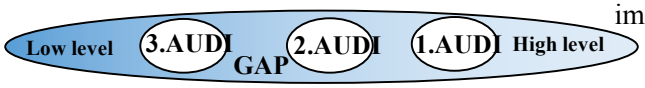
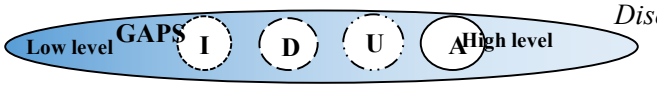
It should be noted that the sub-elements mentioned in Table 3 could also be categorised under other elements and there could be other sub-elements. In this research, this framework will be applied for the first time, but the authors believe that the framework should also be evaluated by experts and professionals in future studies. The authors believe that the five basic elements of the model could be used to research other industries and a smaller market unit as well, but this idea should be researched as well.

Not only the identification of each element and sub-element is important but also the tendencies, which could help to reveal the gap's increase or decrease.

The framework could help researchers to evaluate the industry and explore existing gaps. The element level identified could reveal different situations in the industry; see Table 4.

Table 4

Results of the G-AUDI framework

Performance of the framework elements	
	*1.Concerted – positive* – the levels of the elements are high, which means that the performance of the actors, users, and domain are coherent and the impact is also high. But even if there is a perfect situation, this doesn't rule out improvements or development. *2.Concerted – neutral* – the levels of all the elements are medium, which means that the situation is coherent, but the performance could improve. *3. Concerted – negative* – the levels of all the elements are low, which means that the performance and results of the industry show that its potential is not used.
Disconcerted performance and results of the framework elements	
	*Disconcerted* – if there are different levels for the factors or some elements are at the same level, there are problems or unused potentialities – there could be improvements according to the situation. Also, the level of the elements and sub-elements demonstrates where the main problems are.

! It should be noted that the absolute variants of the results in the real situations will always have some disconcerted and concerted elements, so there will be gaps. The situation is better if the elements are closer and at a higher level, and also, if all the elements are on the same level, there could be gaps.

An absolute concerted variant will be rare, because there are always some disconnections between elements, and if the performance and results of the industry are concerted and positive, there could still be gaps and room for improvement. So, after Stage 1 – identification of sub-elements and their levels as well as the element level – comes Stage 2: identification of situation-positive aspects and gaps as well as possible strategies for several industry actors. In Stage 2, the authors recommend applying a SWOT matrix. Regarding the application and the results for the ICT industry situation in Latvia, see Section 2.

2. THE ICT INDUSTRY IN LATVIA

In this section, the authors evaluate the ICT industry in Latvia, applying the G-AUDI framework. This process is divided into several steps: (1) selection of sub-elements; (2) identification of sub-element levels; (3) identification of element levels; (4) evaluation of sub-element tendencies; (5) identification of the situation and gaps and an illustration of framework-based development strategy creation by applying a SWOT matrix.

2.1. EVALUATION OF THE ELEMENTS: G-AUDI FRAMEWORK

The evaluation of the ICT industry is based on the G-AUDI framework. For every framework element a group of 5 experts (2 – ICT researchers, 3 – ICT company CEOs) with more than 5 years of experience with the ICT industry assessed each potential sub-element from 0.1 (not important) to 1 (important). All elements with an average score above 0.6 were applied, that is, those elements that are more important than not important. The levels of the sub-elements influence the level of the elements. The levels of the sub-elements and tendencies are evaluated by tertiary data from public and private-

sector reviews and statistics. The sub-element level is established by assessing if the element indicator of Latvia in the tertiary data source is higher, lower or on the same level as the average in the group of countries where Latvia is included according to the review. To identify the tendency, the authors have compared the data on industry performance with the previous period. See the evaluation in Table 5.

Table 5

Elements and sub-elements of the G-AUDI framework

Level	Sub-elements	Sub-level	Tendency	Source
Actors Medium- low	1. Internet & telephony competition	High	=	World Economic Forum, 2015; 2014
	2. Number of ICT enterprises	Low	+	Eurostat, 2013; CSB, 2016
	3. Export of ICT goods	Medium	+	World Bank, 2016
	4. Turnover of ICT enterprises	Low	+	Eurostat, 2013; CSB, 2016
	5. Added value	Low	+	Eurostat, 2012; CSB, 2016
	6. R&D expenditure in the ICT sector	Low	+	European Commission, 2015
Usage Low	1. Government usage 1.1 Importance of ICTs to the government's vision 1.2. Government Online Service Index 1.3. Government success in ICT promotion	Low	+ + + +	World Economic Forum, 2015; 2014
	2. Business usage 2.1. Firm-level technology absorption 2.2. Capacity for innovation 2.3. Business-to-business Internet use 2.4. Business-to-consumer Internet use 2.5. Extent of staff training	Low	+ + + + + +	World Economic Forum, 2015; 2014
	3. Individual usage 3.1. Mobile phone subscriptions/100 pop. 3.2. Individuals using Internet % 3.3. Households w/ personal computer % 3.4. Households w/ Internet access % 3.5. Fixed broadband Internet subs/100 pop. 3.6. Mobile broadband subs/100 pop. 3.7. Use of virtual social networks	Medium	+ + + + + + + +	World Economic Forum, 2015; 2014
Domain of environment Medium	1.Political and regulatory environment 1.1. Effectiveness of law-making bodies 1.2. Laws pertaining to ICT 1.3. Judicial independence 1.4. Efficiency of the legal system in settling disputes 1.5. Efficiency of the legal system in challenging regulations 1.6. Intellectual property protection 1.7. Software piracy rate, % software installed	Low	+ = + + = - = -	World Economic Forum, 2015; 2014

	2.Business and innovation environment 2.1. Availability of the latest technologies 2.2. Venture capital availability 2.3. Intensity of local competition 2.4. Tertiary education gross enrolment rate % 2.5. Quality of management schools 2.6. Government procurement of advanced	Medium	+ + + + - + =	World Economic Forum, 2015; 2014
	3. ICT sector labour productivity	Low	+	European Commission, 2015; CSB, 2016
	4. Infrastructure	Low	-	World Economic Forum, 2015, 2014
	5. Affordability	High	-	World Economic Forum, 2015, 2014
	6. Skills 6.1. Quality of educational system 6.2. Quality of math & science education 6.3. Secondary education gross enrolment rate % 6.4. Adult literacy rate	Medium	= + + - +	World Economic Forum, 2015, 2014
	7. Public funding for ICT R&D expenditure	Low	+	European Commission, 2015; 2014
	8. Average personnel costs (low costs – high level)	High	+	Eurostat, 2013, CSB, 2016
Impact Medium- low	1. Social impact 1.1. Impact of ICTs on access to basic services 1.2. Internet access in schools 1.3. ICT use & gov't efficiency 1.4. E-Participation Index	Medium	+ + + + +	World Economic Forum, 2015; 2014
	2. Economic impact 2.1. Impact of ICTs on new services & products 2.2. ICT PCT patents, applications/million pop. 2.3. Impact of ICTs on new organizational models 2.4. Knowledge-intensive jobs, % workforce 2.5. Employment in the ICT sector 2.6. ICT sector value added share of GDP	Low	+ + + + - + =	World Economic Forum, 2015; 2014 European Commission, 2015; CSB, 2016

*Main gaps

The results show that the levels of the elements are close and mostly at a medium-low level, which means that the situation in the industry is almost concerted, but there are gaps to fill in order to improve the performance of the industry in Latvia. However, most of the elements show positive trends toward improvement. In the next section the authors use a SWOT matrix to demonstrate how to develop framework-based strategies.

2.2. SWOT MATRIX

To demonstrate how to create strategies based on the framework results, the authors have developed possible development strategies for policymakers and ICT enterprise managers in Latvia, applying the most frequently applied method – the SWOT matrix. To create a SWOT matrix, the authors have developed a 4-stage process: (1) compilation of all possible SWOT factors; (2) factor evaluation based on the adaptable methodology described by Jurevicius (2013) (strengths and weaknesses are evaluated by factor importance in the industry from 0.1 (not important) to 1 (important), while opportunities and threats are evaluated through a 3-stage process: (a) evaluation of the possible influence of the factor (0.1 – no influence; 1 – great influence), (b) possibility (1 – small possibility to 3 – great possibility), (c) multiplication of (a) and (b); (3) application of the 6 main factors in every SWOT group; (4) development of strategies. The data source for strengths and weaknesses is the previously developed G-AUDI framework, while opportunities and threats are based on Digital Agenda for Europe. Unlocking the ICT growth potential in Europe: Enabling people and businesses (European Union, 2013). See Table 6 for the SWOT matrix.

Table 6

SWOT matrix

Internal factors (ICT industry in Latvia) / External factors (EU and global-level factors)	**Strengths** S1 Business and innovation environment S2 Individual usage S3 Skills S4 Affordability S5 Social impact S6 Competition	**Weaknesses** W1 Infrastructure W2 Policy and regulatory environment W3 Business usage W4 Government usage W5 Economic impact W6 Public funding, ICT R&D
Opportunities O1 Positive transformations in the EU and/or global economy and technology O2 Digital rainforest in the EU (EU economic growth and creation of single digital and service markets) O3 Investments and funding O4 New EU ICT-supporting regulations and directives O5 The rapid diffusion of high-speed networks and mobile devices empowers consumers to drive demand in new ways O6 Europe's economic woes create a vacuum that technology and innovation can fill	*For policymakers and ICT organisations in Latvia:* • Evaluate and implement the new EU regulations and directives and establish institutional arrangements and coordination mechanisms to drive transformation *(O4; S3)* • Support for the supply side *(O2; S6)* • Capture part of the global opportunity and promote a skilled workforce in close partnership with the private sector and academic sector *(O1; S3)* *For ICT enterprises in Latvia:* • Create new products and services for which the EU has significant strength in demand and capability *(O6; O5; S1)* • Use a healthy business and innovation environment to attract investments and funding *(O3; S1)* • Increase incentives to innovate and the chance to use new business models *(O6; S2, S6)*	*For policymakers and support organisations in Latvia:* • Facilitating a regulatory environment *(O2; O6; W2)* • Dealing with funding and finance issues by improving infrastructure and regulations / policy *(O3; W1; W2)* • Putting the right investment conditions in place to stimulate ICT entrepreneurs and infrastructure *(O3; W1)* • The public sector moving more activities online – leading by example *(O6; W4)* • Creating a common ICT strategy in Latvia *(O2; W2)* • Promoting private-sector use of ICT and increasing new technology absorption capabilities *(O1; W3; W4)* *For ICT enterprises in Latvia:* • Invest in infrastructure and capacity improvements appropriate for the new wave of requirements *(O2; W1)*

Threats	*For policymakers and support organisations in Latvia:*	*For policymakers and support organisations in Latvia:*
T1 Negative transformations in the EU and/or global economics and technology T2 New EU/global barriers (political, educational, social, organisational) T3 Decrease in competitiveness T4 Digital desert in the EU (the EU's slow economic growth, keeps service markets fragmented) T5 Decrease in willingness to adopt and use new ICT in the EU T6 Security issues (privacy issues, EU and global security issues)	• Build trust among users of ICT applications – information security and user privacy *(T6; S3)* • Cooperation with other EU countries to create a single local digital and service market *(T4; S1; S6)* *For ICT enterprises in Latvia:* • If the EU becomes a digital desert, use business and an innovative environment to develop new, innovative solutions for growth and survival *(T4; S1)* • Develop and improve products that will also be relevant in an economic downturn *(T1; S1)*	• Aggregating demand by removing barriers *(T2; W2)* • Stimulate local demand and usage *(T1; W3; W4)* • Stimulate private funding in ICT R&D *(T1; W6)* • Stimulate knowledge-intensive jobs *(T2; W5)* • Introduce policies to enhance the competitiveness of the industry *(T3; W2)* *For ICT enterprises in Latvia:* • Diversify target markets and products to decrease potential risks *(T1, T2, T4, T6; W5)* • ICT integration with other technologies *(T1, T2, T4, T6; W5)*

Due to the paper's length limitation, strategies are not detailed, described and justified. The authors note that the strategies described in this section are not verified by experts and should be evaluated and developed in future research. In this case, strategies are developed with the main aim of demonstrating how the framework created could be applied.

CONCLUSIONS

The paper explores 4 research questions: (RQ1) What is the level of research on the ICT industry in Europe and Latvia based on the researched literature? (RQ2) What are the most researched trends and challenges? (RQ3) What are some future research ideas for the ICT industry in Latvia? (RQ4) What are the main dimensions for ICT industry evaluation (sub-elements and elements)? These questions are addressed by conducting a systematic literature review and developing a conceptual model of ICT industry evaluation. At the end of the paper the framework created is applied to evaluate the ICT industry in Latvia and to illustrate the framework's application.

To sum up, according to the literature research it could be concluded that the level of research on the ICT industry in Europe is appropriate, while the main research gap is that there are no focused and holistic studies on the ICT industry in Latvia that evaluate not only the current situation in the industry but also describe tendencies. The most frequently researched trends and challenges in the literature could be divided into three groups: challenges for the industry, challenges related to external elements, the impact of the industry.

The authors have also concluded that even though there are many studies about the ICT industry related to management and business, there is a lack of studies that show how to evaluate the ICT industry overall and even less recommendations on how to conceptualise evaluation results in strategies. This is a highly relevant topic and the large range of possible future research directions proves that it has scientific potential:

- To research challenges in the ICT industry in Latvia specifically, research challenges that are explored in the researched literature, such as (1) clustering and clusters in the ICT industry in Latvia, (2) innovation and innovation performance in the industry, (3) networks and linkages in the industry, (4) convergence in the industry, (5) productivity growth, efficacy, employment performance in the industry, (6) the impact of knowledge management / sharing / transfer, learning, intellectual capital on

ICT industry firm performance, (7) business insolvency in the industry, (8) industry growth capacity, (9) foreign investments in ICT, (10) ICT security, (11) labour standards and ethics in the industry, (12) entry barriers in the industry, (13) gender-related aspects, such as female professionals' perceptions of working in the ICT industry, (14) industry competitiveness, (15) forecasting, etc.

- To research the ICT industry's impact: (1) social; (2) economic, etc.
- To research external challenges and tendencies, for example, (1) sustainability and energy consumption, (2) ICT industry globalization, (3) the ICT ecosystem, (4) problems with ICT affordability, application, (5) the effect of patents on the ICT industry, (6) the impact of different economic cycles on the ICT industry, etc.

The authors concluded that the ICT industry could be evaluated according to the performance level of its actors, usage, domain and impact, and that the levels could reveal the gaps in the industry's development. The authors have created a G-AUDI framework to help evaluate the ICT industry based on these elements. Evaluation of the ICT industry in Latvia showed that the levels of the elements are close and mostly at a medium-low level. Most of the elements show positive trends toward improvement. This means that the situation in the industry is almost concerted, but there are gaps to fill in order to improve the performance of the industry in Latvia. The G-AUDI framework and the results of its application should be evaluated by experts and professionals. It should be noted that like many evaluation models, it is subjective and does not have the purpose of exact indication.

The theoretical contribution of the article is as follows: (1) it is one of the few up-to-date studies in which trends and challenges of the ICT industry mentioned in the scientific literature are compiled; (2) based on the literature review, a new framework for ICT industry evaluation is created, and this G-AUDI framework should be evaluated by experts and tested empirically in future studies.

Limitations. This study has several limitations, for example: (1) the paper is conceptual, so empirical work is therefore needed to validate the model; (2) the framework is developed based on 158 papers from 6 databases – *Scopus, ScienceDirect, Sage Journals, EBSCO Academic Search Complete, Emerald, Web Science* – from a limited time frame: January 2000 – March 2016; (3) the sub-elements applied in the evaluation of the ICT industry in Latvia was selected by only 5 experts; (4) the effectiveness and usefulness of the framework has not been evaluated by the experts; (5) strategies in the SWOT matrix were developed subjectively to demonstrate how the framework created works, the strategies lack additional justification and validation.

Future work. In future research more ICT industry actors should be involved to evaluate the framework created and its elements in order to suggest the most appropriate sub-elements and to evaluate the overall usefulness of the framework. Also the strategies proposed in this research should be described in more detail and evaluated and validated by experts. The illustration of the framework application to evaluate the ICT industry in Latvia in order to create strategies in this paper is not sufficient to make conclusions on the usefulness of the framework. There is a need for further research, whereas the framework could be used further as a tool to evaluate the situation of the ICT industry. This could be done, for example, with empirical tests. The authors hope that this article will stimulate a scholarly dialog and future studies about the evaluation of the ICT industry.

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