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Higher Education and Smart Specialisation in Portugal

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Abstract

Universities and other higher education institutions (HEIs) are expected to play a catalytic role in S3. They are increasingly being asked to fulfil many new and wide-ranging tasks, probably with an overly optimistic perspective. To be effective in answering to all demands - such as being sources of knowledge, providers of education and training for strategic leaders of regional regeneration, suppliers of knowledge intensive services and infrastructure, local connectors with external knowledge and markets, and also animators of their innovation systems – HEIs face internal and external limitations. This report presents the main results of the JRC project on Higher Education for Smart Specialisation in Portugal. The project intends to help build innovation capabilities by strengthening the participation of HEIs in regional networks; and by promoting the integration of higher education with research, innovation and regional development in the S3 policy mix. The results are divided into two categories. First, a quantitative and descriptive analysis of the publicly available information about the HE system and on the use of European Structural and Investment Funds. Second, the presentation of qualitative results, based on the content analysis of interviews administered to key stakeholders and focus groups conducted in all regions. Results identify aspects for the innovative and transformation potential of Portuguese regions while they also underline contextual and specific problems facing HEIs, while highlighting measures to help overcome these limitations.

Executive Summary

In 2019, Portugal was chosen as a case study for the European Commission project on Higher Education for Smart Specialisation (HESS). Supported by DG Education, Youth, Culture and Sport, the HESS project is implemented by the Joint Research Centre (JRC) in Seville. The project aims to understand how Higher Education Institutions (HEIs) can play a more effective role in the design and implementation of Smart Specialisation Strategies (S3), while helping to build partnerships with the regional authorities responsible for these strategies.

The case study was launched in May 2019, during a conference in Faro on "Smart Specialisation in Portugal: Reflection and Update", organised by the JRC and hosted by the Regional Development and Coordination Commission (CCDR) for the Algarve. Before Portugal, the HESS case studies all involved individual regions, namely Navarra (Spain), North East Romania, Centre Val Loire (France), Puglia (Italy) and North Central Bulgaria. In the current phase of HESS, four more regions were selected as case studies: Lubelskie (Poland), Northern Netherlands, Lower Austria and Eastern Macedonia and Thrace (Greece). In addition, one other country was chosen as a case study, namely Lithuania. However, while this case study was carried out in partnership with the national authorities, in Portugal all seven NUTS 2 level regions were involved, including the five continental regions and the two autonomous governments of the Azores and Madeira.

All HESS case studies adopt principles of 'action research', meaning they are carried out with and for the research 'objects', which for HESS has been local and regional authorities as well as HEIs. The case study in Portugal aimed to increase the debate and the understanding of the role of HEIs in implementing S3, to reflect on innovation capacity and to possibly lead to collaborative projects. It also aimed to provide advice for more effective spending of the European Structural and Investment Funds (ESIF). In this respect, the results are timely, since Portugal, like all EU Member States, is currently designing the operational programmes for the ESIF in the 2021-2027 period.

Method

The research included three main phases. The first involved background research, in particular with regard to the spending of the ESIF on HEIs in Portugal. This was followed by 23 interviews with actors identified by the regions and conducted between June and September 2019. Following a semi-structured approach, the interviewees were asked about the innovative potential of their regions (including its strengths, weaknesses, opportunities and threats), the role of HEIs in transforming them and what could be done to make this role more effective. The interview transcripts were analysed using the content analysis software Nvivo11. Specific categories of themes were identified, and the number of references made to each of them was calculated. The results were organised in Tree Maps to visualise the weight of the different references. The interviews were followed by focus groups which allowed for a deeper understanding of the main themes and discussion between regional actors. Participants included some of the interviewed actors and others identified by the region. The discussion was divided into two main parts: the first covered the problems encountered by HEIs in fulfilling their role in S3 and the second identified policies and measures that could reduce the problems and allow HEIs to have a more transformative impact in their regions. The results of the focus groups were also analysed using the Nvivo content analysis software. The problems are presented in groups, namely those that are contextual (for example in relation to the S3 framework in Portugal overall), specific regional problems, cross-cutting problems for HEIs in S3 and, finally, relevant problems in specific regions.

Regional context

While Portugal is a relatively small country, there is great diversify between its regions and its higher education landscape. Continental Portugal has strong intra and inter regional disparities. The most populated and economically dynamic parts of the country are the metropolitan agglomerations of Lisbon and Porto. Together, they account for around 65% of the student population, including about half of polytechnic students and more than 70% of university students. There are strong divides between coastal and interior regions, despite the creation of a number of new universities following the arrival of democracy in the 1970s (for example the universities of Trás-os-Montes e Alto Douro and Beira Interior).

Among the three continental regions classified as less developed in the EU Cohesion Policy, Norte has the highest number of HEIs and proportion of students, leading to a competition for ESIF, while Alentejo only has one university and two polytechnics, leading to problems in absorbing R&I funds. Lisbon, like many capital cities, is in the paradoxical position of having the highest numbers of students and researchers but a very low allocation of ESIF, due to its status as a more developed region. Algarve is confronted by relatively low levels of research infrastructure and even less students per head of population than Alentejo but, because of its size and status as a transition region, it has a low ESIF allocation without the capital city benefits enjoyed by Lisbon.

Finally, Centro has high performing HEIs, including Coimbra, the oldest university in Portugal, and other important research actors, such as the internationally recognised Pedro Nunes Institute. The region prides itself on its symbolic capital in terms of knowledge and science but, despite these achievements, the impact on business and innovation is out of step with the global status of its universities. Norte and Centro have been the two most active Portuguese regions in promoting smart specialisation and developing international cooperation around S3 priorities.

Unlike the continental regions, the archipelagos of Madeira and Azores are autonomous and with elected governments. Yet, they also face significant and specific challenges as ultraperipheral regions, far from the economic core centres of Portugal and the rest of Europe. The University of Madeira is the only public HEI in the region and the most recently established in Portugal. The University of Azores is also the only public HEI and has a specific problem of being formally dependent on the central government rather than the regional government, leading to difficulties in accessing ESIF from the regional operational programme.

Main results

Use of European Structural and Investment Funds by Higher Education Institutions in Portugal

Spending ESIF by HEIs is an important measure of their participation in S3, even though their role is much larger than this. The case study research involved an analysis of the approved ESIF co-financed projects, which is published on the PT2020 website. Using data covering the programming period until 31 December 2018, the overall value of ESIF awarded to HEIs was calculated, followed by an identification of projects which explicitly mentioned smart specialisation in their description. This second exercise was limited because not all projects include descriptions in the publicly available data. Of those that do, the text was analysed for key words (RIS3, S3 and smart specialisation). It must be recognised that this also precludes projects that may indirectly contribute to the implementation of smart specialisation. Nevertheless, the main conclusions from the analysis are that:

- Independently of their geographic location, HEIs have operations approved in various Operational Programmes (OPs).
- There were 1.537 projects approved involving HEIs, with the presence of 55 different beneficiaries forming part of HEIs.
- The total eligible expenses for these projects was 645.278.423 €, of which 519.896.648 € was ESIF, thus representing an average co-financing rate of 20%.
- There are large differences between HEIs in terms of the overall eligible expenses and total value of funds approved.
- A number of HEIs stand out for having the highest number of projects and funds approved, namely the Universities of Aveiro, Porto, Minho and Coimbra.
- The highest number of projects approved was funded by the Operational Programme for Competitiveness and Internationalisation (COMPETE 2020);
- Projects led by HEIs have predominantly been in the first investment priority of the thematic objective on research and innovation, which mostly involves knowledge generation, while only a small number of projects on knowledge transfer (IP1.2) have been led by HEIs.
- A substantial amount of spending under thematic objective 10 has been linked to smart specialisation, which goes beyond the legal requirement involving
- The regional operational programmes with the most projects and funds approved were Lisbon, North and Centro.

Interviews

The interviews showed that the role of HEIs can be seen at different phases of S3 and goes beyond the fact of just being beneficiaries of the ESIF. While there are variations between regions, HEIs were overall crucial in the design of S3, participating in discussion groups and often providing the competences to evaluate existing innovation capacities. Regarding the implementation, the main activity concerns participation in, as well as leadership of, innovation communities/platforms. A related role of HEIs is in the provision of information to other actors, particular companies, about the possibilities for collaborative projects in the S3 priorities. Another relevant factor is the contribution of HEIs to regional infrastructures that add value and transfer knowledge, such as incubators, intensive knowledge services and science and technology parks. HEIs are also seen as crucial

in creating partnerships and mobilising actors around a vision. Finally, some of the interviewees mentioned the services provided by HEIs to design and – mainly intentions – to implement S3 monitoring systems.

HEIs participate in governance structures and are very much involved with the revision of the regional S3.

Some of the principal limitations identified for the effective participation of HEIs in S3 were the followings:

- Low levels of knowledge absorption capacity among businesses;
- Difficulties in identifying the change actors within the university (those that really want to cooperate);
- Problems in sustaining the interest of academics in S3;
- Tensions among actors due to a lack of understanding of HEIs and its role;
- Differences among HEIs and other types of actors about the meaning of S3.

Some crucial changes to the process of S3 were underlined in the interviews, including:

- Change the incentives for academics to participate in collaborative activities with other actors in the R&I system;
- Enlarge and adapt the policy mix to fit the different regional priorities;
- Stimulate models of open innovation;
- Tackle social factors related to innovation;
- Integrate multi-national companies with local SMEs;
- Promote a cluster policy;
- Only allow strategic research and limit the financing of basic research by regional operation programmes;
- Deepen collective engagement in S3 because the experience has been very positive for innovation and regional cooperation.

Regarding regional transformation, interviewees strongly felt that it can happen through the strengthening of the role of HEI, notably through increasing their regional impact, adjusting the metrics of evaluation for academic staff and researchers, developing networks of cooperation and adapting curricula to regional S3 priorities. Interviewees also underlined more structural changes to regional governance and S3 overall, including a greater focus on regional strategies, giving them more specific measures and flexibility. In this sense, they pointed towards the coordination of regional strategies with national and European priorities, a broader understanding of innovation while strengthening the institutions to implement S3. There was also a feeling that education and training had to become more place-based. The interviewees identified a number of changes that could transform the region, such as a stronger territorial approach to public policies and a new model for the management of regional funds, with an increase in synergies between programmes and stronger human resources.

Focus Groups

Content analysis from the focus groups reveals several problems related to the context and specific role of HEIs, as well as possible measures to increase their contribution to S3.

Contextual problems that were discussed were in fact transversal to the country as a whole, even though some are felt more strongly in some regions than others. The problems that were mentioned the most can be categorised as failures in S3 and are related to the process and the approach implemented in Portugal, which were described as disconnected, especially in the alignment between the national and regional strategies. Other contextual problems are related to the education and training system, the culture of entrepreneurship, the business environment (which consists mostly of companies with small dimensions), bureaucracy and time scales for approving ESIF applications. Other limitations referred to by the participants were the absence of a long-term vision and the weakness of innovation ecosystems.

Concerning the common problems of HEIs in all Portuguese regions, participants considered the principal limitation to be the contrast in the objectives, modus operandi and internal culture of the HEIs and the world of business. Otherwise, the main themes discussed were bureaucratic delays, the disconnection between knowledge produced and regional needs, the low levels of resources available to HEIs, and the evaluation metrics (which are overly biased in favour of scientific output, such as publishing academic articles). Other

problems, that were mentioned less often, were the high dependence on scholarships, exclusivity clauses in academics' contracts, overload of tasks, low levels of staff turnover and mobility, and failures in cooperation.

Participants identified a number of problems in HEIs that are more specific to the regional context. The most common is related to disconnections, notably between the academy and businesses, between HEIs and S3 managers and even between the same HEIs. The educational programmes offered were also mentioned by participants, principally in relation to regional problems. The dislocation between the objectives of researchers and their contribution to S3, together with incipient structures and difficulties to attract and retain talent, were also dimensions that participants referred to as strong limitations. Problems that were mentioned less often were related to interface institutions, equipment and infrastructure, the form in which the ESIF OPs are structured, the internal strategies of HEIs and the lack of doctoral graduates in businesses.

In order to resolve the main problems identified, participants considered that, at national level, the most important and transformative measures are: for HEIs to assume a structured new role, thus increasing their links with the business environment, developing a more effective culture of collaboration, improving the alignment of human capital and S3 as well as outlining stable public policies and the reduction of the bureaucratic burden. While mentioned in fewer occasions, participants also considered important to develop new statutes for academic staff, increase the autonomy of HEIs, contract personnel for knowledge management, finance regional anchor projects with a greater mobilising effect, and increase the size and duration of the supported projects. Finally, some participants referred to the need to end the exclusivity clauses in academic contracts.

In relation to regional measures, participants gave most relevance to the need to create and strengthen institutions that promote innovation. After this aspect, participants mentioned once more the need for a more structured cooperation, to develop regional public policies that increase the attraction and add value to regional product chains, and to empower HEIs. Other measures that were mentioned an improvement in the expression of regional needs, the restructuring of operational programmes, the alignment between education and training with regional needs, the decentralisation and territorialisation, and finally the measures to adopt to promote the region.

Concluding remarks

Smart Specialisation is strongly associated with the capacity to change that HEIs are capable to bring to their regions. In less developed regions, HEIs can assume an even greater role in the animation of innovation dynamics. However, they are also confronted with bigger challenges. In order to be effective as sources of knowledge, providers of education and training, as well as providers of knowledge intensive services and infrastructure, and connectors of local knowledge and external markets, HEIs have to overcome various internal and external limitations.

An important challenge refers to the financial pressures of HEIs. Other relevant challenges refer to the risk of fragmentation and incompatibility between the university and the local economic fabric, the low levels of autonomy and the system of evaluation and incentives for academic staff related to knowledge exchange and local engagement.

This project not only identified such limitations but also the type of measures, both national and regional, that could reinforce the role of HEIs in S3 and promote a transformative agenda in Portugal's different regions.

1. Introduction

Higher Education Institutions (HEIs) can play a crucial role in smart specialisation, an assertion made in the early thinking about Smart Specialisation Strategies (S3) (Goddard & Kempton, 2011). However, a series of evaluations about S3 in Portugal (cf. Technopolis 2017; Quartenaire, 2019; Laranja et al., 2020) have paid relatively limited attention to the specific situation of HEIs, in particular about the challenges they face and how these can be overcome to maximise their contribution to this key EU policy for the knowledge economy at regional level.

This technical report presents the results of action research undertaken in Portugal between September 2019 and July 2020 in the context of the project on Higher Education for Smart Specialisation (HESS). In cooperation with DG Education, Culture, Youth and Sport (DG EAC), the Joint Research Centre (JRC) of the European Commission launched the HESS project in 2016 to better understand how HEIs can contribute to the successful implementation of S3, and help build close partnerships between regional authorities and their local HEIs. Furthermore, it analyses how the European Structural and Investment Funds (ESIF) can be better spent to strengthen the contribution of HEIs to S3 in their regions.

Before the case study in Portugal, action-research had taken place in five European regions, namely Navarra (Spain), North East Romania Centre Val Loire (France), Puglia (Italy), and North Central Bulgaria. During the case study, action-research was also ongoing at national level in Lithuania and in three other European regions, namely Northern Netherlands, Lubelsike (Poland) and Lower Austria. In Portugal, the case study covered all seven regions, including the five mainland regions and the archipelagos of the Azores and Madeira. Each region helped to identify participants for action-research, namely representatives of their local HEIs. In addition, national level agencies and associations were involved, most importantly the rectors' associations of the two main branches of the Portuguese Higher Education System, namely universities and polytechnics.

The case study involved some desk-based research on the Portuguese HE system and ESIF spending on HEIs in Portugal. The main part was action-research in the field, namely interviews and focus groups in all seven Portuguese regions. It was concluded with an online workshop to discuss the results of the research, contributing to the case study final remarks.

This report is divided into eight sections. After this introduction, a background chapter includes a brief review of the concepts and main contributions to the subject of HEIs and their role in regional development and smart specialisation. A third section summarises the research methodology, explaining how the fieldwork was developed together with the national and regional authorities responsible for smart specialisation. After this, a fourth section presents an overview of the different Portuguese regions and a brief introduction to the national higher education system. The fifth and sixth sections present results from the interviews and regional focus groups. These two sections are crucial to identify the main challenges for Portuguese HEIs and smart specialisation. A seventh section summarises the key ideas from the post-project workshop. The report ends with the main conclusions of the project application in Portugal and with some policy implications.

2. Theoretical background

Smart specialisation is the virtuous process of related diversification of the regional economy through the local concentration of resources and capabilities in a limited number of domains that represent possible paths for a desirable transformation (Foray, 2016). The S3 approach emphasises the generation of innovation and the creation of new connections among innovation actors within and beyond the region, enabling the transformation of existing structures and the construction of new competitive advantages (Foray at al., 2020). Following a logic of regional differentiation, S3 does not focus the whole economy and not even a whole sector. It is neither a sectoral nor a horizontal policy (Foray, 2016), it is a transformational policy for the region to improve its uniqueness in the global arena.

Universities and other Higher Education Institutions (HEIs) are expected to play a catalytic role in smart specialisation (Kempton et al., 2014; Edwards et al., 2017). This involves many activities and changes to the way HEIs are managed, and it is perhaps over optimistic to think that they can deliver all that policy makers wish for. HEIs are asked to contribute to the evaluation of regional knowledge assets, capabilities, and competences. They are also asked to contribute to the regional entrepreneurial discovery process by creating awareness and stimulating collaboration. Moreover, they are supposed to provide specialist knowledge and links to national and international innovation networks of knowledge. Their teaching programmes, including professional development, lifelong learning, undergraduate and post-graduate degrees, should develop skills and competences. Likewise, HEIs are supposed to contribute to capacity building on the innovation demand side through spin-offs and knowledge transfer activities. They are also considered a key factor in building dynamic innovation ecosystems. HEIs are even expected to assume governance and leadership responsibilities, especially in regions where the local government is fragmented and unable to act beyond its own immediate boundaries. Furthermore, if this was not enough, HEIs are now being asked to find solutions to societal challenges at global and local level.

Yet, this role for HEIs is often too optimistic regarding the capacity of the university. In fact, to be effective in answering to all these demands, the university faces internal and external limitations (Reichert, 2019). Some of the most relevant limitations refer to the risk of fragmentation and mismatch between the university and the local economic fabric, the existing institutional thinness which often makes universities part of the problems of path dependency and lock-in, and the evaluation and function incentives related to knowledge exchange and local engagement (Benneworth et al., 2017). However, the continued importance of Smart Specialisation Strategies (S3) and associated financial resources in the next programming period of the European Structural and Investment Funds means that HEIs will need to find solutions to the limitations they face.

Regardless of smart specialisation, the university had already changed, with its functions becoming more diverse and complex. As a matter of fact, in a knowledge-based society, there are huge public expectations around the results and impacts of HEIs. With the Humboldtian revolution, the traditional role of HEI - training and qualification of individuals - was expanded with the additional relevance given to scientific research, therefore emphasising the contribution of the university to the production of new knowledge. This university paradigm, which combines education and research, dominated the organisation and the functioning of universities for a whole century.

With the success of some regions in transferring scientific knowledge to valuable innovation as a result of university-industry interactions, policy-making began to give additional significance to the role of the university. This change in the role of HEIs is reflected not only in the change of the modality of knowledge production (Gibbons et al., 1994), which became more transdisciplinary and applied. It also implied the active involvement of actors from different institutional spheres such as the universities, companies and governments, which created new hybrid and overlapping areas in the governance of innovative dynamics, namely in the form of a triple helix with shared objectives and new types of intermediary actors (Etzkowitz and Leydesdorff, 1997).

Many successful stories were made famous and were imported from specific environments, especially the North-American reality. In this context, the concession of industrial property rights was seen as a crucial mechanism in the relationship between university and society. This factor mainly derived from the existence of a strong regime of private property rights that, stimulated by the implementation of the Bayh-Dole Act, assured to the university the opportunity of obtaining financial benefits from the commercial exploitation of publicly funded research. In a moment of contraction of public government investment in HEIs, the possibility of additional incomes in US universities increased the awareness related to the protection of knowledge, primarily through patenting. This model, based on the commercialisation of science, became dominant and has been replicated in several contexts, including in European countries. Nevertheless, its replication in very different contexts has been repeatedly questioned (Mowery, 2011).

The new role of the university expanded the linear model of innovation, which assumed the HEIs as leading providers of knowledge, and whose efforts in R&D started to generate innovation as well as it led to the commercialisation of new products to be absorbed by the companies, thus stimulating economic performance. Nowadays, this view became essentially evolutionary and non-linear, with the university embedded in a specific territorial context and economic fabric. Nevertheless, the HE system is a key element of the regional innovation system (Cooke, 1998). In this conception, the university participates in a number of interactive processes with different actors and networks, framed by specific institutions, which stimulate collective learning, the genesis of incentives for innovation and the strengthening of social capital by promoting competitiveness. This vision entails with the so-called 'third mission' of the university, a more complex role for the regional development that is not strictly limited to a simplistic contribution to technology transfer (Molas-Gallart et al., 2002).

The growing complexity of the role of the university is well summarised by Uyarra (2010), where it is suggested that universities evolved from mere factories of knowledge, whose impact was primarily driven by knowledge spillovers, to institutions with a relational understanding, where HEIs were seen as privileged partners for large companies, embedding a technologic strategy into their activity. HEIs were later transformed in entrepreneurial universities, therefore emerging as a corollary of the view of the triple helix, a factor that highlighted the imperative of commercial exploitation of scientific knowledge. This vision is still very present today and it is associated to knowledge transfer and valorisation, namely though academic entrepreneurship, while also being connected, among other aspects, to the emergence of various intermediary actors such as technology transfer offices (Etzkowitz et al., 2000). The university began to be seen as an actor capable of diluting distances between the various nodes of the innovation systems where it belonged (Guston, 1999). In Uyarra's proposal, the final step is a more recent approach where the university has an active role in developing the territory in which it operates. In fact, the 'engaged university' is an actor focused on promoting the region.

This concept of the 'engaged university' has been expanded to a more comprehensive idea of 'civic university' (Goddard, 2009). This idea underlines that universities should have a wider role than just teaching and research. As a matter of fact, the university is a civic engaged institution which recognises the importance of building networks with local businesses and existing territorial clusters but it is simultaneously a university with national and international connections. All these aspects are considered key elements in defining its strategy and performance. In this context, the university has a civic duty to engage with the whole society, locally, nationally and globally, linking social and economic development and promoting place-based leadership. There is an increasingly greater recognition of the fact that universities can and should do more to help solve social problems in the areas where they are located. This could positively contribute to the research agendas developed by HEIs and to the learning experiences of students, not to mention the direct benefits to local stakeholders. Furthermore, the notion of public commitment of the university is not a simple addition in the existing functions of universities but it should rather redefine the nature of the university itself.

The civic university is concerned with blending institutional borders, particularly between public and private spheres, by recruiting individuals capable of translating interests and building bridges between different types of agents. Nevertheless, this integration is not only focused on transactional interventions that have clear outputs, such as patents, spin-offs or contracted research, but also on transformational mechanisms that are more difficult to quantify. Despite this aspect, the civic universities attempt to scrutinise their action, which is related with the results of their interaction with society. Qualitative assessments are, in these cases, the most appropriate.

At local level, the university strengthens civic innovation in enterprises and the qualification of human resources, which is adapted to existing or latent needs. It contributes to the expansion of cultural and creative activities and to the integration of a more inclusive society. Nationally, it favours the setting of agendas on societal problems and enables the effective interconnection between national actors and localised system of innovation. Although locally embedded, the civic university must be globally competitive, encouraging investment and external financing, the attraction and retention of talent and connection possibilities of local actors with transnational networks. The 'civic university' is therefore a particularly relevant vision for the understanding of regional innovation systems and S3 implementation.

The civic university promotes the place-based leadership stimulating, together with various relevant stakeholders, internal and external to the region, a transformational vision of the territory. The development of place-based leadership involves substantive knowledge ('know what'), networks ('know who') and skills ('know how') to implement the process (European Commission, 2011). The university can be the facilitator of this process, ensuring the improvement of skills and connections within the system. The place-based civic leadership, crucial for S3 implementation, can be broadly defined as any activity where leadership serves a public purpose in a given location. In simple terms, it can be distinguished from other types of leadership that are a-territorial

(Hambleton, 2011). The place-based leadership illustrates the decision process with a concern for communities living in 'a place' and a specific social capital. Social capital is a spatial phenomenon (Rutten et al., 2010) related to the actual spatial distribution of actors where a dense network of relationships is easier to maintain if there is geographical proximity. This is even more evident for weak ties that need to be consistently lubricated and that are seen as crucial in innovative dynamics.

Nevertheless, there is a trend to delimit the boundaries of innovation systems as closed systems, defined by a particular administrative region. As a matter of fact, the paradigm of regional innovation system has been used as a normative notion that too often resulted in policies that stimulate partnerships located internally to the system, ignoring that no system works in isolation and disregarding the connections with other systems and external actors in the region (Uyarra and Flanagan, 2012). Neglecting the global vocation of universities means inducing the replication of inadequate institutional practices, thus creating obstacles to collective learning and allowing for self-reproducing path dependencies and lock-in.

3. Research methodology

3.1 Case study launch

The case study adopted principles of 'action research', meaning that the objects of the research were closely involved, namely the managers of Smart Specialisation Strategies (in the case of Portugal, the Commissions for Regional Development and Coordination – CCDRs) and the higher education community. The CCDRs made proposals for interviews and focus groups based on their experience with higher education institutions in their regions. This was followed by a workshop to discuss the results of the research, and these discussions have been reflected in this final report.

The HESS case study was launch in May 2019 during a conference on smart specialisation in Portugal, organised by the Joint Research Centre and hosted by CCDR Algarve in Faro[1]. The conference concerned the discussion of the implementation of S3 in the period 2014-2020 and looked ahead to the proposed enabling condition for the European Regional Development Fund in 2021. It brought together representatives of the Portuguese Government and its regional offices, stakeholders, DG Regional Policy and a number of European experts and peers. It covered key issues such as the functioning of the Entrepreneurial Process of Discovery, the spending of the ESIF, the role of higher education institutions and cross border cooperation.

The workshop session on 'The role of Higher Education Institutions', moderated by Hugo Pinto, involved the participation of Paulo Águas, Rector of the University of Algarve and representative of the Portuguese Rectors Conference (CRUP) and the Polytechnics Coordinating Council (CCISP), Anne Delouis, from University of Orléans, and John Edwards, HESS Project Manager of the Joint Research Centre of the European Commission.

The discussion followed five questions proposed by the moderator:

1. What is the role that higher education should play in RIS3?
2. What is the role of HEIs in adapting training provision to the needs and competencies that markets and societies ask for (in our desire to transform society)?
3. How can universities organise themselves to benefit ESIFs based on this vision of smart specialisation (use of the most economically and socially effective funds)?
4. What is the risk of universities hijacking their own RIS3 (thematic agendas, research interests) and not being so fruitful?
5. How can universities adapt to the challenge of RIS3 by creating incentive structures so that people have a real sense of being engaged in these activities of transferring knowledge to the market (since scientific production and teaching are the indicators of excellence for career advancement)?

3.2 Desk Research

The desk research consists mainly of a review of academic literature and policy documents related to the subject, both at EU level and for Portugal specifically. In addition, data on the spending of the European Structural and Investment Funds was analysed to see how HEIs have benefited. The funds were analysed for all projects involving HEIs as well as a more qualitative analysis that searched for key words related to smart specialisation. While there are limitations to the data, it helps reveal the scope of the support HEIs receive from the ESIF and, therefore, how smart specialisation could make an impact on the HE sector in Portugal.

3.3 Interviews

Interviews followed a semi-structured script and were done in person or online, each one of them digitally recorded and transcribed. A synopsis was prepared for each interview. In total, 23 interviews were administered between June and September 2019. The interviewees who participated in this study, as well as their entities and the region they represent, are also detailed in Table 1.

The goal of the interviews was to understand more deeply the articulation of S3 with HEIs. In this sense, it attempted to focus on the dimensions that can condition and/or facilitate these factors, on the innovative potential of the regions as well as on the priority changes, the transforming activities and the role of HEIs in

1 More information can be found at: https://s3platform.jrc.ec.europa.eu/-/smart-specialisation-in-portugal-reflection-and-update

the regional transformation. For this purpose, we chose to conduct interviews with HEIs and innovation intermediaries, in order to build common trajectories and perceptions. The interest in using this type of qualitative analysis is the depth of the data collected, given that particular cases can be enlightening of collective phenomena.

This empirical phase comprised the following stages: firstly, the interviewees were selected according to criteria established for the purpose - people linked to higher education in different regions who may be responsible for management, leaders of R&D units, group leaders or researchers actively engaged in the regional S3 dynamics; in parallel, a script was constructed for conducting the interviews; and finally, the information collected was analysed.

The interviews were supported by a set of questions focusing on the dimensions identified in the desk research and literature review which can condition and/or promote the innovation dynamics of a territory and/or sector. These dimensions are the base of a semi-directive script with a set of questions that were divided into four large groups:

Group 1 – included issues related to the description of the entity, differentiating aspects and areas of expertise, as well as collaboration networks with firms, other HEIs and other knowledge centres, together with consolidated external partnerships;

Group 2 – collected information on the intervention in S3, either about the role in the period 2014/2020 or about the prediction of that very same role for the post-2020 period;

Group 3 – proposed questions about regional innovative potential, namely, the identification of strengths, weaknesses, opportunities and threats;

Group 4 – submitted inquiries intended for the interviewees to reflect on the transformation of the region, mainly in terms of identifying (structural) changes that should be the priority, the kind of transformational activities that would lead to these changes, the resources needed and the role of HEIs.

Table 1: Interviews according to Region (NUTS II)

Organisation	**Region**
CRUP – Conselho de Reitores das Universidades Portuguesas / Universidade de Trás os Montes e Alto Douro	Norte
Laboratório Colaborativo em Transformação Digital (DTX) / Universidade do Minho	Norte
INESC TEC - Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência / Universidade do Porto	Norte
BIOCANT - Centro de Inovação em Biotecnologia	Centro
Universidade de Aveiro	Centro
Universidade de Aveiro	Centro
Instituto Politécnico de Coimbra	Centro
Conselho Coordenador dos Institutos Superiores Politécnicos / Instituto Politécnico de Setúbal	Lisboa
Universidade de Lisboa	Lisboa
Instituto Superior Técnico	Lisboa
Fundação Champalimaud	Lisboa
Universidade de Évora	Alentejo
UMPP - Unidade de Monitorização de Políticas Públicas / Universidade de Évora	Alentejo
Instituto Politécnico de Portalegre	Alentejo
CRIA - Divisão de Empreendedorismo e Transferência de Tecnologia / Universidade do Algarve	Algarve
CCMAR - Centre of Marine Sciences / Universidade do Algarve	Algarve
Universidade do Algarve	Algarve
Pró-Reitora para a Inovação e Empreendedorismo / Universidade dos Açores	Açores
NONAGON – Parque de Ciência e Tecnologia de São Miguel	Açores
Universidade dos Açores	Açores
OOM– Observatório Oceânico da Madeira / ARDITI - Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação	Madeira
Universidade da Madeira	Madeira
Universidade da Madeira	Madeira

Source: Own Elaboration

After the interviews were carried out, their full transcription was performed, followed by a content analysis using the NVivo Qualitative Data Analysis Software (QSR International Pty, Ltd., version 11.1, 2015).

Content analysis can be understood as a qualitative technique focused on the interpretation, the frequency of occurrences and the interconnection of certain dimensions of analysis, explicit or latent, in all types of written documents (Hsieh and Shannon, 2005). The analysis of the interviews carried out followed a specific set of techniques, namely:

(a) Latent content analysis: it refers to the process of interpreting the text with the creation of categories. These categories can be open (conventional analysis) or suggested by the literature review (directed analysis) (Hsieh and Shannon, 2005);
(b) Quantification of qualitative information: it allows to check the prevalence of a given idea among respondents and suggests the breadth and relevance of a given topic to respondents (Namey et al., 2008).

Before starting the content analysis, it was necessary to identify a set of categories that could facilitate the interpretation of the meaning of the text in the transcripts. Starting from the literature review on smart specialisation strategies and HEIs, the categories identified were defined and are listed in Table 2. After that, the occurrence of categories in the text was also classified and, finally, their interpretation and counting were analysed.

Table 2: Categories Created for Content Analysis

Dimension	**Category**	**Subcategory**
Entity Characterisation	Entity Characterisation	Differentiating features
		Expertise areas
	Networks	Enterprises
		Governance
		Interface Institutions
		Universities and R&D Centres
Role in RIS3	2014-2020	N/A
	Post-2020	N/A
Innovative Potential in the Region	Strengths	Business Fabric
		Institutional Architectures
		Natural Conditions
		Structural Conditions
		Universities and R&D Centres
	Opportunities	Critical Mass
		Innovation Ecosystems
		Specialisation Areas
		Territorial Specificities
		Universities and R&D Centres
	Threats	Attractiveness
		Business Fabric
		Capital
		Innovation Culture
		Networks
		Overspecialisation
		Regional Asymmetries
		Regional Governance
	Weaknesses	Attractiveness
		Business Fabric
		Collaboration/Cooperation
		Innovation Culture
		Investment in R&D
		Regional Asymmetries
		Regional Specificities
Transformation of the Region	Role of HEIs	Collaboration
		Curricula
		Evaluation Metrics
		Finance
		Internationalisation
		Knowledge Economy
		Regional Impact

		Static Structure
	Priority Structural Changes	Capitalisation of Institutions
		Coordinated National Strategy
		Education
		Innovation Culture
		Leadership
		Priority Areas
		Regional Strategies
		Training
	Transforming Activities	Decentralisation
		HR and Qualification
		Leadership
		Maintenance/Reinforcement of Areas
		New Areas
		New mechanisms
		Synergies
	Necessary Resources	N/A

Source: Own Elaboration

3.4 Focus Groups

As an additional data collection method to validate and deepen the ideas in the exploratory interviews with key actors associated with HEIs and innovation intermediaries, a series of focus groups (FGs) were organised. The main goal of these focus groups was to consolidate a vision on the main limits of HEIs in the implementation of S3 in the Portuguese context and to list possible projects, 'ideas-partnerships', to solve identified problems. The discussion was intended to firstly address the main problems and concerns of the regional actors and secondly to reflect on possible measures.

Seven FGs were carried out in all NUTSII regions of Portugal: Norte, Centro, Lisbon Metropolitan Area, Alentejo, Algarve and the Autonomous Regions of Azores and Madeira. The participants were identified in the respective regions by the S3 management bodies in order to ensure that they were linked to higher education and had actively participated in the regional S3 dynamics. Each FG had between 7and 15 participants, with an average duration of two and a half hours. The participants were regional actors responsible for HEIs or R&I units, professors and researchers, innovation intermediaries, companies with research activities and regional governance actors

FGs are a method of collecting data of qualitative and interpretive inspiration. FGs are moments of discussion (Krueger and Casey, 2009), carefully planned, designed to obtain perceptions about a specific area to be analysed and in which a permissive environment should be built to allow for discussion and sharing among the group. In order to make the most of the numerous possibilities of this approach, it is advisable not to apply a set of very strict criteria: any group discussion can be called a focus group, provided that the researcher actively promotes group interaction (Edmunds, 1999; Fern, 2001). As the subjects covered in the HESS study are of regional interest, articulated and developed through a set of key actors in collaboration, this technique is a relevant complement to individual interviews, providing a glimpse of a meso-level perspective.

In order to define the group to be questioned, it is important to keep in mind the main objective of the focus groups, that is, to stimulate discussion and provide comparison between groups. Ideally, the researcher should seek sufficient diversity within groups to stimulate discussion and sufficient homogeneity to facilitate comparison between groups (Barbour, 2007). In this case, the selection of participants was made by S3 management bodies in order to involve key actors in the innovation and HE communities, and guarantee that participants are simultaneously involved in both aspects. Thus, their perceptions and contributions are as close to the field as possible.

3.5 Post-Project Seminar

In order to finalise the HESS project in Portugal, a seminar was organised to disseminate and discuss the results with the project participants and with national and regional stakeholders. Due to the context caused by the Covid-19 pandemic, the seminar was held online. The seminar took place on the 24th of July 2020 and sought, in addition to presenting the main results, to understand the feedback from stakeholders regarding the conclusions and to deepen the specific measures suggested. It included participants from relevant national level institutions such as FCT - Portuguese Foundation for Science and Technology, ANI - National Innovation Agency

and ADC - Agency for Development and Cohesion. In addition, representatives of the Regional Coordination and Development Commissions (CCDR) and HEIs, who participated in the project, were also present in the discussion.

This final working session was dedicated to the presentation of consultation results to stakeholders. It included a moment for questions and answers, with suggestions and comments by participants and the deepening of the 'ideas partnerships' emerging from the interviews and focus groups. The working session also made possible to collect perspectives on the impacts that the current (Covid-19) crisis will have on HEIs and S3.

4. Higher Education, regional development, and Smart Specialisation in Portugal

4.1 The Portuguese HE landscape

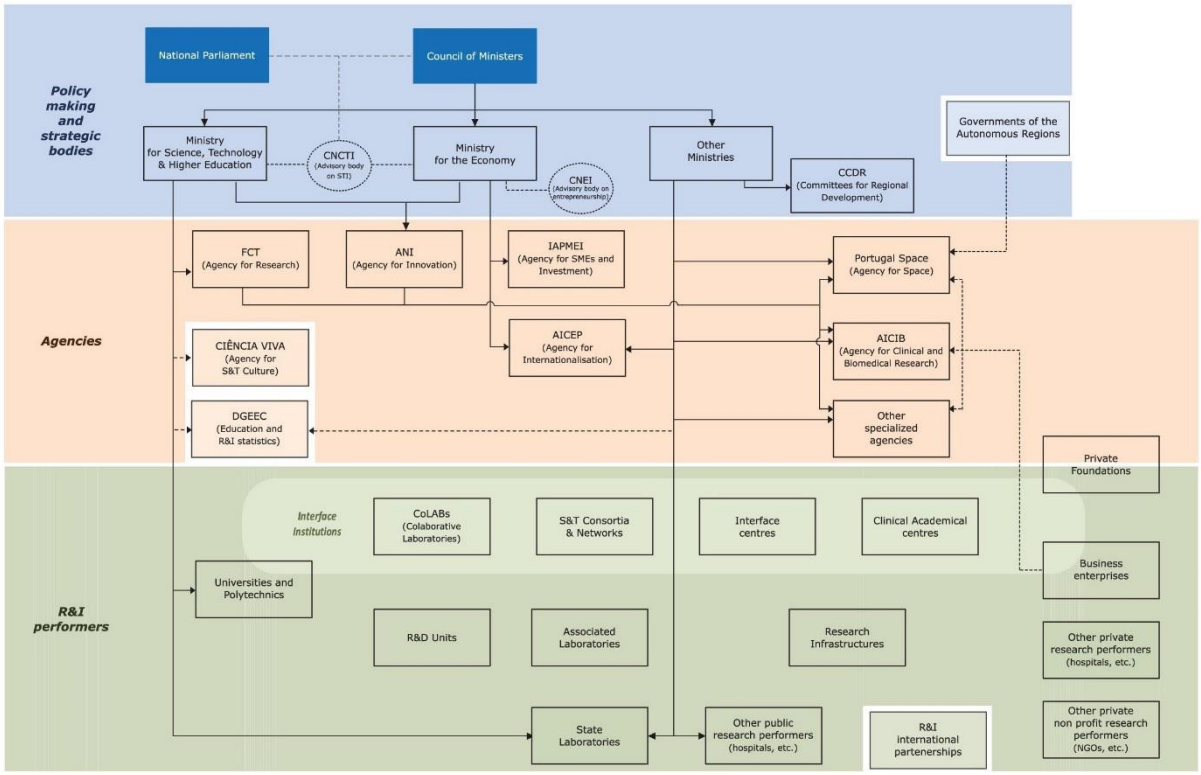
A recent and much debated OECD report (2019: p. 69) suggests a series of challenges for HEIs in Portugal. Many are related to aspects of governance, strategy and funding in the higher education, research, and innovation system that are closely related to smart specialisation. In particular, the report asserts that the "(…) profiles and missions of Portugal's public higher education institutions, viewed as a system, are not well aligned to national and regional needs". In line with the smart specialisation approach, there is an underlying idea that it is crucial to improve Portugal's HE system as a diversified network of institutions, where their missions are better aligned to national and regional needs. The recommendations on resources to upgrade innovation capabilities are especially relevant to establish regional innovation platforms capable of providing domestic SMEs with access to critical resources – such as information, expertise, and equipment. Another relevant recommendation is to continue upgrading polytechnics and regionally-profiled universities by reinforcing their capacity to further develop as 'practice-based knowledge-intensive institutions' dedicated to local development.

A recent national agenda published by the Council of Rectors of Portuguese Universities (CRUP, 2019) emphasised the commitment of its members to explore and strengthen emerging areas, thus forging national and foreign strategic alliances, both academic and non-academic, renewing knowledge production, and improving collective responsiveness to societal challenges. Directly related to S3, CRUP underlined the objective of enhancing knowledge, ensuring new dynamics of digital transformation and internationalisation, bringing academic and scientific systems closer to the productive fabric, public administration and cultural agents, as well as improving interaction with society and territory and stimulating the creation and promotion of activities of qualified employment in Portugal. CRUP also reflected on the issues of territorial inequality and the need for differential treatment in low density territories. It argued that only education and knowledge will be able to produce sustainable economic growth. Therefore, the social impact of knowledge on both people and regions needs to be recognised and appreciated to fully realise the urgent need for this investment.

The Coordinating Council of Higher Polytechnic Institutes (CCISP) made a similar contribution last year (CCISP, 2019). A key aspect, also suggested by the OECD, is the creation of interface doctorates in polytechnics, in coordination with companies and other partners. The CCISP argues that research is a key pillar for all modern HEIs, because of its impact on the quality of training as well as its contribution to the creation of new knowledge and solutions that respond to the challenges of society, organisations and territories. The OECD report, a recent assessment of R&D Units by the FCT (Portuguese Foundation for Science and Technology), presence in international rankings, results in projects funded by the FCT, Horizon 2020 and the ESIF all demonstrate the research capacity of polytechnics (ANI, 2019). However, despite these results, as in other EU Member States, there is still a need to diversify and broaden the range of HEI partners in European funded projects, and to consolidate and strengthen R&I activities in polytechnics. In Portugal, their R&D units are at different stages of maturity regarding activities, level of specialisation, and capacity to engage regionally, nationally, and internationally. The CCISP report urges the reinforcement of mature units and the consolidation of those recently established, thereby boosting their quantitative and qualitative progress. Funding programmes should enable polytechnics to be more competitive in accessing regional, national, and European funding programmes and partnerships in their strategic areas, as well as in engaging with economic actors.

Portugal is a centralised state, with no government at regional level and where municipalities have limited responsibilities compared to other OECD countries (OECD, 2019). This pattern is reflected in the governance and funding of the HE system, in which the national government has a central responsibility. Most of the funding for R&I is directly dependent on ESIF, which is administered at national level by the Thematic Programmes and at regional level through regional Operational Programmes by the CCDRs. However, these are bodies that are hierarchically dependent on the national government. The situation is different in the archipelagos of Madeira and Azores that benefit from larger autonomy, a regional elected government, dedicated resources, and a different governance structure. Taking as reference the OECD report 'Review of Higher Education, Research and Innovation: Portugal', the functions of the national HE system in mainland Portugal (Figure 1 can be seen as structured in three levels: the strategic and advising coordination bodies, the ministries, the agencies, and the performers of science, technology and higher education activities, where universities and polytechnics play the major role (for details, check Box 1).

Figure 1: Structure of the Portuguese HE landscape



Source: FCT (2020)[2]

HEIs in Portugal are the main R&I actors, representing a significant proportion of the country's research expenditure while employing most of the scientific workforce. R&I activities are organised around units that contain researchers from a single HEI, a group of HEIs, or even researchers who are employed outside public HEIs, such as a private (non-profit) foundation or state laboratories. To stimulate the development of research groups, funding is directly designated to R&I units that are chosen through a competitive process organised by the FCT. In 2017, there were 307 R&I units with around 40 000 researchers, of which 22 000 had a PhD. More than two-thirds of R&I units were hosted by HEIs while the rest were located in an Associated Laboratory (AL) or, less often, in private foundations. ALs form a key feature of R&I in Portugal. These are high-performing R&I units with critical mass. By 2018, a total of 26 ALs had been recognised by the FCT for a ten-year period. Portugal's eight State laboratories also perform R&I, each operating under the direct supervision of a specific ministry. Successive governments have chosen to focus on funding research performed in HEIs and ALs rather than State Laboratories. Thus, their role in research has diminished, accounting for only 3% of GERD in 2015, as compared to an average 11% in OECD countries (OECD, 2019).

The Portuguese HE system experienced a considerable increase in the last two decades of the last century, resulting in a wide coverage of the national territory with educational offer in all district capitals. Nevertheless, the supply of HE is concentrated in the two main metropolitan areas, an issue that is stimulating the government to create mechanisms to attract students to non-central cities[3]. In 2017/18, the total number of enrolled students was 359,390, with most of them in the public system (294,540), more than half of which in universities (183,192). Public polytechnics are more dispersed, being present in 47 municipalities, whereas public universities are located in 16 municipalities, private universities in 13 municipalities and private polytechnics in 28 (OECD based in MCTES, 2017).

2 This diagram was prepared by a FCT team in 2020, and has been validated by the respective Board of Directors. Being currently "official", it is based on several other diagrams, namely the diagrams prepared by the FCT in the scope of ENEI 2014-2020 and by OECD (2019), from the reflection on the system, its current configuration and complexity in terms of actors, roles and interactions.

3 Cf. for example https://www.rtp.pt/noticias/pais/ensino-superior-concurso-de-acesso-arranca-com-numero-de-vagas-estavel_n1160865

Box 1: Structure of the Portuguese HE system

At the highest level, the Portuguese government (Council of Ministers) has collective responsibility for higher education, research, and innovation policy and for setting strategic direction. It is also responsible for implementing EU Structural and Investment Funds in Portugal within guidelines set by and agreed at EU level. Advice to government on research issues is provided by the National Council for Science and Technology (*Conselho Nacional de Ciência, Tecnologia e Inovação,* CNCTI), and on innovation and entrepreneurship by the National Council on Entrepreneurship and Innovation (*Conselho Nacional de Empreendedorismo e Inovação*, CNEI).

The second tier of governance is composed of individual line ministries, headed by ministers with a specific portfolio. A ministry in charge of research was established in 1995, and higher education and research have been under the responsibility of a single, dedicated ministry since 2002, with the exception of the period 2011-2015, when these responsibilities were merged into a single Ministry of Education and Science. The Ministry of Science, Technology and Higher Education (*Ministério da Ciência e Tecnologia e Ensino Superior*, MCTES) is responsible for higher education, public research and science-based innovation activities involving HEIs and public research units supported by MCTES. The Directorate-General of Higher Education (*Direção-Geral do Ensino Superior* DGES) is responsible for ensuring the design, implementation and co-ordination of higher education policies developed by the MCTES. The Ministry regulates the higher education sector, including through the establishment of admissions policies that set the total number of student places for all study programmes in both the public and private sectors. The Co-ordinating Council for Higher Education (*Conselho Co-ordenador do Ensino Superior*, CCES) advises MCTES on higher education policy. Primary responsibility for business innovation policy lies with the Ministry of the Economy. Important prerogatives are also in the hands of the Ministry of Planning and Infrastructure, which is responsible for the management of the EU structural and investment funds in various areas, including regional development, sea and fisheries, and agriculture, among others.

The third tier of governance is composed of agencies with implementation or regulatory responsibilities. The Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*, FCT) manages project-based funding of public research and carries out associated *ex ante* evaluations of research projects and centres. The national innovation Agency (*Agência Nacional de Inovação*, ANI), created in 1997 and re-established in 2014, manages incentive programmes targeting businesses and technological interface centres. It aims to foster technology transfer and knowledge promotion and focuses on collaboration. ANI also manages the tax incentive scheme "System of Fiscal Incentive for Business R&I" (*Sistema de Incentivos Fiscais à I&D Empresarial*, SIFIDE). The Competitiveness and Innovation Agency (for the support of SMEs) (*Agência para a Competitividade e Inovação*, IAPMEI) aims to foster innovation activities and boost the competitiveness of Portuguese firms through financial support as well as business support services and training. Portugal Global – Trade & Investment Agency (*Agência para o Investimento e Comércio Externo de Portugal,* AICEP) was created in 2007 to encourage investments in Portugal by foreign companies as well as support the internationalisation of Portuguese companies. The Agency for Assessment and Accreditation of Higher Education (*Agência de Avaliação e Acreditação do Ensino Superior*, A3ES) is an independent foundation tasked with the evaluation and accreditation of higher education institutions and their study programmes, with the objective of ensuring the quality of the higher education system.

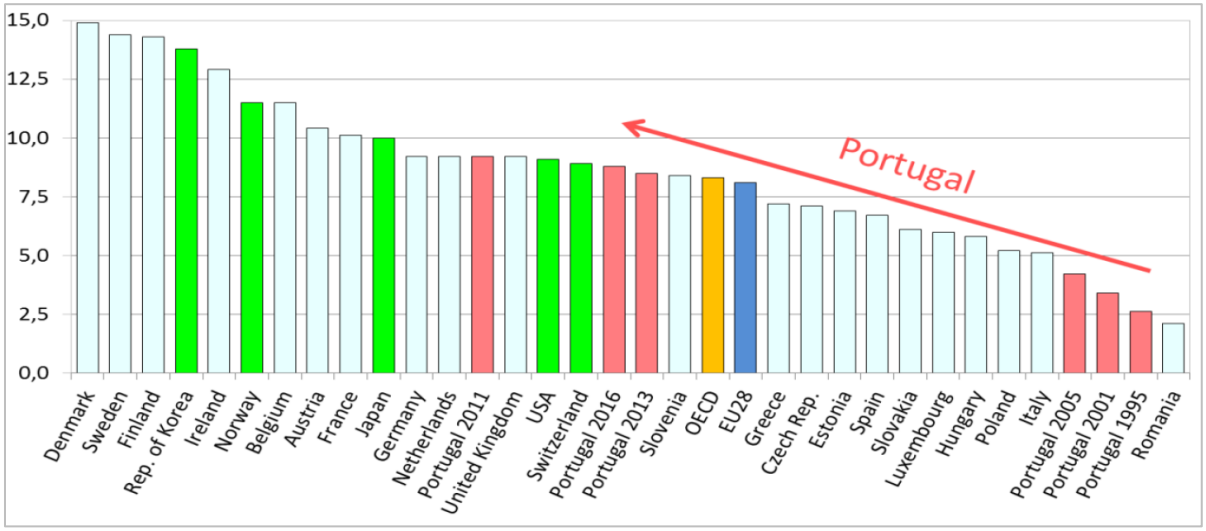
The fourth level of the HERI system is composed by organisations that carry out the work of teaching, research, and knowledge-based innovation, including affiliated higher education institutions and public research organisations. In 2018, Portugal had 118 higher education institutions, 39 of which were public – 14 universities and 20 polytechnics. It had 79 private higher institutions – 24 universities and 55 polytechnics. Additionally, its higher education system included five public military institutions.

The 2007 Legal regime for higher education institutions (*Regime Jurídico das Instituições de Ensino Superior*, RJIES) defines the missions and the scope of autonomy enjoyed by higher education institutions in Portugal. Portugal has a binary structure in which polytechnics are legally responsible for providing professionally-oriented study programmes, while universities are responsible for providing theoretically-led academic programmes. Polytechnics are distinguished in the legal framework by their focus on professionally oriented studies and 'targeted research' (*investigação orientada*) and the fact they are only entitled to award bachelor and Master's degrees, but not doctorates, which can only be awarded by universities.

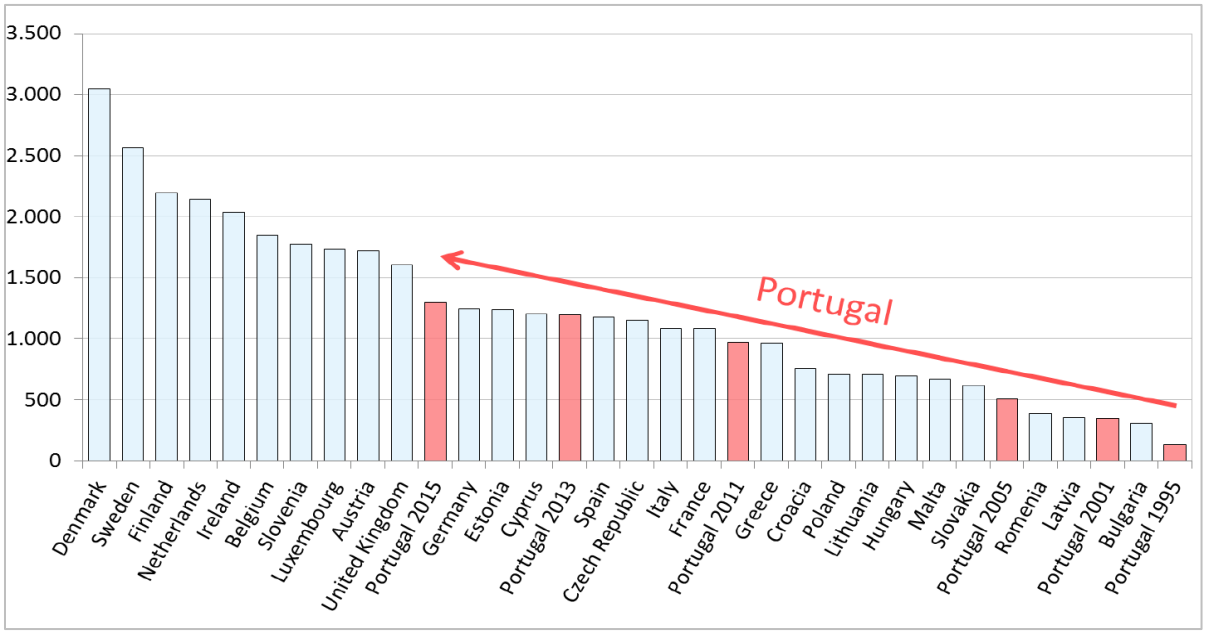
Source: Extracted from OECD (2019: 93 – 96)

This evolution is also evident in the research, both in terms of scientific employment and scientific production, as shown in Figure 2.

Figure 2: Intensive Growth of Research in Portugal



(a) Number of researchers by 1000 employed



(b) Number of scientific publications by million inhabitants

Source: FCT (2019: 4-5)

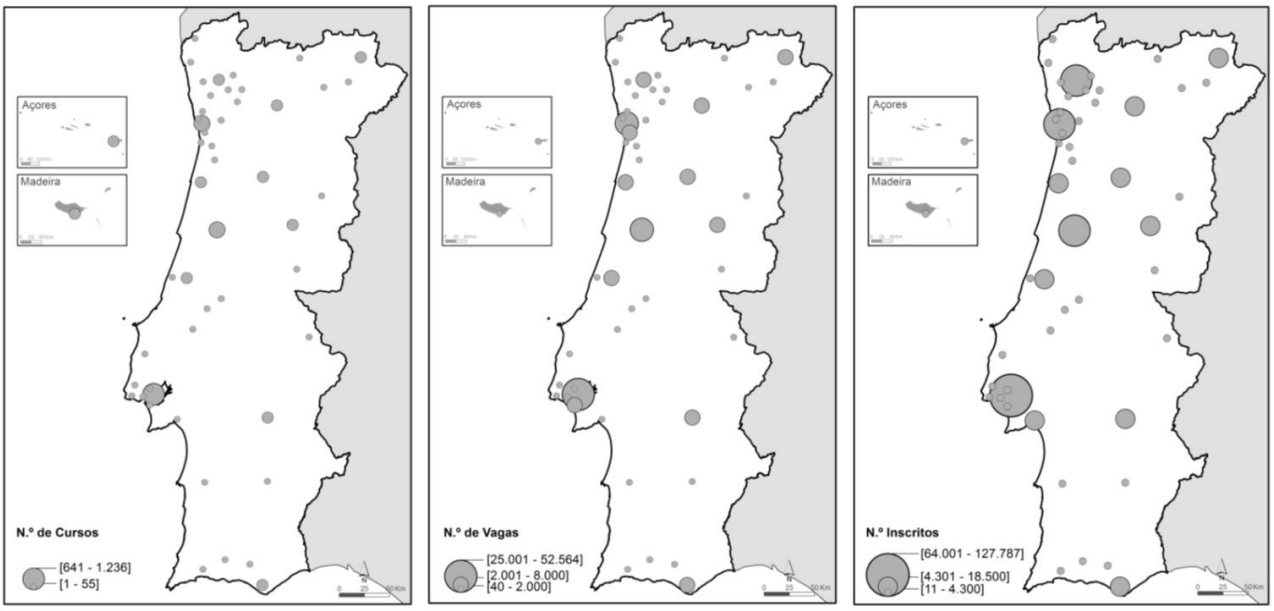
4.2 Regional context

The distribution of the HE system reproduces some of the concentrations of the urban system. There is nonetheless a higher territorial dispersion that could be expected, creating a situation in smaller towns where the HE function is present but the population dimension, service profiles and economic fabric do not reach the necessary critical mass to assure efficiency and sustainability to the institutions located there (Fonseca & Encarnação, 2012).

Figure 3 maps the distribution of the offer of study cycles, vacancies and enrolled students and illustrates both the dispersion and concentration of higher education in Portugal. In term of number of students enrolled, it is evident that the larger urban centres polarise the network.

The same conclusions are evident in Table 3 which provides an aggregated vision by NUTS II. Lisbon and Centro concentrate a higher share of students relative to the overall population. Norte has a similar weight of students and population in the national totals.

Figure 3: Distribution of the offer of study cycles, vacancies and enrolled students



Source: Fonseca & Encarnação (2012: 23)

Table 3: Enrolled Students 2017/18 in Public Universities and Polytechnics by NUTS II

NUTS II	# Univ.	# Poly.	# NI Schools	STDNT Univ.	STDNT Poly.	STDNT TOTAL	PhD Staff	Population
Norte	3	4	1	28.0%	32.5%	29.7%	30.1%	34.8%
Centro	3	2	1	20.1%	35.6%	25.9%	24.8%	21.7%
Lisboa	4	6	3	44.1%	21.0%	35.4%	34.4%	27.5%
Alentejo	1	3	0	3.3%	6.8%	4.6%	5.1%	6.9%
Algarve	1	0	0	2.0%	3.5%	2.6%	3.2%	4.3%
Madeira	1	0	0	1.3%	0.2%	0.9%	1.1%	2.4%
Açores	1	0	0	1.2%	0.4%	0.9%	1.3%	2.5%
Portugal	14	15	5	183,192	110,142	293,334	16,546	10,291,027

Source: Águas (2019) with data from DGEEC/MEd – MCTES

More specifically, Table 4 shows that the university attracting most students in Norte is the University of Porto, in Centro it is the University of Coimbra and in Lisbon the University of Lisbon. There is only one university in the regions of Alentejo, Algarve, Madeira and Azores. In the case of polytechnic education (Table 5), the Polytechnic Institute of Porto has the highest number of students in Norte, while the Polytechnic Institutes of Leiria and Coimbra stand out in Centro. In the case of Lisbon, the institution with most students is the Polytechnic of Lisbon and in Alentejo it is the Polytechnic of Santarém.

Table 4: Universities associated with CRUP and respective number of students in 2017/18 by NUTS II

NUTS II	CRUP	Students
Norte	U Porto	28,400
	U Minho	17,481
	U Trás-os-Montes e Alto Douro	6,236
Centro	U Coimbra	20,233
	U Aveiro	12,782
	U Beira Interior	6,837
Lisboa	U Lisboa	47,989
	U Nova de Lisboa	18,727
	ISCTE – IUL	8,651
	U Aberta	5,427
Alentejo	U Évora	6,596
Algarve	U Algarve	7,529
Madeira	U Madeira	2,634
Açores	U Açores	2,683

Source: Águas (2019) with data from DGEEC/MEd – MCTES

Table 5: Polytechnics associated with CCISP and respective number of students in 2017/18 by NUTS II

NUTS II	CCISP	Students	NUTS II	CCISP	Students
Norte	P Porto	17,718	Lisboa	P Lisboa	13,190
	P Bragança	6,782		P Setúbal	5,938
	P Viana do Castelo	4,026		ES Hotelaria e Turismo do Estoril	1,829
	P Cávado e Ave	3,918		ES Enfermagem de Lisboa	1,469
	ES Enfermagem do Porto	1,599		ES Náutica Infante D. Henrique	686
Centro	P Leiria	10,513	Alentejo	P Santarém	3,489
	P Coimbra	10,182		P Beja	2,511
	P Viseu	4,840		P Portalegre	1,871
	P Castelo Branco	3,971			
	P Guarda	2,699			
	ES Enfermagem de Coimbra	1,952			
	P Tomar	1,946			

Source: Águas (2019) with data from DGEEC/MEd – MCTES

Data presented by Águas (2019) highlights regional specialisations based on the number of enrolled students by academic field. The tables below (Table 6) show the percentage in a specific academic field, considering the

national total (external specialisation) and considering the distribution of students in the region (internal specialisation). Taking into consideration both tables, we can underline that Norte is externally specialised in ICT but internally in Engineering and H&W. Centro is both externally and internally specialised in H&W and internally in A&H. Lisboa is both internally and externally specialised in SSc but also internally in B&A. Alentejo is specialised in agriculture (externally and internally) and in H&W (internally). Algarve is (externally and internally) specialised in services and in natural sciences. Madeira is specialised in Edu (both situations) and also SSc. Azores is specialised externally in ICT and internally in H&W.

Table 6: Enrolled Students 2017/18 in Public Universities and Polytechnics by NUTS II

(a) Considering external specialisation (i.e. regarding the national total, 100% in column)

NUTS II	Edu	A&H	SSc	B&A	Nat. Sci.	ICT	Eng.	Agr.	H&W	Serv.	TOT
Norte	33.5%	28.1%	**23.7%**	26.2%	26.7%	**36.3%**	32.9%	30.6%	32.1%	32.8%	29.7%
Centro	23.1%	28.6%	20.7%	26.7%	23.4%	21.8%	25.2%	**14.5%**	**31.4%**	27.9%	25.9%
Lisboa	27.4%	34.9%	**45.2%**	39.2%	39.2%	34.6%	37.6%	**23.9%**	26.6%	25.8%	35.4%
Alentejo	7.7%	4.9%	4.2%	4.0%	4.1%	3.9%	**2.1%**	**27.0%**	5.2%	5.9%	4.6%
Algarve	2.6%	2.0%	2.9%	2.7%	4.2%	**0.7%**	1.6%	2.3%	2.8%	**5.6%**	2.6%
Madeira	**4.5%**	0.9%	1.7%	0.5%	1.1%	1.0%	0.6%	**0.1%**	0.4%	1.2%	0.9%
Açores	1.2%	**0.5%**	1.7%	0.8%	1.5%	**1.8%**	0.2%	1.7%	1.5%	0.9%	0.9%

(b) Considering internal specialisation (ie, regarding the regional total, 100% in line)

NUTS II	Edu	A&H	SSc	B&A	Nat. Sci.	ICT	Eng.	Agr.	H&W	Serv.
Norte	4.1%	10.0%	7.8%	16.7%	6.3%	3.3%	**27.1%**	2.6%	**16.4%**	5.7%
Centro	3.2%	**11.7%**	7.8%	19.4%	6.4%	2.3%	23.8%	1.4%	**18.4%**	5.6%
Lisboa	2.8%	10.4%	**12.5%**	**20.9%**	7.8%	2.7%	25.9%	1.7%	11.4%	3.8%
Alentejo	6.0%	11.3%	8.8%	16.5%	6.3%	2.3%	10.8%	**14.5%**	**17.0%**	6.5%
Algarve	3.7%	8.4%	10.9%	19.8%	**11.5%**	0.7%	15.0%	2.2%	16.6%	**11.2%**
Madeira	**18.0%**	11.9%	**18.7%**	10.0%	8.4%	2.9%	16.1%	0.3%	6.8%	6.9%
Açores	4.9%	5.9%	**18.2%**	15.8%	11.6%	5.3%	4.1%	4.6%	**24.5%**	5.2%
Portugal	3.6%	10.6%	9.8%	18.9%	7.1%	2.7%	24.4%	2.5%	15.2%	5.2%

In yellow are indicated domains with higher scores higher than the national, revealing external specialisation.

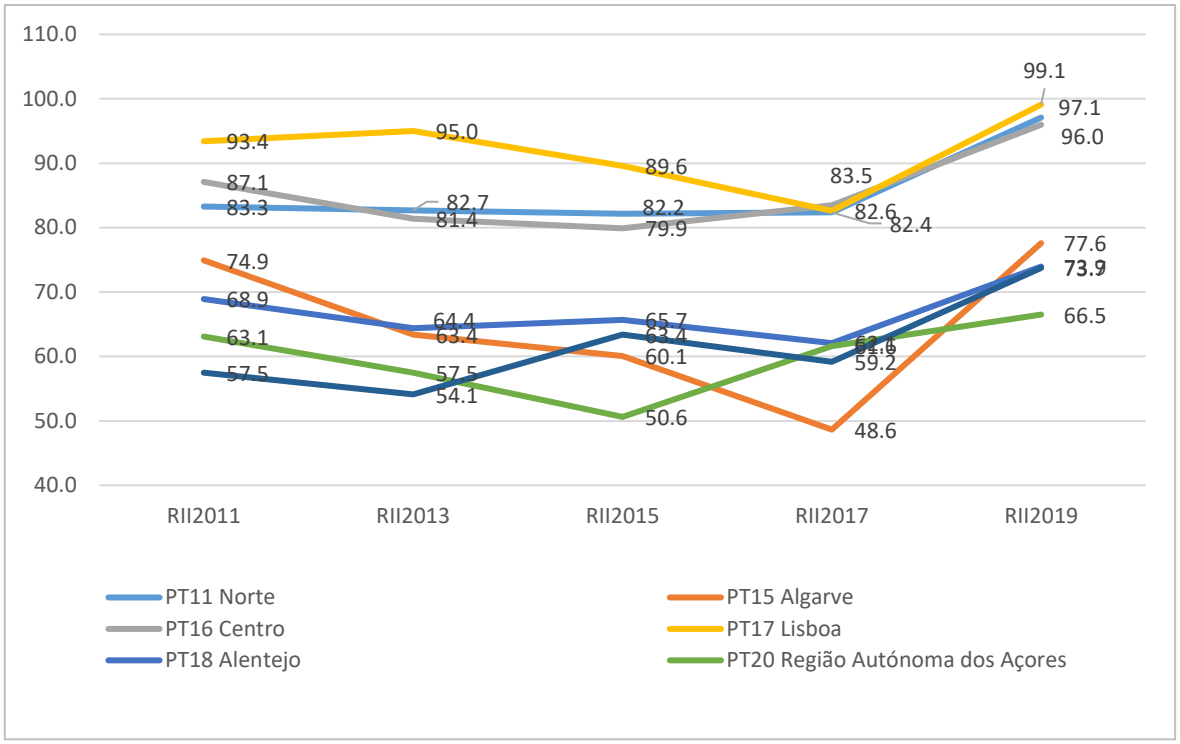
Edu – Education; A&H – Arts and Humanities; SSc – Social Sciences, Journalism and Information; B&A - Business, Administration and Law; Nat.Sci. – Natural Sciences, Mathematics and Statistics; ICT – Information and Communication Technologies; Eng. - Engineering, Manufacturing and Construction; Agr. - Agriculture, Forestry, Fisheries and Veterinary; H&W – Health and Welfare; Serv. – Services.

Source: Águas (2019) with data from DGEEC/MEd – MCTES

A crucial dimension affecting the new role of the HEIs regards absorptive capacity. The European innovation scoreboard 2019 ranks Portugal is as a strong innovator, with a performance that has greatly increased compared to the performance of the EU in 2011. After a fall in the years of the crisis, the sharp increase in 2018 is almost entirely explained by the improved performance of the CIS indicators. Nevertheless, there are significant differences between the regions of Lisbon, Centro and Norte, now appearing as strong innovators, while the others have more modest performances (See

Figure 4).

Figure 4: Evolution of Performance in the Innovation Scoreboard by NUTS II (EU=100)



Source: Prepared with Regional Innovation Scoreboard 2019 data[4]

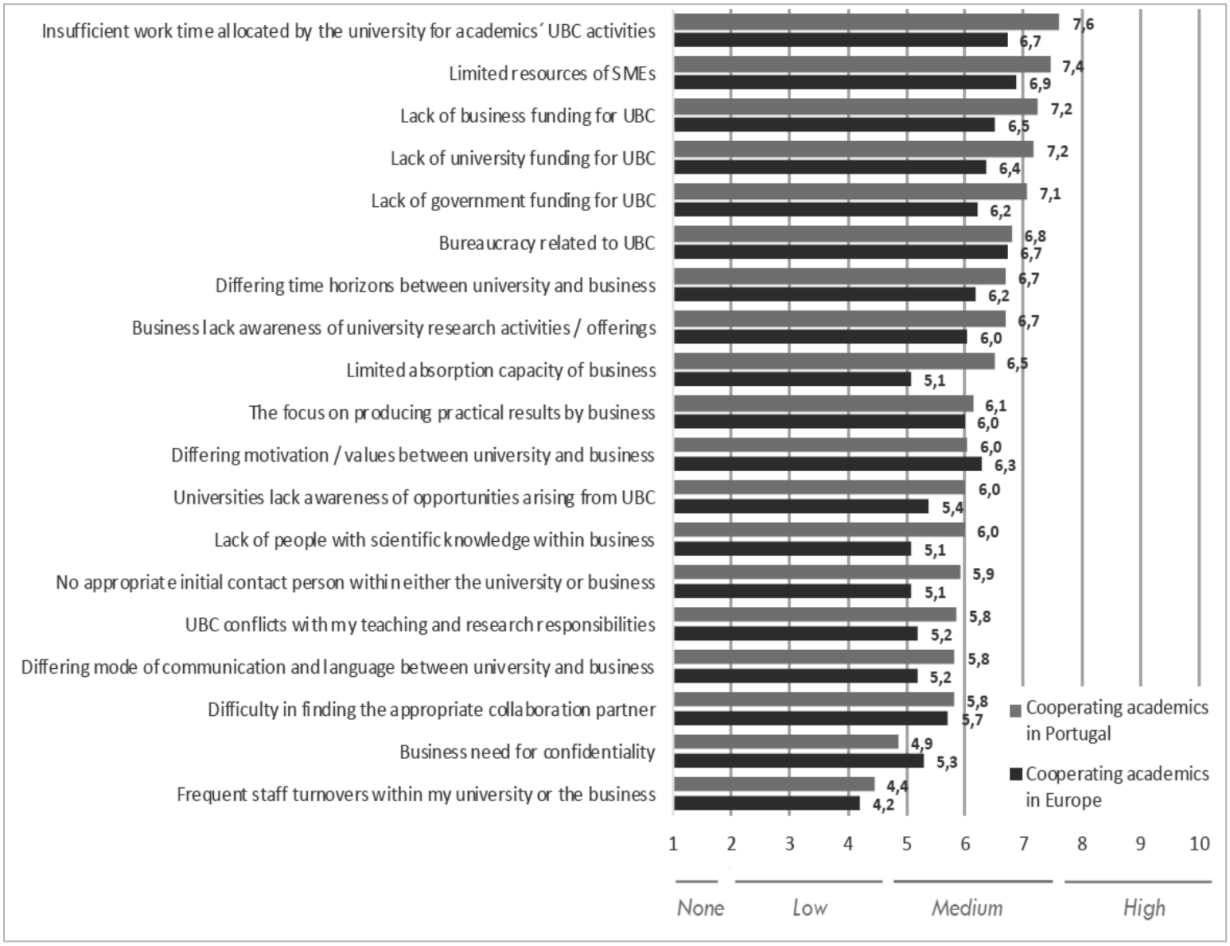
When it comes to knowledge dissemination, there is a variety of barriers that may prevent universities from collaborating with firms. A European Commission report on 'The State of University-Business Cooperation in Europe', conducted during 2016 and 2017 showed that in Portugal, the major barrier is the insufficient work time allocated to cooperation activities with firms within universities, due to the general perception that working with industry is of lesser value than other academic activities such as publishing papers. Other barriers from the perspectives of the university include the lack of business, university, and government funding for cooperation. It is also identified by academics that SMEs tend to have a limited absorptive capacity, which is likely due to the fact that high and medium high-tech industrial companies and knowledge-intensive service companies are less represented in Portugal compared to the EU as a whole. As a final point, academics point to the lack of scientific knowledge within business human resources as a noteworthy barrier for cooperation.

Intermediary organisations, such as knowledge transfer offices and S&T parks, help bridge the gap between firms and academic institutions and to overcome the limited absorptive capacity among traditional SMEs. The Portuguese knowledge transfer infrastructure has experienced a gradual expansion, notably in the last 15 years (FCT, 2013; MCTES, 2017). More recently, the number of CoLabs[5] have grown to 26.

4 https://ec.europa.eu/growth/industry/policy/innovation/regional_en

5 CoLabs are collaborative laboratories, a new scientific actor in Portugal, consisting of at least the involvement of one company and one R&D unit associated with a HEI, with the main goal to create skilled and scientific jobs, both directly and indirectly, by implementing research and innovation agendas geared at creating economic and social value.

Figure 5: Barriers to University-Business Cooperation, according to academics



Source: Muros et al. (2017)

4.3. Spending of the European Structural and Investment Funds on higher education

In order to understand how HEIs in Portugal currently benefit from the European Structural and Investment Funds (ESIF), project data made available by the Portuguese government was analysed, using the most recent data existing at the start of the case study - the list of approved operations by 31 December 2018[6]. The analysis was divided into two phases: a first phase in which the approved operations are led by HEIs were analysed, across Operational Programmes (OPs), Thematic Objectives (TOs) and Investment Priorities (IPs); and a second phase where, among these, projects that mentioned in their description a direct and explicit relationship to smart specialisation were analysed.

It should be noted that the databased provided by the Portuguese government lists projects with more than one beneficiary ('co-promoted projects') as well as those with single beneficiaries. Thus, it does not reflect the full scale of ESIF spending on HEIs. In particular it does not include projects led by other types of beneficiaries such as firms and in which HEIs are junior partners, which is the case for example in co-promoted R&I projects[7]. Moreover, in some projects the beneficiaries sub-contract HEIs and this participation is not captured either. However, what the data does show is the extent to which HEIs have led ESIF financed projects which is an important role to take in building their capacity to engage in innovation ecosystems.

6 The latest data on ESIF spending can be found at: https://www.portugal2020.pt/content/lista-de-operacoes-aprovadas. The nature of the calls and proportion allocated to HEIs has not changed significantly.

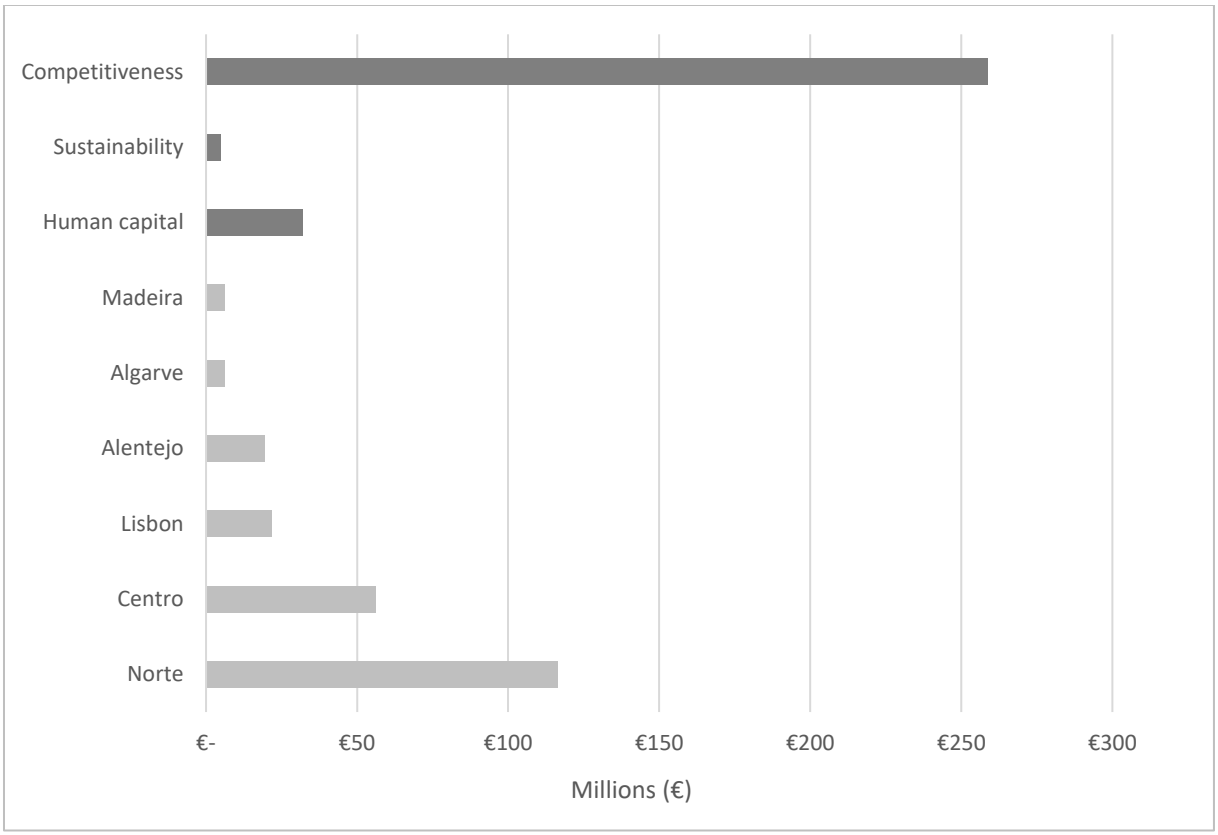
7 An analysis of co-promoted ESIF projects in the field of R&I, showing the extent of HEI participation, both in the previous and current programming period, will be published shortly (EY-Parthenon, forthcoming)

Overall, in the period analysed, there were 1 537 approved operations involving a total of 55 beneficiaries from the HE sector[8]. The total eligible expenditure for these operations was 645 278 423,02€ and an approved total fund of 519 896 679,55€, which means that around 80% was co-financed by the ESIF.

A general conclusion that can be drawn from the data is that, despite the geographical location of HEIs, they usually have operations allocated to more than one OP. Another general conclusion is the asymmetry between the different institutions, both in terms of the eligible expenses allocated to the operation and the total approved fund. This asymmetry is related to the number of projects approved by each institution.

Figure 6 shows that the OP with the most projects and funds allocated to HEIs was the thematic OP for Competitiveness and Internationalisation (COMPETE 2020). The regional OPs with the most operations and approved funds were those of Norte and Centro, which is expected as they host many HEIs, as presented in the previous section (Lisbon has the most but also has much fewer funds due to its status as a more developed region). The HEIs with the highest number of projects and value of approved funds were the University of Aveiro (Centro), the University of Porto (Norte), the University of Minho (Norte) and the University of Coimbra (Centro). In the OP of the Azores, HEIs were not identified as beneficiaries of approved operations, which can be explained by the specific legal status it has, as explained earlier in the report.

Figure 6: Value of approved ESIF financed projects with HEIs as single beneficiary or lead partner

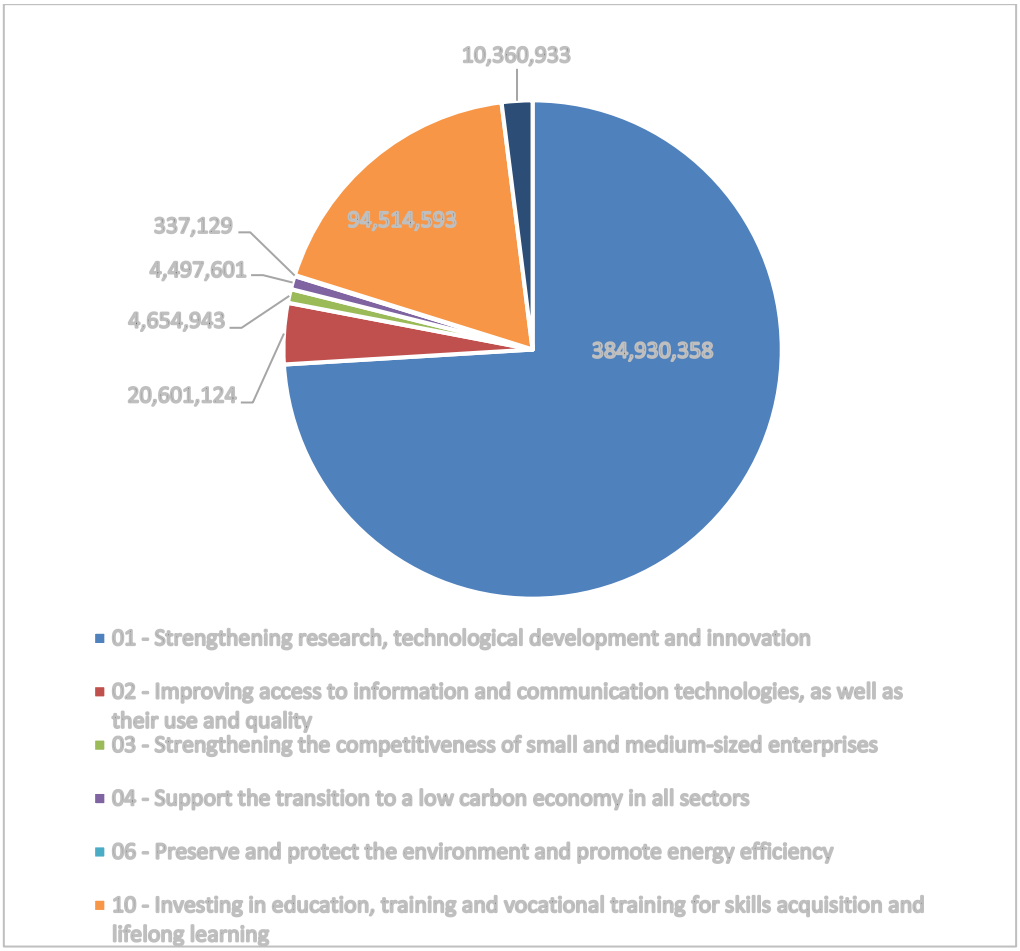


Source: Prepared with Portugal 2020 data

Figure 7 shows that TO1 (R&I) accounts for almost three quarters of the ESIF allocated to projects led by HEIs, followed by TO10 (Education, Training and Lifelong learning) with just under 20% of the funds allocated. Smaller levels of funding have been allocated to projects led by HEIs in TOs, such as those related to ICTs (4%), support for SMEs (1%), transition to a low carbon economy (less than 1%) and institutional capacity in the public sector (2%). This analysis confirms the assumption that Portuguese HEIs receive by far the most ESIF for R&I led projects, also considering that when it comes to education, a part of the TO10 funds infrastructure (ERDF financed projects) rather than actual education activities.

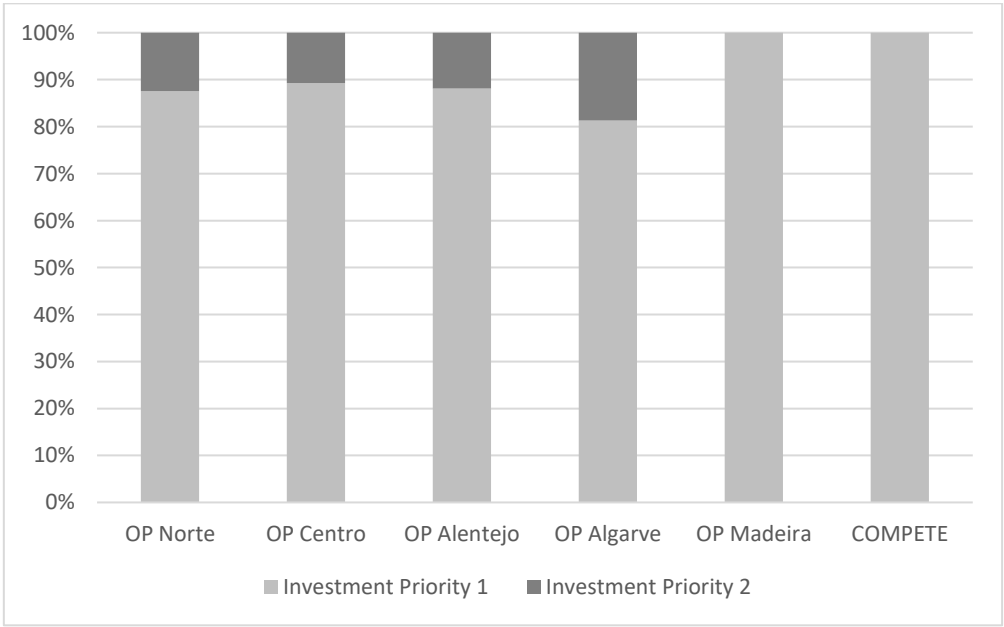
8 In addition to the universities and polytechnic institutes being listed, faculties or associations linked to HEIs are also listed as beneficiaries.

Figure 7: ESIF spending on HEIs as single beneficiaries or project leaders, by Thematic Objective



Source: Prepared with Portugal 2020 data

Figure 8: Proportion of R&I projects (Thematic Objective 1) classed as Investment Priority 1 and 2 that are led by Higher Education Institutions in Portugal

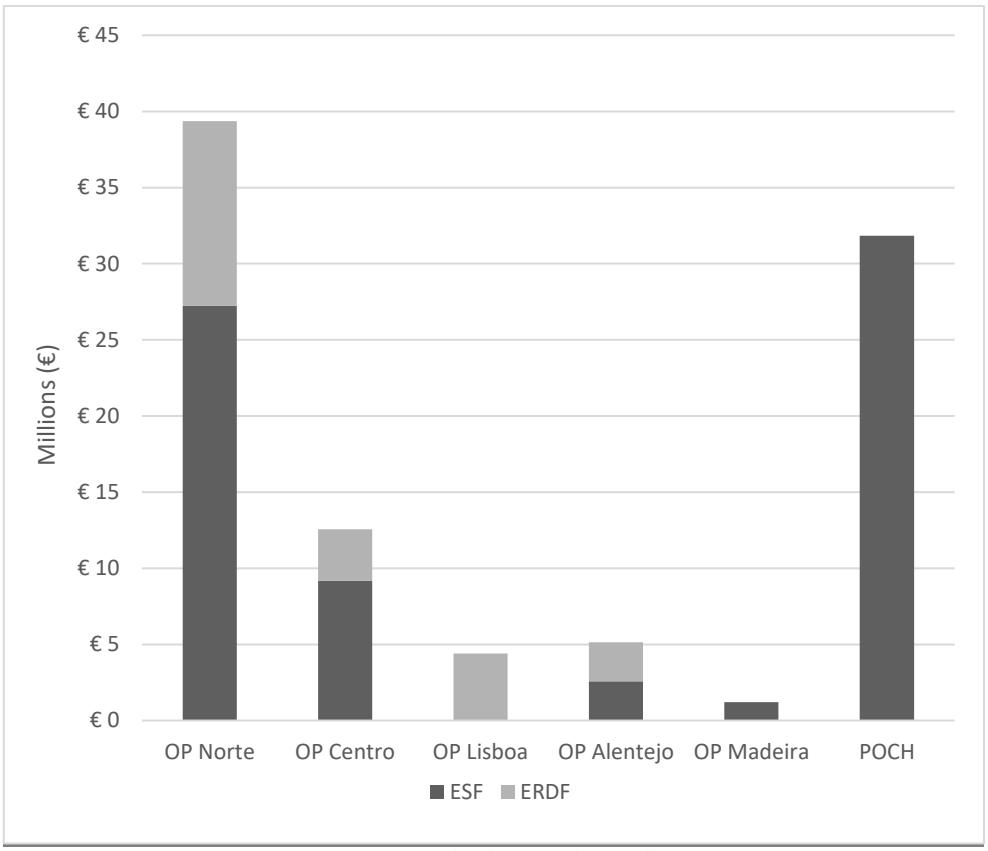


Source: Prepared with Portugal 2020 data

The most striking finding from analysing the ESIF is the very low levels of funding for projects led by HEIs in knowledge transfer (IP1.2) compared to knowledge generation (IP1.1). Notwithstanding the fact that our analysis does not cover all HEI participation in ESIF financed projects (notably copromoted projects, as explained above), it does show that when it comes to leadership of ESIF HEIs have not been able to assume the broad based role that would maximise their contribution to smart specialisation.

Another interesting finding is the large amount of ESIF spent on projects led by HEIs in the field of education, training and lifelong learning by the Norte OP, compared to all other regional OPs, and even higher than the thematic OP on human capital (Figure 8). Many of these ESF financed projects, such as the technical and professional courses (TeSP) and doctorates, are linked to S3 priorities through eligibility and assessment criteria, which is not required for such investments as opposed to those financed under TO1 (cf. Figure 9). This suggests that HEIs in Norte region are assuming a broader role in helping to implement S3 in this region compared to others, and would be a good candidate for future research.

Figure 9: Financial value of ESIF co-financed investment projects in education, training and lifelong learning (Thematic Objective 10) by Operational Programme, divided between the European Social Fund (ESF) and the European Regional Development Fund (ERDF)



Source: Prepared with Portugal 2020 data

Regarding the second stage, it is important to clarify some methodological questions. The first one is that the projects were identified through a search for the following words: RIS3, S3 and smart specialisation and leaves out the majority of projects involving HEIs that are aligned to S3 even if they do not explicitly state this in the description The second is that the data has an important limitation, namely the fact that projects do not always include a description, which may represent a shortcoming with respect to the projects mentioned in S3. This is notably the case for the OP COMPETE which does not include any project descriptions for objective 1. Therefore, the data included in the second stage is a reflection of the analysis of the projects that had a description available and that explicitly mentioned S3, either in the description provided, the priority axis, the thematic objectives or the investment priorities. Nevertheless, it can be argued that such projects, by virtue of explicitly mentioning S3 in the description, are likely to be more linked to S3 implementation that mere alignment, which can be reduced to a simple bureaucratic exercise.

Table 7 shows the number of operations and the funds approved that explicitly mentioned S3 classified by OP. TabThe OPs from Norte and Centro are the OPs with more operations identified and the Norte and OPHC have the highest values of approved funds. In the OPs of Lisbon, POSEUR and COMPETE2020 no operations were identified that explicitly mentioned links to S3.

Table 7: Operations with an Explicit Mention to S3

OPs	Number of Projects	Approved Fund (€)
OP Algarve	**3**	**1 115 836,80**
OP Alentejo	**7**	**1 691 098,73**
OP Centro	**15**	**8 351 928,76**
OP Norte	**21**	**19 329 646,83**
OP Madeira	**1**	**846 651,02**
OP HC	**8**	**15 865 569,68**
Total	**55**	**47 200 731,82**

Source: Own Elaboration

In general, it can be seen (Table 7) that, among the operations that explicitly mention the connection to RIS3 and ENEI, 55 operations and an approved total fund of 47 200 731,82€ were identified. It should also be noted at the outset that there are significant differences between the various OPs under consideration. In fact, in the case of OP Lisbon, Competitiveness and Internationalisation and Sustainability and Efficiency in the Use of Resources, there were no entries that explained the connection to S3. Therefore, they were not analysed.

The OP with more approved operations that mentioned S3 was the Norte region with 21 identified projects, followed by Centro with 15, OPHC with 8, Alentejo with 7 and Algarve and Madeira, with respectively 3 and 1 identified operations. Concerning the funds approved for the identified operations, it is possible to notice that, in the case of the Norte region, there is both the largest number of operations and the highest amount of funds (19 329 646,83€). However, while the OPHC only has 8 approved operations, it also has the second highest value of funds (15 865 569,68€). Finally, although there are two more operations identified in the Algarve than in Madeira, the value of the approved funds is very similar.

As already mentioned, this analysis of the projects that have a connection to S3 has limitations, thus making these data merely indicative and exploratory and only capable of giving some clues of future lines of analysis but not allowing any decisive conclusion.

5. Interview results

A transversal analysis of the interviews shows that the role of Portuguese HEIs in S3 is visible in different phases. In general, they were crucial for the design of the strategies, the participation in the discussion groups, the qualitative exercises, and they often guaranteed the necessary competences to evaluate regional innovation capacity. It was stressed by several interviews that S3 design was one of the most ambitious and unprecedented participatory efforts to define a real strategy, adequate for the region and with a consensual vision for development.

Regarding implementation, the participation of HEIs in the platforms/communities established to facilitate entrepreneurial discovery processes was a central aspect. Another underlined factor was the role of HEIs in providing information to other actors about areas/possibilities for collaborative projects in the selected S3 priorities. A relevant focus of HEIs was the infrastructure for knowledge valorisation and exchange (such as incubation, knowledge intensive services, S&T parks), which are considered crucial for the creation of partnerships and in the mobilisation of actors around a strategic vision. Many interviewees also referred to their role in the design and implementation of monitoring tools.

Currently, HEIs participate in the governance bodies and are deeply engaged in the revision of the regional S3s. Some of the main limitations identified for the effective participation of HEIs in S3 were the following:

- Low levels of knowledge absorption capacity among businesses;
- Difficulties in identifying the change actors within the university (those that really want to cooperate);
- Problems in sustaining the interest of academics in S3;
- Tensions among actors due to a lack of understanding of HEIs and its role;
- Differences among HEIs and other types of actors about the meaning of S3.

The following improvements to the S3 framework were suggested:

- Change the incentives for academics to participate in collaborative activities with other actors in the R&I system;
- Enlarge and adapt the policy mix to fit the different regional priorities;
- Stimulate models of open innovation;
- Tackle social factors related to innovation;
- Integrate multi-national companies with local SMEs;
- Promote a cluster policy;
- Only allow strategic research and limit the financing of basic research by regional operation programmes;
- Deepen collective engagement in S3 because the experience has been very positive for innovation and regional cooperation.

The (formal) content analysis of the transcripts of the interviews, assisted by software (using N-Vivo), facilitated a deeper understanding of these issues. The transcriptions were translated from Portuguese to English by the authors.

5.1 Areas of expertise

Regarding the areas of expertise, the interviewees showed a tendency to report the scientific areas of their training courses but also to underline their research units, technological capacity, and links with the region. Most institutions offer a wide range of training offers and research, especially in regions with fewer HEIs, such as in Alentejo, Algarve, Madeira and Azores.

“The Faial hub is mainly intended for the Sea area; the centre of Terceira has an aspect linked to the area of Agriculture or other issues connected to this area and there is also a part of Nursing… In São Miguel, we also have Nursing and then we have all the other areas, we have departments of the Faculty of Science and Technology here… Because Faial is also part of this Faculty of Science and Technology. Then, we have the section of Economics and Management where I am integrated. Then, we have a Faculty of Social and Human Sciences that covers Education, Public Relations, History…” (HEI University, E9)

"(...) covers most areas of training offer common to Portuguese public universities, with the exception of Law, we also have a medical course up to the 2nd year in collaboration with the University of Lisbon. We have all courses in the areas of Humanities, also part of Management, Physical Education." (HEI University, E17)

"It is structured in four schools: a School of Technology and Management; a School of Health; a School of Social Sciences and an Agrarian School that is the only not in Portalegre, but based in Elvas." (HEI Polytechnic, E16)

In the cases of Lisbon, Norte and Centro, which have more density and critical mass, there are some HEIs with a degree of specialisation.

"I usually say that there are 3 + 1 areas of specialisation at the University (...) And interestingly, all of them are related to the region in different ways. For example, electronics and communications, because we had here the research centre of what was PT Portugal, today Altice" (HEI University, E6)

"It stands out for developing research in engineering, science, technology and architecture covering all areas of technology engineering, with more than a third or some 40% dedicated to new technologies... Therefore, informatics, electrotechnics, electronics, telecommunications" (HEI University, E4)

The main conclusion that can be taken from this is:

- HEIs in less developed regions may find it harder to specialise their academic offer compared to those in regions with a large and wider range of HE provision (which can potentially boost performance and relevance of regional priorities).

5.2 Role in Smart Specialisation Strategies

Participants were also asked to explain their role in S3, both in the current and in future frameworks (2014-2020 and 2021-2027). Overall, all participants played a role in regional strategies, in a more or less structured way, namely in: the definition of priority areas, the participation in meetings with different stakeholders, the design of the strategy, and, in some cases as the one from Centro, the support in monitoring the implementation.

The interviewees identified their role in the future of S3 in the following dimensions: the need for the strategy to be more articulated between the regional and national levels and the importance of HEIs intervening in a more detailed and structured way, such as monitoring and implementation. In addition, they consider that in the future it will be necessary to look carefully at impact indicators, adapt them to each one of the areas of specialisation and think about capturing information on the changes in the regions. All respondents showed availability and interest in participating in S3 dynamics in the near future.

S3 assumes that innovation is a key factor in competitiveness and that the growth in output and productivity depends on the development and diffusion of new technologies. Hence, there is an urgent need for different entities to bet strongly on innovation as a growth mechanism, based on a knowledge with greater capacity to produce added value, thus becoming more competitive. However, the innovation process is not linear but rather a complex, interactive process, involving business and non-business institutions (Pinto et al., 2019). In fact, innovation should be understood as the result of the interaction between several actors, both institutional and organisational. For this reason, it is important to analyse the existing innovation networks.

Figure 10 illustrates the most prominent types of collaboration. The majority of the interviewees chose to highlight partnerships with universities and R&D centres, which have the highest percentage of coded text (40,7%). In a close second place there are partnerships with companies, with very similar amounts of coded text (38,4%). This is followed by collaboration networks with interface institutions (16,3%) and, finally, relations with governance bodies (4,7%), namely regional and territorial.

In order to construct a more fine-grained analysis, the responses were compared by region and by entity (Table 8 and following tables and figures). As mentioned in the methodological section, one of the analytical strategies used was the quantification of qualitative information, providing an overview of trends in the data. As with any other type of content analysis, the process depends heavily on the research team to identify the relevant citations in the text and the associate them to the defined categories.

The interpretation of the following tables that breakdown the results by region is as follows: The **total** number of references in each category is divided by the seven regions, that had a very similar number of interviews and coded text. The values represent the proportion of all references that were made by region in each category. This allows for a comparative analysis of which regions emphasised a particular actor or theme. The percentages also facilitate the understanding of regional preferences (reading the table rows). Even if the

percentages between categories in each region are not directly comparable, they provide evidence of where particular categories were mentioned most. For information, the overall weight of each category from all results nationally (used to create the tree diagrams) are indicated in brackets next to the actor or theme.

Figure 10: Tree Map, Hierarchy Graph on Innovation Networks

Source: Own Elaboration Using Nvivo 11

Table 8: Comparison of Existing Collaboration Networks Disaggregated by Region and Type of Entity

	Enterprises (38,4%)	**Governance (4,7%)**	**Innovation Intermediaries (16,3%)**	**Universities and R&D Centres (40,7%)**
Norte	30,0%	0,0%	16,8%	10,1%
Centro	17,9%	40,4%	16,0%	12,5%
Algarve	12,8%	0,0%	20,5%	8,1%
Alentejo	13,0%	36,9%	16,8%	3,1%
LVT	6,3%	0,0%	5,0%	21,2%
Madeira	2,1%	0,0%	0,0%	30,0%
Açores	18,2%	22,7%	24,8%	15,1%
Total	**100%**	**100%**	**100%**	**100%**

(Percentages next to actor is overall weight of references nationally)

Source: Own Elaboration

Table 8 shows that of all the references in the most prevalent category (Networks with other universities and research centres) most of them were from interviews in Lisbon (21,2%) and Madeira (30%), which suggests that cooperation with these types of activities was the highest concern in these regions. For example, the following two quotes come from interviews in these regions:

“But there are five life science institutions in the Lisbon region with which we have partnerships: it's the Polytechnic Institute of Science of the Calouste Gulbenkian Foundation, the Molecular Medicine Institute, the CEDOC that belongs to Nova Medical School and Universidade Nova from Lisbon and the ITQB, which also belongs to Nova, is another novelty of Nova, which are trying to organise themselves to be more attractive for collaboration and support platforms.” (Innovation Intermediary, E12).

“We have regular and signed protocols, effective partnerships with 4/5 universities in China. Therefore, we work a lot with one of them, which is Donghua University, in Shanghai, where we have our researchers working and we also regularly receive Chinese researchers and students here.” (HEI University, E13)

With regard to references to Enterprises, which represent the second largest category overall, 30% were recorded in Norte, 18,2% in the Açores and 17,9% in Centro. Two quotes from these regions include:

"It is a partnership between entities of the scientific and technological system, namely, the University of Minho, the Catholic University, the University of Évora, the INL-Institute of Nanotechnology and, also, the CEiiA-Centre for Engineering and Product Development. And there are two more interface structures linked to the University of Minho, the Computer Graphics Centre and the PIEP, and then a set of 12 very complementary companies, which include four large multinational companies: Bosch, Ikea, Embraer which is an aircraft manufacturer, Accenture, among many others..." (HEI University, E3)

"The relationship with industry is obvious from the beginning. Therefore, it has always been very consolidated. The region, the Intermunicipal Community of the Aveiro Region, therefore the CIM of Aveiro and two municipalities, in addition to the fact of being part of the Science and Innovation Park, are also shareholders. Some large companies, the banking sector as well, and therefore, business associations are also part." (HEI University, E8)

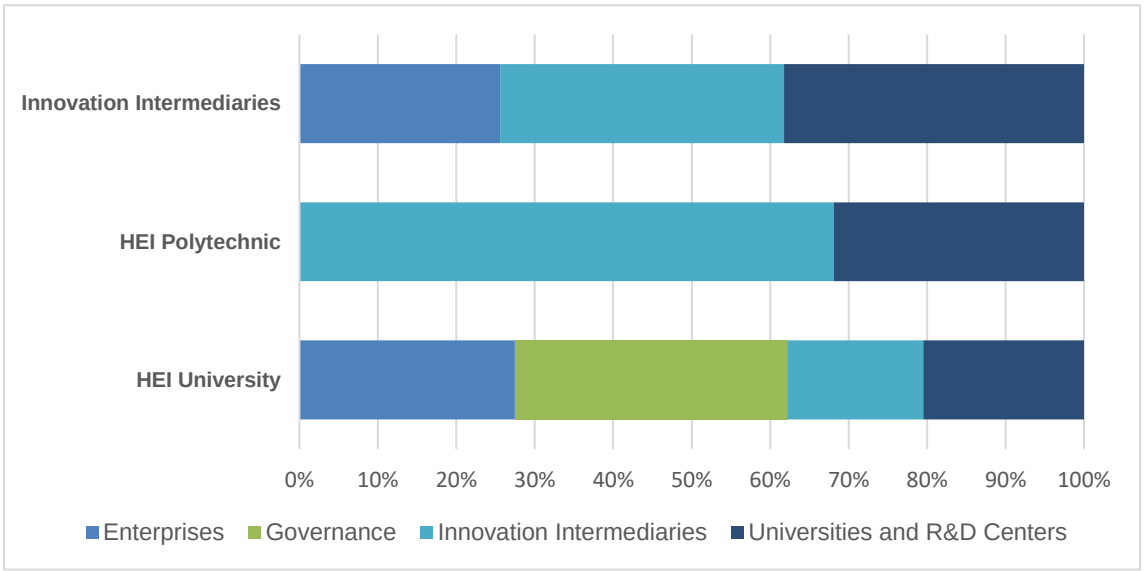
The role of innovation intermediaries was referenced in a more balanced way across all regions. Nonetheless more emphasis was given by the Açores (24,8% of total mentions) and the Algarve (20,5%), including the following quote:

"So, the University of Algarve I think maintains links above all with companies in the region. At least there seems to be this effort to try to connect a little with the needs of the region or at least with companies. CRIA has an important role here." (Innovation Intermediary, E1)

Relationships with governance actors, representing the smallest number of total references, were mainly recorded in three regions: Centro (40,4% of total references), Alentejo (36,9%) and Açores (22,7%), including the following quote:

"The University has very good connections with the institutions, with the municipalities, in particular the Évora City Council; they always had, regardless of the political power that is in the city hall, the relationship has always been very collaborative and, also, with surrounding municipalities, in which the university has hubs." (HEI University, E7)

Figure 11: Comparison of referenced collaboration networks disaggregated by type of entity



Source: Own Elaboration

Figure 11 makes an analogous approach by type of entity. In this case, it is possible to realise that HEIs are the ones that report more partnerships. This data is not particularly relevant except to draw attention to some unfeasibility of this disaggregation given that, since the majority of respondents were universities, it is normal that the highest percentages of coded text are from this type of institution. Furthermore, it is possible to see that: most of the relations mentioned by universities are with governance bodies, followed by enterprises, other universities and R&D centres, and finally, innovation intermediaries. Polytechnics. talk about their partnerships with innovation intermediaries and with universities, while innovation intermediaries emphasise their links with universities and R&D centres, other innovation intermediaries, and with companies

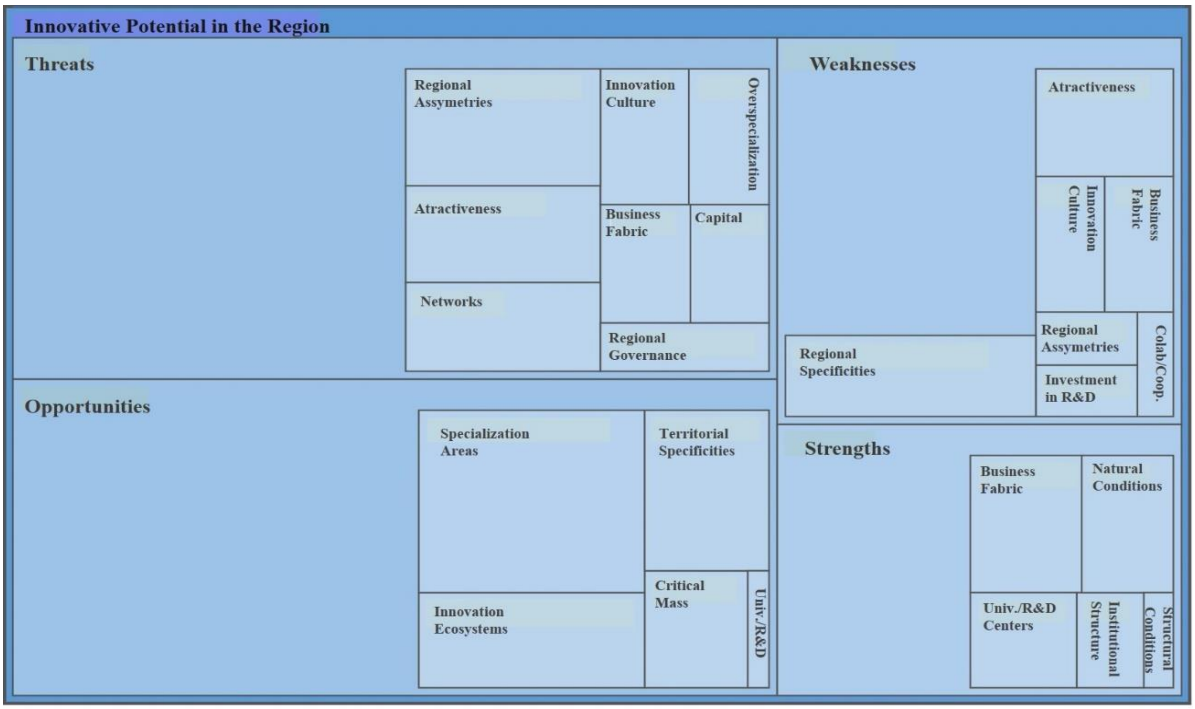
Some of the conclusions of this analysis could be that:

- CCDRs Centro and Alentejo may have taken on the most active developmental role in S3, perhaps to compensate for a fragile business fabric, especially comparing with regions of Lisbon and Norte.
- Polytechnics have been less engaged with S3 managers than universities.

5.3 Regional innovation potential: Strengths, weaknesses, opportunities and threats

A region's innovative potential was evaluated by HEIs through an identification of its main strengths, weaknesses, opportunities and threats. Similar to what was done previously, a first exploration of the data was made to verify the predominance of certain categories. In general, respondents identified mostly threats (35,4%) and opportunities (32%), as shown in Figure 12. Next, detailed hierarchy charts are presented to verify the most coded categories within each of the dimensions.

Figure 12: Tree Map, Hierarchy Graph on Innovative Potential

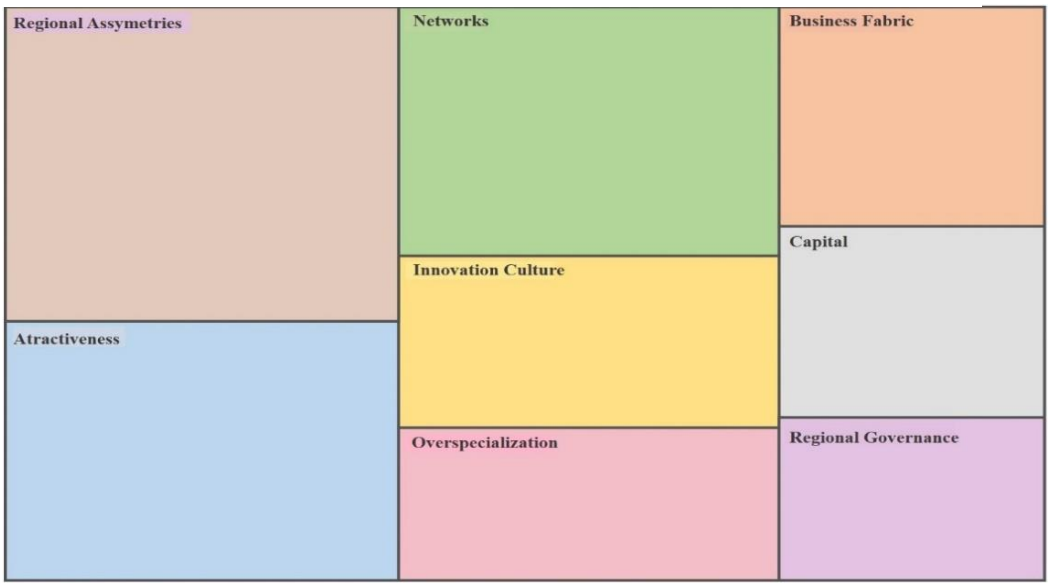


Source: Own Elaboration Using Nvivo 11

5.3.1 Threats

Figure 13 shows that the main threats that were identified during the interviews were regional asymmetries (21,8%), lack of attractiveness (17%) and poorly consolidated networks (15,5%). The remaining risks are related to the lack of innovation culture or to some misperceptions on this subject (11%); the over-specialisation of some territories in regions concerning certain sectors of activity (9,5%); the business fabric (9,5%), which is mostly composed of SMEs; the lack of capital, both in terms of investment and risk capital, and in terms of capitalisation of institutions (8,3%); and finally, the low capacity of regional governments to make some decisions, which is due to the centralisation of power in national bodies, thus compromising the alignment of regional asymmetries and specificities (7,3%).

Figure 13: Tree Map, Hierarchy Graph on Threats



Source: Own Elaboration Using Nvivo 11

When the data is disaggregated by region (Table 9), it is possible to see that the threats reported by Norte that stand out in the national comparison are: poorly consolidated networks (21,73% of total references in that category), business fabric (15,59%), and attractiveness (14,96%).

"We cannot be working in an individual way, we have to work more in a network, in a shared way, because in that old way our potential is very compromised and that is a great threat" (HEI University, E10)

In the case of the Centro, there is a concern with the lack of a culture of innovation (75,34% of total references), the weak governance at regional level (34,03%) and the asymmetries of its territory (25,31%).

"I ask how many agents of those who use S3 in the field analyse innovation so much. And therefore, when I want them to be partners, I am immediately conditioned by a range of people available to be enthusiastic about innovation. There are some preconceived ideas that are still dominant over what innovation is, usually restricted to cutting-edge science and technology and entrepreneurial capacity. These preconceived ideas delimit the field of application of the S3 conceptual framework." (HEI University, E6).

In the case of the Algarve, the most codified threats were overspecialisation, namely in the tourism sector (79,85% of total references), the lack of attractiveness (27,33%) and of capital (17,48%).

"On the other hand, we have the issue of this more or less monolithic activity, and I would say almost predatory, that is the tourism, because many of these tourist companies are companies from outside the Algarve. They come here and, therefore, they no longer come with the idea of, let's say, developing anything in the region. They already come with their packages assembled, they take the money, they leave and, therefore, there is ... That is, the potential investment in the Algarve is very low and hardly changes if the economic structure of the region does not change." (Innovation Intermediary, E1)

In the Alentejo region, the characteristics of the business sector (32,93%), the low attractiveness (27,80%) and the asymmetries of the region (24,35%) stand out.

"Companies have very weak dynamics because they are small and, therefore, if there are no jobs, we cannot attract people, if we cannot attract people, we cannot generate leverage, can we?" (HEI University, E7)

For the respondents of the Lisbon region, the major challenge is to increase capitalisation (66,46%), mainly at the level of co-financing percentage in programmes.

"What most affects the region's innovative potential is our limited capital to invest in new laboratory, teaching and research infrastructures. (...) in areas where applications were possible, the co-financing rate was very low, it was only 40% and it therefore only applied to great needs, I think that will continue to be a major limitation for the next programming period". (HEI Polytechnic, E4)

"(...) a very strong threat that is identified, that is public, that there are manifestos about it, that position in research institutes, in general, is very strong about it, is the lack of constant funding, of course, for their investigation." (Innovation Intermediary, E12)

Table 9: Main Threats/Risks Identified According to Each Region (NUTS II)

	Attractiveness (17%)	Business Fabric (9,5%)	Capital (8,3%)	Innovation Culture (11%)	Networks (15,5%)	Overspecialisation (9,5%)	Regional Asymmetries (21,8%)	Regional Governance (7,3%)
Norte	14,96%	15,59%	0%	0%	21,73%	6,51%	8,11%	0,00%
Centro	0%	12,87%	0%	75,34%	12,85%	0%	25,31%	34,03%
Algarve	27,33%	13,66%	17,48%	0%	4,20%	79,85%	9,39%	65,97%
Alentejo	27,80%	32,93%	0%	0%	0%	0%	24,35%	0,00%
LVT	0%	0 %	66,46%	12,02%	0%	0%	0,00%	0,00%
Madeira	21,54%	24,95%	16,06%	0%	8,53%	0%	25,75%	0,00%
Açores	8,36%	0 %	0%	12,64%	52,69%	13,64%	7,09%	0,00%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

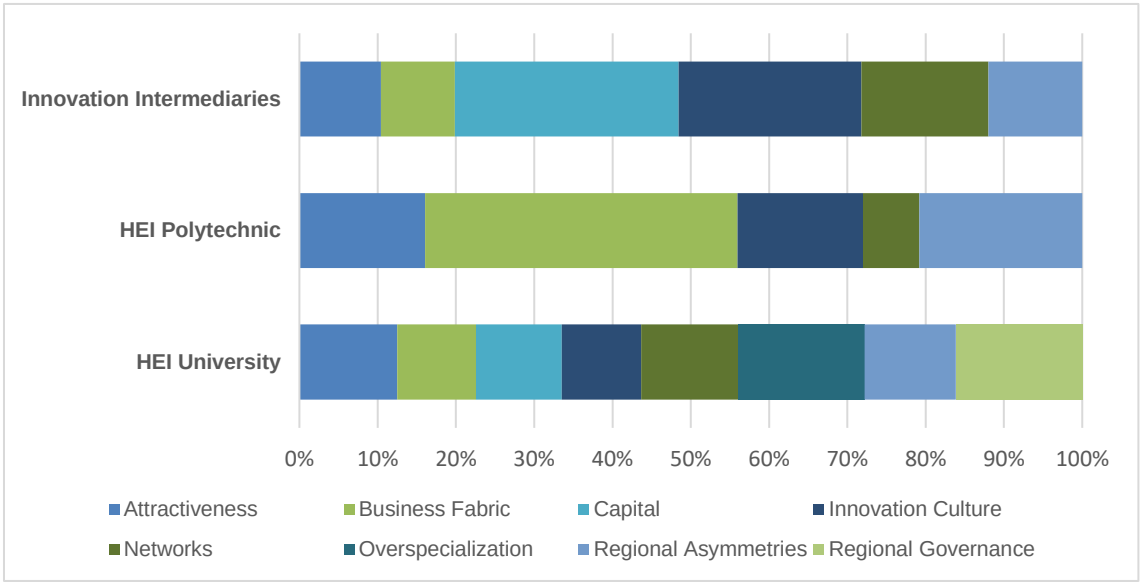
Source: Own Elaboration

In the case of Madeira, regional asymmetries (25,75%), the characteristics of the business fabric (24,95%) and the lack of attractiveness (21,54%) are highlighted.

"And then as threats we have the situation of being ultra-peripherical; it is always the most difficult. The framework is too specific to be a copy paste of the European framework. In that context we have an approved European project which is FORWARD that is uniting all ultra-peripheral regions precisely to support this and without needing the European Union, the specific nature of the outermost regions that cannot have a research and innovation framework equal to a European framework because companies and the productive fabric are not the same as Europe." (Innovation Intermediary, E20)

Finally, in the Azores, the concern lies essentially in poorly consolidated networks that are highly dependent on the researchers' contacts (52,69%). "Right now, I think the challenge is for us to articulate our action. (...) Yes, the issue of cooperation is also a challenge that will take some time. Everything has to do with cultural issues, ways of being, but because it takes time we cannot neglect ourselves. There are also some difficulties here, especially the articulation of the ecosystem itself since we think that the ecosystem itself has actors with different capacities" (HEI University, E21)

Figure 14: Main Threats/Risks Identified According to Type of Entity



Source: Own elaboration

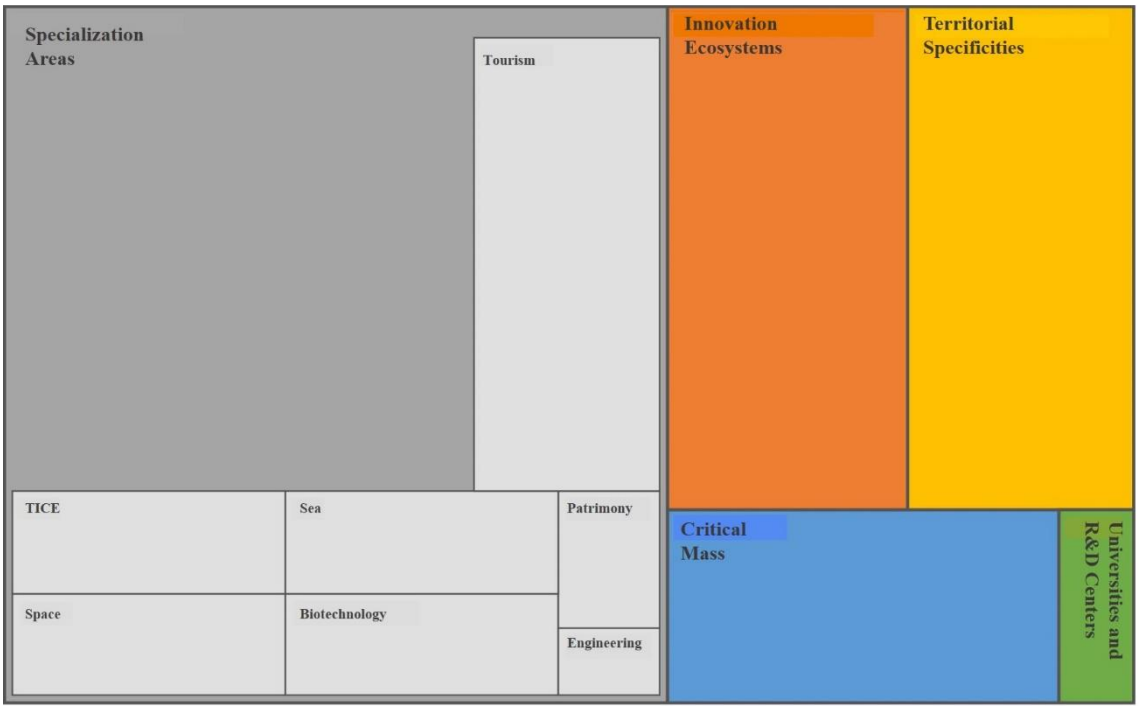
When analysing the data by type of entity[9] (Figure 14), the main threats pointed out by universities are over-specialisation, regional governance, and poorly consolidated networks. Polytechnic institutes identify the weaknesses of the business fabric, regional asymmetries and the attractiveness of territories. Finally, innovation intermediaries highlight the need for capital and financing, the weak culture of innovation, and networks.

5.3.2 Opportunities

In the case of opportunities, the vast majority of respondents chose to identify possible areas of specialisation for S3 (58,7% of total references) (Figure 15).

Usually, these interventions were aimed at reinforcing the idea that the areas identified by the regions continue to be seen as great opportunities, such as tourism (19,7%) in the Azores and the Algarve. In other cases, it was to point out emerging areas that had not been initially foreseen but that over the last few years have been consolidated, as it is the case with the aerospace sector in the Alentejo (6,6%). There was also a group of interviewees who underlined the importance of areas such as information and communication technologies (6,6%), biotechnology (6,6%) and engineering (1,6%), as key sectors to create priority changes in conjunction with the areas already identified in the different S3. Dimensions also mentioned were the emergence of innovation ecosystems (15,4%), the greater voice given to regions and territorial specificities (14,4%) as a mechanism of distinction, the existence of critical mass (9,6%), and of universities and R&D centres (1,9%).

Figure 15: Hierarchy Graph of Opportunities Divided by Areas of Specialisation



Source: Own Elaboration Using Nvivo 11

Table 10 shows that interviewees in Norte identify the main opportunities as the region's universities and R&D centres (80,07% of total references in the specific category), critical mass (40,17%) and the innovation ecosystems (37,98%).

"But in practical terms, then, here we have some of the main research and innovation structures in the country: the University of Porto; the University of Minho; UTAD itself does a very interesting job, certainly with a smaller dimension because it is a university with a much lower number of students; large research centres are linked to medicine: IPS do Porto and 3B's here in Taipas; large laboratories such as the INL, International Iberian Nanotechnology Laboratory" (Innovation Intermediary, E3)

Table 10: Opportunities Divided by Areas of Specialisation According to Each Region (NUTS II)

	Critical Mass (9.6%)	Innovation Ecosystems (15,4%)	Specialisation Areas (58,7%)	Territorial Specificities (14,4%)	Universities and R&D Centres (1,9%)

9 Percentages concern the number of textual passages in the specific categories present in the total of passages of the identified categories.

Norte	40,17%	37,98%	3,07%	0,00%	80,70%
Centro	6,24%	7,75%	3,72%	7,47%	0,00%
Algarve	11,36%	24,93%	20,99%	16,16%	19,30%
Alentejo	28,11%	13,51%	15,68%	37,08%	0,00%
LVT	14,11%	10,83%	18,31%	0,00%	0,00%
Madeira	0,00%	0,00%	8,10%	9,99%	0,00%
Açores	0,00%	5,00%	30,13%	29,29%	0,00%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

The Centro region also highlights innovation ecosystems (7,75%), critical mass (6,24%) and territorial specificities (7,42%).

In the case of Algarve, there are also innovation ecosystems (24,93% of total references), areas of specialisation (20,99%) and universities and R&D centres (19,30%).

"We have a group of hoteliers in the region with whom we have been collaborating and who recognise that if I sell the continental breakfast, it will be the same everywhere in the world. I was away for a week now, these are the same bacon and eggs that I eat here, the stuff is all the same. What I don't get on the other side is honeydew spirit, carob bread, it's what I don't know and many of them have been doing this. This is a great opportunity for the innovation ecosystem." (CRIA, E11)

In Alentejo, territorial specificities (37,08%), critical mass and areas of specialisation are seen as the main opportunities in the region.

"One of the sectors that accompanies this exercise is also a particular part of the agricultural sector, which may have played a very important multiplying factor and serves as an incentive to other areas, which is the wine sector. Alentejo is currently receiving international awards, a major expression in very demanding international circuits, namely wine markets, national markets with a lot of capacity and this is synonymous of a great opportunity that comes from a specificity of this territory." (UMPP, E18)

Lisbon highlights critical mass, innovation ecosystems and areas of expertise. While in the Azores, the areas of specialisation (30,13%) stands out again, together with the specificities of the territory (29,99%) and the fledgling innovation ecosystem (5%).

"We have an exceptional opportunity that, if we stabilise this national funding, and link it to another opportunity, which is the international networks, helped largely through academic researchers, we can use partnerships to bring big players or to innovate more, bring best practices here and help the ecosystem itself to succeed." (Innovation Intermediary, E12)

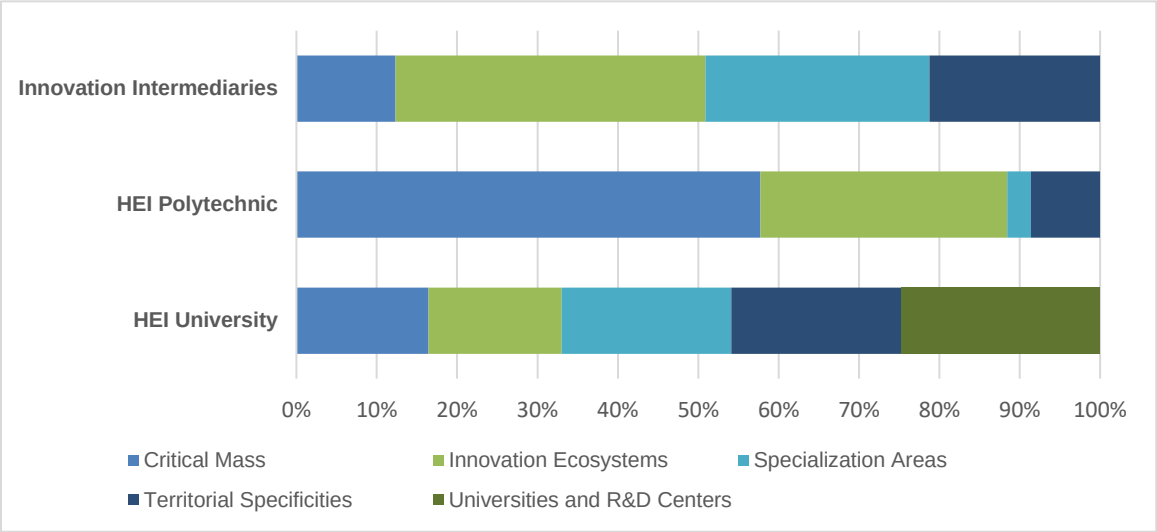
In the Azores, specialisation areas and territorial specificities are key opportunities.

"One of the great opportunities at the moment within one of the areas, namely tourism, is the fact that the region is working to ensure that it is a sustainable destination that will produce added value in terms of the product that we are offering and that can naturally contribute to the development of the regional economy" (Innovation Intermediary, E5)

Finally, in Madeira the coded text is divided between territorial specificities and areas of specialisation.

"In terms of opportunities, we have the most natural ones, which is the fact that we have an enlarged exclusive economic zone, we have a natural scenario that enhances the study of natural, meteorological and oceanographic phenomena; strategic positioning. I think this is all too current to be honest. Therefore, the potential to experiment in a living environment, that is, we can have a living day lab to study the phenomena that are relevant to Europe, is an opportunity." (Innovation Intermediary, E20)

Figure 16: Referenced Opportunities Divided by Areas of Specialisation According to Type of Entity



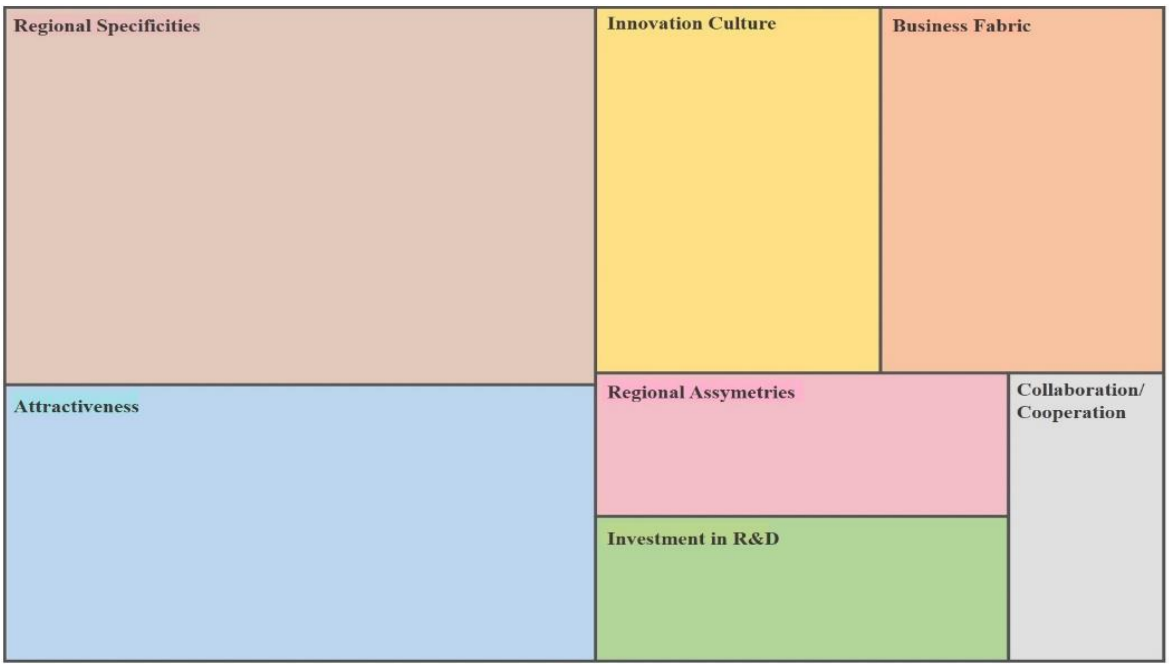
Source: Own Elaboration

If we look at data classified by type of entity (Figure 16), we can see that universities consider that the greatest opportunities are due to the structure of universities and R&D centres, critical mass and innovation ecosystems. In the case of polytechnics, the critical mass, innovation ecosystems and territorial specificities are highlighted. Finally, the interviewed representatives of innovation intermediaries consider that the greatest opportunities reside in innovation ecosystems, in areas of specialisation and in the specificities of territories.

5.3.3 Weaknesses

If, on the one hand, some of the interviewees identified territorial specificities as opportunities, on the other hand they also recognise this as one of the main weaknesses (29,4%), together with the lack of attractiveness (21,6%) (Figure 17). This is followed by the lack of a culture of innovation (13,7%) and the business fabric (13,7%), as it was the case with threats and, finally, regional asymmetries (7,8%), lack of investment in R&D (7,8%) and failures in collaboration and cooperation (5,9%).

Figure 17: Tree Map, Hierarchy Graph on Referenced Weaknesses



Source: Own Elaboration Using Nvivo 11

Table 11: Referenced Weaknesses According to Each Region (NUTS II)

	Attractiveness (21,6%)	Business Fabric (13,7%)	Collaboration/ Cooperation (5,9%)	Innovation Culture (13,7%)	Investment in R&D (7,8%)	Regional Asymmetries (7,8%)	Regional Specificities (29,4%)
Norte	0%	5,76%	0%	0%	0%	29,50%	16,01%
Centro	0%	45,31%	47,20%	33,07%	0%	22,48%	0%
Algarve	6,09%	12,12%	0%	0%	52,67%	48,02%	29,23%
Alentejo	35,29%	9,58%	0%	6,93%	0%	0,00%	36,63%
LVT	0%	26,97%	0%	0%	0%	0,00%	0%
Madeira	58,62%	0%	0%	0%	47,33%	0,00%	0,00%
Açores	0%	0%	52,80%	60%	0%	0,00%	18,12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

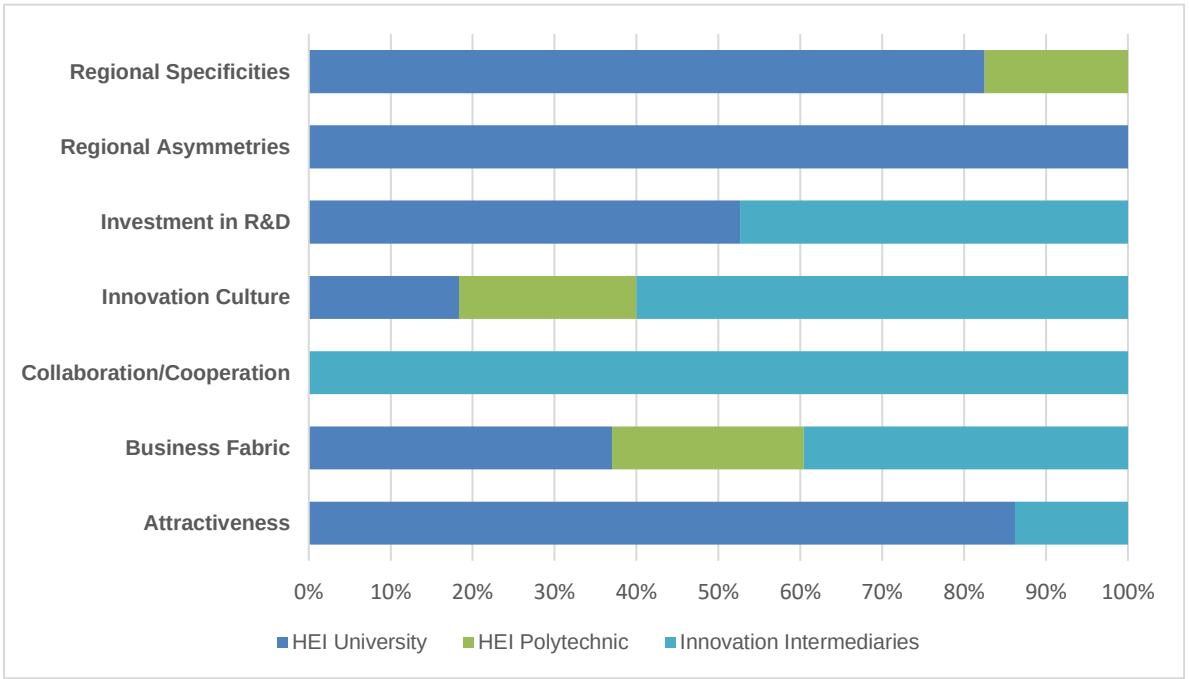
Table 11 indicates that Norte interviewees consider that the main weaknesses of the region are the regional asymmetries and specificities (29,50% and 16,01% respectively of the total references in these categories).

"But the Norte region, from the point of view of economic indicators and, in particular, of income levels and of all the indicators that are used on the economy side, have not very friendly indicators. Therefore, they are very negative. We can say that this has to do with the Norte region, where the asymmetries between the coast and the interior are even more accentuated, where the issues of educational levels between the Porto - Braga - Guimarães axis and other parts, namely, in terms of educational indicators, the question is stark if we see what is going on here." (Innovation Intermediary, E3)

On the contrary, Centro made references to the most of the dimensions under analysis as weaknesses, with emphasis on the lack of collaboration and cooperation (47,20%), the business fabric (45.31%) and the culture of innovation (33.07%).

"Well, what could I... I think the synergies. I think there is still some tightness. For example, if we think about academics, there are very few projects between UBI, UC and others." (Innovation Intermediary, E2)

Figure 18: Referenced Weaknesses According to Type of Entity



Source: Own Elaboration Using Nvivo 11

The Algarve highlights the lack of investment in R&D (52,67%), and the asymmetries and regional specificities (48.02% and 29.23%, respectively).

"However, it is also necessary to keep in mind the following: Algarve is the region of the country that receives less investment in science and technology, and it is not by a small difference. It is 1/3 of the national average. Therefore, while the Algarve over the years has never received more than 0.4% of the regional GDP for investment in research or even innovation, the rest of the country has been receiving at least three times more. So, this is a major limitation in terms of what the region could theoretically provide." (HEI University, E22)

Respondents consider that Alentejo's greatest weakness regards its regional specificities (36,63%) and, consequently, the absence of conditions that create attractiveness (35,29%).

"The city is small, the region is very sparsely populated and economically thin, but in population terms it has a very low density, therefore the regional scarcity, the population dynamics of the regions is very important. And, we have a big problem there because we have a very low population density and an aging population." (HEI University, E7)

Madeira also underlines this issue of attractiveness (58,62%) and the lack of investment in R&I (47,33%).

"Our limitations here are related to other types of issues that are more related, in fact, to the size of the university and the difficulty we have in attracting highly qualified human resources. (...) This is related to the ability of attracting highly trained resources because, this is the case, nobody comes to Madeira because of the sun and the beaches and landscapes." (HEI University, E13)

Lisbon highlights only the business fabric and the Azores highlight the culture of innovation (60%) and the failures in collaboration (52,80%).

"One of the difficulties is the wrong perception, sometimes through our micro, small and medium-sized companies, which are the overwhelming majority of our business fabric, that innovation is only for large companies, for scientists, for companies that have the capacity to include researchers in their staff" (Innovation Intermediary, E5)

Data by type of entity (Figure 18) reveals regional asymmetries (100%), the specificities of territories (82,15%) and their attractiveness (86,24%), are main weaknesses specifically identified by the universities. Polytechnics, on the other hand, highlight the business fabric (23,43%), the culture of innovation (21,67%) and regional specificities (17,49%). Innovation intermediaries consider that failures in collaboration (100%), the culture of innovation (60%) and the lack of investment in R&D (47,33%), are the main weaknesses.

5.3.3 Strengths

Although the business fabric has been identified as one of the main limitations to the innovative potential, due to the fact that it is often linked to the absence of a culture of innovation, it is also identified as one of the main strengths (32,4%), as shown in Figure 19. In this case, in fact, the interviewees often assume that the business fabric is mostly composed of SMEs; however, some start-ups give vitality to the innovation ecosystems, especially when it is fed by the presence of large companies. Then the interviewees indicate the natural conditions of the territories (27%), such as the climate, and the universities and R&D centres (21,6%). Finally, there are institutional conditions (13,5%), such as leadership and institutional trust, and structural conditions (5,4%). Further analysis shows that the different regions tend to underline mainly two or three strengths that best characterise their territory (Table 12).

In the case of Norte, the business sector (23,35%) and universities and R&D centres (12,81%) stand out as main indicated strengths.

"Norte has muscles and has muscles that, after the crisis, were consolidated. And it has a muscle both in terms of knowledge, in terms of the university, in terms of research and, in terms of business, companies, exports..." (Innovation Intermediary, E14)

The Centro region highlights institutional structures (65,85%) as the main strength, followed by universities and R&D centres (52,59%) and the business community (44,52%).

"And therefore, there are conditions here, that the region has, in terms of stable institutional networks and interinstitutional trust. Some political leadership has always existed. Different actors, different leaders, but leaders. It has political leadership." (HEI University, E8)

"Centro took a huge leap but it took a huge leap... I have this perception, I am not very knowledgeable but I have this perception that the region took a huge leap but also because there are different industries, which

evolve more quickly and there have been cases of success from people who were pioneers and somehow inspired other people, and then the ecosystem was created and emerged." (Innovation Intermediary, E2)

Figure 19: Tree Map, Hierarchy Graph on Referenced Strengths

Source: Own Elaboration Using Nvivo 11

Table 12: Identified Strengths According to Each Region (NUTS II)

	Business Fabric (32,4%)	Institutional Structures (13,5%)	Natural Conditions (27%)	Structural Conditions (5,4%)	Universities and R&D Centres (21,6%)
Norte	23,35%	0 %	0%	0%	12,81%
Centro	44,52%	65,85%	0%	0%	52,59%
Algarve	0%	34,15%	12,93%	100%	0%
Alentejo	0%	0%	21,26%	0%	4,53%
LVT	13,84%	0%	0%	0%	9,05%
Madeira	0,00%	0%	19,68%	0%	21,02%
Açores	18,28%	0%	46,12%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

In the case of the Algarve, the main strengths are the structural conditions (100% of total references), institutional structures (34,15%) and natural conditions (12,39%).

"(...) but it has infrastructure, it has good conditions, it has a standard of living, etc. which are also important factors to attract, eventually, such companies or whatever." (Innovation Intermediary, E1)

"The things that I think can be an advantage is actually being small. Even what is a disadvantage is an advantage, which is relatively simple to get to know each other, is relatively simple if we want to do this. I think it's not quite like wanting, if we had the opportunity to do this, we managed to do it and, we managed to be highly creative doing" (HEI University, E22)

Alentejo highlights natural conditions (21,26%) and universities and R&D centres (4,53%).

"I think it goes through the rural cluster a lot... I think it's even better to put the emphasis on this classification of rural and not agricultural because at this moment, in fact, when we look at rural space it is much more multifunctional than agricultural valence or forest that we point out" (HEI University a, E7)

"(...) the academic structure today is moving in a very interesting way..." (HEI Polytechnic, E18)

Lisbon also highlights universities (9,05%) but considers that its business fabric stands out (13,84%).

"We have an internationally established research potential that is unique in this region, and the Lisbon region is competitive worldwide." (Innovation Intermediary, E12)

"Lisbon is currently imposing itself as the knowledge society, the capacity to attract start-ups, to attract large companies interested in our urban potential, in the development of innovative activities, we are imposing ourselves and we are, fortunately, despite limitations, one of the European knowledge capitals." (HEI Polytechnic, E4)

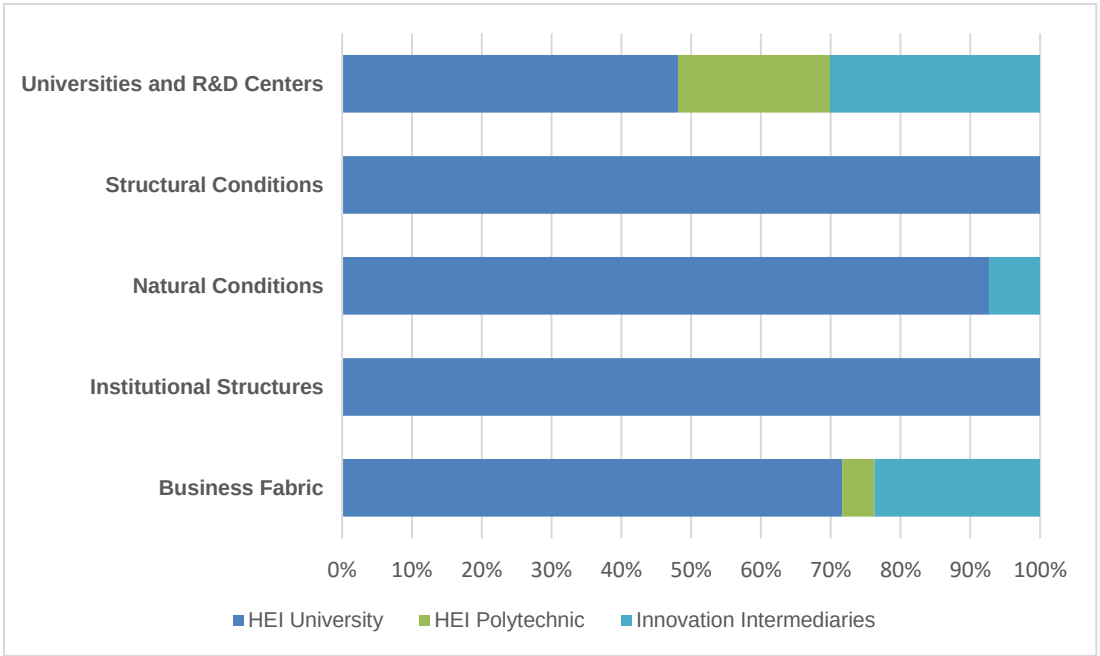
Both Madeira (19,68%) and the Azores (46,12%) consider natural conditions to be a strength. The Azores also highlights the business sector (18,28%) and Madeira the universities and R&D centres (21,02%).

"Our competitive advantage is clearly landscape but Agriculture also plays an important role here because it ends up causing and having interactions. (...) because the Azores still has a very significant genuineness and that allied to other areas, such as Gastronomy, can have very interesting aspects here and, it is what can give us competitive advantages, it is not resorts with pools that we will achieve value in the region" (HEI University, E9)

"In reality, the island is very mountainous, has a great diversity of climates, has a great diversity of ecological and agro-ecological conditions that allowed the evolution of these same resources" (HEI University, E17)

In this case, universities consider that the main strengths are structural conditions, institutional conditions, and natural conditions. Polytechnic institutes highlight the knowledge structure through universities and R&I centres, and the business fabric. Innovation intermediaries also highlight universities and R&I centres, the business community, and natural conditions as the main strengths (Figure 20).

Figure 20: Identified Strengths According to Type of Entity



Source: Own Elaboration Using Nvivo 11

5.4 Regional Transformation

After identifying the main problems and possible opportunities around the innovation potential of the different regions in Portugal, respondents were asked to reflect on the measures that could be implemented in order to generate structural changes that might close the gaps and enhance the opportunities, so to result in the development of the ecosystem. This aspect of the regional transformation had two main objectives: on the one

hand, to seek the chance to make a qualitative leap between the identification of specialisation areas and the construction of transformative activities, which cross sectors and can consequently introduce variety; on the other hand, to reflect on the role of higher education institutions in these changes and to favour a greater success in the implementation of S3. The dimensions and categories under analysis are presented in

Table 13.

Table 13: Dimensions of the Analysis on Regional Transformation

Transformation of the Region	**HEIs' Role**	**Collaboration**
		Curricular Programs
		Evaluation Metrics
		Finance
		Internationalisation
		Knowledge Economy
		Regional Impact
		Static Structure
	Priority Structural Changes	**Capitalization of Institutions**
		Coordinated National Strategy
		Education
		Innovation Culture
		Leadership
		Priority Areas
		Regional Strategies
		Training
	Transforming Activities	**Decentralisation**
		HR and qualification
		Leadership
		Maintenance/Reinforcement of Areas
		New Areas
		New mechanisms
		Synergies
	Necessary Resources	**N/A**

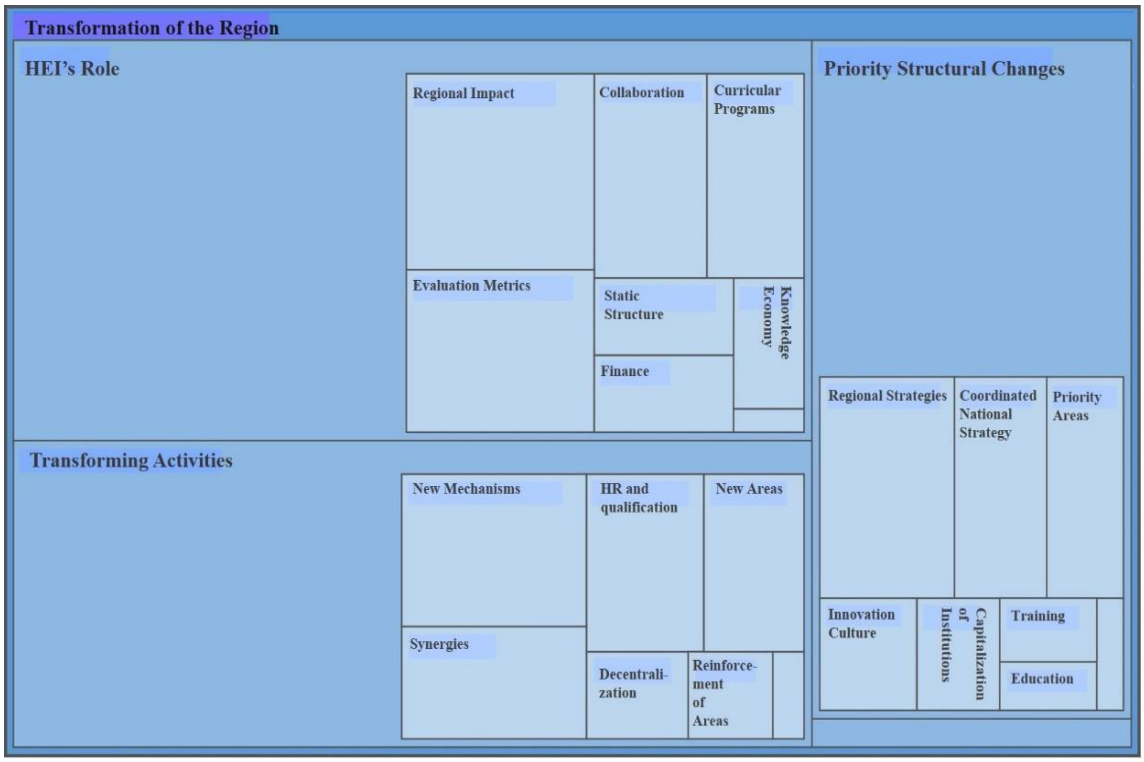
Source: Own Elaboration

The general perceptions of the interviewees were obtained through an exploratory analysis that helped to understand which strategies and changes they considered to be fundamental for the transformation of the region and for the minimisation of weaknesses and threats, as well as for the maximisation of opportunities.

Figure 21 shows that the dimension with the highest percentage of coded text refers to the role of higher education institutions (40,3%). This result was expected and even desirable as it was the main objective of the interview. In addition, it was easier and more intuitive for participants to talk about the existing conditions than to reflect on the main changes needed. The second most codified dimension was the identification of transformed activities (30,9%) and priority structural changes (28,5%) - which were often confused and interconnected in the interviewees' discourse.

Starting with the **priority structural changes**, it is possible to see that, in general, the interviewees consider that a greater focus on regional strategies (27%), with a higher specificity and independence, is one of the main necessary changes. After that, they highlight the coordination of strategies (20,6%) with the national and even with Europe's priority growth designs, the greater leverage of priority areas (17,5%), a higher understanding of the need for innovation (11,1%) and an increase in the capitalisation of institutions (9,5%). Finally, they reflect on the necessity of a change in the paradigms of education (4,8%) and training (6,3%).

Figure 21: Tree Map, Hierarchy Graph on Regional Transformation



Source: Own Elaboration Using Nvivo 11

The perspectives of the interviewees according to each region (

Table 14) show some trends.

Table 14: Priority Structural Changes According to Each Region (NUTS II)

	Capitalisation of Institutions (9,5%)	Coordinate National Strategy (20,6%)	Education (4,8%)	Innovation Culture (11,1%)	Leadership (3,2%)	Priority Areas (17,5%)	Regional Strategies (27%)	Training (6,3%)
Norte	**8,85%**	**21,83%**	**87,87%**	**0%**	**0%**	**0%**	**24,24%**	**0%**
Centro	**22,08%**	**7,91%**	**0%**	**33,58%**	**100%**	**0%**	**2,52%**	**32,19%**
Algarve	**41,15%**	**0%**	**12,13%**	**0%**	**0%**	**30,02%**	**13,49%**	**0%**
Alentejo	**10,33%**	**10,72%**	**0%**	**3,24%**	**0%**	**0%**	**26,92%**	**63,99%**
LVT	**0%**	**28,43%**	**0%**	**25,68%**	**0%**	**28,51%**	**0%**	**0%**
Madeira	**0%**	**6,28%**	**0%**	**22,20%**	**0%**	**11,47%**	**0%**	**0%**
Açores	**17,60%**	**24,84%**	**0%**	**15,31%**	**0%**	**29,99%**	**32,82%**	**3,82%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

In the case of Norte, a change in the way of looking at education and school models (87,87% of total references in this category) is considered a priority, along with a greater focus on regional strategies (24,24%) and the articulation between strategies (21,83%).

"Today, in the region, we continue to have kids whose levels have improved a lot, but we still have people who lose their education, who have early school leaving, and therefore, even under an economic logic, it will certainly

be profitable to invest in these people and make a big investment in them. Besides, we have a moral and social obligation to do so, we cannot lose anyone!" (Innovation Intermediary, E3)

"I think it is essential that we definitely continue with programmes, not centralised programmes, but with operational programmes at regional level. And I pointed to the creation of regional innovation ecosystems" (Innovation Intermediary, E10)

In the case of Centro, the transformations include a change in the culture of innovation (33,58%), training (32,19%) and the capitalisation of institutions (22,08%). Centro was the only region that emphasised the crucial role played by Leadership (100% of references in this category).

"It is not so much the report that will appear, it is the evaluation process and then what we have done with the results, how we are going to present them, how we are going to discuss them, where, how, who. Listen, I think that only after people gain a certain visibility of how innovation responds to their wishes can we increase the number of users, users of regional policy more sensitive to the merits of innovation, but at the same time better able to ensure the rooting of innovation in local dynamics." (HEI University, E6)

"And empower the people who are responsible for this S3, give them the capacity for action and intervention at one time or another" Innovation Intermediary, E2)

Respondents from Algarve consider capitalisation of HEIs a priority (41,15%), followed by the leverage of priority areas (30,02%) and regional strategies (13,49%).

"And the other, I repeat, it is important to capitalise institutions. (...) Then they are taking classes on the floor, they are taking classes without equipment. The science that could work at the level of the state of the art, is working with things that don't exist. With patched things. So, when I say that institutions should be capitalised, the transfer should be qualified and make people permanent." (CRIA, E11)

"The elderly of the future are certainly not our grandparents, nor will they be our parents, so it is us. So, who is, at this moment, between 40 and 55, will be the boom of the elderly who already use smartphone, who already use skype as we are using now, who have access to information (...) They want to have other types of support structures and, I think this must also be foreseen, it must be thought from a regional point of view." (HEI University, E22)

The Alentejo highlights the importance of differentiated training (63,99%) and regional strategies (26,92%).

"I would look at the social a lot at this point because the social is the realisation of all this and it is in the social that confidence will be recovered in relation to the European Union and it is in the social that conditions will be created for the sustainability of all these sectors activity and culture and identity and all of that... And I think this is a side that was rather undiscovered by S3 despite the very significant number of professional training courses but there is something here that we still have to do, namely in this case, in the resolution of the demographic plan and in an even more effective match in the case-by-case relationship, the way this articulates the country's needs, how the strategy for higher education or for the economic strategy of teaching in Portugal is defined, maintaining freedom of choice for each person (...)." (Innovation Intermediary, E18)

"(...) I think this is an opening and, I think it was important that, perhaps, from the perspective of the recommendation, that there was also some freedom for the regional development commissions to have a margin here for themselves to decide whether that project is or not aligned with S3, whether or not it has a positive impact on the development of the region, which I think is the most important." (HEI Polytechnic, E16)

Respondents representing the Lisbon region also consider these priority areas issues (28,51%) as a prerogative, as well as a coordinated national strategy (28,43%) and the culture of innovation (25,68%).

"So, if you asked me what the priorities of the future would be, they would be Science and Technology and Innovation and Knowledge Transfer, on the one hand. And on the other hand, in terms of strategic areas, I would think, Digital Technologies, Materials and Nanotechnologies, Biotechnology and, Transport, in particular, Land and Sea Transport." (HEI Polytechnic, E4)

"On the other hand, at this level it seems to me that the issues of financing are very important. In a context of scarce resources in which higher education institutions are confronted with the issues of a greater democratisation of the access to education, there is some restraint in the tuition fee and everything else, it is important to clarify here the role of higher education institutions as trainers of skills for the regions (HEI Polytechnic, E14)

"In other words, the capacity of the public policy agencies themselves, where in particular the FCT fully integrate the S3 dimension of their RIS/ENEI in their processes, is relevant. Is the participation of regional OPs, thematic

national OPs, adequate to promote these articulations? So, this may be one of the topics that is here. (...) it is that the European Union also has incentives out of alignment in some aspects." (HEI University, E23)

Madeira also highlights the culture of innovation (22,20%) and priority areas (11,47%).

"So, I think that the first major need for change has to do with culture and with oneself ... it is a cultural issue and also with corporate culture. From a cultural point of view, I think that the first big issue that needs to be changed is mentalities because I think that there is very little, shall we say, capacity to be an entrepreneur, to try to use what is local in order to create your own project, your own venture and try to go forward with it. From a business culture point of view, people do not take risks and do not have the capacity to do so. It would also be necessary to change that." (HEI University, E17)

"(...) it is like that, I think the region does not have the capacity to continue investing in so many areas, that is clear to me! On the other hand, and this should have been done before, one should have evaluated the investment that was made in certain areas and the actual impact that this had, at different levels, whether in the area of innovation or in the more academic area, in terms of publications etc." (HEI University, E13)

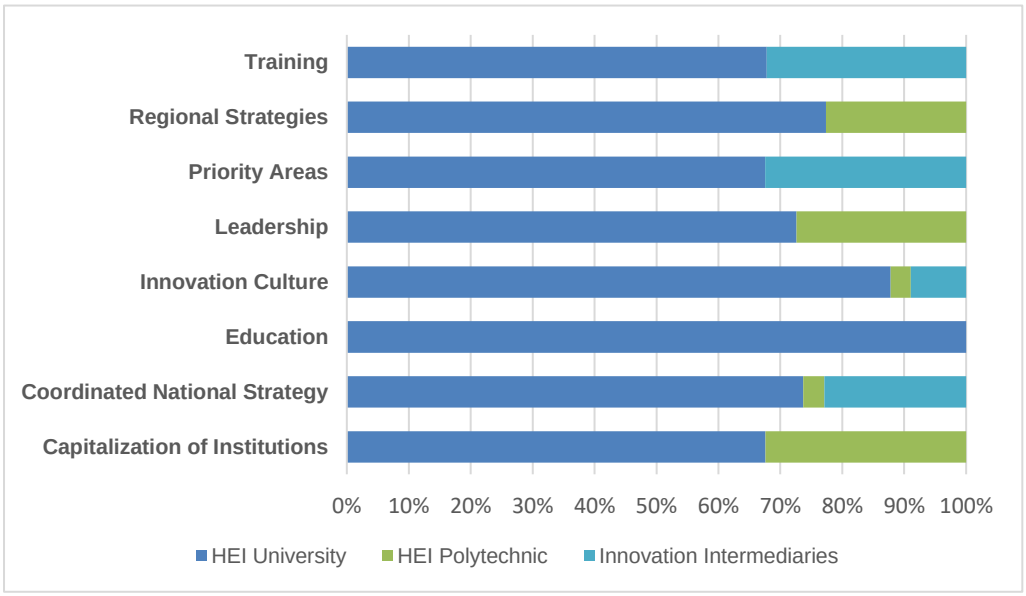
Finally, the Azores actors consider regional strategies (32,82%), priority areas (29,99%) and national coordination of strategies (24,84%) as priorities.

"Then the other areas, which it is important to continue to bet on, which is the monitoring of this growth in the Azores, that is, never losing sight of the issue of sustainability that quickly, and in other tourist destinations, we have analysed and studied, are moving towards yet another massification." (HEI University, E9)

"(...) therefore, we are not able regionally, we have no framework, there are no support lines, notices for these areas. And we cannot compete for the national OP because we are in the Azores. We are connected to the central government, but our Rector has said several times, joking but seriously, it would be better to put the headquarters of the University of the Azores in Marquês in Lisbon and there we can run for the national OP. So, here we have a series of constraints and afterwards we go into the game, so to speak, with several agents with different capacities, but in my view and I think that at this moment everyone has realised this, is that in the innovation pipeline we are at the beginning. This is where knowledge can arise, there is knowledge ready to be transferred and there is this gap." (HEI University, E21)

In fact, universities consider that the main structural change must involve the way in which higher education is implemented, in order to adapt training offers to areas of specialisation, followed by the question of the innovation culture and the coordination of strategies (Figure 22). Polytechnic institutes consider capitalisation of institutions, regional strategies, and leadership as priorities. Finally, innovation intermediaries emphasise the issue of priority areas, training, and the coordination of strategies.

Figure 22: Priority Structural Changes Identified According to Type of Entity



Source: Own Elaboration Using Nvivo 11

Table 15: Transformative Activities According to each Region (NUTS II)

	Decentralisation (8,8%)	HR and Qualification (20,6%)	Leadership (2,9%)	Reinforcement of Areas (7,4%)	New Areas (17,6%)	New Mechanisms (22,1%)	Synergies (20,6%)
Norte	**9,98%**	**54,69%**	**0%**	**0%**	**0%**	**17,75%**	**0%**
Centro	**7,83%**	**4,81%**	**100%**	**0%**	**5,71%**	**15,66%**	**22,82%**
Algarve	**32,96%**	**0%**	**0%**	**58,41%**	**19,82%**	**15,12%**	**0%**
Alentejo	**48,23%**	**15,55%**	**0%**	**0%**	**0%**	**11,53%**	**17,64%**
LVT	**0%**	**14,54%**	**0%**	**0%**	**36,60%**	**10,48%**	**31,84%**
Madeira	**0%**	**0%**	**0%**	**41,59%**	**27,25%**	**19,41%**	**27,70%**
Açores	**0%**	**10,42%**	**0%**	**0%**	**10,61%**	**10,06%**	**0%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

In the dimension related to transformative activities (Table 15), the interviewees, in general, consider that, to begin with, they must go through the construction of new mechanisms (22,1%), such as: a greater territorialisation of public policies; support for industrial parks; new fiscal conditions for territories such as the outermost regions, the Algarve and the Alentejo and the interior of the Norte and Centro regions; a new model of regional funds centred on the principle of specific programmes by region, in accordance with the interests of each territory; a specialised mechanism to support knowledge transfer, which should have a dedicated budget and then show results; the incorporation of professional structures for research management; the creation of centres of excellence for mobilising innovative projects; venture capitals with international know-how; changes in funding and access to finance given that there is a very large bureaucratic burden; and the possibility of multi-annual financing to maintain infrastructure and staff.

After that, they highlight: the bet on synergies between institutions (20,6%); the qualification of human resources (20,6%), in order to bring them closer to the areas of specialisation; the decentralisation of public policies (8,8%); the emergence of new areas (17,6%); and the reinforcement of some areas of specialisation that have proved pivotal in recent years (7,4%).

In this case, Norte highlights the qualification of human resources (54,69%), the creation of new mechanisms (17,75%) and decentralisation (approximately 10%), as the main transformational activities.

“Now, I think that the main problem of the region and, above all, of a region that has a lot of industry, will be the human issue and, therefore, the region will have to have a strategy for the human issue. To have people to support economic development or, that you want to have, have people in scientific structures, have people in industrial structures…” (Innovation Intermediary, E3)

“On the other hand, if we want to create regional innovation ecosystems, we should also support regional innovation councils. We were all together (…). I think it took the specialisation model that was made, gave it a new dynamic and led to demand for a new model of regional funds, centred on this principle of programmes by region according to the interests of the region” (Innovation Intermediary, E10)

In the case of Centro, the focus should be on leadership (100%), synergies (22,82%) and new mechanisms (15,66%).

“Therefore, when smart cities, urban innovation, related start-ups, new technologies appeared in territorial innovation, it was possible to create a set of activities because there were leaders. (…) I would say, the leaders have to be identified, the mobilisers and policy entrepreneurs, entrepreneurs of activities that can be factors of change.” (HEI University, E8)

“The Centro region must be in Brussels, must be permanently present in Brussels, but everybody from the Centro region must have access, who is in Brussels must also have a region that is not fractured and that is not jealous (…)” (Innovation Intermediary, E2)

“An activity that will certainly be transformative in all sectors is ensuring that there are processes (…) and also a bet on industrial districts or a bet on innovation parks” (University of Aveiro, E8)

Respondents from the Algarve consider that transformation must go through the reinforcement of some areas of specialisation (58,41%), decentralisation (32,96%) and the emergence of new areas (19,82%).

"Tourism itself, of course, which should have a slightly more advanced view because I think that most people who are outside Portugal still do not know what exists in Portugal (...). Because we have, on the one hand, a population that even calls the Algarve, who comes from the rest of the country to the Algarve because of tourism, therefore, because there are job opportunities here, but we also have many foreigners and Portuguese people who are aging and this, of course, also means that it is necessary to take care of these people and, therefore, invest in that direction." (HEI University, E1)

"I am not going to talk about regionalisation, but decentralisation was essential ... just look at regional funds." (Innovation Intermediary, E11)

"So, I think that TICE here is very important, because they are transversal with everything else: with energy, with health, with I don't know what." (Innovation Intermediary, E11)

The Alentejo region also highlights decentralisation (48,23%), synergies (17,64%) and the qualification of human resources (15,55%).

"And, this is what differentiates because, afterwards, we cannot all pay the same tax for a public service that is common and that is not available everywhere. I cannot pay the same as a taxpayer in Lisbon because the Portalegre hospital does not have all the facilities. And you can tell me: "Ah, but you can go to Lisbon.", Okay, but then pay me a transport allowance, right?! And these questions are questions that are paradigmatic and that have to be developed and studied, obviously, it is very easy to send a set of measures here, without actually measuring the economic impact but, in practical terms and, making a relationship here simple, we take the data from INE and PORDATA and we make a balance between the variations that exist and, afterwards, we made a very simple analysis to see this question of the tax what impact it had and, if the impact was zero, there was no need to go up 1%, nor did it reach 1% in the population that lives on the coast" (HEI Polytechnic, E16)

"There is an area that we should also mention here, not only horizontal coordination but also vertical coordination. Portugal was one of the member states of the European Union, not many did it but we did it and, probably, I think it was interesting and it is worth continuing to explore this format. In the S3 context, member states could choose to have either a national strategy, but above all regional strategies, or just regional strategies, we chose to have a national and regional strategy. Now, one of the things that I think was worth seeing is the horizontal coordination and governance axis between S3 and also between ENEI and that seems to me to be one of the really important areas." (Innovation Intermediary, E18)

Lisbon considers supporting new areas (36,60%), synergies (31,84%) and the qualification of human resources (14,54%) as the most important.

"I think it is the appropriate way to define the areas for investment, that is, everything that has to do with resource efficiency, responses to dynamic demands. Old people who need certain goods. Ensuring a fight against exclusion and inclusion... it is here at these intersections, how digitalisation interacts with efficiency in the use of resources and how it interacts with productivity, it is here that the guys should be putting our cards, from the point for the future. (...) but, I would say that the key element to define this is that we are going to see the societal challenges and the great technological trends in the world and we will try to be positioned in these areas." (HEI University, E23)

"Therefore, I think that everything that helps to lower these barriers and that allows the approximation of the two ecosystems, the call for innovation and the call for research that are not truly integrated, in my perspective, will help, mainly in these areas, where anticipates in the near future in Europe that the development is an Amazon or something like that, in Lisbon." (Innovation Intermediary, E12)

Respondents from Madeira stress the importance of strengthening areas of specialisation (41,59%), synergies (27,70%) and the emergence of new areas (27,75%).

"The issue of agri-food safety and quality seems to me obvious, also a way of defending regional products, protecting them from competition, protecting them from counterfeiting, valuing them and, therefore, we too, within the centre, do not have a regionalist perspective of knowledge, quite the opposite and, I think this has been important for the affirmation of the region." (HEI University, E13)

"Try to continue to organise the innovation and research fabric at the regional level, trying to converge efforts and not fragment. Fragmentation in our case is more harmful than in areas of continuity where it is possible to identify certain areas with sufficient critical mass to develop a given theme. There is not enough critical mass here for anything, for any thematic area and, therefore, if we retreat there will always be very few. I think that

would be another fundamental point. Therefore, we have the issue of producing a number of areas, the convergence of efforts perhaps within the scope of an institute at the regional level and the greater political awareness of investment in this area of research and innovation. We continue to see a lot of fragmentation in this area." (Innovation Intermediary, E20)

"(...) the area of Health and Aging, is obviously a fundamental area, I am not saying this because I am involved with the area but because it seems to me that in a region that even has some very specific pathologies, in which the population itself, like the rest of the country, is aging, it is important to have this area reinforced and well financed for the foreseeable future." (HEI University, E13)

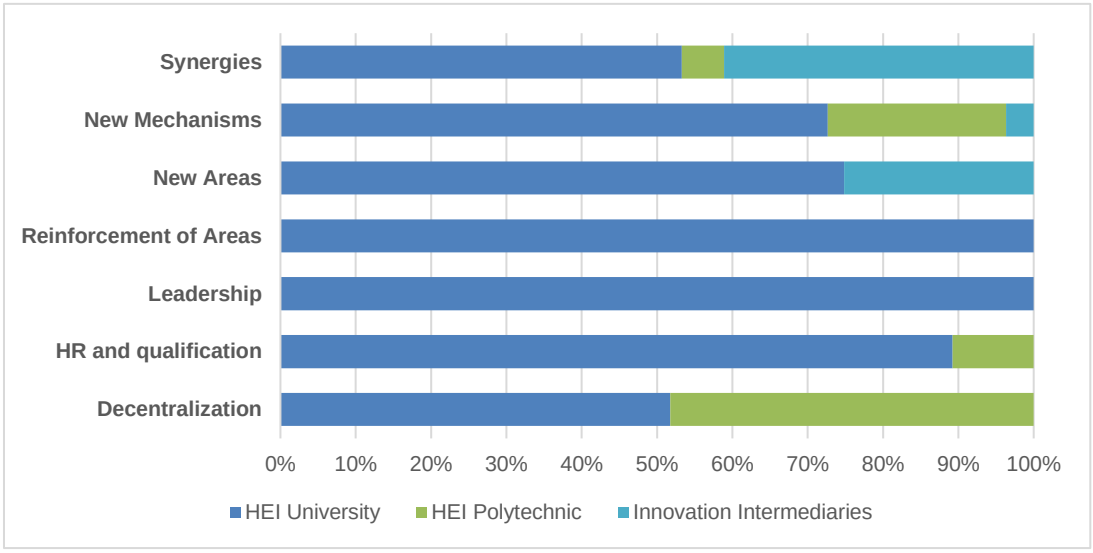
Finally, the Azores also highlight the emergence of new areas (10,61%), qualification (10,42%) and new mechanisms (10,06%).

"I consider that one of the areas where issues can potentially grow, could be in the digital area, in all aspects of the Digital Economy, because we would have the ability here to offer, so to speak, a very interesting lifestyle for people working in this area, providing a space of creativity and productivity. Since the Digital Economy has no boundaries, therefore we would not feel this constraint of being far or close." (HEI University, E9)

"(...) polytechnic education would have to be a priority in the Azores, but independent polytechnic education. Polytechnic education has been developed within the university, which then significantly limits its scope and, although I am at university, I think it would not hurt the university to have healthy competition from polytechnic education. Because there are teaching offers and there are areas that I believe that polytechnic education has better solutions than traditional university teaching." (HEI University, E21)

"In fact, it would be necessary, above all, to have conditions for companies to be located in the Azores, namely fiscal conditions, I have no doubt that this would attract companies and, at the same time, policies for attracting people, that is, people who want to return to the Azores because many Azoreans are out because they do not have the conditions to settle here. That is one of the issues that I have been talking about the most, developing policies of attraction for Azoreans who left, for Higher Education or for other activities, and could return ... But also create structures in the Azores that would allow this leverage, for example, a centre that was not dependent on the University itself but had the capacity to attract" (HEI University, E9)

Figure 23: Transformative Activities Identified by Type of Entity



Source: Own Elaboration

University institutions (Figure 23) consider that the main transformational activities should include, in the first place, the strengthening of some areas, human resources and their qualification, and the emergence of new areas. Polytechnic institutes, on the other hand, highlight decentralisation, new mechanisms, and also qualification and human resources. Finally, innovation intermediaries underline the importance of synergies, the emergence of new areas and new mechanisms.

HEIs role can be the key factor in the design and implementation of S3 and for building innovation capabilities in the regions. This potential contribution has not been harnessed by many S3, especially in less developed regions where HEIs can have a particularly important role to play. Some structural changes in the way HEIs function can help build innovation capabilities by strengthening the role of HEIs in regional partnerships and by

promoting the integration of higher education with research, innovation and regional development in S3 policy mixes, particularly in the use of European Structural and Investment Funds.

Respondents in Portugal consider that, in this sense, the role of HEIs must pass first through the strengthening of their regional impact (25,8%), and subsequently, but in an equally important way, through a restructuring of evaluation metrics (21,5%), placing, on the one hand, the focus on applied research and not exclusively on scientific production and, on the other hand, a revision of the teaching career statute. This is followed by a commitment to collaboration (16,1%) and adaptation of curricular programmes (13,9%) to the real needs of the market and areas of specialisation. Finally, they advocate for a change in its structure (7,5%) that is too static, hierarchical and bureaucratic so that it can adapt more easily to social and economic changes as well as for more funding and capitalisation (7,5%) and a focus on the knowledge economy (6,5%).

In the analysis disaggregated by regions (Table 16), Norte considers that the role of HEIs must essentially pass through a focus on internationalisation (100%) - a trend reported only by the Norte region - on the knowledge economy (43,12%) and on collaboration (23,69%).

"(...) they will have to have a logic of differentiation and a great logic of internationalisation but they should be known in areas where they develop their expansion and affirm themselves by specificities because today's world will not be possible, if we don't affirm ourselves in a way" (Innovation Intermediary, E3)

Table 16: HEIs Role According to the Dimensions of Structural Change and Disaggregated by Region

	Collaboration (16,1%)	Curricular Programs (13,9%)	Evaluation Metrics (21,5%)	Finance (7,5%)	Internationalisation (1,1%)	Knowledge Economy (6,5%)	Regional Impact (25,8%)	Static Structure (7,5%)
Norte	**23,69%**	**23,58%**	**9,09%**	**19,94%**	**100%**	**43,12%**	**13,57%**	**0%**
Centro	**24,77%**	**23%**	**5%**	**0%**	**0%**	**36,39%**	**32,05%**	**9,55%**
Algarve	**10,66%**	**25,58%**	**25,49%**	**58,65%**	**0%**	**14,32%**	**3,67%**	**37,13%**
Alentejo	**15,31%**	**4,60%**	**22,17%**	**0%**	**0%**	**0%**	**9,20%**	**33,09%**
LVT	**25,57%**	**0%**	**17,40%**	**0%**	**0%**	**0%**	**21,30%**	**0%**
Madeira	**0%**	**0%**	**8,43%**	**21,42%**	**0%**	**6,18%**	**16,91%**	**3,83%**
Açores	**0%**	**23,23%**	**12,42%**	**0%**	**0%**	**0%**	**3,30%**	**16,31%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(Percentages next to each theme is overall weight of references nationally)

Source: Own Elaboration

"We are in the so-called century of knowledge, in the 21st century, where knowledge is a theme, both in societies and economies. From this point of view, we could think that, therefore, we are in the century of universities and that universities are going to gain a central role because universities are supposedly institutions of knowledge and, therefore, it should be their century." (Innovation Intermediary, E15)

"I think that researchers cannot look to regional funds as a way to finance their lines of research. For that they have to find other mechanisms and with international conosrtia. In other words, these funds are not to finance teachers' research, but to finance what matters to the region's Economy and Development." (CRUP, E10)

In Centro, it is considered that this role should also include a focus on the knowledge economy or on the university of the future (36,39%), followed by a strengthening of its regional impact (32,05%) and collaboration (24,77%).

"And this knowledge economy and high added value that we want to be part of the strategies of regional development and, therefore, it is necessary to change the scientific employment to the employment of knowledge so that the people who are in the employment of knowledge can ... sometimes, there is this dichotomy, just change this for the impact to be very different. And speaking not in Science but in Knowledge, the impact is completely different! Even from a psychological point of view it is different, we may be talking about the same thing but Science is a part of culture" (Innovation Intermediary, E2)

"(...) therefore, be a key actor in the definition of the strategy and then there is more scale of proximity, NUTS III and cities. NUTS III and municipalities. Also be an actor at the level of this strategic definition. For regional development to occur, universities must have these conditions. First, political actor. Second, a key partner in the implementation. Actors active in the definition of strategies, actors active in the implementation of strategies,

capable of doing so and betting from the point of view of their areas of expertise, also in an articulated way" (HEI University, E8)

"Universities probably have... they occupy this privileged place in this triangle or this quadrangle because they can serve as a bridge, they can serve as "boundaries expanders" in this thing, those that generate... widen borders and allow articulation. This is asking for more than universities do today, I am also aware." (HEI University, E8)

In the Algarve, interviewees consider that HEIs should, first of all, be aware of finance issues (58,65%), eliminate some more static structures (37,13%) and implement a change in curricular programmes (25,58%).

"The financing model has to be revised because we cannot continue to value courses because they have 300 candidates and were full. I would like to see a study made of the number of students who come from other scientific areas in secondary school compete for the humanities because they can't be positive in anything else" (HEI University, E22)

There is a pattern of hierarchy within the university, it stays up there, it never goes down here. (...) It does not work on the basis of merit, but of other values. Maybe they are important, but they are inefficient. And in fact, it could work in a different way because the problem with universities (...) is that they are very hierarchical entities, not very functional, not very malleable and that end up, in fact... anyway, do not contribute as much as they could. (Innovation Intermediary, E1)

Another situation that, from our point of view, has to be seen, is the creation of new professions and this is particularly relevant when we look at the issues of aging. (HEI University, E22)

In the Alentejo, it is considered that there should also be support for eliminating static structures (33,09%), improving evaluation metrics (22,17%) and developing collaboration (15,31%).

"The level of complexity of public policy instruments and universities that the population have from period to period has increased in complexity but I think it was necessary for us to do an exercise of joint reflection, eye to eye, between the different entities, to see what we learn from this. And to what extent is the custom that we are generating in relation to each of these solutions that often determines what is the result of what is happening. And this question for me is an important issue so that we don't run the risk of making the new fabric more or less the same cuts as always, it is not" (Innovation Intermediary, E18)

"This, for researchers and teachers, is less interesting than the possibility of turning the results into a paper, than publishing a paper in a good journal, for example ... Because our evaluation model is made like that, isn't it? Therefore, the level of evaluation of teaching staff, I confess that our evaluation model is a little skewed, and values scientific production much more than collaboration with the region so, from this point of view, researchers and teachers will always give more to projects where they managed to get one or two papers than those that give them only as a connection and solution to the institution's concrete problem." (HEI University, E7)

"(...) basically, to continue to maintain the position of openness to partners and the position of collaboration with the region, I think that this is what the university can do without a doubt." (HEI University, E7)

In Lisbon, the importance of collaboration (25,57%), the regional impact (21,30%) and the evaluation metrics (17,40%) are also highlighted.

"In terms of research, they have to be increasingly prepared for the madness that is to make synergies between funds not only public, but national, international, private, outside Europe. And be prepared to do all of this and be in compliance with all of it. (...) being prepared to communicate them, there are often no channels for this interface, everything is done a little ad-hoc, identifying people well. This is only achieved with collaboration." (Innovation Intermediary, E12)

"In the previous definition that was made in the Government that was in Portugal between 2011 and 2015 (if I'm not mistaken), universities were practically ignored when defining the lines of the structural programmes. What I say is a relatively obvious thing, isn't it? A system that is so important for the future of the country, the university system, should be strongly involved in defining strategic lines and, even now, in the definition of financing mechanisms or, at least, in the discussion of financing mechanisms to be adopted. That was my reflection, which is more or less obvious, isn't it?" (HEI Polytechnic, E4)

"Then there is a topic, in which I think the university falls short, of what could be the role, it was always heard, so the dynamics exist, because there is pressure from their own careers, from promotions, also the result of the internal processes of schools to value the behaviours of the actors. (...) there is a clear imbalance in the

valuation of the different components of the function of a university professor in internal consideration for the purposes of performance evaluation and after progression. Therefore, if I want to further reinforce the role of universities and higher education institutions in the country's innovation, I have to recognise or attribute equal, I don't say equal, but a better balance must be found in the valuation of university extension activities in relation to pure research activities" (HEI University, E23)

The interviewees from Madeira focus on the capitalisation of institutions (21,42%), on the regional impact (16,91%) and also on the evaluation metrics (8,43%).

"Universities are drowned in a set of financial difficulties that I think have to be resolved in some way. Otherwise, its role for the region always falls short of what it could be." (HEI University, E17)

"(...) if we want to affirm ourselves from a scientific and technological point of view, we should not have been able to allow researchers, in an almost systematic way, to integrate other research centres external to the region. We should have created conditions to have them, I do not say in all areas, I admit, but in two or three areas, we have research centres with a rating of at least, I say, very good, in the region. And, in fact, the number of centres located in the region is minimal. We do not have a centre in the region, rated as excellent" (HEI University, E13)

"The most senior researchers at the centre have other responsibilities besides research, therefore, as in all universities. And the younger seniors have their research projects and, therefore, they also have to take them forward because there are also people with availability here. This must then be made clear in the evaluation metrics". (HEI University, E13)

The Azores highlighted the adaptation of the curricular programmes (23,23%), the static structure (16,31%) and the evaluation metrics (12,42%).

"Universities must increasingly be drivers of change in the context in which they operate. This is done through the way they prepare their students, the way they do their research and get to the market and the way they themselves are the engine of life and not of.... I think that inertia no longer fits in the context where we live today." (HEI University, E21)

"There are many structures that are rigid within the university and in this condition the novelty may not arise. You want to do something but then there is no framework." (HEI University, E9)

"I will suggest something that may seem far-fetched, but that the metrics of the success of its professionals, of its academics are rethought because if we rethink it there is indeed an incentive for the participation of applied research in a business context to be valued for its progression, this can also make them more interested in this area. (...) many times the concern lies only with scientific publication and people sometimes forget that they have very interesting results that they could patent or have some type of intellectual property rights over them (...)" (Innovation Intermediary, E5)

Universities represent the large majority of textual references in this topic (Figure 24). They emphasise the internationalisation and financial aspects. Evaluation metrics and curricular programmes are particularly mentioned by polytechnic HEIs interviewees. Innovation intermediaries underline aspects concerning the regional impact, the participation in the knowledge economy and collaboration.

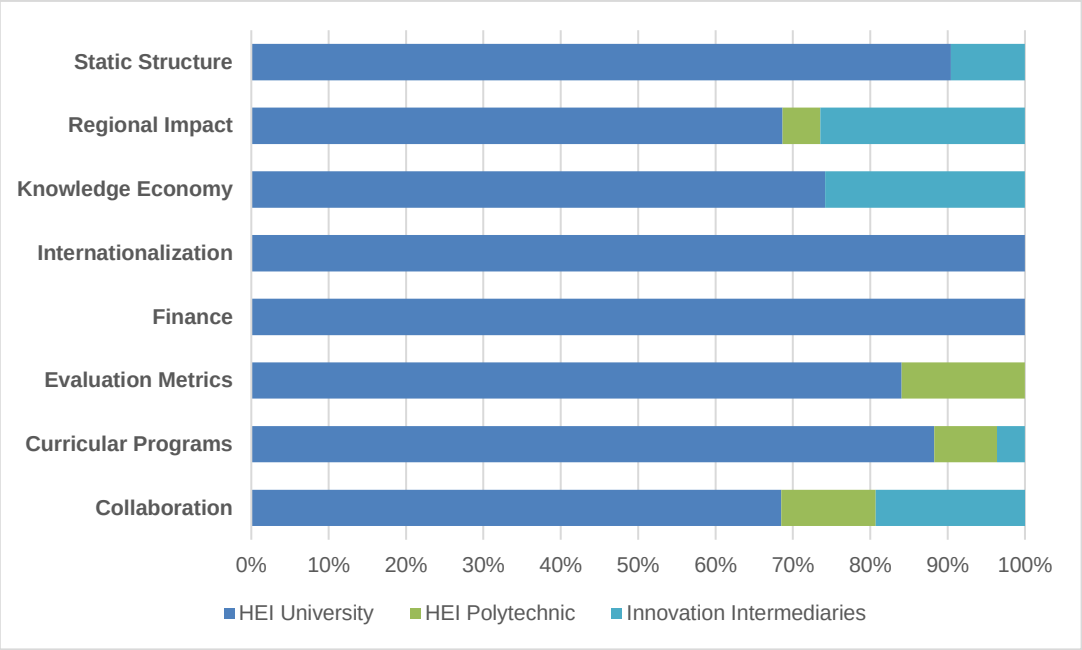
Participants were also asked to identify the resources needed for these changes. Frequently, the interviewees found it difficult to identify these resources and the information coded in this question does not allow us to draw a segmented analysis. However, these responses can be grouped into three main dimensions.

First, financial resources, both in terms of capitalisation of institutions and mainly in terms of incentive systems to promote research:

"in terms of financial resources, I am thinking of, everything that is an incentive system that promotes research or at least the partnership between knowledge centres and companies is extremely important." (Innovation Intermediary, E5)

"Well, it was necessary that the structural funds that are really going to be available in Portugal, whose value is not yet known, that of those structural funds a more significant fraction than in the past was allocated to the Lisbon region and that a more significant fraction had a co-financing rate in excess of 40%, which is currently the norm." (HEI Polytechnic, E4)

Figure 24: HEIs' Role According to Type of Entity



Source: Own Elaboration

Second, a question of self-empowerment and concrete guidance on what is preferable to achieve a particular development path:

"The question of money is always a bit secondary as resources, because when people know what they want, they go after the money and usually find it. So, the thing has to work on that basis and not the other way around, it is not putting the money in and then going to see how it is used." (Innovation Intermediary, E1)

"When designing the strategy there must also be a response in terms of self-training and then look for resources to also train themselves in scientific areas that are compatible. Design, implementation, networks." (HEI University, E8)

Third, a question of organisation of the funds themselves:

"In this specific case, what I think is, I don't think it is a question of resources. For example, at the moment the execution rate of the Portugal 2020 is 38%, it means that it is not a good resource although I know that this execution rate has to do with the State that often does not apply so it does not have to put its share, therefore we have to know what we have. If we have a 38% execution rate, it is not due to lack of money, because there is all that money available there, but we could not go there, so maybe it has to do with organisational problems." (Innovation Intermediary, E18)

In sum, it is possible to realise that, regardless of the region, there are assumptions that are symptomatic of the national context of Portuguese HEIs. Issues such as the status of the teaching career, the rigidity of structures and the decapitalisation, often prevent them from playing the most structural role they are asked to. When these factors are associated with regional specificities, there is an increase in asymmetries that result in a perpetuation of trajectories. However, there is a set of measures well identified by the authors that could help to minimise these problems. These measures need, on the one hand, a cultural and mind-set change, and on the other hand, structural changes in the way HEIs are organised and led.

6. Focus groups' results

6.1 General Overview

To explore the results of the interviews, understand the perceptions of actors, and help build partnerships in the region, a series of focus groups (FG) were carried out. The focus groups were divided into two main parts: a first, in which participants were encouraged to identify the problems of universities and other HEIs in the implementation of activities that can contribute to the success of S3, taking into account the essential dimensions of smart specialisation (such as future vision and priorities, governance, implementation, monitoring); and a second in which the participants tried to debate possible measures or actions ('ideas partnerships') to eliminate or reduce identified problems, taking into account possible transformative activities critical for the region and/or with transversal social challenges. The FGs took place as face-to-face interactions in the seven Portuguese regions between September and December 2019.

The FG were implemented in each NUTS II region, and even if the method was exactly the same in all contexts, the discussion of each group varied because of the individual perceptions, collective dynamics, and regional innovation profiles and HE system.

Norte has strong territorial contrasts, which are also reflected in the morphology of its HEIs, where the very dynamic University of Porto and Minho, UTAD and smaller polytechnics cohabit. This situation seems to generate some tension between HEIs in accessing public resources, evident in the focus group, including competitions under the ROP (ESIF Regional Operational Programme). The collective process of building ENEI and EREI is seen as a strong learning opportunity, attracting large levels of participation and generating a strong alignment of S3 with existing resources in the region. However, in the focus group, many actors were sceptical about the implementation of S3, particularly in terms of governance and monitoring.

Centro is of paramount importance in the history of higher education in Portugal, as Coimbra is one of the oldest universities in Europe, an institution that has been central to the nation's development for centuries. Today, the University of Coimbra is complemented by a complex and relatively dense network of HEIs composed by the University of Aveiro, the University of Beira Interior, several polytechnics and other relevant actors of innovation, the most internationally recognised case being the Pedro Nunes Institute. The region prises and prides itself on its symbolic capital in terms of knowledge and science but, despite these achievements, the impact on business and innovation is out of step compared with the global status of its universities. Centro remains a region with development problems and large intra-regional disparities. For this reason, it was opportunely selected by the JRC project on targeted support to lagging regions which, according to many regional actors, constituted a valuable learning opportunity for the consolidation of the regional S3. Within the framework of the Portuguese regions, Centro is currently a successful example of the implementation of smart specialisation principles, in particular in the creation of mechanisms for listening to local actors, as well as their innovation platforms (working groups).

The Lisbon region benefits from capital city effects. It is the region with the most robust innovation indicators and the most populated ecosystem. HEIs more easily attract national and international students and benefit from greater direct demand from companies and the state. As a more developed region, the ESIF allocation is relatively small which, together with a low co-financing rate and the narrow range of instruments, makes Portugal 2020 less relevant for the HEIs located here.

Alentejo is a region that occupies a third of the national territory but presents several structural problems not only in its population density but also in its demographic structure. It has an educational offer that covers most of the scientific areas, scattered throughout the three HEIs in the region: the University of Évora and the Polytechnic Institutes of Portalegre and Beja. As for its innovation ecosystem, the region has taken some steps towards consolidating its capacity, namely through the creation of several science and technology institutions, such as the PACT - Alentejo Science and Technology Park. Through the interconnection between regional players, the Regional Technology Transfer System (SRTT) was established. However, due to some gaps in the synergies and cooperation between the different institutions as well as in their link to the business fabric, these initiatives did not have the desired impact on strengthening the regional innovation ecosystem, and Alentejo remains a region with low capacity for innovation.

Algarve is characterised by a relatively small innovation ecosystem with few actors where the University of Algarve (UAlg), the only public higher education institution, dominates the education offer and research. With about 10,000 students, this HEI aggregates the two subsystems - university and polytechnic - and has been growing nationally in some areas aligned with S3. UAlg has had a leading role in the design and implementation

of many phases of S3, in particular through its Division of Entrepreneurship and Technology Transfer (CRIA), which is often highlighted as a key part in the regional innovation ecosystem but which, nevertheless, suffers from a chronic lack of resources.

The Autonomous Region of Madeira has particular characteristics due to its governance and its geographical location. It is an island and ultraperipheral region with its own political and administrative status and governing bodies. The University of Madeira (UMa) is the only public HEI in the region and the most recently established in Portugal. It has five colleges that cover most of the areas of training offered by Portuguese public universities. It has an incipient and fragmented innovation ecosystem with a limited number of actors such as ARDITI - Regional Agency for the Development of Research Technology and Innovation. ARDITI, under the responsibility of the Department of Education, Science and Technology (SRECT) was the main actor in the design and management of S3 2014-2020 and is also the institution formally responsible for streamlining and updating the strategy ahead of the next ESIF programming period.

The Azores is also an ultraperipheral region constituted by nine islands and, like Madeira, is an autonomous territory of the Portuguese Republic. The dispersion and geographical characteristics of the archipelago are a limitation to the consolidation of an innovation ecosystem that integrates all the islands, as well as to a development model that meets their specific needs. The region's innovation ecosystem is marked by a limited number of actors, which are mostly located on the largest island of São Miguel, and by weaknesses, particularly with regard to links between the private sector, education and research. The University of the Azores (UAc) is the only public HEI in the region, founded during the policy of expanding higher education in Portugal, and has a three-pole structure, with centres in the cities of Ponta Delgada, Angra do Heroísmo and Horta. This HEI belongs to the national government and is headquartered in Ponta Delgada, which gives it a particularly fragile situation in relation to access to the ESIF. On the one hand, it has difficulties in accessing the Azores Operational Programme because it does not belong to the regional government, and on the other, it cannot access the mainland operational programmes, because its headquarters is in the Azores. These restrictions - namely in the access to policy measures on administrative modernization / ICTs and internationalization of higher education - contribute to a greater incipience and inability to mature the role of the University of the Azores as a structuring actor in the region. In any case UAc is the major beneficiary at regional level in axis 1 - Research, Development and Innovation and in the Specific Objective 1.1.1 To increase quality scientific production and oriented towards smart specialisation.

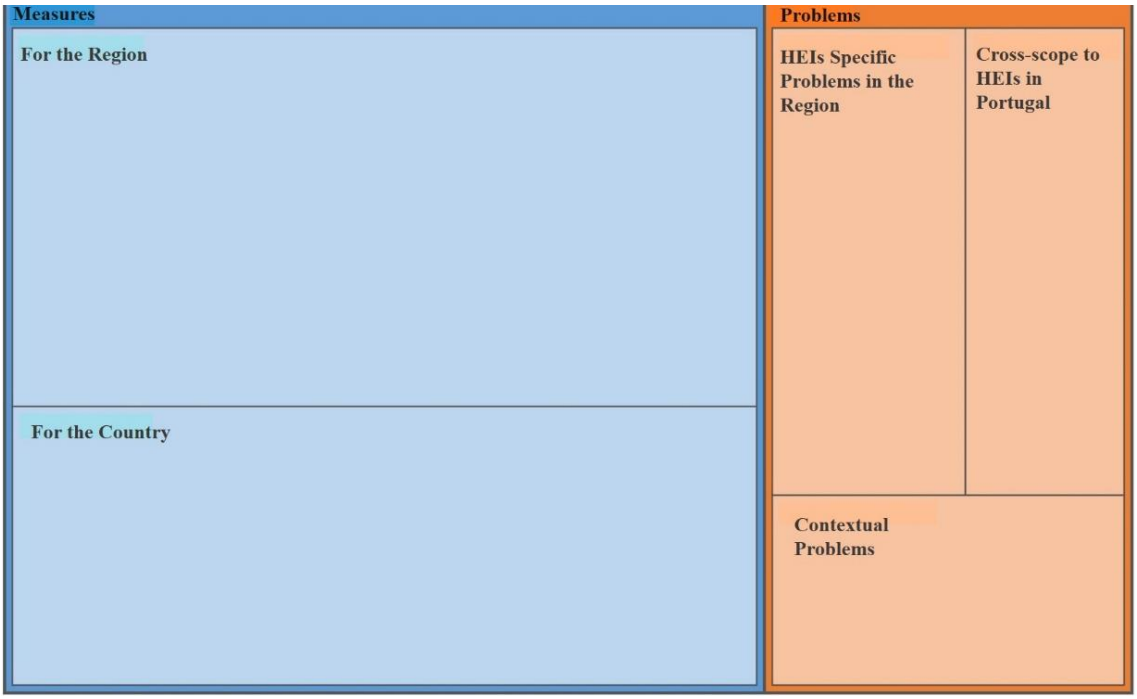
There are some main ideas that are important to underline and that were common to all the participants. In fact, there has been a greater awareness of the importance of the role of HEIs in regional dynamics. In recent years, HEIs have started to engage with society, seeking to respond, in a structured way and with added value, to the challenges that are being faced. However, there is still a set of limitations that affect the impact and that undermine their role as active and structural agents of S3.

Although there is, in the vast majority of cases, participation of HEIs in the different phases of the S3 process, many consider that these actors could, and should, have a more structural role that would benefit regional development. Firstly, their primary mission is to train students whose knowledge and critical mass is fundamental for economic and social development. However, the role of HEIs goes far beyond that and currently, HEIs are participating in governance bodies and are deeply engaged in the revision of the regional S3. Aligning the training offer with regional priorities, mobilising creativity to understand the spaces from which 'related variety' can emerge and bridging the gap between governance structures and the social and economic fabric, are just some examples of the potential accumulated in HEIs to achieve the objectives of S3.

The limitations often result in desynchrony and heterogeneity. In the FGs, one of the central ideas that stands out is the relative regional heterogeneity in terms of innovation dynamics, in particular with regard to the network of existing actors and the densities of HEIs. In addition, there is a difficulty in identifying actors of change within the university and there are differences of opinion on what S3 means. The solutions to these and other difficulties depend on a greater articulation between regional priorities, training provision and research; on the possibility to rethink some statutes of exclusivity and career evaluation; and on a vision of collaboration and effective articulation between regional stakeholders.

FGs were analysed using the Nvivo software and the formal content analysis facilitates a deeper understanding of several issues. The data presented below are divided into two categories. A first category relating to the various types of problems that actors experience, both at the national level and at the level of their particular regions. A second category, instead, refers to the proposed measures to address these problems. It must be stressed that the content analysis only reflects opinions of those involved in the FG and has not been triangulated with other data to verify their factual accuracy.

Figure 25: Hierarchy Graph on Measures and Problems



Source: Own Elaboration Using Nvivo 11

Figure 25 shows, in general, the most prominent categories, taking into account the information given by the participants in the discussion, which were the most coded categories. This allows us to understand which group of questions/dimensions of analysis the participants gave more importance to and, consequently, to determine their views regarding problems and measures to address them.

First of all, it should be noted that Figure 25 shows a general output of all FGs, that is, the view of all participants from all regions. In this sense, it is possible to see that there is a set, both of problems and measures, that is transversal to the regions, and another set that is specifically regional. The analysis attempts to account for these differences. Still, in this general context we can conclude that the participants identified more measures (58,7%) than problems (41,3%). Among the measures mentioned, the analysis allowed to categorise them in two dimensions: the specific measures for the regions and the measures for the country. The same tendency was verified in the discussion around the problems, being possible to codify problems that cross all HEIs in Portugal, specific problems of regional HEIs and contextual problems.

To facilitate the guiding thread of the analysis, the identified problems will be presented first.

6.2 Problems

Participants were asked to identify problems related to the context, to the HEIs and the ones specific to the region. These data are presented below.

6.2.1 Contextual Problems

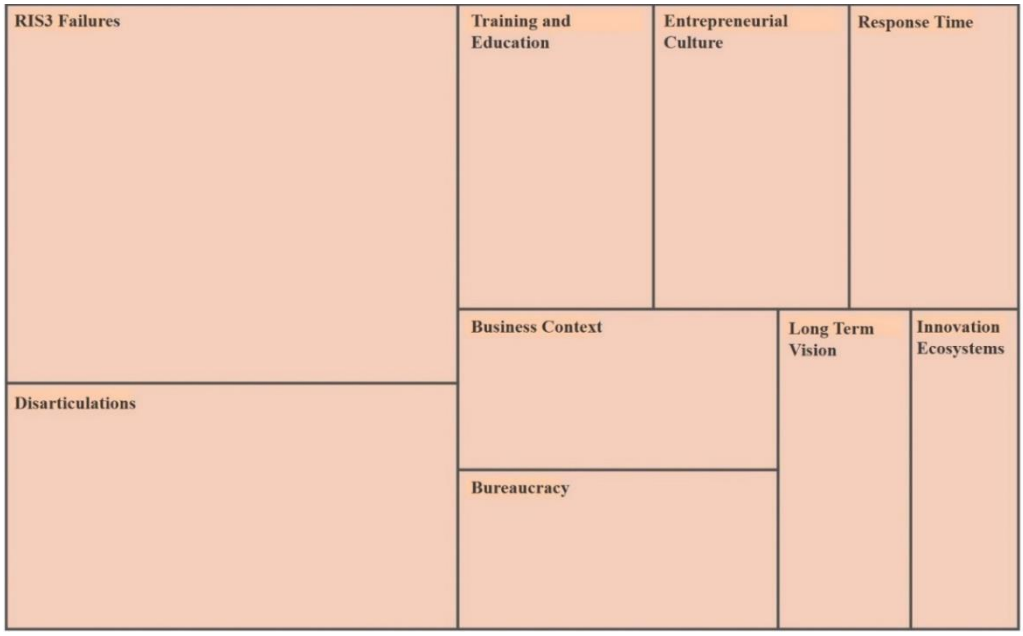
The participants identified a set of problems that were categorised as contextual and that are in fact transversal to the entire national context, even if they are stronger in some regions than others. The national contextual problems can be classified into the dimensions shown in Figure 26, below.

The most mentioned set of problems and, consequently, the most coded, was the one referring to the problems related with the **failures in S3** (27% of references). Here are included: the vision of S3 as a form of subsidising existing costs; the early design of S3 that was poorly attended and failed to listen to different regional actors; the 'education' dimension that was absent from the S3 discussion; the lack of national focus in the policies for S3; the vision of S3 as conditions for admissibility and evaluation of projects in OPs but not always in a clear or homogeneous way; the excessively asymmetric regional S3 experiences and the strong intraregional heterogeneity that needs a S3 capable of fitting in these differences; the focus on transforming the economy that was very superficial in the ongoing S3; the fact that the S3 does not value the role of social sciences; a

great deal of funding dispersion, thus compromising the impact of the actions; the usually short-lived projects (2 years) supported by OPs; the lack of transversal and systemic instruments for stimulating innovation; the lack of S3 monitoring; the lack of focus on S3 as a regional cohesion policy instrument; the failure of S3 in incorporating the understanding of value chains; the offset between regional and thematic OPs and S3; the difficulty allocating resources for S3 dynamisation by public administration entities; and a fractured implementation of S3 governance.

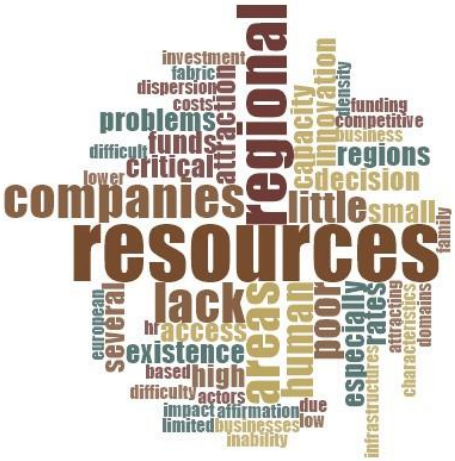
A second dimension concerns **disarticulations** (17,6%), namely: difficulty in finding consensus; a culture of competition over a culture of cooperation; staggered ENEI and EREI, which means that ENEI/EREI link is not always well achieved in the strategy and there is a practical disarticulation in implementing ENEI and EREI; the disarticulation between operational programmes and other European programmes; the lack of interconnection between regions; no institutional orchestration; the lack of alignment between strategies (European, national) which precludes real knowledge for regional strategies; the lack of consensus on what policy actors in particular want from S3; the differences between S3 understanding and practices among regions; the difficulty in financing interregional initiatives; and the articulation between S3 and other programs like INTERREG and H2020.

Figure 26: Tree Map, Hierarchy Graph on National Contextual Problems



Source: Own Elaboration Using Nvivo 11

Figure 27: Regional Contextual Problems - 30 Most Frequent Words



Source: Own Elaboration using Nvivo

6.2.2 Specific Problems

Not all regions have identified specific problems. Centro, for example, only identified contextual problems that were coded at national level. Norte, instead, identified the following: the lack of resources to support TT and encourage regional innovation; the infrastructure deficit (everything is getting outdated, especially in high-end areas); and the fact that the Porto Metropolitan Area context is not a leverage for lower density territories. Lisbon, instead, highlights: the fact that the status of access to ESIF in the LVT region creates a more limited range of instruments and smaller budget allocations; and that the rate of 40% for incentives prevents the participation of less financially robust companies and make it very difficult for underfunded HEIs.

The specific problems identified by the other regions are divided as follows:

- **Azores**: excessive dependence on exports of raw materials due to the lack of equipment to make products and generate increased value in the value chain; the existence of several islands makes it difficult for all actors to participate in the construction of a strategy that is simultaneously regional and addresses the specificities of each island; difficulty in attracting and especially retaining HR; problems in the affirmation of the region in the national and European competitive plan; few qualified infrastructures for investment attraction; lack of insight concerning the need for lifelong learning; and non-utilisation of natural and geological resources as a distinguishing feature for the training offer (living-lab).

- **Alentejo:** poor population density and desertification of territory; no housing; poor access to health and education services; territorial disparities; high unemployment rates; companies with skilled work needs cannot find human resources; business fabric are mostly composed of family businesses; proximity to Lisbon limits the attraction of human resources and companies to be based in the region; poor accessibility and scarce and inefficient public transport network; poor salary attractiveness; inability to create tools to provide continuous support to micro and/or family businesses; the valorisation of endogenous resources and short circuits were very discreet in the strategy and should gain dimension because they go directly to the characteristics of the region; companies based in the region, but which do not have in their objectives to bring economic impact or solve regional problems; inability to retain young people in the region; and inland (interior) tax burden is the same as in coastal regions without the same access to key services.

- **Algarve:** limits caused by political decisions and project selection, far from the regions, which motivate the discussion of regionalisation/decision-making autonomy; ROP funding is very limited in the region; ROP and TOPs co-financing rates are low and deter companies from collaborating with the university; regional actors have little critical capacity; human resources are insufficient; capacity to multiply small investments is considered of little value due to the importance given to the existence of critical mass; ultra-specialisation in tourism, creating a little diverse business fabric and decision centres located outside the region; regional tourism subsists with several segments of activity that are mainly seasonal and predatory (reflecting the precariousness and qualification of the jobs created, unrelated to local/territorial dynamics); lack of actors and little critical mass (institutional thinness) in terms of innovation; lack of accommodation for human resources wishing to be in the region; and dispersion of forces and lack of shared innovation objectives between municipalities;

- **Madeira:** the inherent characteristics of insularity and/or ultraperipheral; uncompetitive and unattractive international salary structure; the number of S3 areas of expertise is out of line with UMa's reality because there is no technical capacity to invest simultaneously in so many areas; difficulty in attracting and especially retaining HR; problems in the affirmation of the region in the national and European competitive plan; funds devoted to S3 are a small part in the Ultraperipheral Regions (RUPs); very low rates of regional R&D expenditure; alignment with domains is not always a required criterion; in a small region with few resources, the existence of several domains and scientific areas leads to a greater dispersion of funds and, consequently, a lower impact of the funding itself; and few qualified infrastructures for investment attraction.

6.2.3 Cross-scope Problems for HEIs in Portugal

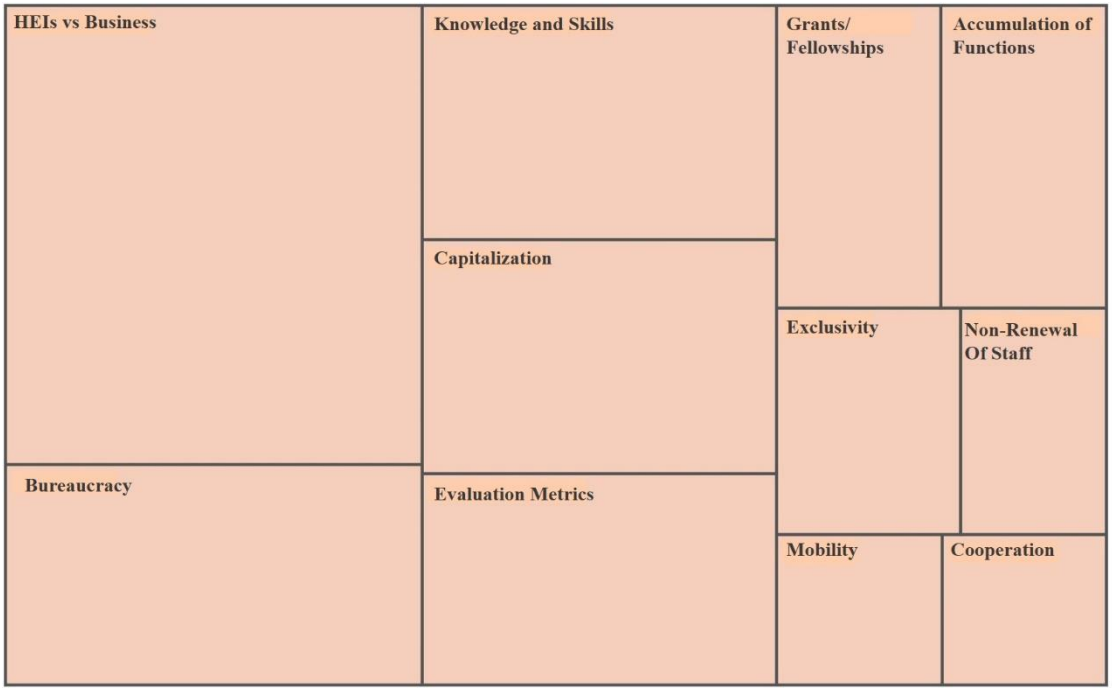
Concerning the problems related to higher education institutions, participants identified a wide range of issues. Some of these are transversal to all HEIs in Portugal and are structural problems (30,9% of total references).

Of all those mentioned, the most codified (Figure 28) are those that **compare higher education institutions with the business context** (25,5%), namely in questions regarding: the process of transformation of Portuguese universities that eventually led to a 'commercialisation' of universities, distorting their role in the ecosystem; the S3 prioritisation of the business component and therefore its failing in the purpose of creating symbioses between academia and business needs; the SMEs, which can neither absorb researchers nor ensure sustainable and respectable work; the absorption of PhD students by companies, which is often a source of

precariousness and injustice because the company generates added value with the outputs of scientific work and after the end of the contract between them, the doctorate loses access to intellectual property; the communication barriers between academic and business discourse; the unavailability of time management between HEIs and companies, especially between some areas of knowledge that necessarily need more time; the competitiveness of the scientific system, that makes individual objectives prevail over cooperation with companies; the inability of the business fabric to perform certain activities that are necessary for its collaboration with HEIs; the inability to work to attract large companies to collaborate with HEIs, due to equipment obsolescence; the tension between university and R&D projects with large companies, due to intellectual property disputes and access to available resources; the fact that open science and science transfer and commercialisation have aspects where they conflict (for example, patents); the lack of trust between actors in the innovation system, particularly in the university-business relationship; the transformational activities linked to S3, which involve a cultural rupture - that is not easy and not always desirable - with the mission of the HEIs (creation of public knowledge, open sharing, free speech, differentiated value, plurality); the universities' approach to connect with society, which remains centred on a few channels (via patents or via the provision of services); the fact that when research is top, there are no regional business entities to interact with, so it is essential to find ways of collaborating with other companies with S3 support; the funding programmes which are not directed to the development of the academic activity; and the focus of financing programmes on enterprise rather than on the university dimension (2-year projects do not allow results to be generated and translated into the business context).

Problems regarding **knowledge and skills** (11,1%) include: the internal culture of HEIs without concern for transfer; poor adaptability between knowledge produced and regional needs; tension between R&D projects with scientific merit (excellence) and projects with regional impact (which may not be state-of-the-art, but have greater socio-economic impact); polytechnics that lament the impossibility of granting a PhD degree; TeSPs (Technical professional higher education) that are fundamental but not really aligned with S3; lack of demand for TeSPs; teaching, which does not train consistently the capacity of reflection and learning for the constantly changing challenges of the future, as it is fundamental to have a research that generates mental elasticity and HR better prepared for the real demands of the market; the idea that the knowledge economy is a threat to the traditional economy; the lack of an articulated offer from the HEIs for the necessary skills for S3; and the lack of training provision in transversal skills.

Figure 28: Hierarchy Graph on Cross-scope Problems of HEIs in Portugal



Source: Own Elaboration

The third category of most codified problems is the **capitalisation** (11,1%) of HEIs: disinvestment in infrastructure and equipment in education and science; centralisation of resources for S&T, namely at the FCT; lack of ability to generate own sustainable revenues; recurrent under budgeting from HEIs; the absence of structured financing for systemic activities, for the dynamisation of innovation, for inter-sectoral translation, and for knowledge transfer; the limited capacity of HEIs (general retirement fund, commitment law, technical, operational and financial incapacity); the crisis period, which has put companies and HEIs fighting for survival, focusing on the very short term, without creation and even destruction of vision / future project; the projects' lack of framework for hiring non-scholarship researchers effectively and sustainably; and, in sum, the chronic sub-budgeting of HEIs. Another of the most mentioned problems regards **evaluation metrics** (10%), in fact: teaching and research career status is not suited to contemporary realities; scientific production as an evaluation metric par excellence does not sediment applied research; professor career status does not encourage conducting applied research; there is inertia in the adaptation of the research career; there is a lack of financial incentive to teachers and researchers in applied research projects; services are not attractive to the principal researcher (inserted in the career) due to the lack of incentives (financial) and the impossibility of obtaining additional resources; although the statute of the teaching career contemplates this possibility, engagement is not valued so there is no incentive for these type of activities; teaching status is not attractive for S3 prioritisation and knowledge transfer assumptions; and in general, there is the hegemony of scientific production as an evaluation metric.

These problems are associated with the exclusive employment status of university staff, because: the legal requirement of exclusivity for researchers is counterproductive in terms of cooperation; the exclusivity of teachers and researchers inhibits the synergy between academia and business and, consequently, the transfer of knowledge; fellowship owners (*bolseiros*) status and exclusivity make it unclear (and difficult) for researchers (particularly young people) to participate in multiple projects (such as providing services); university teaching career status has several inconsistencies that hinder collaboration with companies, in particular, issues of exclusivity; and there is a very restrictive interpretation of exclusivity, in particular for research fellows and for teaching and research staff.

Another problem concerns **grants and fellowship** (6,6%) owners, namely: the heavy reliance on scholarships/grants that limits the possibility of opening other opportunities and gain independence; the tensions between the dominant generation of university professors and the generation of scholarship/grant holders; the acknowledgement of fellows as the driving force of scientific production; the new Fellowship Statute, which brings a set of new problems that HEIs are not prepared to solve; and the obligation to hire PhDs which is perverse because it will not fulfil the purpose of solving the precariousness of an academic career.

The **accumulation of functions** (6,6%) is also a concern for the participants, namely: the need for accumulation of teaching, research and management functions that compromise the effective and efficient performance of staff; HEI difficulties in managing project financing; difficulties in making research and teaching activities compatible with collaborative R&D activities, in particular service provision (it is still viewed with suspicion by peers, as illegitimate); the lack of a true research career in HEIs, with teaching staff focusing on other tasks (teaching and university management); senior technicians in technology transfer (formerly OTIC, GAPI, Neotec) that are still a neglected group internally in HEIs, without a career, subject to highly precarious contracts (often S&T scholarships), regardless of results achieved or qualifications, thus meaning that professors' time to dedicate to transformative activities is necessarily short, given the intensification of teaching and bureaucratic burdens.

Another issue is the **non-renewal of teaching staff** (4,4%) who are aged, thus compromising the sustainability of HEIs. To this question also contributes the problem of **mobility** (3,3%) because the professional paths of academic staff are very rigid (usually in a single HEI), with little exposure to other experiences, whether business or even in other HEIs, while at the same time there is a transition inertia and teacher mobility, both between HEIs and the business context, especially in regions with only one HEI. Finally, the problems of **cooperation** (3,3%), such as: the fact that there is no interinstitutional link for collective learning (the role of CRUP and CSISP does not seem to be sufficient to exchange good practices); the relationship between polytechnics and universities, which is focused on competition rather than collaboration; and the tendency to ignore contributions from private HEIs.

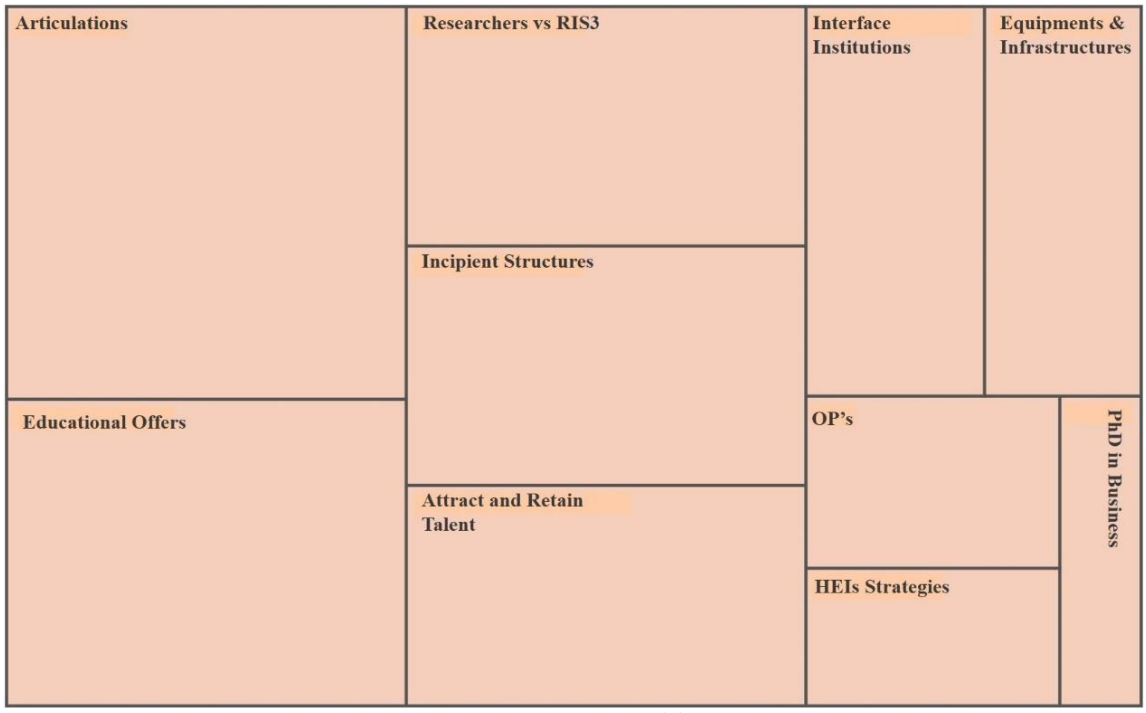
6.2.4 HEIs specific Problems in the region

In the case of the regional problems (31,7%), it was possible to group them into categories (Figure 29). These results are now presented, mentioning the most coded categories, which regions identified them and how.

The most codified category concerns connections and disconnections (19,8%). The only region not to mention problems coded as articulation was the Algarve. Centro identified the highest number of limitations, namely: the fact that the role of business associations is limited in connecting with universities for problem detection and collective response creation; the S3 in the region, in particular the different working groups, and how they had a very positive balance of intensifying collaboration, but there is still a need for more active involvement of many HEIs and their members in these WGs; the internal fragmentation of HEIs by different entities, with objectives not necessarily in agreement; the disarticulation between extension and research (HEIs do not know themselves); the limited levels of motivation for collaborative work in some HEIs; the delimitation created by intermunicipal communities which led to, in some cases, another artificial barrier and logics of local clientele with HEIs; the lack of systemic connection to work and animation of local innovation, because collective learning and polytechnics have little culture of participation in collaborative and co-creation projects with companies.

In addition, **Lisbon** presented the following problems: the increasing but insufficient concern in linking universities and societies; the HEIs' failure to connect with other types of actors and the unfair competition of HEIs in other regions with far superior support. **Norte,** instead, considers fundamental to discuss priority areas and better align with regional capacity, as well as the fact that the definition of priority areas should reflect participatory dialogue with partners. **Madeira** stresses that the University of Madeira (UMa) has its strategy but is not always in agreement with that of the Regional Government, together with a lack of research scale that causes fragmentation between small groups working separately. **Azores** considers that resource allocation, the bias between areas that have the potential for profit, the funding constraints of fundamental research, the distance of the region and the need to access networks to foster research and best practices, constitute the main issues of the region. Finally, **Alentejo** considers the poor use of advantageous partnerships that could be fostered with Spanish institutions as detrimental for the territory.

Figure 29: Tree Map, Hierarchy Graph on HEIs Specific Problems in the Region



Source: Own Elaboration

Another fundamental problem in the regions is the **educational offer** (15,4%). The Lisbon FG did not raise this as a problem. The region that referred the most to this problem, indeed, was **Alentejo** which, according to the participants, is an uncompetitive region in terms of research contracts and doctoral scholarships in some areas, such as Information Technology, where regional HEIs cannot train enough students to meet business needs, there is an insufficient use of the region's distinctive resources for training provision and a poor communication of outstanding educational offer in the region (such as the agrarian and veterinary sciences). The region of **Azores** considers that the national university offer is not very competitive and this limits the attraction of students in the region, while there is also a low level of training that makes students opt for other national HEIs, together with the fact that there are students with various gaps in personal and educational development, behaviour and attitude. **Centro** mentions an inadequacy of the training offered by HEIs to address the needs

of the territory and the fact that the provision of HEI services must have a differentiated value in terms of knowledge, compared to what regional companies can offer, even with the risk of distorting the functioning of the market and preventing the creation or strengthening of companies in advanced domains. **Algarve** highlights that research fellowship value is below market value in various sectors (such as IT) and that there is a university's excessive focus on attracting undergraduate students to the detriment of research and extension (which have chronic shortages of resources). Finally, **Madeira** considers that the change in the scholarship statute, which, although important, does not look at regional specificities and realities (in the case of Madeira there is no possibility of transit), is an evident issue, while in the **Norte** there is a mismatch between graduate supply and business demand.

Another problem related to connection is between **researchers and S3** (12,1%). Neither Algarve nor Alentejo mentioned any difficulties in this dimension. **Azores** was the region with more inputs here, namely: the rigidity of the priority domains, which means that there are areas of research that cannot find alignment; the research career that has never been aligned with market needs and, although S3 seeks to reverse this trend, it still persists as one of the biggest difficulties, while at the same time key projects for the region do not get funding, even when they are aligned; and the need to distort some scientific areas in order for the scientific community to adapt to the priorities of S3. **Centro** considers that S3 was understood essentially as a mechanism for accessing the FEEI but it was not absorbed by the organisational culture, or even less was it valued by researchers/teachers, in fact there is still a lot of work to be done in communicating S3 within HEIs which, although it has largely moved to the top agenda, it has not been incorporated in any measure by intermediate levels of decision**. Lisbon** mentions that actors found it difficult to mobilise around regional S3 priorities and that favouring crossings domains does not seem to have been adequate because, in relation to priorities, it may have reduced the capacity of HEIs to intervene. **Madeira** highlights that the specialisation index is higher in some areas than others, precisely because there is more research in these specific areas, and that is easy for any project to achieve alignment with S3 due to the presence of many domains. Finally, **Norte** considers that S3 domains did not reflect the existing research capacity.

The **incipience of the structures** (12,1%) was also a factor considered problematic for the Azores, Alentejo, Algarve, Madeira and Lisbon regions. The **Algarve** was the region that listed most problems, namely: the fact that R&D centres and dynamics are institutionally fragile and poorly consolidated in their research routines; how the internal organisation of the university reveals a lack of resources related to knowledge transfer and valorisation; the issue that project leadership skills are missing, due to the limited capacity of project preparation support services; and the excessive burden of project organisational and administrative tasks on research staff. **Alentejo** considers that there is: a poor management in the way regional HEIs have been working with small businesses; accountability around institutional inertia (the idea of a vicious cycle of non-action for lack of resources and vice versa); and also gaps in the ability to take on project leadership. **Azores** consider that, at the level of knowledge transfer, the University of the Azores is at a disadvantage vis-à-vis the region's S&T parks because it has only recently started this process and relies exclusively on its own investment, along with the incipience of incubation structures of the University of the Azores. **Lisbon's** participants maintain that the academic community in general does not know or understand what S3 is and **Madeira** stresses the lack of preparation and organisational culture within UMa to turn funding into results.

Another recurring difficulty was the **attraction and retention of talent** (10,9%). This was a problem identified by all regions, even if less emphasised in Lisbon and Centro. **Azores** considers that they have a poor ability to attract students and the low levels of training provision in the region make students opt for other national HEIs. **Alentejo** also highlights this difficulty in retaining students and a lack of critical mass. **Norte** considers that there is a little use of non-traditional students and a difficulty in attracting/retaining talent because there is no competition between HEIs and therefore values are not competitive**. Algarve's** participants mention a shortage of undergraduate students, which causes recruitment shortfall in postgraduate education and early career fellowship recruitment, while **Madeira** refers to the lack of critical mass within HEIs themselves as one of the main problems that leads to a set of other limitations, such as in the generation of knowledge to be absorbed by society.

Then, we have problems regarding **interface institutions** (8,7%). In the case of **Azores,** problems concern the weak Regional Government support towards the University of Azores as a regional development hub, the failures in the University's disclosure of research produced that may be of interest to the market, and the fact that NONAGON (as an ideal interface entity) is unsuccessful in the knowledge generation component. Participants from **Centro** refer to a capacity gap of technology transfer technicians (or other innovation intermediaries), despite examples of excellence, while Lisbon instead refers to the difficulty for HEIs to mobilise

companies for these types of projects (due to little financial incentive and excessive bureaucratic burden) and **Norte** stresses the difficulty in translating research for market's purposes. **Madeira** considers that the main limitations are related with business knowledge about the access to funds, which is limited, and the burden of work that falls on the university or on a small number of researchers, together with the fact that there is no knowledge management and transfer office.

Regarding **equipment and infrastructure** (7,7%), the region of **Azores** mentions the loss of equipment at the University, the inaccessibility of this equipment to the community, and the lack of laboratory technicians that make the teachers, who use these facilities, loose useful time in the management and maintenance of the equipment itself. **Alentejo** considers the energy failure of HEI buildings (when there is an educational offer directly related to energy efficiency) and the difficulty in the access to research equipment and infrastructures as most relevant. Participants from **Algarve** state that a lot of research is not carried out because of a lack of resources (e.g. archaeology), which limits opportunities for innovative product creation (e.g. new historical narratives for new tourism products). Finally, **Lisbon** highlights that scientific infrastructures are becoming obsolete.

The problems categorised as **Ops** (5,5%) are those related to the way the OPs are structured. For the **Azores** region, the main problem is that the financing of Operational Programmes do not allow to reequip the university, as well as to modernise it and, above all, there is the matter of the particular condition of the University of the Azores in the access to finance – in fact, it is a university that is under the responsibility of the central government and therefore cannot operate under the OP Azores but is otherwise based in the Azores and therefore unable to access none of the other regional OPs. For **Lisbon**'s participants, the funding of the OP was very difficult to access when compared to European programmes, while they also consider that the support from ESIF is not strategic for HEIs.

HEIs' own **strategies** (4,4%) are mentioned as potentially problematic in the Algarve, Centro and Madeira. For **Algarve,** it is because the university lacks a true articulated strategy for valuing knowledge and technological services to companies. For **Centro,** the problem referred is the misalignment of the institutional strategies of several HEIs with the regional strategy and the lack of temporal continuity of HEI strategies. For **Madeira,** there are failures in how the region communicates and sells the offer of the University of Madeira. Finally, regarding the **PhD and Business** (3,3%), **Azores** considers that there is a limited number of doctorates and PhD fellows in the business context and **Norte**'s participants also agree that there are few doctorates in companies - because companies do not perceive potential capital gains. **Madeira** also stresses the need for a greater inclusion of HEI people in company boards.

6.3 Measures

Participants were asked to identify specific measures to resolve the identified problems. The answers given by the participants were codified in transversal measures (42,2%) and in specific measures for the regions (57,8%), similar to the analysis of problems. To give an overview, measures for the country (Figure 30) are analysed first.

6.3.1 *For the Country*

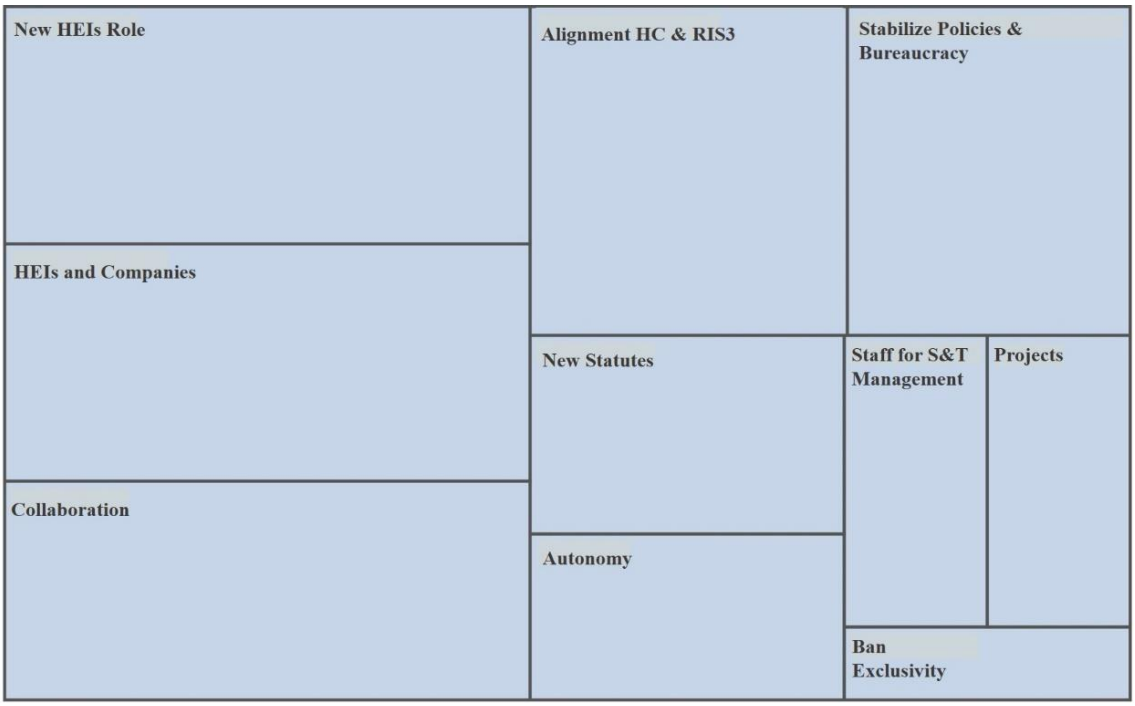
Among all the measures identified by the participants, one of the most categorised set of proposals was the need for a new vision and a **new role for Portuguese higher education institutions** (16%). The proposals classified in this dimension were: reinvent HEIs at the national level; change the role of the professors and the way they teach by stimulating cooperation between students and focusing on the experience; develop a programme for valuing and sharing pedagogical innovation practices in HEIs in S3 domains; structure a training programme for S3 (Government of IES-Faculty-Students); promote HEIs as sources of differentiating factors for companies in the region; think new audiences for HEIs; clarify the expected role of HEIs in S3; implement industry attractiveness programmes for young people (valuing professions); address issues of attractiveness of HEIs (career, precariousness, scholarship values and contracts); carry out government programme contracts with HEI linked to S3 targets; introduce new methodologies (pedagogical innovation) in HEIs appropriate to S3 priority areas; and conduct HEIs Forum for Transformation in the Region.

The need to bring **HEIs closer to companies (**16%) received the same number of codified references. The following suggestions are placed in this dimension: use the equipment and services of companies to offer training in order to foster collaboration and proximity between students and enterprises; create new funding mechanisms for SMEs to leverage and enter the scientific system; discuss payment models for HEI concerning

the private component of projects co-financed by ESI Funds; identify HEI interlocutors for the regional employers and create interlocutors in SMEs for HEIs; reinforce the doctoral scholarships programme for companies in the S3 domains; create moments and places for students to connect with the business fabric; build in-company training programmes; and conduct prospective analysis of the needs of companies by HEIs.

There is then a set of proposals related to **collaboration** (14,7%), which was also one of the dimensions most shared by the participants, namely: bring together policymakers and researchers; change the mindset from individualism to cooperation; foster the culture of innovation; implement structures and spaces for (interinstitutional) co-creation and innovation; support university-company missions and visit programmes between different sub-regions; create twinning/pairing programmes between European regions with strong complementarities for each regional S3; articulate synergies between projects and funds; explore HEIs as network creators; establish quadruple helix articulation instruments that transcend (normal) knowledge transfer mechanisms; form an ENEI matrix structure that can allow interregional projects between HEIs; and create intersectoral network for IES staff exchange in S3 priorities.

Figure 30: Tree Map, Hierarchy Graph on Measures for the Country



Source: Own Elaboration

In the same connection logic, the most codified category is the **alignment between human capital and S3** (13,3%), namely through: fostering a greater alignment between human capital/training provision and S3 priorities and regional demand; including students in research; acting in a preventative way to create transversal areas adapted to the labour market - soft skills and personal development; supporting educational initiatives linked to the S3 priorities for the development of necessary skills in students; implementing skills training programmes in S3 areas; establishing professional and technological training linked to S3; improving the complementarities between soft and hard competencies (which have very rapid obsolescence); carrying out government programme contracts with HEIs linked to S3 targets; funding year zero of HEIs in priority S3 training areas; and involving training and education entities (schools, colleges, departments) in the S3 process (reducing focus on R&D units).

Another domain also important for the participants is the **reduction of bureaucracy and the stabilisation of policies** (12%), namely: balance 21st-century instability/mobility contours and stabilise frameworks to increase investment; change the culture of error by eliminating the resulting stream of discrimination, even from the OP; ensure continuity of funding cycles; understand the prior knowledge needed to align S3 with public policies to be implemented in the coming years (both at European and national level); carry out a policy alignment exercise before redefining priority areas; make the need for strategy assessment able to allow for building on the basis of continuous improvement rather than on the instability and permanent change of the

frameworks; stabilise programmes and make scheduling more serious; reduce bureaucratic burden on projects; and introduce "competences for regional transformation" dimension into S3 review.

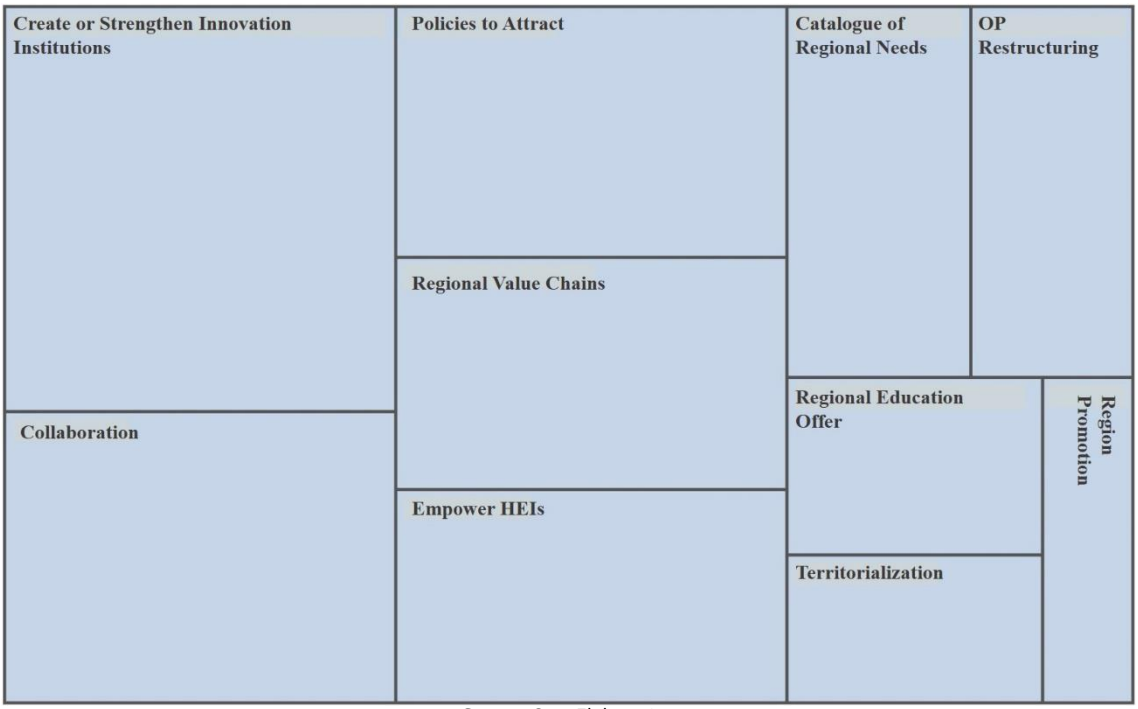
Then we have a dimension that is less codified but is extremely important because it was shared and much discussed in all focus groups. This dimension refers to the need for **new statutes** (8%) and evaluation metrics for the teaching and research career. These were the proposals of the participants: 'decriminalise' the researcher and create a new statute with clear rules on what is and is not allowed, in collaboration with companies and other institutions; frame parallel careers in research, teaching and management within HEI policy; promote the integration of teaching and research staff that favours the articulation with companies and society within performance assessment; organise an action plan about valuing scientific employment, reducing precariousness and attracting talent; promote a wide debate on academic staff evaluation and ways of valuing the participation of this type of transformative activities; and establish the evaluation of programmes by A3ES that should take into account regional specialisations. There is also a dimension that could be associated with this and that has to do with **banning exclusivity (**2,6%) in scholarship and faculty regulations.

Participants also consider important to bring more **autonomy** (6,6%) to HEIs, namely allowing HEIs to directly manage some calls and decentralise the governance to HEIs, but it should not detach public actors from implementing the strategy. Participants evoke the need for personnel with **specific training in science and technology management** (5,3%), more precisely, for the support in hiring highly qualified HR for project development in S3 priority domains and in the professionalisation of education and innovation support services, together with the employment of professional staff to maintain equipment and laboratories, and funding for requalification and professional reorientation. The issue of **projects** (5,3%) was also mentioned, namely, in the aspect of financing regional anchor projects, that are mobilisers of a larger dimension, thus demonstrating the desired transformation with S3 in the different priorities and increasing the size and duration of supported projects.

6.3.2 *For the Region*

There were regional measures (57,8%) that were possible to group into categories (Figure 31). These results are now presented, mentioning the most coded categories, which regions identified them and how.

Figure 31: Hierarchy Graph on Measures for the Region



Source: Own Elaboration

The most codified category is related to the **creation or strengthening of innovation institutions** (20,2%). All regions suggested some measures in this dimension. **Azores** proposed the creation of an agreement between the University of Azores and NONAGON, the consolidation of the role of Regional Government as an intermediary and facilitator between the university-business interface, the engagement of the regional

government to find solutions to specific problems that impede the transfer of knowledge and technology to businesses, and the shift from an oppositional paradigm towards the creation of an innovation ecosystem. **Alentejo** considers important to ensure the articulation of research entities for small-scale transfer and consolidate and formalise the SRTT - Regional Technology Transfer System. **Algarve's** participants defend the creation of a centralised equipment management unit at the university (TCF - Technological Core Facilities) in domains where the university already has equipment and demand (such as biotechnological analysis of water, salt, plastics), the creation of a think-tank at the university to discuss trends and areas in which the university should focus on medium to long term research and transfer, and the promotion of the internationalisation of innovation in the Algarve with the support of the existing innovation intermediaries or the creation of an entity implemented for this very same purpose (regional innovation agency). **Madeira** highlights: the creation of a Valorisation Centre to harness technological knowledge for economic and social purposes and ensure that this knowledge is translated into products, services, processes and new businesses; the creation of Digital Innovation Hubs in the areas that will be effectively prioritised; the institution of the broker figure (someone who earns a success fee for each successful transfer); a regional political support mechanisms for the University of Madeira's research groups, that is a specific innovation secretariat to bring together and guide innovation produced in the region; and the reactivation of the Regional Innovation Council. **Norte** considers important to enhance co-location spaces for R&D centres-companies, to create programme contracts for innovation infrastructures, that is an intermediary body for S&T + I promotion and the evaluation in the region, and to implement living-labs. For **Centro** is also important to constitute a shared model of resources (including human resources) for regional innovation dynamisation, including the transfer and valorisation of HEI knowledge, while for **Lisbon** the organisation of the regional ecosystem with platforms and participatory governance is crucial.

The issue of **collaboration** was again highlighted (14,4%), this time as possible solution. For the **Azores,** this has to do with the communication between regional entities, the delimitation of responsibilities for increasing institutional resilience, and the creation of stronger contact networks that can be enhanced and facilitated by the size of the region. For **Alentejo,** the most important measures in this dimension are: enhance networks between HEIs; foster cooperation between companies to share the cost of university services; empower and allow partnerships for the acquisition of equipment between different projects where the same institution is beneficiary; foster links with Spain; and create a weekly air connection between Beja and Porto. **Norte** proposes to boost co-creation with business and civil society, a regional intersectoral network for training provision related to S3 and an improvement of the Euroregion Norte-Galicia through dedicated funding for S3 activities. For **Madeira,** it is important to empower the university's regional networking, so that they do not depend on the specific contacts of a set of researchers, and to map equipment and technology infrastructures while fostering their collaborative use, both between research groups and between university and businesses. The **Algarve** highlights the importance of encouraging collaborative networks and other collective initiatives (laboratories) to generate university-enterprise projects, for example in the context of the S3 governance model, while **Centro** underlines the need to foster an interinstitutional collaboration framework.

Participants also highlighted the need for a set of **policies to attract** (12,5%) both talent and companies. The **Alentejo** was the region that suggested the highest number of measures in this dimension, namely: increase salary attractiveness; reintroduce the interior subsidy (which paid 30% more for teachers coming to the region) to attract talent; reduce the real tax burden with proven impact on inland regions, not only to attract people but to attract businesses; conduct in-depth study of the conditions required for people to choose to reside in the region; create qualified and attractive employment opportunities; encourage specific support for the establishment of large companies in the region; and establish mechanisms to ensure that human resources in the region are effective (such as a daily attendance monitoring system). Following, **Madeira** considers important to: create or hire HR specialised in knowledge transfer and technology; hire internationally-renowned or full-time Professors to act as 'anchor teachers' and increase the appeal of students and researchers; hire specialised HR in the priority areas; and increase attractiveness for the establishment of investment-capable companies. **Lisbon** proposes to promote the attraction of companies and talent with S3, bypassing the bias of S3 for resources that are already in the region, while **Norte** suggests training as a way to attract resources to the territory.

Also important are **regional value chains** (11,5%). For the **Azores,** this implies establishing production fields for the manufacture of endemic plants and fruits to generate value, working on short circuits, fostering industrial symbiosis to ensure the reuse and transformation of waste into resources, and ensuring investment in energy efficiency**. Madeira** considers important to: decrease the number of the priority areas; create an INTERREG RUP (Ultraperipheral Regions); foster related variety and synergies between tourism and energy efficiency, so as to reduce the carbon footprint of tourism activities; enhance the products of energy efficiency

companies and also those related to the variety and synergies between tourism and local production, in order to promote a 'return to land' and to value regional products; raise the level of energy and food self-sufficiency to reduce the costs of insularity; and support the circular economy. **Algarve's** participants proposed to align technological platforms with industry in consolidated areas of the university, as it happened in the past with the Golf industry, while **Lisbon** pointed out at strengthening the link between the EIT Knowledge and Innovation Communities and S3.

Regarding the **empowerment of HEIs** (10,6%), **Centro** highlights the implementation of an internal mobility programme for teaching staff among HEIs and the renewal of scientific equipment in S3 domains. **Lisbon** considers important to empower HEIs for liaison/transfer and knowledge enhancement activities, communicate and mobilise actors in HEIs for the transformation of the region, and create spaces for co-discovery and co-creation. **Madeira** proposes a focus on the dissemination of the university's research groups to enable their continuity and increase their visibility, success, and project leadership capacity. **Norte** considers important a holistic approach to articulate different types of resources and instruments, the knowledge transfer through the displacement of people to industry and the creation of pilot initiatives for regional transformation. For the **Azores**, it is crucial to invest in equipment that can distinguish the characteristics of university education from secondary education.

Another analysed dimension was the need to create a **catalogue of regional needs** (8,7%). For **Alentejo,** this must be done through learning to work more effectively with businesses in the region, thus recognising the know-how of SMEs. **Azores** propose to create a skills catalogue of business needs. **Centro**, instead, suggests a prospective assessment of training needs and an articulated training plan of the HEIs for an adequate response. **Madeira** advises to create a collaborative structure to map the knowledge produced at the university (which is scattered), map the needs of the territory and find synergies. Finally, **Norte** recommends to articulate, in particular in polytechnic institutes, graduate training (2nd and 3rd cycle with business interests).

The participants also identified a set of measures that seek to resolve limitations in the **OP** (7,7%). Nevertheless, the only regions to identify this dimension were the autonomous regions of Madeira and the Azores. The case of the **Azores** is particularly important and proposes the following measures: a need for OPs to provide the possibility for funding to retrofit the university; provide the University of the Azores with a portion of the Regional Government to allow access to funds; improve the access of the University of the Azores to the funds in order to bring it on an equal foot with other national HEIs; simplify the processes/mechanisms for applying to the OP; and return to invest in fundamental knowledge for the subsequent generation of more knowledge. For **Madeira,** it is important to rethink the strategy assessment indicators, and especially the impact assessment indicators for each area and priority area, increase recognition and appreciation of the importance of RIS3 in Operational Programmes and make the allocation of ESIF conditional on actual alignment with S3.

Participants from the Azores also consider that the **regional educational offer** (5,8%) should be more aligned with regional needs. In particular: specialise the educational offer in areas where the **Azores** are, in fact, competitive; create an educational offer that harnesses the potential of the region (for example, the biology course has a strong diving component), in order to enhance its value and competitiveness at national level; create a list of equipment and skills that students from each course can access, in the 2nd and 3rd cycle, to increase tuition fees; improve the mentoring culture for graduates to expand their learning in the job market; adapt existing skills to the needs of the region; and design post graduations with companies to serve market needs.

Proposals to **promote the region** (3,8%) **included**: for the **Algarve**, to create, in cooperation with the RTA and the university, actions to externally promote the Algarve as a region to be visited, but also to do research and innovate (place of employment and investment); for **Norte**, the creation of representation in Brussels and its HEIs, as well as an internationalisation programme for research on S3 priorities; and for **Alentejo**, knowing how to "sell" the quality of life of the region and the proximity to Lisbon. Finally, some proposals for **decentralisation** and **territorialisation** were presented. **Alentejo** proposes to create mechanisms for CCDRs to manage regional R&I funds. **Centro** considers important to encourage entrepreneurial discovery processes (for example, co-laboratories) in a local setting and a regional mobilisation programme for business associations and HEIs around S3 design. **Lisbon** participants say that EREI review should focus on territorially anchored priorities and **Norte** suggests a S3 "territorialisation" (4,8%) programme with EDP and local creative laboratories.

The focus groups consolidated and extended the results of the interviews. On the one hand, there is a set of contextual problems mostly related to S3 design and the existing lack of connections between actors. On the

other hand, there are specific problems of HEIs, mainly related to the fragile and tenuous relationship between the academic and business context and the excessive bureaucracy. The proposed measures are essentially focused on solving these problems. At the regional level, there is clearly a gap between the most technology-intensive regions, with more internationally competitive HEIs, a stronger economic fabric and over-specialised regions, a more fragile demographic structures and less presence of HEIs in their territory. The case of the Azores is a case that deserves particular attention due to the difficulty of the university accessing the ESIF, which puts the region in a fragile situation.

7. Results from the post-project workshop

The workshop held online to discuss the results of the project (participants had been sent a copy of the draft executive summary) underlined how the importance of improving the overall smart specialisation framework is necessary if HEIs are to be more effectively mobilised. Some of the main points from this discussion include the following statements:

- There are insufficient collaboration dynamics at institutional, regional and national level.
- Regions, which are the focus of the debate, should care more about their supra-regional connections because smart specialisation at the level of each region can be more effective with a strategy of inter-regional cooperation.
- Weaknesses in exploiting inter-regional interactions, even by the regions with more developed interactions of this kind, have a lot of space for improving and growing.
- It is crucial to optimise the access and use of infrastructures and bet on their potential also outside the region.
- Business attractiveness has improved in the past ten years, even if there is still much left to do.
- There continues to be issues of (mis-)trust between S3 actors, as they tend to represent an official position and are afraid of exposing themselves.
- S3 ambivalence, on the one hand, of suggesting more specified and focused choices but, on the other hand, of being not able to select specificities as it considers almost everything as relevant and wants flexibility.
- Bureaucracy continues to have high transactional costs.
- Lack of alignment between macro-planning and national and regional institutions.
- A linear model of innovation still dominates policy-making.
- Different capabilities for smart specialisation within the country prevent success of key investments in regions with limited critical mass.
- Portugal has no system to permit effective knowledge acceleration, thus being incapable of creating an entrepreneurial ecosystem.

In relation to issues surrounding the involvement of HEIs, the main points from the discussion were:

- Professors and researchers that choose exclusivity have difficulties in reconciling with extension activities.
- HEIs should be civic institutions that care about the territory and sustainability, becoming more and more relevant, and demonstrating an alignment with regional S3.
- HEIs are important not only in the research and training but also in the creation of a critical mass and in its interaction with the society.
- HEIs should be deeply involved in entrepreneurial discovery process.
- HEIs are more or less significant actors and play different roles according to the type of priority, if it is more consolidated or emergent. In emergent priorities, the role of HEIs is even more important.
- They have a role in constructing related variety, mapping innovation potentialities and understanding how it is possible to use them.
- They have a fundamental role in the re-utilisation of knowledge and not only in its production, a 'monitoring perspective', that is understanding how to foresee the needs of the market at national and regional level.
- They need to combine the technological component with the social sciences to build strategies related with the specialisation profiles of the country and regions.
- They have territorial permeability and are easier to mobilise than firms, thus being able to mobilise other actors towards entrepreneurial discovery.

- They have a decisive role for a faster/slower and/or better/worse implementation of the S3 even if, until now, they had a marginal part in the management and in the influence on the governance bodies that supervise the funds and S3.
- They have the capacity to look for territorial specificities and create local articulation.
- They have a vital role in monitoring S3.
- There is a role for the HEIs also in digital and economic transformation, thus underlining the need for a consistent incentive to universities to train human resources.
- The HE system was resilient to respond to the challenges that increase over time, for example, with the huge budgetary constraints after the 2007/2008 crisis.
- There is a deep cooperative behaviour between HEIs that transcends any competitive logics.
- Internationalisation of S3 depends on HEI interaction at global level.

Given that the case study ended during the Covid-19 pandemic, there was an opportunity to discuss issues that have arisen related to S3 and HEIs. Participants referred to the following main points:

- The pandemic causes confusion and this is reflected into the economy, all actors and domains.
- The pandemic could negatively affect the attractiveness and retention of talent, in particular from HEIs.
- Even the most technological companies will follow, even more intensively, short-run logics while they should have a long-term perspective.
- S3 lost its momentum with the pandemic, after the 2019's increase in speed and intensity. Mobilisation of stakeholders will be more difficult.
- HEIs are absolutely crucial to manage and find solutions to Covid-related issues.

8. Conclusions

Smart specialisation is deeply associated with the capacity for change and this case study has added extra weight to the argument that HEIs play a big part in the construction of such capacity in their territories. On the one hand, this concerns the integration of the regional element into their core missions of education and research but, on the other hand, it relates to their willingness to work in partnership with regional authorities to implement S3. The detailed and insightful comments during the action research also show that Portuguese HEIs, or at least the representatives that participated, are knowledgeable about S3 and the regional dynamics.

In less developed regions, civic and engaged HEIs can have an even more decisive role in animating the dynamics of innovation. However, they are also confronted with greater challenges. To be effective - as sources of knowledge, education and training providers, service suppliers and knowledge-intensive infrastructures, local connectors with knowledge and external markets - HEIs face several internal and external challenges.

An important challenge concerns the pressure on HEI finances. Other relevant challenges are related to the risk of fragmentation and incompatibility between the university and the local economic fabric, the existing institutional thinness so that HEIs are often part of the dependencies of the regional path, and the inadequate assessments and incentives to academic staff related to activities regarding knowledge transfer and local engagement.

Table 17: Summary of limitations and proposed measures for increasing HEI involvement in S3

Limitation	**Measures**
External to HEIs	
Regional asymmetries not addressed through place-based policies	**Consolidate a continuous regionally embedded entrepreneurial discovery process to better define priorities and policy mixes** **Focus regional OP related innovation funds in Transformative activities anchored in R&D with clear territorial impact**
Lack of innovation culture and collaboration	**Stimulate ecosystem services, in particular though the financing of dedicated teams in innovation bodies to support the development and animation/orchestration of collaborative transformative activities** **Support the creation of anchor projects for the consolidation of regional transformation networks**
Excessive bureaucracy of ESIF	**Implement ongoing initiatives for simplification of processes**
Lost momentum in S3 regional engagement	**Give new assertive steps, namely in the operationalisation of EDP, for example, with platforms defining calls and monitoring tools**
Internal to the HEI	
Difficulties to increase limited financial resources	**Create new medium-term schemes for HEIs financing based in transformative project achievements**
Attraction and retention of talent	**Programmes to stimulate professors and researchers with transformative projects (not necessarily only research based, can be educational)** **Programme to contract highly specialised staff to support transformational activities**
Evaluation	**Articulate at the level of CCISP and CRUP guidelines for the evaluation of teaching and research staff (and measures to implement it both in evaluation and selection processes).**
Skills do not fulfil S3 transformation requirements	**Stimulate new forms of education and training through pedagogical innovation** **Stimulate a new programme of PhDs for society (to be developed in firms and other organisations)**

The relationship between HEIs and S3 presents several challenges that were verified both in the interviews and in the FG: lack of entrepreneurial culture, lack of articulation between OPs and between agents, lack of common understanding about what S3 is, excessive bureaucracy, relationship difficulties between academia and companies, exclusive status and a career evaluation that puts many barriers to this cooperation.

A major problem for S3 is the qualitative leap that remains to be made, from identifying priority domains to building transformative activities that generate a related variety. Here, HEIs play a fundamental role and are the privileged actor to teach and guide this process in the regions - with the knowledge they produce and the critical mass they have.

However, the HESS project not only identifies many of these internal and external problems but also recognises the types of measures, transversal (national) and localised, which can help to reinforce the role of HEIs in implementing the transformative and ambitious agenda that smart specialisation presupposes. Table 17 summaries these limitations and measures.

The hardest part is of course how to incorporate measures into effective policies. On the one hand the case study has added weight to the calls for a more decentralised approach to policy making in Portugal, which would help design place-based approaches to innovation and higher education. The key to such policies that respect national parameters with local needs is to implement an effective system of multi-level governance, including for smart specialisation; a system that was designed in the national strategy but never implemented. Place based policies are by definition not sectoral and indeed require intervention from across the policy spectrum to achieve required results, such as the need for investments in the business environment and quality of life to attract talent to HEIs in Portugal's interior.

In terms of the ESIF, it appears that new and complementary instruments are needed to strengthen regional ecosystems, rather than investments only in research and education. The Portuguese government needs to find a way to support innovation intermediaries than span boundaries between higher education and the private sector, operating at a local and regional level.

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Annex 1: Focus Group Participants

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