

The Efficiency of Intellectual Capital Formation at the Scientific Institutions of Engineering and Computer Sciences

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Abstract: The research of the formation of intellectual capital (IC) of engineering and computer sciences (E&CSs) at scientific institutions (SIs) in Latvia in the present situation is highly topical. The object of the research is the formation of IC of E&CSs at SIs while the subject of the research is the comparative analysis of the efficiency of the involvement of academic staff and students in the formation of IC of E&CSs at SIs of Latvia. The objective of the research is to study the involvement of academic staff and students in the formation of IC of E&CSs at SIs in Latvia in the period from 2013 to 2018. The following tasks were determined to reach the objective: to study the formation of IC of E&CSs at SIs; to identify the concept of the efficiency of the involvement of academic staff and students in the formation of IC of E&CSs; to calculate main indicators thereof, and, to carry out the comparative analysis of indicators characterising the efficiency of the involvement of academic staff and students in the formation of IC of E&CSs at SIs in Latvia. Research methods used in the paper are content analysis, economic analysis, and economic experiment.

Keywords: Intellectual capital, Scientific institutions, Efficiency, Engineering science, Computer sciences

1. Introduction

Every six years, the Ministry of Education and Science of the Republic of Latvia (MoES) organises the International Evaluation of Scientific Institutions' Activity (IESIA) of SIs registered in Latvia. The last IESIA refers to the period from 2013 to 2018. In order to establish the dynamics of efficiency indicators of academic staff involved in the formation of IC in E&CSs at SIs of Latvia (MoES, 2021), the authors used the output data of findings across the set of evaluation of SIs of E&CSs per period from 2013 to 2018 offered by "Technopolis-group" (TG).

The comparative analysis will reveal whether the score of E&CSs at SIs of Latvia in the IESIA of TG coincides with the place of SIs of Latvia in the ratings of IC indicators, and whether the overall score of SIs of Latvia also reflects the efficiency of the involvement of the academic staff of SIs of Latvia in the IC formation.

Hypothesis: The overall score of SIs shows the efficiency of the IC formation at SIs of Latvia.

2. Theoretical Background

Spica et al (2017a) state that IC is an economic category, the spiritual value created by the human potential, and it can be accumulated and converted into the value of other capitals. By investigating certain information about the management of education, we can increase the capacity and significance of the country's total economic capital movement. Rondeau et al (2022) remind that peer reviewed publications remain a traditional form of academic productivity. Spica et al (2017a; 2017b) have worked out four indicators of the efficiency of the formation of IC in the higher education establishment (HEE): (1)The efficiency of the involvement of academic staff in the formation of IC per year in percentages (AIK); (2)The efficiency of the involvement of academic staff with a Doctorate degree in the formation of IC per year in percentages (DIK); (3)The efficiency of the involvement of students in the formation of IC per year in percentages (SIK); (4)Mutual efficiency of the involvement members of the academic staff with Doctorate degrees and the academic staff without Doctorate degrees in the formation of IC per year in times, (DE).

3. Methodology

In order to calculate the AIK, DIK, SIK, and DE of the HEE Spica et al (2017a; 2017b) have worked out four formulas: (1) $AIK = (ZPS : AS) \times 100$; (2) $DIK = (ZPS : DS) \times 100$; (3) $SIK = (ZPS : SS) \times 100$; (4) $DE = DIK : AIK$. Where: ZPS represents the number of scientific publications of the HEE per year; AS represents the number of academic staff in full-time jobs per year; DS represents the number of academic staff with Doctorate degrees holding in full-time jobs per year; SS represents the number of students per year.

The authors modified the above mentioned formulas for the purposes of the study. Namely, they calculate IC efficiency indicators for total numbers of full time equivalent (FTE) academic and research personnel (KIK), for FTE academic personnel (AIK), for FTE academic and research personnel (PIK) and for PhDs completed at SIs (SIK). In addition, all the said IC efficiency indicators were calculated for different forms of IC such as total number of self-reported outputs of IC (KS), articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS (WS), articles in peer reviewed edited journals, and conference proceedings not included in WoS or SCOPUS (RS), monographs (MS), and Latvian patent (LPS), and European patent and International patents (EPS). The authors calculated mutual efficiency indicators (PE) regarding involvement of the FTE academic and research personnel (PS) and the FTE academic personnel (AS) in the formation of IC in times.

In the present research, the authors used the following data from the IESIA: output data on the number of FTE academic personnel (AS), the number of FTE academic and research personnel (PS), the total number of FTE academic and research personnel (KS), the number of PhDs completed (SS), the number of articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS (WS), the number of articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS (RS), the number of monographs (MS), the number of Latvian patents (LPS), and the number of European and International patents (EPS), and total number of self-reported outputs (KS) in period from 2013 to 2018 per SI of E&CSs in Latvia. Authors revised the above WS, RS, MS, LPS, EPS and KS for the year.

The number of scientific publications and patents are the main results of the IC formation at SIs of E&CSs. TG analysed 16 SIs of E&CSs of Latvia, 2 were private SIs and 14 were public SIs. During the period analysed in the IESIA, there were such SIs in Latvia: Institute of Physical Energetics (IPE); ISMA Computer Technology Laboratory (ISMA/CTL); Research Institute of Latvian Maritime Academy (LMA); Rezekne Academy of Technology Institute of Engineering (RAT/IE); Riga Technical University (RTU) Faculty of Civil Engineering (CE); Transport and Telecommunication Institute (TTI); RTU Faculty of Electronics and Telecommunications (FET); Ventspils University of Applied Sciences Engineering and Technology Research Platform (VU/ETRP); RTU Faculty of Materials Science and Applied Chemistry (FMSAC); RTU Faculty of Mechanical Engineering, Transport and Aeronautics (FMETA); RTU Faculty of Power and Electrical Engineering (FPPE); Institute of Electronics and Computer Science (EDI); Latvian University of Life Sciences and Technologies Engineering and Technologies Unit (LULST/ETU); Liepaja University Engineering and Technologies Unit (LU/ETU); RTU Faculty of Computer Science and Information Technology (FCSIT); University of Latvia Institute of Mathematics and Computer Science (UL/IMCS).

In this study, one scientific publication or one patent are accepted as one unit of IC. Further, using the modified formulas 1; 2; 3; 4, were calculated: AIK, PIK, KIK, SIK, PE. Then, according to the results obtained through the author's calculations, a corresponding rating place was assigned to each SI of Latvia per year and each of the above indicators AIK, PIK, KIK, SIK.

Each place in the rating was then assessed with an appropriate score, where the lowest score is 1 point, while the highest score is 5 points. Thus, the SI, which took first to third place in - AIK, PIK, KIK and SIK received 5 points in the ranking, took fourth to sixth place - received 4 points, seventh to ninth place - received 3 points, tenth to twelfth place - received 2 points, and thirteenth to sixteenth place - received 1 point.

The above mentioned assessment system allows to compare the quantitative efficiency indicators of SIs of E&CSs in Latvia calculated by the authors to IESIA overall assessment criterion - quality of the SI research performance. The re-levant TG was the score of research performance of each SI using a scale where score 5 means an outstanding level of research, score 4 means a very good level of research, score 3 means a good level of research, score 2 means an adequate level of research, and score 1 means a poor level of research (MoES, 2021).

The follow-up authors compared the results of their own estimates of SIs quantitative indicators to the qualitative indicators of the relevant TG, and calculated the difference between the indicators and the changes. For this purpose, the authors calculated the average score of indicators for each SI recording the efficiency of the IC formation and compared these scores to scores of the research quality of each SI and overall score developed by the TG Panel.

4. Results

According to the authors' estimates, from the IESIA data show that the total number of self-reported outputs of SIs of E&CSs in Latvia is taken in the largest proportion by the WS - 61,80%, which is followed by the RS - 32,65%, the LPS - 3,94%, the MS - 0,96%, the EPS - 0,65%.

To calculate the efficiency of the involvement of academic and research staff in the WS formation, the authors used formulas:

$$AIK = (WS : AS) \times 100 \quad (1)$$

$$PIK = (WS : PS) \times 100 \quad (2)$$

$$KIK = (WS : KS) \times 100 \quad (3)$$

$$SIK = (WS : SS) \times 100 \quad (4)$$

$$PE = PIK : AIK \quad (5)$$

Table 1: The efficiency of the involvement of academic and research staff in the WS formation at SIs of E&CSs in Latvia per year in period from 2013 to 2018

SI	AIK	AIK	AIK score	PIK	PIK	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
IPE	0	0	0	141	13	1	141	5	4	0,5	0	257	8	3	1,3
ISM/CTL	833	4	4	833	1	5	417	2	5	4,5	1,0	0	0	0	3,0
LMA	14	13	1	76	15	1	12	16	1	1,0	5,5	133	15	1	1,0
RAT/IE	274	8	3	202	8	3	116	12	2	3,0	0,7	288	6	4	3,3
RTU/CE	301	7	3	202	9	3	121	10	2	3,0	0,7	209	11	2	2,7
TTI	933	3	5	468	3	5	312	3	5	5,0	0,5	279	7	3	4,3
RTU/FET	467	6	4	180	11	2	130	8	3	3,0	0,4	202	12	2	2,7
VU/ETRP	1264	2	5	234	6	4	198	4	4	4,5	0,2	654	1	5	4,7
RTU/FMSAC	706	5	4	161	12	2	131	7	3	3,0	0,2	247	10	2	2,7
RTU/FMETA	236	9	3	219	7	3	114	13	1	3,0	0,9	154	14	1	2,3
RTU/FPEE	1584	1	5	627	2	5	449	1	5	5,0	0,4	516	2	5	5,0
EDI	0	0	0	54	16	1	54	14	1	0,5	0	185	13	1	0,7
LULST/ETU	221	10	2	337	4	4	134	6	4	3,0	1,5	252	9	3	3,0
LU/ETU	74	12	2	194	10	2	53	15	1	2,0	2,6	467	3	5	3,0
RTU/FCSIT	201	11	2	292	5	4	119	11	2	3,0	1,5	360	5	4	3,3
UL/IMCS	0	0	0	124	14	1	124	9	3	0,5	0	413	4	4	1,7

SI	AIK	AIK	AIK sco-re	PIK	PIK	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK score
Average	392			242			150				0,6	296			

These indicators of SIs and their place in the rating of SIs of E&CSs in Latvia as well as its scores are summarized in Table 1. The table of the SIs indicators, ratings, and score was drawn up by authors. The summarized indicators show that in general, in Table 1, the figure rests in the range from 1584% to 12% in respect of the SIs in Latvia.

The authors compared the SIK indicators of all students of HEE in Latvia to SIK indicators of PhDs students of SIs of E&CSs in Latvia, and found that SIK indicators of the PhDs students were considerably higher. It follows from the study by Spica et al (2018) that the highest SIK indicators were held by Daugavpils University (1,45% in 2013) and the University of Latvia (1,82% in 2014). Meanwhile, between 2013 and 2018, the highest annual SIK indicator for PhDs students of SIs of E&CSs in Latvia was held by the VU/ETRP and represented 654%.

When analyzing the results obtained by SIs in the IC formation in the field of E&CSs, the same methodology was used as in the fields of social sciences, and, humanities and art sciences. Thus, the quantitative results of SIs in these fields can be compared. One of the main criteria for the quantitative evaluation of SIs is the efficiency of the involvement of the SIs staff in the formation of WoS and SCOPUS publications.

Table 2: The efficiency of the involvement of academic and research staff in the RS formation at SIs of E&CSs in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK ra-ting	AIK sco-re	PIK (%)	PIK ra-ting	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK score
IPE	0	0	0	99	9	3	99	5	4	1,5	0	180	6	4	2,3
ISMA/CTL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LMA	16	12	2	88	11	2	14	15	1	2,0	5,5	154	8	3	2,3
RAT/IE	95	10	2	70	12	2	40	12	2	2,0	0,7	100	12	2	2,0
RTU/CE	248	5	4	166	5	4	100	4	4	4,0	0,7	172	7	3	3,7
TTI	829	1	5	416	1	5	277	1	5	5,0	0,5	248	4	4	4,7
RTU/FET	150	9	3	58	13	1	42	11	2	2,0	0,4	65	14	1	1,7
VU/ETRP	547	2	5	101	8	3	86	6	4	4,0	0,2	283	3	5	4,3
RTU/FMSAC	393	3	5	90	10	2	73	9	3	3,5	0,2	138	9	3	3,3
RTU/FMETA	159	8	3	148	6	4	77	7	3	3,5	0,9	104	11	2	3,0
RTU/FPPE	267	4	4	106	7	3	76	8	3	3,5	0,4	87	13	1	2,7

SI	AIK (%)	AIK ra-ting	AIK sco-re	PIK (%)	PIK rat-ing	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK score
EDI	0	0	0	16	15	1	16	14	1	0,5	0	55	15	1	0,7
LULST/ETU	174	7	3	265	3	5	105	3	5	4,0	1,5	198	5	4	4,0
LU/ETU	71	11	2	187	4	4	51	10	2	3,0	2,6	450	1	5	3,7
RTU/FCSIT	219	6	4	317	2	5	130	2	5	4,5	1,5	392	2	5	4,7
UL/IMCS	0	0	0	38	14	1	38	13	1	0,5	0	128	10	2	1,0
Average	207			128			79				0,6	156			

The comparison of the results of the three fields of science leads to conclusion that the highest score of the KIK indicator in the field of social sciences is 278% (Spica et al, 2022) while the highest score of the KIK indicator in field of E&CSs is 449%, and, the highest score of the KIK indicator in field of humanities and art sciences is 53% (Spica et al, 2023). In addition, it should be noted that the highest score of the KIK indicator in the field of humanities and art sciences is almost 9 times lower than the highest score in the field of E&CSs, and, the highest KIK indicator in field of social sciences is almost 2 times lower.

In Table 2 authors calculate efficiency of the involvement of academic and research staff in the RS formation, the authors used formulas:

$$AIK = (RS : AS) \times 100 \quad (6)$$

$$PIK = (RS : PS) \times 100 \quad (7)$$

$$KIK = (RS : KS) \times 100 \quad (8)$$

$$SIK = (RS : SS) \times 100 \quad (9)$$

$$PE = PIK : AIK$$

In Table 2, in respect of SIs of E&CSs in Latvia, the figure rests in the range from 14% to 829%. The highest indicator is the AIK in the TTI, but the lowest indicators is the KIK in the LMA. The AIK indicators were not collected for the 4 SIs of E&CSs.

Table 3: The efficiency of the involvement of academic and research staff in the MS formation at SIs of E&CSs in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK ra-ting	AIK sco-re	PIK (%)	PIK rat-ing	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK score
IPE	0	0	0	2	12	2	2	10	2	1,0	0	3	9	3	1,7
ISMA/CTL	142	1	5	142	1	5	71	1	5	5,0	1,0	0	0	0	3,3
LMA	0	11	2	2	9	3	0	13	1	2,5	5,5	4	5	4	3,0

SI	AIK (%)	AIK ra-ting	AIK sco-re	PIK (%)	PIK rat-ing	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK sscore
RTU/CE	3	10	2	2	10	2	1	11	2	2,0	0,7	2	11	2	2,0
TTI	88	2	5	44	2	5	29	2	5	5,0	0,5	26	2	5	5,0
RTU/FET	8	4	4	3	7	3	2	6	4	3,5	0,4	3	8	3	3,3
RTU/FMSA C	4	8	3	1	13	1	1	12	2	2,0	0,2	1	12	2	2,0
RTU/FMET A	6	7	3	5	5	4	3	5	4	3,5	0,9	4	7	3	3,3
RTU/FPPE	7	5	4	3	8	3	2	7	3	3,5	0,4	2	10	2	3,0
LULST/ET U	3	9	3	5	6	4	2	8	3	3,5	1,5	4	6	4	3,7
LU/ETU	6	6	4	16	3	5	4	4	4	4,5	2,6	39	1	5	4,7
RTU/FCSI T	8	3	5	11	4	4	5	3	5	4,5	1,5	14	3	5	4,7
UL/IMCS	0	0	0	2	11	2	2	9	3	1,0	0	6	4	4	2,0
Average	6			4			2				0,6	5			

In Table 3 authors calculate efficiency of the involvement of academic and research staff in the formation of MS, the authors used formulas:

$$AIK = (MS : AS) \times 100 \quad (11)$$

$$PIK = (MS : PS) \times 100 \quad (12)$$

$$KIK = (MS : KS) \times 100 \quad (13)$$

$$SIK = (MS : SS) \times 100 \quad (14)$$

$$PE = PIK : AIK \quad (15)$$

In Table 3 the figure rests in the range from 0% to 142% in respect of the SIs of E&CSs in Latvia. The highest indicator are AIK and PIK in the ISMA/CTL but the lowest indicators are AIK and KIK in the LMA.

In Table 4 authors calculate efficiency of the involvement of academic personnel and research personnel in the formation of LPS, the authors used formulas:

$$AIK = (LPS : AS) \times 100 \quad (16)$$

$$PIK = (LPS : PS) \times 100 \quad (17)$$

$$KIK = (LPS : KS) \times 100 \quad (18)$$

$$SIK = (LPS : SS) \times 100 \quad (19)$$

$$PE = PIK : AIK \quad (20)$$

Table 4: The efficiency of the involvement of academic and research staff in the LPS formation at SIs of E&CSs in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK ra-	AIK sco-re	PIK (%)	PIK ra-ting	PIK sco-re	KIK (%)	KIK ra-ting	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ting	SIK sco-re	Ave-rage of AIK & PIK & SIK score
IPE	0	0	0	22	3	5	22	2	5	2,5	0	40	3	5	3,3
RAT/IE	16	8	3	12	5	4	7	8	3	3,5	0,7	17	5/6	4	3,7
RTU/CE	17	7	3	12	6	4	7	7	3	3,5	0,7	12	9	3	3,3
TTI	20	6	4	10	8	3	7	9	3	3,5	0,5	6	11	2	3,0
RTU/FET	12	9	3	5	12	2	3	11	2	2,5	0,4	5	12	2	2,3
VU/ETRP	32	3	5	6	11	2	5	10	2	3,5	0,2	17	5/6	4	3,7
RTU/FMSA C	39	2	5	9	10	2	7	6	4	3,5	0,2	14	8	3	3,3
RTU/FMET A	24	5	4	22	2	5	12	4	4	4,5	0,9	16	7	3	4,0
RTU/FPEE	28	4	4	11	7	3	8	5	4	3,5	0,4	9	10	2	3,0
EDI	0	0	0	17	4	4	17	3	5	2,0	0	59	1	5	3,0
LULST/ETU	45	1	5	69	1	5	27	1	5	5,0	1,5	51	2	5	5,0
LU/ETU	4	10	2	9	9	3	3	12	2	2,5	2,6	22	4	4	3,0
RTU/FCSIT	1	11	2	2	13	1	1	14	1	1,5	1,5	2	14	1	1,3
UL/IMCS	0	0	0	2	14	1	2	13	1	0,5	0	5	13	1	0,7
Average	25			15			10				0,6	19			

In Table 4 the figure rests in the range from 1% to 69% in respect of the SIs of E&CSs in Latvia. The highest PIK is held by the LULST/ETU, while the lowest AIK and KIK belongs to the RTU/FCSIT.

Table 5: The efficiency of the involvement of academic and research staff in the EPS formation at SIs of E&CSs in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK ra-ti-ng	AIK sco-re	PIK (%)	PIK ra-ti-ng	PIK sco-re	KIK (%)	KIK ra-ti-ng	KIK sco-re	Ave-rage of AIK & PIK score	PE in ti-mes	SIK (%)	SIK ra-ti-ng	SIK sco-re	Ave-rage of AIK & PIK & SIK score
IPE	0	0	0	4	4	4	4	2	5	2,0	0	7	3	5	3,0
RTU/CE	1	7	3	1	9	3	0	9	3	3,0	0,7	1	10	2	2,7
TTI	4	4	4	2	6	4	1	6	4	4,0	0,5	1	9	3	3,7
VU/ETRP	8	1	5	2	7	3	1	7	3	4,0	0,2	4	5	4	4,0
RTU/FMSA C	5	2	5	1	8	3	1	8	3	4,0	0,2	2	7	3	3,7
RTU/FMETA	3	6	4	3	5	4	2	5	4	4,0	0,9	2	6	4	4,0
RTU/FPEE	1	8	3	0	12	2	0	11/12	2	2,5	0,4	0	12	2	2,3
EDI	0	0	0	11	1	5	11	1	5	2,5	0	38	1	5	3,3
LULST/ETU	5	3	5	7	3	5	3	3	5	5,0	1,5	5	4	4	4,7
LU/ETU	4	5	4	9	2	5	3	4	4	4,5	2,6	22	2	5	4,7
RTU/FCSIT	0	9	3	1	10	2	0	11/12	2	2,5	1,4	1	11	2	2,3
UL/IMCS	0	0	0	0	11	2	0	10	2	1,0	0	1	8	3	1,7
Average	4			3			2				0,6	3			

In Table 5 authors calculate efficiency of the involvement of academic personnel and research personel in the formation of EPS, the authors used formulas:

$$\text{AIK} = (\text{EPS} : \text{AS}) \times 100 \quad (21)$$

$$\text{PIK} = (\text{EPS} : \text{PS}) \times 100 \quad (22)$$

$$\text{KIK} = (\text{EPS} : \text{KS}) \times 100 \quad (23)$$

$$\text{SIK} = (\text{EPS} : \text{SS}) \times 100 \quad (24)$$

$$\text{PE} = \text{PIK} : \text{AIK} \quad (25)$$

In Table 5 the figure rests in the range from 0% to 38% in respect of the SIs of E&CSs in Latvia; the highest SIK is held by the EDI while the lowest KIK belongs to the RTU/FPEE and RTU/FCSIT.

In the all tables, the average indicators PE are the same, and the average SIK indicators are the highest, while the average KIK indicators; the average AIK indicators are the highest, while the average PIK indicators.

The highest average rate of the PE indicators is 1,8 (Spica et al, 2022) in social sciences, the second highest average rate of the PE indicators is 1,7 (Spica et al, 2023) in humanities and art sciences, and, the lowest average rate of the PE indicators is 0,6 in E&CSs. In addition, it should be noted that the highest average rate of the PE in the field of social sciences is three times higher than the average rate in the field of E&CSs.

Table 6: The Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of E&CSs using the IC forms for period from 2013 to 2018

SI	Quality score by TG (QTG)	Overall score by TG (OTG)	Total average score of AIK & PIK using IC forms (TAAP)	Difference of score (QTG-TAAP)	Difference of score (QTG-TAAP)	Total average score of AIK & PIK & SIK using IC forms (TAAPS)	Difference of score (QTG-TAAPS)	Difference of score (OTG-TAAPS)
IPE	2	2	1,0	1,0	1,0	1,7	0,3	0,3
ISMA/CTL	1	1	4,5	-3,5	-3,5	3,0	-2,0	-2,0
LMA	1	1	1,0	0,0	0,0	1,0	0,0	0,0
RAT/IE	2	2	2,0	0,0	0,0	2,3	-0,3	-0,3
RTU/CE	3	3	3,0	0,0	0,0	2,7	0,3	0,3
TTI	3	3	5,0	-2,0	-2,0	4,7	-1,7	-1,7
RTU/FET	3	3	2,5	0,5	0,5	2,0	1,0	1,0
VU/ETRP	2	2	4,0	-2,0	-2,0	4,3	-2,3	-2,3
RTU/FMSAC	3	4	3,0	0,0	1,0	2,7	0,3	1,3
RTU/FMETA	2	2	2,5	-0,5	-0,5	2,0	0,0	0,0
RTU/FPEE	3	4	5,0	-2,0	-1,0	4,7	-1,7	-0,7
EDI	4	4	0,5	3,5	3,5	1,0	3,0	3,0
LULST/ETU	2	3	3,5	-1,5	-0,5	3,3	-1,3	-0,3
LU/ETU	2	2	3,0	-1,0	-1,0	3,7	-1,7	-1,7
RTU/FCSIT	3	4	3,5	-0,5	0,5	4,0	-1,0	0,0
UL/IMCS	3	3	0,5	2,5	2,5	1,7	1,3	1,3

Table 7: The Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of E&CSs using the overall IC for period from 2013 to 2018

SI	Quality score by TG (QTG)	Overall score by TG (OTG)	Total average score of KIK using IC overall	Difference of score (QTG-TAKO)	Difference of score (OTG-TAKO)	Total average score of KIK & SIK using IC overall (TAKOS)	Difference of score (QTG-TAKOS)	Difference of score (OTG-TAKOS)
IPE	2	2	4,0	-2,0	-2,0	4,0	-2,0	-2,0
ISMA/CTL	1	1	2,0	-1,0	-1,0	1,0	0,0	0,0
LMA	1	1	0,6	0,4	0,4	1,1	-0,1	-0,1
RAT/IE	2	2	1,4	0,6	0,6	1,7	0,3	0,3
RTU/CE	3	3	2,8	0,2	0,2	2,6	0,4	0,4
TTI	3	3	4,4	-1,4	-1,4	3,9	-0,9	-0,9
RTU/FET	3	3	2,2	0,8	0,8	1,9	1,1	1,1
VU/ETRP	2	2	2,6	-0,6	-0,6	3,1	-1,1	-1,1
RTU/FMSAC	3	4	3,0	0,0	1,0	2,8	0,2	1,2
RTU/FMETA	2	2	3,2	-1,2	-1,2	2,9	-0,9	-0,9
RTU/FPEE	3	4	3,4	-0,4	0,6	2,9	0,1	1,1
EDI	4	4	2,4	1,6	1,6	2,4	1,6	1,6
LULST/ETU	2	3	4,4	-2,4	-1,4	4,2	-2,2	-1,2
LU/ETU	2	2	2,6	-0,6	-0,6	3,7	-1,7	-1,7
RTU/FCSIT	3	4	3,0	0,0	1,0	3,2	-0,2	0,8
UL/IMCS	3	3	2,0	1,0	1,0	2,4	0,6	0,6

5. Conclusions

The study of the authors did not result in confirmation of their hypothesis. When comparing the qualitative ratings of TG group to the quantitative assessments performed by the authors, it can be concluded that they differ from minus 3,5 points to plus 3,5 points in total.

The study shows that the TAAP, TAAPS, TAKO, and TAKOS of SIs of E&CSs in Latvia were higher than the results compiled by the relevant TG Panel except for the EDI, where all scores were too lower, and, except for the LMA, where QTG, OTG, TAAP, TAAPS scores coincided.

The authors is encouraged to supplement the methodology for international evaluation of scientific institutions with four efficiency indicators AIK, PIK, KIK, SIK of the involvement of academic staff and students in the formation of IC per year in percentage, and, PE in times, in order to improve the quality of the evaluation of SIs.

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