
Increasing RDI Outputs through the Competitive Research Funding Operational Programme with Impact on the Emerging Market

Carmen DOBROTA

Faculty of Administration and Business, University of Bucharest

Maria-Magdalena ROSU

Faculty of Cybernetics, Statistics and Informatics, The Bucharest Academy of Economic Studies

Andreea-Ionela PUIU

Faculty of Cybernetics, Statistics and Informatics, The Bucharest Academy of Economic Studies

Eduard C. MILEA

Faculty of Cybernetics, Statistics and Informatics, The Bucharest Academy of Economic Studies

Mihaela PAUN¹ (mihaela.paun@faa.unibuc.ro)

Faculty of Administration and Business, University of Bucharest,
Research Institute of the University of Bucharest–ICUB, University of Bucharest
National Institute for Research and Development for Biological Sciences

ABSTRACT

Considering the broad impact of applied research on the economy, RDI funding evaluations are required both in terms of the number of allocated resources and the management of these resources. RDI efficacy depends on human resources productivity and the financing instruments established through national priorities. This paper offers an analysis of the RDI investments in Romania allocated through the Competitiveness Operational Programme 2014-2020, covering the European Structural and Investment Funds, namely the European regional development fund. The analysis of the funded projects highlighted the common trends among the beneficiaries of RDI projects, their options in managing resources in relation to the eligibility of costs, and their national distribution between the seven development regions of Romania. The amount of funding was discussed in terms of the smart specialization domains es-

1. Corresponding author

established by the national strategy. The conclusions of the study, correlated with the objectives set by the SNCDI 2014-2020, are relevant for the management of the future funding instruments allocated to RDI by the ERDF in the period 2021-2027.

Keywords: *competitive research funding, RDI funding evaluations, financing instruments, national strategy, funding eligibility*

JEL Classification: Z18

1. INTRODUCTION

The European Regional Development Fund (ERDF) aspires to strengthen the social and economic cohesion in the European Union. The ERDF funding programs are governed by Regulation (EU) No. 1303/2013 and Regulation (EU) No. 1301/2013. While the former regulation lays down the common rules applicable to the ERDF, the latter encompasses specific provisions concerning the Investment for growth and jobs goal.

Each Member State elaborates a Partnership Agreement (PA) covering all Programmes of the European Structural and Investment Funds (ESIF), including the European regional development fund (ERDF). Considering the funding priorities set out in the PA, Romania has implemented the Competitiveness Operational Programme 2014-2020 (Autoritatea de Management pentru Programul Operațional Competitivitate, n.d.).

The PA identifies five main challenges for the development of Romania, with competitiveness being specifically highlighted. The agreement underlines the need to improve the innovation capacity for developing new products and services, to improve the business environment through the implementation of scalable value chains. Additionally, COP contributes to fulfilling the objectives of three other growth challenges: infrastructure, people and society, administration and governance. This enables horizontal interventions in the economy and society.

Increasing investments and stimulating research, development and innovation (RDI) activities can increase competitiveness through smart specialization, added value, and internationalization. One of the objectives of the Europe 2020 Strategy is to reach a level of 3% of EU GDP for research and development expenditure. Romania has assumed a target of 2% of GDP for RDI financing (1% of GDP public expenditure and 1% of GDP expenditure from private sources). This is a very ambitious target given that in 2011 Romania invested only 0.48% of GDP in RDI, 80% of investments being made by the public sector (National Strategy for Research, Development and Innovation 2014-2020, 2018) and it has decreased considerably during the 2014-2020 implementation period. Towards the goal of achieving research investment targets, prerequisites are put in place through a mix of measures and policies

designed to prioritize and focus public resources, on one hand, and encourage private investment and technological development, on the other hand.

1.1. The Competitiveness Operational Program in Romania

The Competitiveness Operational Programme 2014-2020 divides its mission to increase competitiveness in two specific directions:

1. Priority Axis 1 (PA1) - Research, development, and innovation in support of economic competitiveness and business development.

2. Priority Axis 2 (PA2) - Information and Communication Technology.

For the purpose of this paper, we will focus solely on PA1, which addresses market needs, such as creating a more compact and modern RDI environment, or creating an entrepreneurial and innovative culture in RDI, both in the public and the private sector, that contributes to training and development of latent potential in the field. The three types of thematic priorities identified by NSRDI on which PA1 focuses are the following:

- Smart specialization priorities - defining and consolidating areas of high competence where there are real or potential competitive advantages and which by directing resources and organizing a critical mass of researchers, can ensure competitiveness in regional and/or global value chains.
- Priorities with public relevance - developing the capacity of the public sector to scan the space of new and promising technologies and to request novel solutions from public and private RDI operators.
- Fundamental research (funded mainly from NPRDI III and the programs of the Romanian Academy).

Romania invests only 0.3% of GDP in research and development, compared to the 1% assumed target, placing it in the least favourable place in the European Union and making it difficult to effectively stimulate competitiveness.

Nationally, the COP interim evaluation underlines an unbalanced effective execution of funds among regions, with the Bucharest-Ilfov region having contributed almost two-thirds to the achievement of the total expenses from the activity of R&D. On the other hand, the most significant increase compared to 2014 was registered in the West region and the smallest in the North-East region. In addition, although the number of units with research and development activity decreased during this period, there is a slight increase in the number of employees in research and development, mainly due to the positive evolution of the business environment (Autoritatea de Management pentru Programul Operațional Competitivitate, n.d.).

After the 1988 reform of the Structural Funds (Bachtler and Michie, 1995) the systematic evaluation of EU regional policy became proprietary. An ex-post evaluation of a program at the end of its implementation period will provide a clear picture of its effectiveness and insights for the next funding period.

The current study proposes a descriptive analysis of the “Competitiveness Operational Programme 2014-2020” implementation. Based on the aforementioned strategies to increase competitiveness through the consolidation of areas of high competence, we considered the following evaluation objectives:

Objective 1: To identify the common tendencies among fund recipients.

Objective 2: To identify the regional competencies.

Two more evaluation objectives tackle the need for financial incentives to increase competitiveness:

Objective 3: A description of the non-eligible value of the projects.

Objective 4: A description of eligible salaries and non-reimbursement salaries tendencies.

2. METHODS AND MATERIALS

The dataset was obtained from the Ministry of Research, Innovation and Digitalization, under the provisions of the Law no. 544/2001 regarding free access to public information. Statistical analysis was done through R statistical software, version 4.1.1, while the graphics were done in Exploratory version 6.6.3

Data on funded projects under the Priority Axis 1 of the Competitiveness Operational Programme 2014-2020 consists of 331 projects classified in five different types and seven actions namely, Action 1.1.1 Large R&D infrastructures (14.5%), Action 1.1.2 Development of networks for R&D centres (3.6%), Action 1.1.3 Synergies with Horizon 2020 (8.5%), Action 1.1.4 Attract researchers from abroad (15.4%), Action 1.2.1 Stimulate the demand of enterprises for innovation (41.7%), and Action 1.2.3 Knowledge transfer partnerships (16.3%).

The National Strategy for Research, Development and Innovation (NSRDI) defined the five areas of smart specialization for the strategic cycle 2014-2020, based on their scientific and commercial potential. The Competitiveness Operational Programme PA1 had the following smart specialization project distribution: Bioeconomy (12.8%), IT&C, space and security (25.8%), Energy, environment and climate change (16.9%), Eco-Nano-Technologies and advanced materials (27.9%) and Health (16.6%).

Eligible for funding and implementing projects under the Competitiveness Operational Programme are various organizations, classified by their legal status in ten categories. Based on the evaluation process, the distribution of funded projects implemented by each type of institution is as follows: National Institutes for R&D (NIRD) (17.5%), Universities (25.1%), Research Institutes of the Romanian Academy (RIRA) (3.9%), Microenterprises (41.4%), Medium enterprises (4.8%), Large enterprises (3.0%), Associations (0.6%), Foundations (0.9%), Hospitals (1.2%) and another type of beneficiaries (public institutions with research activities; 1.6%).

According to the provisions of EU regulations for the period 2014 - 2020, Romania's development regions fall into two categories: more developed regions (Bucharest - Ilfov Region, which includes the capital Bucharest) and less developed regions (the other 7 development regions of Romania, respectively North-East, South-East, South Muntenia, South West Oltenia, West, North-West and Center).

The allocation of projects for each region is as follows: Bucharest - Ilfov (48%), Center (6.3%), North East (8.8%), North West (16.6%), South East (2.4%), South Muntenia (4.8%), South West Oltenia (7.6%) and West (5.5%).

In the Competitiveness Operational Programme PA1, the Bucharest - Ilfov Region will benefit from a total EU contribution of 249 million euros, while the other seven regions combined will benefit from a total EU contribution of 1.08 billion euros (the distribution of the EU contribution takes into account the project's location of implementation).

The amount (in thousands of euros) of funded projects and eligible and non-eligible contributions is represented in Table 1.

Project funding metrics

Table 1

	Min	Max	Mean	Median	SD
Total value of the project (in thousands of euros)	54.19	157574.81	2907.50	1405.93	9570.13
Eligible value of the project (in thousands of euros)	51.80	157574.81	2670.19	1285.96	9417.79
Non eligible value of the project (in thousands of euros)	0	8613.84	238.03	17.63	798.84
Eligible salaries (in thousands of euros)	13.39	3327.95	624.52	412.07	623.05
Non-reimbursement salaries (in thousands of euros)	3.68	3327.95	558.57	376.29	541.44

Objective 1: Common tendencies among funds recipients

Investigating the common trends among beneficiaries, the following has been identified.

Action 1.1.1 - Large R&D infrastructures.

- Section A (Investments for enterprises R&D departments) - 22 projects were funded, with a total value of 124.96 million euro (out of which 44.20 million euro in the European Regional Development Fund (ERDF)).
- Section B (2015 – Innovation clusters) - 4 projects were funded, with a total value of 10.21 million euro (out of which 4.92 million euro in ERDF).
- Section F (Investment projects for public R&D institutions/universities) - 18 projects were funded, with a total value of 2.04 billion euro (out of which 4.92 million euro in ERDF).
- “Extreme Light Infrastructure - Nuclear Physics (ELI-NP)” - one project was funded with a total value of 157.87 million euro (out of which 126.98 million euro in ERDF). The fund recipient for this project was the national institute for research and development implementing this project.
- “DANUBIUS-RI” - one project was funded with a total value of 4.52 million euro (out of which 3.84 million euro in ERDF). The fund recipient for this project was the national institute for research and development implementing this project.

Overall, for this action, the national institutes of research and development were the most active in securing funds for Section F projects. Among the five domains from the NSRDI, Eco-Nano-Technologies and advanced materials and Health were the ones with the largest share in the COP funding. The recipients with the largest percentage of funds were the national institutes of research and development beneficiaries.

Action 1.1.2 - Development of networks for R&D centres

- Section “Cloud type projects and massive data infrastructures” - 11 projects were funded, with a total value of 10.87 million euro (out of which 8.87 million euro in ERDF).

For this action the largest number of beneficiaries were the universities, implementing projects under the IT&C, space and security - smart specialization domains and Health as priority domain of national interest, however the highest percentage of contracted values was secured by ONG’s beneficiaries.

Action 1.1.3 - Synergies with Horizon 2020

- Section “RO ECSEL” - 11 projects were funded, with a total value of 11.32 million euro (out of which RON 8.33 million euro in ERDF).
- Section “Complement” - 3 projects were funded, with a total value of 5.02 million euro (out of which 4 million euro in ERDF).
- Section “Support Centre” - 13 projects were funded, with a total value of 7.32 million euro (out of which 1.08 million euro in ERDF).

The largest numbers of beneficiaries in this action were the universities, implementing projects under the IT&C, space and security and the Eco-Nano-Technologies and advanced materials smart specialization domains. The highest percentage of contracted values was secured also by university type beneficiaries.

Action 1.1.4 - Attract researchers from abroad

- Section E (Attracting staff with advanced skills from abroad to strengthen R&D capacity) 51 projects were funded, with a total value of 86.39 million euro (out of which 69.13 million euro in ERDF).

The most salient beneficiaries in this action were the universities, implementing projects under the Eco-Nano-Technologies and advanced materials as smart specialization domains and Health as priority domain of national interest. The highest percentage of contracted values was secured also by university type beneficiaries

Action 1.2.1 - Stimulate the demand of enterprises for innovation

- Section C (Innovative start-up and spin-off enterprises) - 91 projects were funded, with a total value of 17.82 million euro (out of which 12.21 million euro in ERDF).
- Section D (New innovative start-ups) - 22 projects were funded, with a total value of 24.27 million euro (out of which 17.82 million euro in ERDF). All funds were assigned to small and microenterprises.
- Section “Innovative technological project” - 25 projects were funded, with a total value of 24.27 million euro (out of which 17.81 million euro in ERDF).

The most salient beneficiaries in this action were microenterprises implementing projects under the Eco-Nano-Technologies and advanced materials, Bioeconomy and Energy, environment and climate change smart specialization domains, however the highest percentage of contracted values was secured by national institutes of research and development type beneficiaries.

Action 1.2.3 - Knowledge transfer partnerships

- Section G (Knowledge transfer partnerships) 54 projects were funded, with a total value of 129.87 million euro (out of which 90.64 million euro in ERDF).

The most salient beneficiaries in this action were the national institutes of research and development (54%) and universities (44%) implementing projects under IT&C, space and security, followed by the Eco-Nano-Technologies and advanced materials smart specialization domains; however, the highest percentage of contracted values was secured by microenterprises.

Overall, we can conclude that the most salient beneficiaries per smart specialization domains and the national priority domain, are as follows:

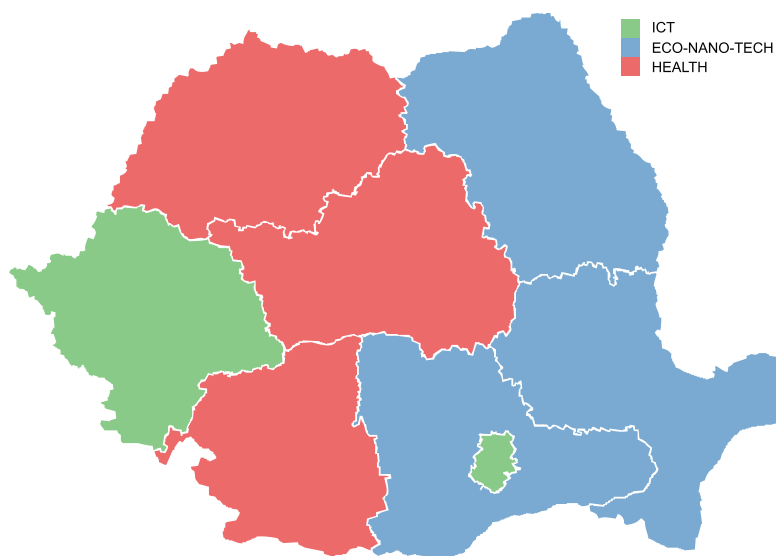
- Bioeconomy (Associations)
- IT&C, space and security (Microenterprise, Small Enterprises, Foundations, NGOs)
- Energy, environment and climate change (Medium Enterprises, Another type of beneficiaries: public institutions with research activities; NGOs)
- Eco-Nano-Technologies and advanced materials (National Institutes for Research and Development, Universities, Large Enterprises, Research Institutes of the Romanian Academy)
- Health (hospitals)

Objective 2: Regional competencies

One of the goals of Priority Axis 1 (PA1) in the Competitiveness Operational Programme is to support the smart specialization priorities, taking into account the research orientation towards the economic needs and correlating them to the founding instruments active in the national R&D plan. The analysis of the funded projects identifies the existence of research critical mass, resources and competencies in the eight development regions in various smart specialization areas, as seen in Figure 1.

Smart specialization funded projects by development regions

Figure 1



For the purpose of economic growth and development, as well as for policy reasons, the analysis provides insight on regional competencies in terms of smart specialization domains: Bucharest-Ilfov and the West region have competencies in implementing projects under the IT&C, space and security area, the South-West, Centre and North-West have competencies in implementing projects under the Health area, whereas the rest of the regions developed competencies in implementing projects funded under the Eco-Nano-Technologies and advanced materials. The other two specialization domains, Bioeconomy and Energy, environment and climate change did not stand out as primary competencies in any area.

Out of the 331 projects funded under the PA1 of the Competitiveness Operational Programme 2014-2020, 146 projects (44% of all projects) are connected to the Classification of Activities in the National Economy (NACE code). The tendencies we have identified are as follows:

Under the IT&C, space and security domain, there is a preference for Service activities in IT (first two digits of NACE code 62), accounting for 14.38% of all national projects. Under the Health domain, there is a preference for Human health activities (first two digits of NACE code 86) accounting for 15.7% of all national projects.

Bucharest-Ilfov region, as the location of project implementation is the host of 10.96% of the projects classified under the Service activities in IT NACE.

Objective 3: Non eligible value of the project by action type, the type of projects and legal status.

In the Competitiveness Operational Programme, we refer to the non-reimbursable financial aid (NFA) as the contribution of the funding body to finalize the investment and can cover partially or fully the eligible value of a project. Investigating the non-eligible value of the funded projects under the PA1 of the COP, the weight of the non-eligible depends on the action under which the project is implemented. Therefore, we emphasize for each action, the type of beneficiary that registered the highest percentage value of the non-reimbursable financial aid and the kind of projects in which it was implemented.

One can note the following general characteristics for all types of beneficiaries and for all types of actions financed through POC 2014 - 2020: the obligation of ineligible expenses with the project audit and erroneous classification of ineligible expenses on eligible activities.

Under the Action 1.1.1 - Large R&D infrastructures - 8 projects were funded for public R&D institutions/universities; the percentage of the non-eligible value was 5.28% of the NFA (87.79 million euro) for universities, for type F projects. Under this action the activities identified as sources that led to the increase of non-eligible expenses are: the complexity and necessity of all the actions for the implementation of the project, projects that had a total value above the maximum eligible value (allowed by the applicant's guide), the difference being considered an ineligible expense supported by the beneficiary or the incorrect classification of certain categories such as approvals and agreements for ineligible expenses.

Under the Action 1.1.2 - Development of networks for R&D centres - 10 projects were funded for universities; the percentage of the non-eligible value was 3.35% of the NFA (56.15 million euro). The highest percent of non-eligible value was recorded for Cloud type projects. Under this action the activities that led to the increase in the non-eligible expenses are: non-compliance with the thresholds established by the applicant's guide, of 15% for indirect costs and 10% management costs, respectively; the total value of the project was above the maximum eligible value (allowed by the applicant's guide) the difference being considered as ineligible expenditure, supported by the beneficiary and also the VAT that was classified by the applicant as ineligible.

Under the Action 1.1.3 - Synergies with Horizon 2020 - 9 projects were funded with universities as beneficiaries; the percentage of the non-eligible value was 0.17% of the NFA (2.03 million euro). The highest percent of non-eligible value was recorded for the RO-ECSEL type projects. Under this action, the beneficiary of type enterprise had the obligation to introduce the following ineligible costs in the project: expenses for information and publicity regarding the project and expenses for project management. If the beneficiary of a project under this action is a research entity (institute or university) and it is part of a consortium, then the publicity expenses of the project and management expenses become ineligible for the research entity as well.

Under the Action 1.1.4 - Attract researchers from abroad - 27 projects were funded with universities as beneficiaries; the percentage of the non-eligible value was 4.48% of the NFA (8.68 million euro). The highest percent of non-eligible value was recorded for type E projects. Under this action the ineligible expenses have the same reason as described under the previous action and it was also observed that failure to comply with the thresholds set by the applicant's guide was identified.

Under the Action 1.2.1 - Stimulate the demand of enterprises for innovation - 10 projects were funded with medium enterprises as beneficiaries; the percentage of the non-eligible value was 20.55% of the NFA (4.39 million euro). The highest percent of ineligible cost value was recorded for the Innovative technological type (PTI) projects. The ineligible cost values under this action are due to the VAT, management or publicity expenses that become ineligible or the fact that public procurement of consulting services in the field of innovation exceed the value maximum of 200,000 euro, established as aid for the beneficiary.

Under the Action 1.2.3 - Knowledge transfer partnerships - 29 projects were funded with national research institutes as beneficiaries; the percentage of the non-eligible value was 1.48% of the NFA (0.87 million euro). The ineligible costs under this action are mostly due to the obligation of the beneficiary to support the ineligible expenses of the project audit.

Objective 4: Eligible salaries and non-reimbursement salaries tendencies.

We have investigated the difference between median salaries -- both eligible and non-reimbursement -- in terms of action type, smart specialization domains, legal status, applicant headquarters, and the location of project implementation. To this end, we have conducted Kruskal-Wallis tests followed by pairwise Mann-Whitney U-test tests with Bonferroni correction available in Appendix A.

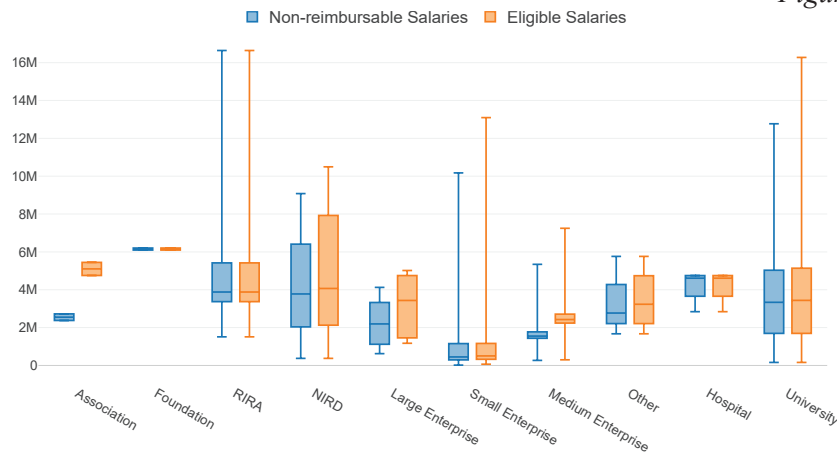
We found no significant difference in terms of applicant headquarters, location of project implementation, and smart specialization domains.

There are significant differences between eligible salaries in terms of legal status as shown in Figure 2. The eligible salaries applied within microenterprises are significantly lower than those applied within medium enterprises, universities, the National Institute for Research and Development, and the Research Institute of the Romanian Academy. This finding is expected, as the max eligible monthly salary stipulated in the COP guidelines is based on education level and professional rank (ex: research assistant, PhD students, tenure professor, manager/director etc), thus universities and other R&D institutes will have a higher median salary requirement.

Similarly, the non-reimbursement salaries are significantly different between the legal status categories. The non-reimbursement salaries applied within microenterprises are significantly lower than those applied within universities, the National Institute for Research and Development, and the Research Institute of the Romanian Academy. However, there is no significant difference between the non-reimbursement salaries applied within microenterprises and medium enterprises.

Eligible or non-reimbursable salaries by legal status

Figure 2



There are significant differences between eligible salaries in terms of action type as shown in Figure 3.

Eligible or non-reimbursable salaries by action type

Figure 3



The eligible salaries significantly differ between most action types with the eligible salaries applied for “*Knowledge transfer partnerships*” being higher than those applied for all the other action types. Similarly, the non-reimbursement salaries applied for “*Knowledge transfer partnerships*” are significantly higher than those applied for all the other action types.

3. RESULTS

This study sought to investigate funding granted through the Competitiveness Operational Programme 2014-2020, which represents the national implementation of Romania’s Partnership Agreement. We have conducted our analysis in terms of four evaluation objectives. The main conclusions are as follows:

Objective 1: To identify the common tendencies among funds recipients

The universities and the national institutes of research and development were the most active in securing funds among all action types. Out of the six action types implemented under COP, universities were over-represented in four categories: Action 1.1.2 - Development of networks for R&D centres, Action 1.1.3 - Synergies with Horizon 2020, Action 1.1.4 - Attract researchers from abroad, Action 1.2.3 - Knowledge transfer partnerships.

The national institutes of research and development are most active among Action 1.1.1 - Large R&D infrastructures, while Action 1.2.1 -

Stimulate the demand of enterprises for innovation is approached mainly by microenterprises.

Objective 2: To identify the regional competencies

The competencies are heterogeneously distributed among NUTS regions.

- Bucharest-Ilfov and the West region -- competencies in implementing projects under the IT&C, space and security area
- the South-West, Centre and North -West regions -- competencies in implementing projects under the Health area
- the North East, South East, and North-West regions -- competencies in implementing projects funded under the Eco-Nano-Technologies and advanced materials.

Objective 3: A description of the non-eligible value of the projects.

Since the financing entity did not foresee all eligible expenses and the beneficiaries still needed to carry out a series of activities necessary for the efficient implementation of the project, we identified non-eligible salaries for all action types. The ineligible expenses found in some projects included additional amounts for the achievement of the objectives established by the project.

Objective 4: A description of eligible salaries and non-reimbursement salaries tendencies.

There are significant median differences between the eligible salaries recorded by microenterprises and the eligible salaries incurred by the medium enterprises, universities, the National Institute for Research and Development, and the Research Institute of the Romanian Academy. The eligible and non-reimbursement salaries applied for “Knowledge transfer partnerships” are significantly higher than those applied for all the other action types. No significant difference between eligible or non-reimbursement salaries in terms of applicant headquarters, or the location of project implementation, or smart specialization domains was identified. However, eligible salaries tend to increase as the total value of the project increases.

4. DISCUSSION

Existing EU policies seek to support national research, development, and innovation activities and, through the structural funds, operational programs aim to promote competitiveness and innovation (EUROPEAN COMMISSION, 2010).

The Competitiveness Operational Programme is anchored in the general strategic objective of NSRDI to increase *the competitiveness of the Romanian economy through innovation*. To this end, it endeavours to support the performance of economic operators on overall value chains. The national strategy supports the conversion from cost-based to innovation-based competitiveness. This transition means to grow the ability of companies to attract state-of-the-art technology, to adjust these technologies to societal needs, and to develop technologies or services enhancing added value. The specific objectives of COP, strongly anchored in the Romanian RDI strategic document and responding to the strategic and cross-cutting objectives of NSRDI, are as follows:

- Increasing scientific capacity in the fields of smart specialization and health;
- Increasing involvement in research at the EU level;
- Increasing private investment in RDI;
- Increasing the transfer of knowledge, technology, and staff with RDI skills among the public environment research and the private one (Competitiveness Operational Programme, 2014).

The contracted projects tackled all domains and subdomains of smart specialization identified in the national strategic framework of RDI as a priority domain of national interest (bioeconomy; ICT, space and security; energy, environment and climate change, eco-nano-materials, health), increasing involvement in research at EU level. COP has supported the consolidation of investments in RDI actions within enterprises, including both the financing of large infrastructures and the implementation of collaboration activities within large innovative clusters, as well as the collaboration for knowledge and technology transfer in smaller partnerships (research organization - enterprise), having the objective of passing the research results to the business environment, able to increase the competitiveness on the market and to bring added value in the global value chain. The RDI component within the COP increases the mobilization of public and private actors in reaching the European objectives taking into account the key role of innovation and research in the transition to a knowledge-based, competitive and sustainable economy by supporting areas of smart specialization. Smart Specialisation plays a major role in stimulating RDI at the national and regional levels in both less and more developed regions.

The contribution of universities in securing funds among all action types aligns with European standards. Under the smart specialization concept, the EU Cohesion Policy underlines the role of universities in formulating innovation strategies and identifying regional priorities (McCann and Ortega-Argilés, 2015; Muller et al., 2017). It has been mentioned that Research and

Innovation Strategy for Smart Specializations (RIS3) strategies, an ex-ante prerequisite to access the European Regional Development Funds (ERDF), can facilitate aligning universities' research with regional needs (Charles et al., 2014; Fonseca and Salomaa, 2020).

Salaries are similar among development regions, action types, and institutions of comparable dimensions. They only tend to increase as the total value of the project increases. Financial incentives are determinant for the number and the quality of human resources in research, given that new jobs have been created and existing ones have been maintained. This contributes to the cross-cutting objectives of NSRFDI (SO5) to incentivize a critical mass of researchers that will transform research and development and innovation into a factor of economic growth, guaranteeing fast and sustainable evolution, from the quantitative and qualitative perspective of the human resource and the innovation and development results.

Our evaluation reveals a good fit between the above-mentioned specific objectives of COP and the actual implementation results. A flaw of COP implementation arises from the deficient anticipation of eligible expenses.

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Objective 4 - Statistical Analysis

We tested the statistical significance of median differences through non-parametric models. Considering the increasing emphasis on effect sizes, results are reported both on means of p-values and effect sizes. To this end, we have conducted Kruskal-Wallis tests followed by pairwise Mann-Whitney U-test tests with Bonferroni correction. We conducted our data analysis using R statistical software, version 4.1.1.

Applicant headquarters

There is a significant difference between the eligible salaries in terms of applicant headquarters (Kruskal-Wallis $H = 17.991$, $df = 7$, $p\text{-value} = 0.01201$, $\eta^2 = 0.0340$). However, pairwise tests with Bonferroni correction reveal no significant difference.

There is no significant difference between non-reimbursement in terms of applicant headquarters (Kruskal-Wallis $H = 16.817$, $df = 7$, $p\text{-value} = 0.01862$, $\eta^2 = 0.0304$). However, pairwise tests with Bonferroni correction reveal no significant difference.

Project implementation

There is no significant difference between the eligible salaries in terms of project implementation (Kruskal-Wallis $H = 13.265$, $df = 7$, $p\text{-value} = 0.06592$, $\eta^2 = 0.0194$).

There is no significant difference between non-reimbursement in terms of project implementation (Kruskal-Wallis $H = 11.971$, $df = 7$, $p\text{-value} = 0.1015$, $\eta^2 = 0.0154$).

Smart specialization

The results reveal a significant difference between the eligible salaries applied within the five specialization domains (Kruskal-Wallis $H = 14.319$, $df = 4$, $p\text{-value} = 0.006343$, $\eta^2 = 0.0317$) with further investigation underling a significant difference between the eligible salaries applied for *Bioeconomy* and *Health* ($p\text{-value} = 0.032$). However, these results are associated with a small effect size. Similarly, we have identified a significant difference between the non-eligible salaries applied within the five specialization domains. The test revealed a significant difference between the five specialization domains (Kruskal-Wallis $H = 11.936$, $df = 4$, $p\text{-value} = 0.01783$, $\eta^2 = 0.0243$). However, pairwise tests with Bonferroni correction reveal no significant difference. Considering these and the small effect sizes, we can conclude that there is no compelling difference between

the salaries (eligible or non-reimbursement) salaries applied within the five specialization domains.

Legal status

There are significant differences between eligible salaries in terms of legal status (Kruskal Wallis $H = 119.39$, $df = 9$, $p\text{-value} < 2.2e-16$, eta squared = 0.377). The eligible salaries applied within microenterprises are significantly lower than those applied within medium enterprises ($p\text{-value}=0.03$), universities ($p\text{-value}=6.7e-15$), the National Institute for Research and Development ($p\text{-value}=7.2e-15$), and the Research Institute of the Romanian Academy ($p\text{-value}<0.01$).

The non-reimbursement salaries are significantly different between the legal status categories (Kruskal Wallis $H = 124.46$, $df = 9$, $p\text{-value} < 2.2e-16$, eta squared = 0.394). The non-reimbursement salaries applied within microenterprises are significantly lower than those applied within universities ($p\text{-value}=8.1e-16$), the National Institute for Research and Development ($p\text{-value}=3.9e-15$), and the Research Institute of the Romanian Academy ($p\text{-value}<0.01$).

Action type

There are significant differences between eligible salaries in terms of action type (Kruskal Wallis $H = 171.71$, $df = 5$, $p\text{-value} < 2.2e-16$, eta squared = 0.561). “*Knowledge transfer partnerships*” eligible salaries are higher than those applied for all the other action types (Large R&D infrastructures: $p\text{-value} = 0.00030$; Development of networks for R&D centres: $p\text{-value} = 8.6e-06$; Synergies with Horizon 2020: $p\text{-value} = 7.9e-09$; Attract researchers from abroad: $p\text{-value} = 7.7e-05$; Stimulate the demand of enterprises for innovation: $p\text{-value} < 2e-16$).

Non-reimbursement salaries are significantly different between action types (Kruskal-Wallis $H = 11.936$, $df = 4$, $p\text{-value} = 0.01783$, eta squared = 0.0243). The non-reimbursement salaries applied for “*Knowledge transfer partnerships*” are significantly higher than those applied for all the other action types (Large R&D infrastructures: $p\text{-value} = 0.00057$; Development of networks for R&D centres: $p\text{-value} = 8.6e-06$; Synergies with Horizon 2020: $p\text{-value} = 7.9e-09$; Attract researchers from abroad: $p\text{-value} = 0.00832$; Stimulate the demand of enterprises for innovation: $p\text{-value} < 2e-16$).