

# Comparative Analysis of the Efficiency Indicators of the Formation of Intellectual Capital in the Field of Humanities and Arts Sciences

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**Abstract:** In the present situation, a comparative analysis of the efficiency of the formation of intellectual capital (IC) in the humanities and arts sciences at scientific institutions (SIs) in Latvia is an actual research topic. The object of the research is the formation of IC of humanities and art sciences at SIs, while the subject of the research is the comparative analysis of the efficiency of the formation of IC of humanities and art sciences at SIs of Latvia. The objective of the research is to compare various efficiency indicators of the formation of IC of humanities and art sciences 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 humanities and art sciences at SIs; to identify various efficiency indicators of the formation of IC of humanities and art sciences; to calculate various indicators thereof; and to carry out the comparative analysis of various efficiency indicators that characterise the formation of IC of humanities and art sciences at SIs in Latvia. Research methods used in the paper are content analysis, economic analysis, financial analysis, and economic experiment.

**Keywords:** Intellectual capital, Humanities sciences, Art sciences, Efficiency indicators, Latvia

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## 1. Introduction

Every six years, the Ministry of Education and Science of the Republic of Latvia (MoES) organises an international evaluation of SIs registered in Latvia. The first International Evaluation of Scientific Institutions' Activity (IESIA) in Latvia covered the period from 2006 to 2011. The second IESIA refers to the period from 2013 to 2018. In order to establish the dynamics of the efficiency indicators of academic staff involved in the formation of IC in humanities and art sciences at SIs of Latvia (MoES, 2021), the authors used the output data of findings across the set of evaluations of SIs of humanities and art sciences for the period from 2013 to 2018 offered by "Technopolis Group" (TG).

TG developed the above IESIA for the periods from 2006 to 2011 and from 2013 to 2018 using a similar methodology. It enables the authors to calculate the IC indicators in humanities and art sciences at SIs of Latvia and to compare their dynamics during the period from 2013 to 2018.

The comparative analysis of efficiency indicators of involvement of academic staff of humanities and art sciences at SIs of Latvia in the IC formation and its financial efficiency indicators will let them establish whether and how the management of SIs affects them. Data from the comparative analysis will help to develop support programmes to increase the efficiency of involvement of the academic staff in the IC formation and its financial efficiency. In addition, the comparative analysis will reveal whether the score of humanities and art sciences 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 academic staff of SIs of Latvia in the IC formation and its financial efficiency.

*Hypothesis: The overall score of SIs shows the efficiency of the IC formation at SIs of Latvia and its financial efficiency.*

## 2. Theoretical Background

The authors rely on the research on understanding, adapting, and applying intellectual capital (IC) in universities (Mercado-Salgado et al., 2016); and on the research on the role of human capital in the educational and training process at a university (Contu, 2017), which presented different aspects of IC.

Spica et al. (2017a) state that IC is an economic category, a spiritual value created by human potential, and it can be accumulated and converted into the value of other capitals. By investigating certain information about educational management, we can increase the capacity and significance of the country's total economic capital movement.

Rondeau et al. (2022) remind us that peer-reviewed publications remain a traditional form of academic productivity. Spica et al. (2017a; 2017b) have elaborated four indicators of the efficiency of the IC formation in a higher education establishment (HEE): (1) the efficiency of the involvement of academic staff in the IC formation per year in percentage (AIK); (2) the efficiency of the involvement of academic staff with a Doctorate degree in the IC formation per year in percentage (DIK); (3) the efficiency of the involvement of students in the IC formation per year in percentage (SIK).

The authors unsuccessfully searched databases SCOPUS and Web of Science (WoS) for scientific literature on indicators of financial efficiency of the involvement of academic staff of SIs' in IC formation as part of the content analysis.

Therefore, on basis of the recognition that financial indicators are explains of financial relationships based on the company's financial information and aim at ensuring comparisons between companies in the financial field, the authors decided, as part of the economic experiment, to develop a number of new financial efficiency indicators and to check them in practice.

### **3. Methodology**

In order to calculate the AIK, DIK, and SIK of a HEE, Spica et al. (2017a; 2017b) have developed three formulas: (1)  $AIK = (ZPS : AS) \times 100$ ; (2)  $DIK = (ZPS : DS) \times 100$ ; (3)  $SIK = (ZPS : SS) \times 100$ .

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 full-time jobs per year; SS represents the number of students per year.

For the purposes of the study, the authors modified these formulas. Namely, they calculated 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 obtained at SIs (ZIK). In addition, all the said IC efficiency indicators were calculated for different forms of IC, such as the total number of self-reported outputs of IC (GS), 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 patents (LPS).

The authors have elaborated new indicators for the purpose of the study of the financial efficiency of the IC formation at the SIs: (1) the financial efficiency of the involvement of academic personnel in the IC formation per year in percentage (AIKF); (2) the financial efficiency of the involvement of academic and research personnel in the IC formation per year in percentage (PIKF); (3) the financial efficiency of the involvement of total numbers of academic and research personnel in the IC formation per year in percentage (KIKF); (4) the financial efficiency of the involvement of PhDs obtained in the IC formation per year in percentage (ZIKF).

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 obtained (ZS), 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), the total number of self-reported outputs (GS), the amount of total funding (TF), and the amount of total funding per researcher (RF) in the period from 2013 to 2018 per SI of humanities and art sciences in Latvia. The authors revised the above WS, RS, MS, LPS, KS, and TF figures for one year.

The number of scientific publications and patents represents the main results of the IC formation at SIs of humanities and art sciences. TG analysed 11 SIs of humanities and art sciences in Latvia. Within the IESIA, output data on 10 public SIs and one private SI in Latvia were collected.

During the period analysed in the IESIA, there were only 11 such SIs in Latvia: Faculty of Architecture and Design and Faculty of Media and Creative Technologies of RISEBA University of Applied Sciences (RISEBA/H); National Library of Latvia (NLL); Latvian Academy of Culture (LAC); Faculty of Architecture of Riga Technical University (RTU/H); Faculty of Translation Studies of Ventspils University of Applied Sciences (VeU/H); Faculty of Humanities and Arts of Liepaja University (LU/H); Daugavpils University Research Programme "Regional Studies, Literature and Arts" (DU/H); Art Academy of Latvia (AAL); Institute of Literature, Folklore and Art of the University of Latvia (UL/LFA); Jāzeps Vītols Latvian Academy of Music (JVLAM); and Cluster of Humanities and Arts of the University of Latvia (UL/CHA).

In this study, one scientific publication or one patent is accepted as one unit of IC. Further, KIK, AIK, PIK, and ZIK were calculated using the modified formulas 1, 2, and 3, while KIKF, AIKF, PIKF, and ZIKF were calculated using the four new formulas. Next, according to the results obtained through the authors' calculations, a corresponding rating place was assigned to each SI of Latvia per year and for each of the new indicators KIKF, AIKF, PIKF, and ZIKF.

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 that took first or second place in KIKF, AIKF, PIKF, and ZIKF received 5 points in the ranking; third or fourth place received 4 points; fifth or sixth place received 3 points; seventh or eighth place received 2 points; and ninth to eleventh place received 1 point.

The above-mentioned assessment system allows the comparison of the quantitative efficiency indicators of SIs of humanities and art sciences in Latvia calculated by the authors with the IESIA overall assessment criterion—the quality of the SI research performance. The relevant TG Panel assessed the 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 score assigned to the overall assessment by the relevant TG Panel was based on the assessment of five sub-elements from A to E, where element A characterises the quality of the research, element B the impact on the development of the specific field of science, element C the economic and social impact of the research, element D the research environment and infrastructure of the institution, and element E the institution's development potential. The Panel was provided with scores for each sub-element and the overall score and was also provided with narrative descriptions of their scores, the overall score, and the sub-elements (MoES, 2021).

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

#### 4. Results

According to Spica et al. (2023) estimates, the IESIA data show that the total number of self-reported outputs of SIs of humanities and art sciences in Latvia is represented in the largest proportion by RS—70,16%, followed by WS—16,22%, MS—13,55%, and LPS—0,07%.

To calculate the efficiency of the involvement of academic and research staff in the WS formation, the authors used formulas that had been developed and applied previously and have now been modified.

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

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

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

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

To calculate the financial efficiency of the involvement of academic and research staff in the WS formation, the authors have now elaborated four new formulas.

$$AIKF = (TF : AS) / (TF : WS) \times 100 \quad (5)$$

$$PIKF = (TF : PS) / (TF : WS) \times 100 \quad (6)$$

$$KIKF = (TF : KS) / (TF : WS) \times 100 \quad (7)$$

$$SIKF = (TF : ZS) / (TF : WS) \times 100 \quad (8)$$

The summarized indicators show that, in general, as presented in Table 1, the figures range from 3.53% to 450.00% with respect to a SI in Latvia. The highest indicators are ZIK and ZIKF in the NLL, while the lowest indicators are KIK and KIKF in the AAL. Comparing the figures presented in Table 1, the authors conclude that the highest AIK and AIKF indicators belong to the DU/H, while the lowest AIK and AIKF indicators belong to the AAL; the highest KIK and KIKF indicators belong to the NLL, while the lowest KIK and KIKF indicators belong to the AAL; the highest ZIK and ZIKF indicators belong to the NLL, while the lowest ZIK and ZIKF indicators belong to the JVLAM.

**Table 1: Comparative Analysis of the Financial Efficiency Indicators of the Involvement of Academic Staff in the WS Formation and the Efficiency Indicators of the Involvement of Academic Staff in the WS Formation at SIs of Humanities and Art Sciences in Latvia per Year in the Period from 2013 to 2018**

| SI       | AIK (%) | AIKF (%) | PIK (%) | PIKF (%) | KIK (%) | KIKF (%) | ZIK (%) | ZIKF (%) |
|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| RISEBA/H | 38,60   | 38,60    | 41,50   | 41,50    | 20,00   | 20,00    | -       | -        |
| NLL      | -       | -        | 52,94   | 52,94    | 52,94   | 52,94    | 450,00  | 450,00   |
| LAC      | 8,70    | 8,70     | 72,88   | 72,88    | 7,77    | 7,77     | 48,58   | 48,58    |
| RTU/H    | 23,07   | 23,07    | 120,73  | 120,72   | 19,37   | 19,37    | 58,25   | 58,25    |
| VeU/H    | 9,76    | 9,76     | 44,11   | 44,11    | 7,99    | 7,99     | 36,17   | 36,17    |
| LU/H     | 19,20   | 19,21    | 51,89   | 51,89    | 14,02   | 14,02    | 42,45   | 42,45    |
| DU/H     | 53,65   | 53,64    | 353,90  | 353,90   | 46,58   | 46,58    | 130,00  | 130,00   |
| AAL      | 3,53    | 3,53     | 40,78   | 40,78    | 3,25    | 3,25     | 24,47   | 24,47    |
| UL/LFA   | -       | -        | 28,40   | 28,40    | 28,40   | 28,40    | 344,33  | 344,33   |
| JVLAM    | 5,23    | 5,23     | 35,28   | 35,28    | 4,55    | 4,55     | 12,76   | 12,77    |
| UL/CHA   | 49,34   | 49,34    | 22,15   | 22,15    | 15,29   | 15,29    | 34,21   | 34,21    |
| Average  | 22,74   | 18,85    | 39,25   | 91,77    | 14,40   | 24,26    | 51,20   | 143,36   |

In Table 2, the authors have calculated the efficiency of the involvement of academic and research staff in the RS formation using formulas 9, 10, 11, and 12.

$$AIK = (RS : AS) \times 100 \quad (9)$$

$$PIK = (RS : PS) \times 100 \quad (10)$$

$$KIK = (RS : KS) \times 100 \quad (11)$$

$$SIK = (RS : ZS) \times 100 \quad (12)$$

To calculate the financial efficiency of the involvement of academic and research staff in the RS formation, the authors used formulas that had been developed and applied previously and have now been modified.

$$AIKF = (TF : AS) / (TF : RS) \times 100 \quad (13)$$

$$PIKF = (TF : PS) / (TF : RS) \times 100 \quad (14)$$

$$KIKF = (TF : KS) / (TF : RS) \times 100 \quad (15)$$

$$SIKF = (TF : ZS) / (TF : RS) \times 100 \quad (16)$$

In Table 2, with respect to SIs of humanities and art sciences in Latvia, the figures range from 4.13% to 1683.01%. The highest indicators are ZIK and ZIKF in the NLL, while the lowest indicators are AIK, AIKF, KIK, and KIKF in the AAL.

**Table 2: Comparative Analysis of the Financial Efficiency Indicators of the Involvement of Academic Staff in the RS Formation and the Efficiency Indicators of the Involvement of Academic Staff in the RS Formation at SIs of Humanities and Art Sciences in Latvia per Year in the Period from 2013 to 2018**

| SI              | AIK (%) | AIKF (%) | PIK (%) | PIKF (%) | KIK (%) | KIKF (%) | ZIK (%) | ZIKF (%) |
|-----------------|---------|----------|---------|----------|---------|----------|---------|----------|
| <b>RISEBA/H</b> | 526,98  | 526,93   | 566,50  | 566,45   | 273,01  | 272,99   | -       | -        |
| <b>NLL</b>      | -       | -        | 198,00  | 198,00   | 198,00  | 198,00   | 1683,00 | 1683,01  |
| <b>LAC</b>      | 19,66   | 19,66    | 164,63  | 164,62   | 17,56   | 17,56    | 109,75  | 109,75   |
| <b>RTU/H</b>    | 308,61  | 308,56   | 1615,03 | 1614,76  | 259,10  | 259,05   | 779,25  | 779,14   |
| <b>VeU/H</b>    | 143,18  | 143,18   | 646,95  | 646,92   | 117,24  | 117,23   | 530,50  | 530,47   |
| <b>LU/H</b>     | 54,83   | 54,83    | 148,11  | 148,11   | 40,02   | 40,02    | 121,18  | 121,18   |
| <b>DU/H</b>     | 186,16  | 186,16   | 1228,13 | 1228,14  | 161,66  | 161,66   | 451,13  | 451,14   |
| <b>AAL</b>      | 4,49    | 4,49     | 51,89   | 51,89    | 4,13    | 4,13     | 31,13   | 31,13    |
| <b>UL/LFA</b>   | -       | -        | 96,23   | 96,23    | 96,23   | 96,23    | 1166,67 | 1166,69  |
| <b>JVLAM</b>    | 56,61   | 56,61    | 382,11  | 382,15   | 49,31   | 49,30    | 138,24  | 138,25   |
| <b>UL/CHA</b>   | 201,46  | 201,46   | 90,47   | 90,47    | 62,43   | 62,43    | 139,70  | 139,70   |
| <b>Average</b>  | 98,41   | 65,48    | 169,86  | 318,83   | 62,31   | 84,27    | 221,58  | 498,07   |

Comparing the figures presented in Table 2, the authors conclude that the highest AIK indicator of 526.98% and the highest AIKF indicator of 526.93% belong to the RISEBA/H, while the lowest AIK and AIKF indicators of 4.49% belong to the AAL; the highest PIK indicator of 1615.03% and the highest PIKF indicator of 1614.76% belong to the RTU/H, while the lowest PIK and PIKF indicators of 51.89% belong to the AAL; the highest ZIKF indicator of 1683.01% and the highest ZIK indicator of 1683.00% belong to the NLL, while the lowest ZIK and ZIKF indicators of 31.13% belong to the AAL.

In Table 3, the authors have calculated the efficiency of the involvement of academic and research staff in the MS formation using formulas 17, 18, 19, and 20.

$$AIK = (MS : AS) \times 100 \quad (17)$$

$$PIK = (MS : PS) \times 100 \quad (18)$$

$$KIK = (MS : KS) \times 100 \quad (19)$$

$$SIK = (MS : ZS) \times 100 \quad (20)$$

To calculate the financial efficiency of the involvement of academic and research staff in the MS formation, the authors used formulas that had been developed and applied previously and have now been modified.

$$AIKF = (TF : AS) / (TF : MS) \times 100 \quad (21)$$

$$PIKF = (TF : PS) / (TF : MS) \times 100 \quad (22)$$

$$KIKF = (TF : KS) / (TF : MS) \times 100 \quad (23)$$

$$SIKF = (TF : ZS) / (TF : MS) \times 100 \quad (24)$$

In Table 3, according to the AIK, AIKF, PIK, PIKF, KIK, KIKF, ZIK, and ZIKF indicators, the first place and highest score is taken by the LU/H.

**Table 3: Comparative Analysis of the Financial Efficiency Indicators of the Involvement of Academic Staff in the MS Formation and the Efficiency Indicators of the Involvement of Academic Staff in the MS Formation at SIs of Humanities and Art Sciences in Latvia per Year in the Period from 2013 to 2018**

| SI       | AIK (%) | AIKF (%) | PIK (%) | PIKF (%) | KIK (%) | KIKF (%) | ZIK (%) | ZIKF (%) |
|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| RISEBA/H | 54,42   | 54,42    | 58,50   | 58,50    | 28,19   | 28,19    | -       | -        |
| NLL      | -       | -        | 3,88    | 3,88     | 3,88    | 3,88     | 33,00   | 33,00    |
| LAC      | 23,63   | 23,63    | 197,88  | 197,88   | 21,11   | 21,11    | 131,92  | 131,92   |
| RTU/H    | 21,49   | 21,48    | 112,44  | 112,43   | 18,04   | 18,04    | 54,25   | 54,25    |
| VeU/H    | 6,75    | 6,75     | 30,49   | 30,49    | 5,52    | 5,53     | 25,00   | 25,00    |
| LU/H     | 124,11  | 124,11   | 335,22  | 335,21   | 90,57   | 90,57    | 274,27  | 274,27   |
| DU/H     | 10,10   | 10,10    | 66,61   | 66,61    | 8,77    | 8,77     | 24,47   | 24,47    |
| AAL      | 2,24    | 2,24     | 25,89   | 25,89    | 2,06    | 2,06     | 15,53   | 15,53    |
| UL/LFA   | -       | -        | 14,65   | 14,65    | 14,65   | 14,65    | 177,67  | 177,67   |
| JVLAM    | 2,41    | 2,41     | 16,26   | 16,26    | 2,10    | 2,10     | 5,88    | 5,88     |
| UL/CHA   | 43,64   | 43,64    | 19,60   | 19,60    | 13,52   | 13,52    | 30,26   | 30,26    |
| Average  | 23,99   | 5,03     | 41,41   | 24,50    | 15,19   | 6,48     | 54,02   | 38,27    |

**Table 4: Comparative Analysis of the Financial Efficiency Indicators of the Involvement of Academic Staff in the LPS Formation and the Efficiency Indicators of the Involvement of Academic Staff in the LPS Formation at SIs of Humanities and Art Sciences in Latvia per Year in the Period from 2013 to 2018**

| SI       | AIK (%) | AIKF (%) | PIK (%) | PIKF (%) | KIK (%) | KIKF (%) | ZIK (%) | ZIKF (%) |
|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| RISEBA/H | 93,02   | 93,02    | 100,00  | 100,00   | 48,19   | 48,19    | -       | -        |
| Average  | 0,55    | 629,14   | 0,95    | 3063,22  | 0,35    | 809,67   | -       | -        |

In Table 4, the authors have calculated the efficiency of the involvement of academic and research staff in the LPS formation using formulas 25, 26, 27, and 28.

$$AIK = (LPS : AS) \times 100 \quad (25)$$

$$PIK = (LPS : PS) \times 100 \quad (26)$$

$$KIK = (LPS : KS) \times 100 \quad (27)$$

$$SIK = (LPS : ZS) \times 100 \quad (28)$$

To calculate the financial efficiency of the involvement of academic and research staff in the LPS formation, the authors used formulas that had been developed and applied previously and have now been modified.

$$AIKF = (TF : AS) / (TF : LPS) \times 100 \quad (29)$$

$$PIKF = (TF : PS) / (TF : LPS) \times 100 \quad (30)$$

$$KIKF = (TF : KS) / (TF : LPS) \times 100 \quad (31)$$

$$SIKF = (TF : ZS) / (TF : LPS) \times 100 \quad (32)$$

In Table 4, according to the AIK, AIKF, PIK, PIKF, and KIK, KIKF indicators, the first and only place is taken by the RISEBA/H.

From the results summarised in Tables 1, 2, and 3, the authors conclude that the average ZIK and ZIKF indicators are the highest for all IC forms.

**Table 5: Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of humanities and art sciences using the IC form and financial efficiency indicators of IC formation for the period from 2013 to 2018**

| SI       | Quality score by TG (QTG) | Overall score by TG (OTG) | Total average score of AIKF & PIKF by IC form (TAAPF) | Difference of score (QTG-TAAPF) | Difference of score (OTG-TAAPF) | Total average score of AIKF & PIKF & ZIKF by IC form (TAAPZF) | Difference of score (QTG-TAAPZF) | Difference of score (OTG-TAAPZF) |
|----------|---------------------------|---------------------------|-------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------------------------------------|----------------------------------|----------------------------------|
| RISEBA/H | 2                         | 1                         | 3,3                                                   | -1,3                            | -2,3                            | 2,2                                                           | -0,2                             | -1,2                             |
| NLL      | 4                         | 4                         | 0,8                                                   | 3,2                             | 3,2                             | 1,4                                                           | 2,6                              | 2,6                              |
| LAC      | 4                         | 4                         | 1,9                                                   | 2,1                             | 2,1                             | 1,8                                                           | 2,2                              | 2,2                              |
| RTU/H    | 3                         | 3                         | 2,6                                                   | 0,4                             | 0,4                             | 2,5                                                           | 0,5                              | 0,5                              |
| VeU/H    | 2                         | 2                         | 1,8                                                   | 0,2                             | 0,2                             | 1,3                                                           | 0,7                              | 0,7                              |
| LU/H     | 3                         | 3                         | 2,0                                                   | 1,0                             | 1,0                             | 2,0                                                           | 1,0                              | 1,0                              |
| DU/H     | 4                         | 4                         | 2,6                                                   | 1,4                             | 1,4                             | 2,3                                                           | 1,7                              | 1,7                              |
| AAL      | 4                         | 4                         | 0,8                                                   | 3,2                             | 3,2                             | 0,7                                                           | 3,3                              | 3,3                              |
| UL/LFA   | 4                         | 5                         | 0,3                                                   | 3,7                             | 4,7                             | 1,2                                                           | 2,8                              | 3,8                              |
| JVLAM    | 3                         | 3                         | 1,2                                                   | 1,8                             | 1,8                             | 1,1                                                           | 1,9                              | 1,9                              |
| UL/CHA   | 3                         | 3                         | 1,7                                                   | 1,3                             | 1,3                             | 1,7                                                           | 1,3                              | 1,3                              |

From the data summarised in Tables 1, 2, 3, and 4, the follow-up authors created the rating and score of SIs in Latvia based on the AIKF, PIKF, KIKF, and ZIKF indicators of academic research personnel and PhD involvement in the IC formation. After that, the authors calculated the total average score of the AIKF and PIKF by IC form TAAPF, and the total average score of the AIKF, PIKF, and ZIKF by IC form TAAPZF. Then, the authors calculated the differences between the quality and overall scores by TG and TAAPF, and TAAPZF calculated by the authors (see Table 5).

In Table 6, the authors summarised the results of the calculation of the total average score of the KIKF by IC overall TAKOF and the total average score of the KIKF and ZIKF by IC overall TAKOZF, and its differences between the quality score and overall score by TG.

**Table 6: Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of humanities and art sciences using the overall IC and financial efficiency indicators of IC formation for the period from 2013 to 2018**

| SI       | Quality score by TG (QTG) | Overall score by TG (OTG) | Total average score of KIKF by IC overall (TAKOF) | Difference of score (QTGTAKOF) | Difference of score (OTG-TAKOF) | Total average score of KIKF & ZIKF by IC overall (TAKOZF) | Difference of score (QTG—TAKOZF) | Difference of score (OTG-TAKOZF) |
|----------|---------------------------|---------------------------|---------------------------------------------------|--------------------------------|---------------------------------|-----------------------------------------------------------|----------------------------------|----------------------------------|
| RISEBA/H | 2                         | 1                         | 3,8                                               | -1,8                           | -2,8                            | 1,9                                                       | 0,1                              | -0,9                             |
| NLL      | 4                         | 4                         | 2,0                                               | 2,0                            | 2,0                             | 2,3                                                       | 1,7                              | 1,7                              |
| LAC      | 4                         | 4                         | 1,2                                               | 2,8                            | 2,8                             | 1,4                                                       | 2,6                              | 2,6                              |
| RTU/H    | 3                         | 3                         | 2,4                                               | 0,6                            | 0,6                             | 2,4                                                       | 0,6                              | 0,6                              |
| VeU/H    | 2                         | 2                         | 1,4                                               | 0,6                            | 0,6                             | 1,5                                                       | 0,5                              | 0,5                              |
| LU/H     | 3                         | 3                         | 1,6                                               | 1,4                            | 1,4                             | 1,8                                                       | 1,2                              | 1,2                              |
| DU/H     | 4                         | 4                         | 2,2                                               | 1,8                            | 1,8                             | 2,0                                                       | 2,0                              | 2,0                              |
| AAL      | 4                         | 4                         | 0,6                                               | 3,4                            | 3,4                             | 0,6                                                       | 3,4                              | 3,4                              |
| UL/LFA   | 4                         | 5                         | 2,0                                               | 2,0                            | 3,0                             | 2,5                                                       | 1,5                              | 2,5                              |
| JVLAM    | 3                         | 3                         | 0,8                                               | 2,2                            | 2,2                             | 0,8                                                       | 2,2                              | 2,2                              |
| UL/CHA   | 3                         | 3                         | 1,6                                               | 1,4                            | 1,4                             | 1,6                                                       | 1,4                              | 1,4                              |

## 5. Discussion

The four mathematical formulae recreated by the authors to calculate the financial efficiency of the academic staff involved in the formation of the IC were developed in practice.

For this purpose, each of the four newly created mathematical formulae included the respective volume indicators of each SI and the total financing indicators from the IESIA of the Latvian humanities and arts sciences for the period 2008-2013, which the authors recalculated to annual indicators before inserting them in mathematical formulae. In addition, the corresponding figures for the total number of academic staff were inserted in each of the formulae. The financial efficiency indicators of the academic staff involved in the IC formation of each scientific institution, AIKF, PIKF, KIKF and SIKF, were then calculated.

Similarly, the authors to check the four mathematical formulae previously developed to calculate the efficiency of academic staff involved in formation the IC for the AIK, PIK, KIK and ZIK. For this reason, in each of the four mathematical formulae previously established, the relevant volume indicators of the IC were inserted from the IESIA in the Latvian humanities and arts sciences for the period 2008-2013, which the authors recalculated to annual indicators before inserting them in mathematical formulae. Each of the formulae also included relevant figures for the total number of academic staff. As a result, the efficiency indicators of the academic staff involved in the IC formation of each scientific institution, AIK, PIK, KIK and ZIK, were calculated.

In the course of the economic experiment, the authors compared the results of the calculations obtained using the four newly created mathematical formulae for calculating AIKF, PIKF, KIKF, and ZIKF indices with the results of the calculations obtained using the four previously developed mathematical formulae for calculating the AIK,

PIK, KIK, and ZIK indices. It was thus concluded that the calculated results coincided with the accuracy of two decimal places. It follows that  $AIKF = AIK$ ,  $PIKF = PIK$ ,  $KIKF = KIK$  and  $ZIKF = ZIK$ .

Over the course of the economic experiment, the authors were also able to arrive at the above conclusions by mathematically converting the four newly created mathematical formulae for calculating AIKF, PIKF, KIKF, and ZIKF scores and getting that  $AIKF = AIK$ ,  $PIKF = PIK$ ,  $KIKF = KIK$ , and  $ZIKF = ZIK$ . However, this would undermine the reliability of the data generated by the economic experiment.

The results of the authors' study led to the conclusion that the efficiency of the involvement of academic staff in the formation of IC also shows the financial efficiency of the involvement of academic staff in the formation of IC and vice versa. In practice, this may be useful if data on the funding of SIs are not available, but data on the amount of IC generated by the SI and the number of academic staff are available.

## 6. Conclusions

The study of the authors did not result in confirmation of their hypothesis. When comparing the qualitative ratings of the TG group to the quantitative assessments performed by the authors, it can be concluded that they differ from minus 2.8 to plus 4.7 points in total. The hypothesis is accepted pro tem for other branches of SIs in Latvia.

The study evidences that the KIKF, AIKF, PIKF, and ZIKF of SIs of humanities and art sciences in Latvia were lower than the results compiled by the relevant TG Panel, except for one SI of humanities and art sciences.

The authors' four mathematical formulae, designed to clarify the financial efficiency of the involvement of SIs in IC formation, allow the calculation of AIKF, PIKF, KIKF and ZIKF indicators. It is further clarified that  $AIKF = AIK$ ,  $PIKF = PIK$ ,  $KIKF = KIK$  and  $ZIKF = ZIK$ . Consequently, the efficiency of the involvement of SIs in the formation of IC also shows the financial efficiency of the involvement of SIs in the formation of IC and vice versa.

The various efficiency indicators provide an opportunity to identify more efficient SIs in the field of humanities and art sciences and to distribute public funding to SIs representing science more efficiently in accordance with these results. Of course, to distribute public funding for SIs should also take into account the results of the qualitative evaluation of SIs from the IESIA. An appropriate methodology for granting public funding to SIs could be developed for this purpose, taking into account the results of their qualitative and quantitative evaluation. Efficiency indicators can serve as a basis for management and future improvement of SIs' performance.

**Ethical Declaration:** The authors declare that there are no ethical issues related to the research presented in this paper.

**AI Declaration:** The authors declare that no significant AI tools or technologies were used in the conduct of the research for this paper.

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