Knowledge ecosystems in the new ERA

A monitoring methodology on institutional change in the area of R&I at universities in Europe

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Knowledge ecosystems in the new ERA - A monitoring methodology on institutional change in the area of R&I at universities in Europe

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A monitoring methodology on institutional change in the area of R&I at universities in Europe

Authors:

Technopolis Group: Florian Berger, Lisa Nieth, Maria Stalla

INCENTiM (KU Leuven): Julie Callaert, Caro Vereyen

Leiden University: Inge van der Weijden, Alfredo Yegros

technopolis
group

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EXECUTIVE SUMMARY

Rapid transformations in society and consequently in **research and innovation (R&I)** affect individuals, institutions, their interactions, and the whole R&I system. **Higher education institutions** (HEIs) are central within this system as they create and transfer knowledge fundamental for R&I processes. Considering the societal and systemic changes taking place, HEIs are facing pressures to transform their institutions in order to meet the new challenges and react to the transforming R&I system. In the context of understanding the current changes and challenges as well as supporting HEIs on their transformational paths, the European Commission has defined six areas in which **institutional transformations** in research and innovation activities among HEIs should be encouraged. These so-called "transformation modules" (TMs) range from capacity sharing and human capital development to collaboration with industry, open science, and citizen involvement. The European Commission is also acknowledging that transformation in the HEI sector needs to be accompanied by an evidence-based process to analyse the status quo of transformation in HEIs and define potential actions on this basis - by universities themselves or by policymakers.

The following report outlines the results of work commissioned by DG RTD and executed in the second half of 2021. The research was carried out as one work package of a larger project on knowledge ecosystems in the new ERA. It aimed at developing a **monitoring methodology** to keep track of progress HEIs have made within each of the **six transformation modules**. As existing HEI rankings and publicly available data on HEIs largely do not cover the aspects of institutional transformation and the specifics defined in the Commission's concept of the transformation modules, the presented methodology is based on newly designed indicators identified for each area and aligned with the themes described in each transformation modules. Since the topics covered in the transformation modules are, however, also cross-cutting in nature, the indicators are thematically linked and need to be considered as a whole.

TM 1, covering the development and implementation of individual and multi-stakeholder **R&I strategies**, roadmaps, and action plans, was translated into 13 indicators. TM 2 thematises the opening of **infrastructures** and resources to external HEIs or research organisations (6 indicators). TM 3 addresses **human capital** in higher education, covering topics such as HR strategies, gender and equality issues, career development, internationalisation, and research assessment (13 indicators). Reinforcing R&I **cooperation** with other sectors is the focus of TM4, addressing the engagement with existing and new partners, enabling staff for engagement and opening doors to potential future careers outside academia (10 indicators). In TM5 **open science** aspects such as open access, data management and open collaboration practices are considered via 7 indicators. Finally, TM6 covers the **inclusion of citizens**, civil society and public authorities in R&I processes (10 indicators).

All indicators were co-created together with representatives from European University Alliances[1] in dedicated workshops in September 2021. Three transformation modules and the respective 29 indicators were furthermore concretely tested via an **online survey** directed at 124 HEIs of the first generation of the Alliances. The results of the testing showed that the overall methodology is suitable, with minor changes regarding the approach, the survey, and the indicators.

Finally, the report outlines a concept for a **dashboard** visualising the developments of (institutional) transformation in the areas of R&I at universities in Europe. This dashboard could become an important tool for visualising, comparing, and monitoring transformation progresses of individual HEIs and groups of HEIs (filtering by types of HEIs, home countries

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[1] In this report, we will refer to the European Universities Alliances as «Alliances».

or regions, etc.). The main users of such a tool could be policymakers, HEIs, and the general public, using the tool according to their individual needs such as:

- Stock-tacking of institutional arrangements, of institutional progress/transformation and outcomes of transformation processes of (groups of) universities regarding different transformation areas (status quo and changes over time),

- defining the needs of individuals and institutions in order to define priorities for further transformational efforts,

- defining what national/regional policies and funding instruments may be needed to maximise institutional transformation.

1 Introduction

The present report is the final Policy Report for Work Package 5, prepared as part of the study Technopolis Group and its partners are conducting on "**Knowledge Ecosystems in the new European Research Area (ERA)**" on behalf of the European Commission. Work package 5 shifts the project focus to **universities and research organisations**, being highly important actors at the core of knowledge ecosystems.

The report represents the **final deliverable** of **Work Package 5**, combing the diverse subtasks into one coherent storyline. Table **1** matches the subtasks and objectives with the chapters of this policy report. Accordingly, the report outlines the developed methodology and respective indicators (Chapter 3), the testing of the indicators through a survey with the first generation of European University Alliances (Chapter 4) and, finally, the conceptual development of a data dashboard (Chapter 5).

Table 1   Objectives of the work package and coverage in this report

Tasks & objectives of WP5	Chapter
5.1: Develop an indicator-based methodology that allows monitoring the progress of higher education institutions (HEIs) in Europe regarding the transformation modules	0 & 4
5.2: Focused testing of the monitoring methodology with the 1st generation of European Universities Alliances	5
5.3: Develop a basic approach / concept on visualising the indicators within a dashboard	6

Methodologically, the Work Package benefitted from a review of relevant literature to situate the task and streamline the understanding of the transformation modules/areas. Existent surveys, data collection methods, and indicators within the HEI sector were reviewed and matched with the transformation areas to understand if existent data can be used to measure institutional progress. The WP also included two half-day co-creation workshops with representatives of the European Universities Alliances in order to discuss the indicators with the respective stakeholder group (HEIs). These workshops as well as the participation in various online events provided further input to contextualize the transformation areas and respective indicators. Finally, the proposed indicators of three transformation areas were tested through an online survey. The results of the survey were used twofold: (i) to analyse the institutional change levels of the respective universities and (ii) to improve the overall methodology.

2 Background: Higher education institutions in transformation

Research and innovation (R&I) systems of our time are facing extensive, all-embracing changes and transitions due to the rise of **new (societal) challenges** (climate change, pandemics, demographic changes, etc.).[2] Different actors/institutions within the R&I system play a crucial role in developing new ways to react to and counteract those challenges. Topics such as digitalisation, globalisation and trans- or multidisciplinary have quickly come to be seen as central aspects that R&I institutions need to consider.

Higher education institutions are essential as knowledge creators and distributors within the R&I systems and thus also within the European Research Area (ERA), which aims to create a "single, borderless market for research, innovation and technology across the EU".[3] Thus, HEIs see themselves confronted with a new reality that questions their current, "standard" way of functioning. Teaching as well as research and innovation activities are more and more expected to think along the lines of these all-embracing challenges and transitions.[4] This development goes hand in hand with the engagement

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[2] See https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges
[3] EC, 2021a
[4] Although both areas - education and R&I – are likewise affected by the mentioned changes, this project/report focuses predominantly on the R&I side of changes within HEIs.

with new types of stakeholders, crossing (physical and digital) borders, searching and finding for new ways of translating (scientific) knowledge into practice and including the society in this transformation – just to name a few.

The entire **R&I cycle of HEIs** is affected. From the way knowledge is created (for instance in interaction with the society), to the way knowledge is managed and distributed (digitally, in diverse languages, crossing countries and nations) to the way knowledge is translated (new entrepreneurial actors have appeared) further on to the way knowledge is – or is not – accepted by society. Departing on these diverse transformation pathways, HEIs are furthermore confronted with the need to strike the balance between competing internationally while also cooperating and networking with each other as well as with external stakeholders. Standing alone against today's challenges is no longer an option.

The above-outlined challenges and changes trigger the need for **internal, institutional changes** within HEIS. Aspects such as the appearance of new work environments (e.g. new scientific disciplines, "spaces" to research and innovate outside academia), new ways to work for researchers (e.g. publishing in open access journals or innovating hand in hand with citizens), and new ways of evaluating work all call for institutional changes within HEIs. Although HEIs across Europe are very diverse - and therefore the starting point of transformation, as well as the levels of transformation needed, are very different – overall, institutional transformation is necessary. This transformation will happen in different areas and at different stages of the R&I cycle but needs to take into account the autonomy and diversity of HEIs. Thus, for transformation to happen successfully, universities cannot be left alone and are in need of (public) support in their efforts towards this new future.

This need for change has also been taken up by policymakers on a national and international scale. The European Commission is taking up the mentioned changes and challenges faced by HEIs within the development of the **European Strategy for Universities** (ES4U), which was presented in January 2022[5]. This strategy aims at supporting and enabling universities to adapt to changing conditions, to thrive and to contribute to Europe's resilience and recovery. Also, the ES4U is to be translated into concrete actions through activities, which are to orient HEIs in their transformation and create synergies between the diverse national and international programs/policies. The development of the ES4U is taking place in the context of the European Research Area (ERA), the European Education Area (EEA) and the European Higher Education Area (EHEA).

The outlined challenges and resultant need for transformation can be observed in different (thematic) areas of HEIs. Within the R&I dimension, the EC[6] has combined these areas/themes in **six areas/modules for institutional transformation**[7] (TMs, see Figure 1), which will be introduced in detail in Section 4. Correspondingly, HEIs have to undergo significant institutional changes in these six areas in order to be able to counteract the new challenges and enable HEIs to become the future universities envisioned in the ES4U. The six transformation areas/modules (and resultant indicators) are in direct cohesion with the policy agenda and tools of the overall European Research Area. As the priorities of the ERA are to improve and complement the European R&I framework conditions, similar themes and challenges are addressed.

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[5] EC, 2022
[6] EC, 2021b; EC, 2020a
[7] As agreed with the EC, this work omits the 7th TM "Exploring joint structures and sharing best practices to ensure system-level impact" as its themes are included within the other TMs.

Figure 1   The modules for institutional transformation within the R&I dimension
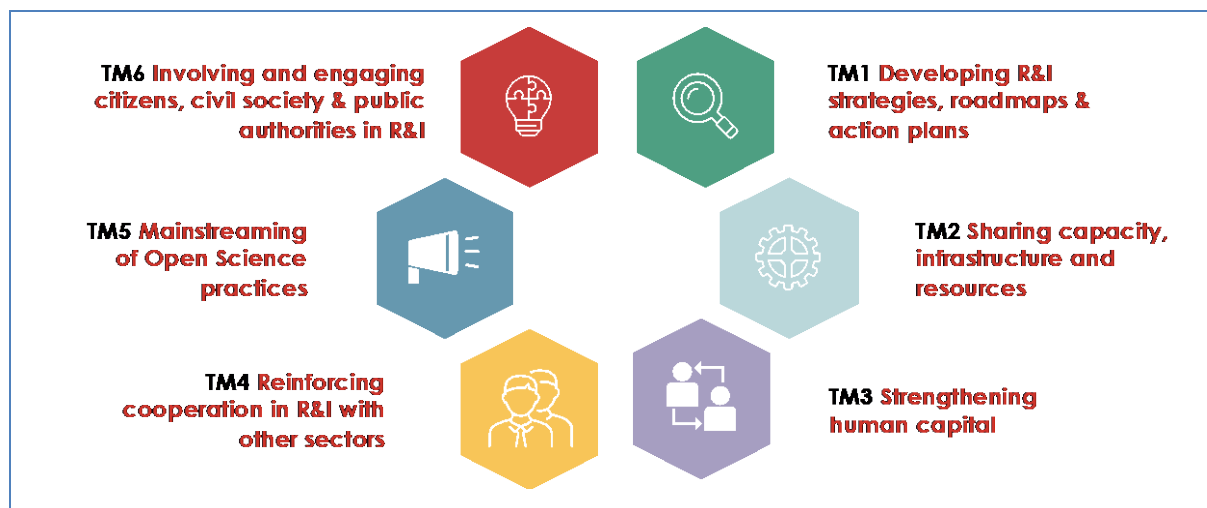
Source: Technopolis

Measuring (institutional) progress in Higher Education
Different **support methods for HEIs in their transformation efforts** can be applied, such as funding projects that support institutional change and giving best practice examples. However, to finetune support to HEI, it is important to **assess the existent and ongoing transformational efforts**. Assessing the status quo and the developments of HEIs serves to understand where achievements have been made and where there is room (and need) for further progress. A combination of indicators (developed here), as well as best practice examples, is proposed as the most suitable methodology that can measure and showcase progress while also being an inspiration for HEIs, governments and society. The indicator-based methodology that allows monitoring the progress of HEIs is the focus of this report and the following sections.

Such a monitoring methodology needs to define clear indicators for measuring institutional progress. Indicators thus need to capture different **institutional characteristics**, existent and new institutional settings/models (which can trigger and embrace the transformation of the system) and measure their quality and applicability of change (not only the existence of new settings/models). It, therefore, needs to measure/embrace diverse activities/changes, such as the creation of joint strategies and concrete action plans, the implementation or deployment of these action plans and the resultant institutionalisation of changes. Monitoring process can then aid HEIs in identifying where they stand regarding the transformation of the(ir) R&I system and guide them towards change.

An indicator-based methodology also comes with **limitations and challenges** that need to be considered: One important challenge is that the HEIs need to have space for academic freedom and focus on quality as well as excellence while being encouraged for institutional change. Second, measuring progress does not have a start or endpoint in time and HEIs face diverse levels of "transformation readiness" Thus, their individual characteristics and process levels show that this methodology is not designed to compare individual HEIs against each other (rather to see development within institutions) and that data collection and analysis should be a long-term, continuous effort.

2.1   Development of the monitoring methodology

In the following subsections we outline the process of how we have fine-tuned the methodology and chosen the indicators for this project.

Figure 2   The process of identifying, matching, and creating suitable indicators
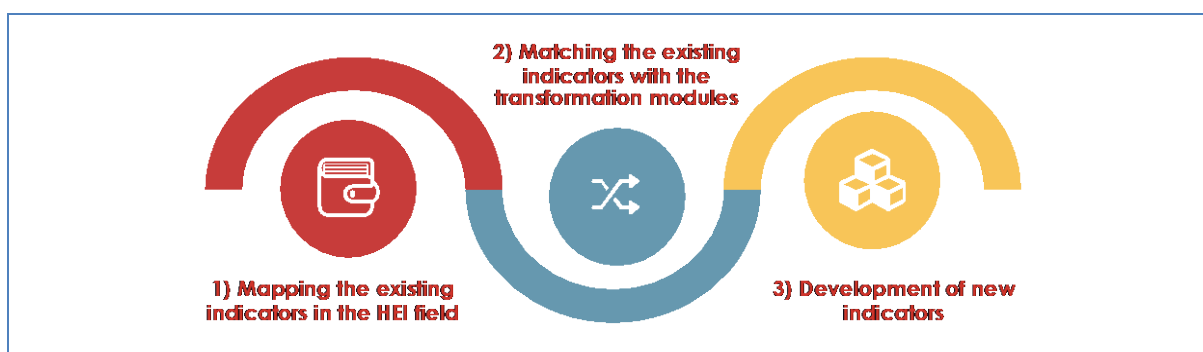
Source: Technopolis

Many efforts have already been made to obtain indicators related to HEI qualifications and performance, among which HEI rankings figure most prominently. Often, data for compiling these rankings are gathered systematically and recurrently, thereby providing a potentially sound starting point for anchoring what is already available and for avoiding multiplication in data gathering efforts. At the same time, different HEI mappings serve different purposes, so the coverage and content of the different indicators vary across repositories. The current task envisages harvesting as much as possible from the landscape of existing repositories. This was done in three steps. First, the landscape of existing repositories and indicators was mapped. Second, these indicators were fitted as much as possible into the transformation modules that have been delineated (see Figure **1** and Section 4). And third, new indicators were developed, as steps 1 and 2 only produced a limited coverage of existent indicators.

2.1.1 Step 1: Mapping the existing indicators in the HEI field

In a first step, available HEI repositories were assembled and scrutinized. The relevant ones that meet quality standards were selected, consisting mainly of broad HEI rankings worldwide. The repositories that were used and mapped are listed in Table **2.**

Table 2   Repositories analysed regarding the mapping of existing indicators

• ETER	• RISIS-EUPRO
• LEIDEN RANKING	• RISIS-JOREP
• LENS.ORG	• SHANGHAI RANKING (ARWU)
• QS World University rankings	• THE (Times Higher Education)
• REUTERS World's Most Innovative Universities	• U-MULTIRANK
• RISIS-ETER	

Source: INCENTiM (KU Leuven)

From these repositories, a list of approximately 120 individual indicators was gathered.[8] As many indicators were used across several repositories, duplicates were removed. Nevertheless, many of the 'individual' indicators listed are still overlapping on a content level but termed differently or show a slight variance in measurement (e.g. "% female academic staff" and "ratio gender balance"). To facilitate the cleaning and harmonization in the list, we classified the indicators into 7 themes and 16 subthemes, which are presented in Table **3**.[9] The resulting table formed the basis for the next step of matching existent indicators with the transformation modules/areas.

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[8] The complete Excel file will be provided to the EC in a separate document.
[9] To complete the mapping and to facilitate future selection of indicators, several additional information elements were added to each of them. The following information elements pertain to the source repository/-ies in which the indicator can be found: name of the repository; URL to the repository; accessibility of the repository: free, licensed, on registration; geographic scope; time scope; update cycle.

Table 3   Themes and subthemes of indicators identified

Themes	Subthemes
Collaboration	Industry linkage
Education	Budget / industry linkage / international dimension / performance level / quality
Global rating	Budget / impact / international dimension / performance level / quality /size
Infrastructure	Facilities
Research	Budget / impact / innovation / interdisciplinarity / international dimension / partnership / performance level / quality / scholarly output level
Societal contribution	Gender / institutional change / public science awareness / regional engagement
Valorisation (3rd mission)	Impact / industry linkage / innovation / international dimension / performance level

Source: INCENTiM (KU Leuven)

Figure 3   Distribution of individual indicators across the main themes (Table 3).
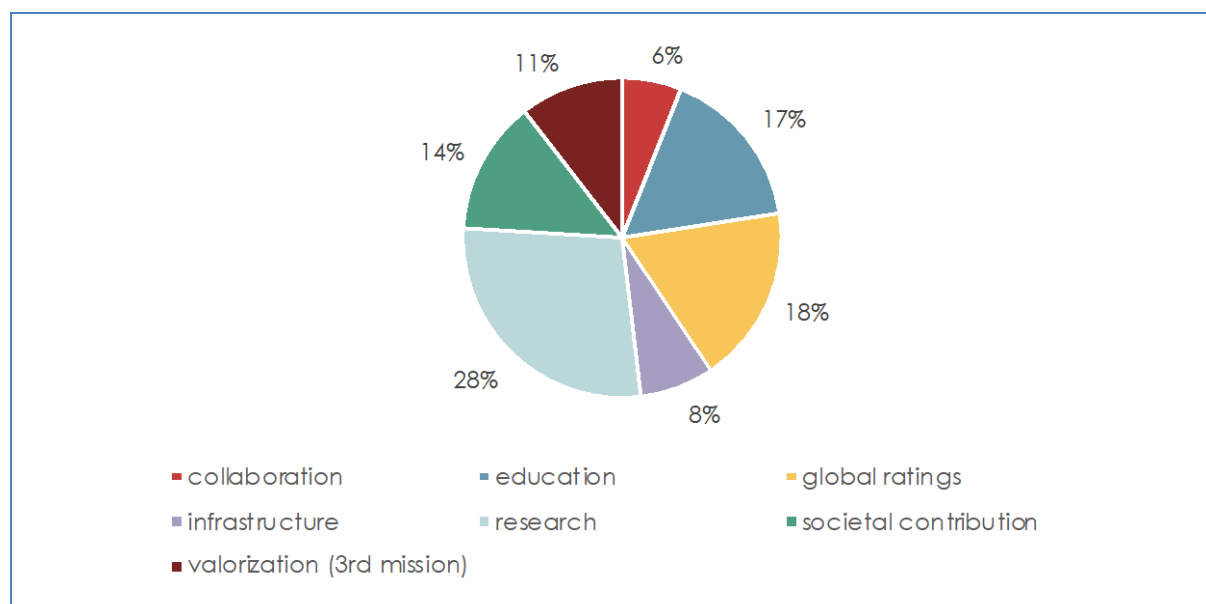
Source: INCENTiM (KU Leuven)

2.1.2 Step 2: Matching the existing indicators with the transformation modules

In this second step, each individual indicator was assessed in terms of fit to the delineated transformation modules (Figure 1 & Section 4). This assessment was performed very meticulously in a dedicated group of four project team members from KU Leuven and Technopolis. Through an intensive process of continuous mutual consultation and iteration, it was assured that the final matching between indicators and modules was agreed upon by everyone. The task proved not straightforward, mostly because the more static technical/measurable indicators from the existing repositories were not always suited or fitting in the more transformative, process-oriented transformation modules that seek to map innovative and institutional dimensions.

This assessment round of matching indicators to transformation modules - and the fact that it was done for each indicator separately – made sure that we reaped from the existing repositories as much as possible. At the same time, the assessment was performed

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The following pertain to the individual indicator: calculation specs and remarks; unit of measurement: departmental, institutional, regional; theme and subtheme (as outlined in Table 3).

sufficiently restrictive to avoid including any loose ends or indirect proxies. The success of the task is fully contingent on striking the right balance between both, which is why so much effort was dedicated to it. 45 of the existing indicators (37%) were considered as potentially fitting with one of the six transformation modules but were chosen not to be included for the reasons described in Section 0. Those indicators are listed in 0.

3.1.3 Step 3: Development of new indicators

During the synthesis of steps 1 and 2, it became clear that the **progress envisioned by the TMs cannot be covered by existing indicators**, surveys, or databases. The dimensions of the transformation modules are rather process-oriented and aimed at aspects that are innovative/new. Thus, these aspects cannot be covered by existing, "standard" indicators and progress has to be measured through new indicators. This also meant that this work cannot rely on existing indicators and the data needed to measure institutional progress has to be collected.

As the transformation agenda is addressing primarily institutional developments and strategies, corresponding indicators must address processes at the individual HEI level. Therefore, new indicators had to be developed to grasp the newness of the institutional changes that are to be implemented at HEIs. In this step, it was highly relevant to find the right **balance** between defining **meaningful indicators** that showcase and measure transformation, while at the same time these indicators need to be **surveyable and accessible** to the HEIs in practice. This "cost of data collections versus value of analyses" review is relevant to not burden HEIs with too many extensive surveys/questions and internal data inquiries. Additionally, this balance is essential because this survey of transformational progress is envisioned to be rolled out among HEIs in Europe at a large scale and therefore efforts need to be realistic.

Text Box 1:   Co-creation workshop

> The development of the indicators also included two half-day **co-creation workshops** with representatives of the European Universities Alliances (see programmes in Table 21 and Table 22). In these workshops, a first draft of the methodology was discussed and further develop through joint discussion and exchange of ideas. The outcome of the co-creation process were concrete ideas on how to measure the progress of HEIs along the transformation modules (see Miro boards in Annex 0). This methodology was included in order to assure that the voice of the respective stakeholder group (HEIs) was included. Thus, the workshops provided further input that was used to understand the indicators but also the challenges that emerge when testing/implementing the methodology. Additionally, the project team participated in various online events organised by the EC and/or other institutions within the HE sector and reviewed relevant literature, policy documents and position papers (such as FOREU, 2021a-f).

4   An indicator framework for developments in Higher Education based on the transformation modules

In the following, the indicators needed to measure institutional change processes at the HEI level are introduced. In presenting the indicators, we follow the **thematic lines of the pre-defined transformation areas**. However, it is important to note that the transformation areas are **thematically linked or cross-cutting** in nature. The coupled nature of the transformation areas is an important consideration when identifying and defining the respective indicators. Accordingly, the indicators per transformation area/module should not be considered in isolation - most of them are interconnected and some even interchangeable in the sense that specific indicators could have been logically assigned to different TMs. There are, for instance, indicators related to training in TM3 "Strengthening human capital", TM4 "Reinforcing cooperation with R&I and other sectors", and TM5 "Mainstreaming of Open Science Practices". Additionally, the nature and the drivers of the institutional change within each transformation area are diverse. Some address internally facing aspects related solely to the workings of the HEIs while others

are externally oriented aspects that also point to and depend on external stakeholders/contexts.

The following sections are organised as follows:

- First, we describe in detail the transformational vision formulated in the individual transformation module. This is crucial since the TM is the basis on which the indicators are built and which they need to correspond to.

- Second, we list the suggested indicators, including a short rationale of how the indicator relates in detail to the vision in the transformation module.

  - We also define the type of indicator: Process indicators measure activities that initiate/encourage processes towards institutional change. Output/Outcome indicators measure whether the expected changes/effects are achieved over time.

  - We outline the detail of the measurement approach (i.e., a binary (0/1) versus ranking approach versus a qualitative indicator) which is relevant for the survey development.

  - TM2, TM3 and TM4 also include the survey questions for each indicator. These TMs were concretely implemented in a test run among HEIs (see Chapter 5) and can therefore be presented in a more detailed manner.

4.1 TM 1: Developing research & innovation strategies, roadmaps, and action plans

Transformation module 1 covers the **development** and **implementation** of concrete R&I strategies at HEIs, either at the level of an individual university or in cooperation with other stakeholders. In general, the existence of individual/joint strategies signals that the individual HEI or the HEI together with its partners have defined a path they want to take regarding R&I and the themes, activities, and partners they want to prioritise. This systematic approach to R&I activities allows for targeted and effective development of R&I activities of HEI. A further underlying logic of why this TM is crucial for a systematic approach to R&I at HEI is that developing or having an R&I strategy means that an organisation is aware of its institutional strengths and weaknesses. Thus, HEIs are knowledgeable of activities and changes needed to react to strengths and weaknesses and thereby reach the goals defined in the strategy in the first place.

Additionally, having joint strategies implies that an institution knows the respective partners (HEIs or stakeholders from other sectors), acknowledges their capacities and is able to tackle shared challenges (often linked to UN SDG's, Missions, the Green Deal, or other societal challenges), building on complementary strengths. Joint strategies are particularly important when facing the just mentioned global challenges, as they are a way of prioritising the most critical aspects and creating critical mass as well as pool expertise, data, and resources.

Figure 4   Visualisation of the process of TM1
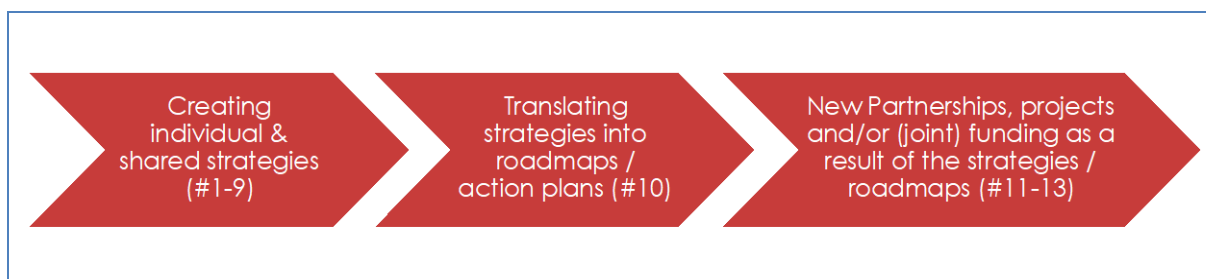
Source: Technopolis

On the basis of these (individual and joint) strategies, the second step includes creating roadmaps/action plans that not only translate the strategy into concrete projects and activities but also distribute responsibilities between partners. If this step is omitted, strategies often remain at an abstract level and do not have an impact and do not get translated into reality.

The final step of this TM is related to implementing the strategies, roadmaps and/or action plans. As a result of this implementation, new partnerships, projects, or funding can become reality, thus enabling the respective HEI to take into account today's challenges and face them systematically.

Table 4   Core indicators of TM1: Developing R&I strategies, roadmaps, and action plans

#	Indicator (description)	Rationale	Indicator type
1.1	Existence of[10] a) individual R&I strategy/agenda b) joint R&I strategy/agenda (with other HEIs) c) common R&I strategy/agenda (with external stakeholders)	Individual/joint R&I strategies offer the opportunity to develop a (common) strategic vision regarding R&I. An individual agenda shows that HEIs are aware of their own strengths. A joint agenda shows the potential to work based on shared values and goals. It enables the HEIs to pursue a high level of enhanced and sustainable cooperation across various levels of the organisation, and across organisations. Thus, these strategies can create and build on complementary R&I strengths. These strategies must integrate global themes/challenges, as well as issues such as interdisciplinarity and international collaboration in order to accelerate joint R&I activities and reach joint solutions.	Process Binary / rating of the status quo
1.2	… which addresses/identifies key (global) challenges and themes (such as the SDGs)		
1.3	… which addresses trans- and/or interdisciplinarity		
1.4	… which addresses / encourages international collaboration		
1.5	… which addresses / encourages regional collaboration		
1.6	… which includes aspects of social and cultural innovation and thus socio-economic sciences and humanities		
1.7	… which is in line with the educational strategy/goals/activities of the HEI		
1.8	…which includes plans on continual engagement of potential R&I partners (business/industry, local authorities, research, and civil society) of the ecosystem		
1.9	Involvement/inclusion of non-university stakeholders from all parts of the quadruple helix (business/industry, local authorities, research, and civil society) at all stages of the creation of the strategy, including in the definition of its goals		Process Binary / rating of the status quo
1.10	Existence of action plans/roadmaps that translate the strategy into activities and distribute duties / responsibilities between the involved stakeholders.	Strategies often are developed at a somewhat abstract level, thus formulating goals and visions, but not breaking these down into activities. Thus, action plans/roadmaps are needed to break down these strategies into concrete actions.	Process Binary / rating of the status quo
1.11	Existence of new partnerships initiated on the basis of the R&I strategies[11]	In order to tackle today's (global) challenges through a holistic approach, diverse and interdisciplinary actions need to be implemented. These indicators build upon the strategies designed, transforming what is planned into reality through new partnerships, concrete	Output Binary / rating of the status quo
1.12	Existence of R&I activities initiated on the basis of the R&I strategies (individual or shared)[11]		

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[10] In the survey, indicator #1 splits into 3 questions (a-c). Each of these questions (a-c) answered with "yes" will be followed by the indicator questions 2-10. If questions a) to c) are answered with "no", questions 2 to 10 will be omitted.

[11] Asking a binary (yes/no) question of whether new partnerships / new R&I activities have been established will give a first direction on ether the strategies/action plans are becoming reality. In order for this indicator to be even stronger, one could ask for the number of new partnerships or for concrete examples of the partnerships. Nevertheless, we obtain from doing this here, as it would involve major efforts/resources from the HEIs to obtain this information.

#	Indicator (description)	Rationale	Indicator type
1.13	Application for new resources / funding at the European, national, and local level (such as Marie S. Curie, INFRA, clusters, Invest EU) on the basis of the R&I strategies or the new partnerships	activities and the (joint) application to funding.	

4.2 TM 2: Sharing capacity, infrastructure, and resources

Transformation module 2 describes the vision of an HEI which exploits systematically and effectively the infrastructures and resources it has by opening up to Higher Education or research organisations outside the own institution. An HEI acting in line with the vision of this TM develops a strategy towards sharing resources and infrastructures across its academic partners – be it within a European University Alliance or with researchers from other institutions.[12]

In this sense, a university takes several "stylised" steps when realising this vision. They build upon each other:

- First, a systematic stocktaking of available infrastructures is needed to develop an internal "database" of what resources can actually be offered to/shared with others. Often it is intransparent to outside stakeholders, but even also within a university, what facilities and resources an institution has in its various departments. Institutional knowledge management, starting with a systematic stocktaking related to available infrastructures is helpful to change this situation and create transparency for all parties involved.

- Second, a systematic needs assessment from partners and a mapping of these needs to the existing infrastructures at the HEI is necessary to match one to the other. This way requirements and needs from partners can systematically be addressed. In its most advanced version, also common planning processes are used in order to take into account partner needs when developing roadmaps for future infrastructures from an early point in time.

- Thirdly, access to infrastructures needs to be clearly defined. This clarifies to all stakeholders how a university intends to regulate, grant and support access to (potential) users from other organisations. As a result, the framework conditions for access are transparent and therefore helpful in sharing infrastructures and other resources.

- All of the above can, fourth, lead to higher numbers of external partners making use of infrastructures of an HEI, i.e., the "sharing" culture described in the transformation module is realised (to a larger degree).

The proposed set of indicators follows the basic logic set up above and makes these concepts measurable.

In order to have a clear understanding of the term "infrastructures" or "research infrastructure" (RI) for this monitoring approach, the established definition from the Horizon 2020 and Horizon Europe regulations are used. In this sense, RI are "facilities that provide resources and services for the research communities to conduct research and foster innovation in their fields, including the associated human resources, major equipment or sets of instruments". The definition also includes "knowledge-related facilities such as collections, archives or scientific data infrastructures; computing systems, communication networks and any other infrastructure of a unique nature and open to external users, essential to achieve excellence in R&I".

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[12] In general, infrastructure can also be shared with non-academic partners of a university in order to connect all actors in the knowledge ecosystem. We concentrate at this point on cooperation between HEI.

Table 5   Core indicators of TM2: Sharing capacity, infrastructure, and resources

#	Indicator (description)	Rationale	Indicator type	Survey Question
2.1	Existence of a systematic stocktaking of infrastructures (at institutional or department level)	Stocktaking of existing infrastructures which can be shared with other researchers or organisations (e.g. private firms) is a first step in making transparent what infrastructures are available at a university. Apart from creating transparency about existing infrastructures, this stocktaking also facilitates strategic, consistent planning of access to infrastructures (see below).	Process Binary / rating of the status quo	Does your university have an up-to-date inventory of research infrastructures (e.g. scientific equipment, archives, computing systems, etc.)? • Yes / No / Don't know
2.2	Awareness of needs of other universities / partner universities regarding infrastructures	An analysis of needs (e.g. specific equipment) of partner organisations is a prerequisite of facilitating access to (specific) infrastructures in a targeted way (i.e., to HEI which have specific needs). It helps to make sharing more efficient since requirements are clearer. A subsequent analysis would yield insights into how these requirements can be addressed (or not) by sharing specific infrastructures. In this sense, it also shows white spots in the infrastructure (needs not matched by existing infrastructures) which could be addressed in future planning processes. An institution confirming it has a high level of awareness about infrastructure needs of other universities can be regarded as well prepared for sharing infrastructures with the "outside world".	Process Qualitative rating	To what extent is your university aware of the research infrastructure needs of other universities? • Completely aware • Moderately aware • Somewhat aware • Slightly aware • Not at all aware
2.3	Existence (or work in progress) of an access policy or institutional guidelines concerning access to infrastructure for other universities	Clear rules for access to infrastructure are a crucial prerequisite for making the framework conditions for access to a specific infrastructure clear. In order to strengthen the objective of sharing infrastructures, this requirement should be fulfilled. Whether this is the case is proxied with this indicator.	Process Qualitative rating of the status quo	Does your university have policies and/or guidelines defining how it regulates access by other universities to its shared research infrastructures? • Yes / In progress / No / Don't know
2.4	Application of the European Charter for Access to RIs	The European Charter for Access to RI principles and guidelines to be used as a reference when defining Access policies for research infrastructures and related services. An institution applying the Charter, therefore, complies with established procedures to opening up RI to partners. The application is therefore an indication of a structured approach to RI, facilitating access.	Process Qualitative rating of the status quo	Does your university apply the guidelines provided by the 'European Charter for Access to Research Infrastructures' in order to share its research facilities? • Yes / Under consideration / No / Don't know

#	Indicator (description)	Rationale	Indicator type	Survey Question
2.5	Existence of a systematic stocktaking of external users of research infrastructures	The ultimate vision of this transformation module is a culture of sharing infrastructures resulting in a higher number of external parties making use of existing infrastructures. The number of researchers accessing the RI is, therefore, a central metric, albeit potentially difficult to obtain for a single Higher Education institution. With this question we document progress on whether a) there are numbers documented on access to RI and b) how large this number for a specific HEI is.	Output Binary / rating of the status quo	Is your university keeping track of the number of users of its shared infrastructures coming from other universities? • Yes • No • Don't know
	Number of researchers from outside the HEI accessing the RIs of the HEI (academic partners)	*Nota bene: As anticipated, challenges in surveying HEIs about the exact (or even estimated) number of researchers accessing RIs have arisen in the survey (resulting in a very high non-response rate of 73%). Nevertheless, we suggest keeping the indicator.*	Quantitative	Please indicate the number of users of your shared research infrastructures coming from other universities during the calendar year 2020.
2.6	Existence of common planning processes for future infrastructures with other universities (participatory strategic planning)	In order to make the sharing of research infrastructure even more efficient and targeted, the needs of parties from other HEI should ideally be involved already in the planning process of infrastructures. Whether this participatory planning is already formally taking place is measured by this indicator.	Process Binary / rating of the status quo	Is your university currently developing plans regarding future shared research infrastructures together with other universities? • Yes • No • Don't know

4.3 TM 3: Strengthening human capital

The transformation module 3 covers the human capital factor in higher education which can be seen as one of the most crucial factors for transformation in the sector: at the core of all activities in Higher Education, it is the people (be it researchers, academic leadership, or administrative staff) which make the difference for progressing towards the university of the future.

In the words of the transformation module, an HEI which addresses the HR challenges of the future "deploys human resources strategies, enriching research and career evaluation systems that mainstream Open Science practices, foster diversity and inclusiveness, including gender equality in research, as well as strategies for balanced circulation of knowledge and researchers, promoting intersectoral/interdisciplinary mobility of researchers".

To mirror the progress made against the ideal situation described above, three dimensions can be focused on in a monitoring system.

- The existence of explicit strategies or action plans at the HEI level to tackle the challenges. They mirror the fact that challenges are taken seriously by addressing them in a structured way and developing strategies to react to the challenges. Furthermore, clear strategies are a prerequisite to developing concrete actions underlying them (see next point)

- The degree to which action plans and strategies have led to initiatives, concrete policies, incentive structures and training offers (e.g. for doctoral students) implemented at the HEI, underpinning the strategies described

- The results which can be observed as a result of the strategies as well as the implementation of the strategies (or will be observed in the future)

Following this logic, the following indicators are proposed to provide a picture of the progress made in HR management at HEI.

Table 6   Core indicators of TM3: Strengthening human capital

#	Indicator (description)	Rationale	Indicator type	Survey Question
3.1	Existence (or development) of an explicit HR strategy or action plan for HR management in research If yes: Assessment of the effective implementation of the HR strategy	This indicator reflects the overall degree to which HR management is addressed at a specific HEI. By formulating an HR strategy or action plans for HR management, the needs in HR management for a specific institution are reflected on and corresponding actions can be taken. HR strategies are therefore an important step to codify the actions to be taken to professionalise the HR management of an institution. An example of an HR strategy could be the "Human Resources Strategy for Researchers (HRS4R)".	Process Qualitative rating of the status quo	Does your university have an explicit human resource strategy or action plan for human resource (HR) management (e.g. Human Resources Strategy for Researchers HRS4R)? • Yes / Under development / No / Don't know How do you currently assess the importance of the human resources strategy or action plan for 'day to day' HR management at your university? • Very important / Important / Moderately Important / Slightly important / Not important / Don't know
3.2	Existence (or development) of a gender equality strategy/gender equality plan at HEI level	Similarly to the overall HR strategy, the existence of a specific gender equality strategy mirrors the degree to which the topic is addressed on a strategic, institutional level. On the other hand, the lack of such a strategy hints at the fact that further strategic attention is needed at the HEI level.	Process Qualitative rating of the status quo. Different information items capturing the details of the status quo	Does your university have **gender equality strategy** and/or a **gender equality plan**? • Yes / Under development / No / Don't know
3.3	Existence (or development) of a diversity strategy at HEI level (beyond gender equality)	Gender diversity is not the only aspect of inclusion and diversity. An institution that has developed a diversity strategy addressing all dimensions of diversity and inclusion credibly showcases the strategic importance it attaches to this.	Process Qualitative rating of the status quo	Does your university have a **diversity strategy** or institutional work plan on diversity *(e.g. ethnicity, sexual orientation, health, religion, socio-economic background)*? • Yes / Under development / No / Don't know
3.4	Existence (or development) of specific support	Diversity management needs structures in order to facilitate transformation and bring it forward. It needs therefore to be analysed whether these structures are in place at HEIs	Process Qualitative rating of the status quo	Does your university have specific support structures in relation to policies about diversity? Please select all that apply (multiple

#	Indicator (description)	Rationale	Indicator type	Survey Question
	structures regarding diversity	and therefore a central prerequisite for transformation in this area is fulfilled.		answers possible).

#	Indicator (description)	Rationale	Indicator type	Survey Question
3.5	Existence (or development) of specific support structures for female researchers (training, mentoring schemes etc)	Similar to the above, the existence of a gender or diversity strategy is a first step in addressing gender equality issues. In a subsequent step, support structures need to be implemented. This indicator thus mirrors more concretely whether relevant support structures in their broadest sense are established in an HEI or not.	Process/Output Qualitative rating of the status quo	Does your university have specific support structures for female researchers?
3.6	Share of female PhD graduates, share of female senior researchers/professors (R3/R4)	The outcome of a gender equality strategy is expected to balance the gender ratio in all levels of the research system. Therefore, an important output indicator to be used is the share of women on PhD level, but also beyond.	Output Quantitative	What is the **current share of females** in your university within various positions? • R1 positions / R2 positions / R3 positions / R4 positions[13]
3.7	Integration (or development) of a training for doctoral students on transversal skills[14] to promote employability and intersectoral mobility	Developing talent not only for careers in research and academia but also career steps outside academia is important to promote inter-sectoral mobility. The formation of such skills is facilitated if such training is obligatory in PhD training programmes. The focus on researchers in earlier career stages (doctoral students) is recommended because at early career stages transversal skills formation is even more important in order to open up career choices and thus careers outside academia (for example after doctoral training). Transversal skills are – by	Process / Output Qualitative rating of the status quo	Does your university have a **training policy on transversal competences and skills** to enhance employability and support inter-sectoral mobility of researchers?

In the 3.5 row, the survey question contains a table:

	Yes	Under development	No	Don't know
Gender Equality Office/Unit				
Gender Equality Network				
Mentoring Program for female scientists				
Training Program for female scientists				
Scholarships for female scientists				
Other, namely				

	Yes	Under development	No	Don't know
Diversity Office/Unit				
Diversity Network				
Buddy or Mentor program				
Training (e.g. implicit bias)				
Other, namely				

In the 3.7 row, the survey question contains a table:

	Doctoral students/candidates (R1)	PhD holders who are not fully independent (e.g. postdocs R2)	Established and leading researchers (R3-R4)
Yes			
Under development			
No			
Don't know			

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[13] R1: first stage researcher up to PhD; R2: recognized researcher, PhD holder or equivalent who are not yet fully independent; R3: Established researcher; R4: Leading researcher, leading research area or field. Source: Euraxess

[14] Transversal skills are typically considered as not specifically related to a particular job, task, academic discipline, or area of knowledge and that can be used in a wide variety of situations and work settings. (Source: *UNESCO*)

#	Indicator (description)	Rationale	Indicator type	Survey Question
		definition – in various sectors and are therefore an adequate tool to promote intersectoral mobility.		
3.8	Integration (or development) of a career mentoring guidance for doctoral students	Mentoring has proved to be an effective tool to guide mentees with respect to potential careers – within or outside academia. Whether this instrument is used influences whether matching between researchers and potential academic and non-academic career paths is efficient.	Process Qualitative rating of the status quo	Does your university offer **mentoring** and/or **employment guidance** for researchers at diverse career levels in order to improve their skills and advance their academic or non-academic career?
3.9	Uptake of training offers for researchers at levels R1 to R2 for transversal skills[15]	Having an institutional training policy as an HR institution is only the first step towards a more structured approach to building up transversal skills among HR. Equally important is what is actually happening "on the ground" and whether training offers are taken up in reality. If this is the case for training on transversal skills, it can be argued that the objective of promoting intersectoral mobility (see transformation module) is more likely to be reached.	Process / Output Qualitative (rating)	What is the uptake of trainings offers on the development of transversal competences and skills in your university?
3.10	Use (or development) of OTMR practices for all recruitment processes of scientific staff (Open, Transparent, Merit-Based Recruitment)	A stringent use of open, transparent, and merit-based recruitment principles all over Europe can be a key driver to improve mobility between higher education institutions and for developing a single European labour market for researchers.	Process/Output Qualitative rating of the status quo	Does your university use **open transparent and merit based recruitment practices** (as defined in the OTM-R Package) for recruitment processes of research staff? • Yes / Under development / No / Don't know

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[15] Potentially translated in the survey as rating "transversal training is required for R1 researchers", "is used by the majority of researchers", "is used by only some".

#	Indicator (description)	Rationale	Indicator type	Survey Question
3.1 1	Existence (or development) of a strategy/action plan to reform current research assessment practices	Alternative approaches to assessing researchers' achievements – departing from relying on publication metrics only – are setting important incentives for researchers to engage in knowledge transfer, societal outreach, teaching and other non-research missions of HEI ("research assessment shapes research culture"). There is widespread consensus that the assessment of researchers' performance needs to be adapted to take into account wider results of research activities. With this indicator, it is proxied whether this need is being addressed at the level of the individual HEI.	Process Qualitative rating of the status quo	Does your university have a policy/strategy or action plan for an **assessment of researchers** that promotes and rewards the value and impact of **a variety of research output** (beyond publications), research activities and research processes? • Yes, both a policy/strategy and action plan • Yes, only a policy/strategy • Under development • No • Don't know
3.1 2	Assessment of whether achievements other than traditional assessment metrics (high-impact publications, success in securing research funding) have gained importance for recruiting and promoting research staff	This indicator builds on the previous one on the existence of an assessment strategy taking into account elements beyond traditional research outputs. It proxies whether there are already quantifiable indicators used in this context. This seems to be important since research assessment has increasingly been based on indicator-based approaches. A widened view on research assessment therefore also needs to be underpinned by "new" indicators.	Process Qualitative rating of the status quo	Are metrics other **other than traditional**, quantifiable output indicators (such as the number of publications in high impact journals, citation indexes, or success in securing research funding) currently **used for recruiting, retaining, and promoting research staff** in your university? • Yes, currently using à Could you give an example? • Not yet, but planned in the next 2 years • Not yet, but planned in the next 5 years • No, also not planned for the future

3.1 3	% of staff from foreign countries (overall, PhD level (R1) and post PhD (R2-R4)	Having international staff is a result (and possibly a further inducement) of international researcher mobility; internationality also fosters diversity in human capital.
		
		In order to detect gender differences in international mobility, the share of female staff can be added.
			Output
			Quantitative
				What is the percentage of international research staff at your university at various levels? Please leave blank if no data is available.
				• Doctoral students/candidates (R1)
				  – among them: share of female staff:
				• Post PhD researchers (R2-R4)
				  – among them: share of female staff:
				• Overall
				  – among them: share of female staff:

4.4 TM 4: Reinforcing cooperation in R&I with other sectors

Transformation module 4 is concerned with the co-operation of HEIs with surrounding ecosystem actors with the goal to combine external perspectives and experience as well as unique, special knowledge within the R&I cycle. The actors to be involved can be summarised as the quadruple helix actors: science, policy, industry, and society[16]. Again, it is the multi-stakeholder approach, that allows HEIs – together with citizens, the public sector, and industry – to face today's challenges.

The inclusion of society and policy is largely covered in transformation module 6 (4.6) and therefore the focus of this module is on the private sector. On the one hand, the aim is to connect industry with the HEI, through academia-business cooperation and knowledge sharing approaches. On the other hand, HEI staff is to be activated and valorised to think entrepreneurial and create businesses or innovations relevant for industry. The indicators can be split along three lines of thought (Figure 5).

Figure 5   Visualisation of the components of TM4
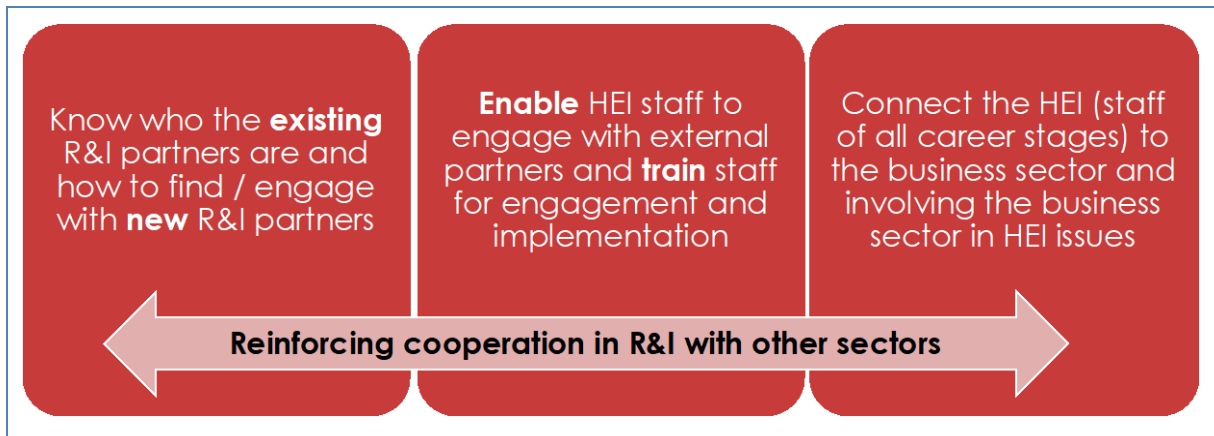
Source: Technopolis

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[16] Carayannis & Campbell, 2009.

Table 7   Core indicators of TM4: Reinforcing cooperation in R&I with other sectors

#	Indicator (description)	Rationale	Indicator type	Survey Question
4.1	Existence of a mapping of current R&I partners (regional, national, international), e.g. through a mapping of formal cooperation agreements with quadruple helix actors	HEIs are at times not sufficiently recognised as interesting partners in the innovation ecosystem and often do not recognise regional partners as interesting R&I actors. Thus, creating a mapping of the existent partners can lead to a higher recognition of joining forces. Exchange with partners from other sectors is important to (dis)cover relevant themes. While HEIS play an important role in creating new knowledge, they must integrate their various innovation activities into a more coherent ecosystem including the industry, society, and the public sector	Process

Qualitative rating of the status quo | Does your university have an **inventory of their existing R&I collaboration partners** from other sectors (e.g. a mapping of (formal) cooperation agreements)? *Please select all that apply (multiple answers possible).*
• Yes, other research/education organisations
• Yes, private firms
• Yes, (public) sector organisations
• Yes, society/3rd sector organisations
• Yes, for all of the above sectors
• No
• Don't know |
| 4.2 | Existence of collaborative spaces (such as innovation labs / hubs, science parks / centres) and initiatives (networking platforms / circles)[17] | | Process

Qualitative rating of the status quo | Does your university currently have **collaboration spaces** (e.g. innovation labs, hubs, science parks) and **initiatives** (e.g. networking platforms, business lunches) which encourage engagement with actors from outside your university? *Please select all that apply (multiple answers possible).*
• Yes / Under development / No / Don't know

Please name the most prominent ones
• collaboration spaces
• collaboration initiatives |
| 4.3 | Existence of R&I support / interface services and structures:
• Support in IP protection & commercialisation | There is a need for a professionalisation of R&I support/interface services and structures as researchers do not have the resources to cover these | Process Binary (#1-4)

Qualitative rating of the | Please indicate which **supporting R&I structures and services** are available in your university. *Please select all that apply (multiple answers possible).*
• Support in IP protection (e.g. patentability assessment)
• Support in IP commercialisation (e.g. licences) |

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[17] We anticipate a high number of HEI indicating that these kinds of collaborative spaces do indeed exist at their institutions. This does not need to be problematic as we include a wide range of aspects: from aspects which are already current practice at many HEI to aspects which are only practiced at "frontrunner" HEIs. This way the monitoring can show where there is a need for HEIs to catch up to the "frontrunners" and where not action (or incentive setting by science policy) is needed.

#	Indicator (description)	Rationale	Indicator type	Survey Question
	• Support in making consultancy agreements, contract research agreements or collaborative agreements • Support in company creation • Possibility of accessing venture funds (co-)provided or organised by the university • Dedicated staff who liaise between the university and other actors • Others, namely	types of activities/tasks within the current, "traditional" academic setting. Thus, the existence of different types of support/interface services and structures (#1-4) allow academics to realise R&I activities (with actors from other sectors) alongside their academic duties.	status quo (#5)	• Support in making consultancy agreements, contract research agreements or collaborative agreements (including confidential disclosure agreements and material transfer agreements, etc.) • Support in company creation (e.g. through start-up incubators) • Possibility of accessing venture funds (co-)provided or organised by the university • Dedicated staff who liaise between the university and other actors (e.g. knowledge brokers/match makers, connecting researchers to external stakeholders) • Others, namely • Don't know
4.4	Existence of (intro & advanced) courses/trainings enabling entrepreneurial aspirations of HEI staff at all career stages.	Academic entrepreneurship (and as a result university spin-offs/outs) are important channels for innovation and knowledge transfer. Thus, training academics to develop an entrepreneurial mindset, but also making sure academics have the adequate knowledge, skills, and resources for entrepreneurial activities are the baseline. These types of training are aimed at ensuring that researchers have (access to) the necessary tools and skills to research and implement innovation.	Process Qualitative rating of the status quo	Does your university offer **training and courses** for doctoral students and/or research staff to develop entrepreneurial skills? *Please select all that apply (multiple answers possible).*

	Yes	Under development	No	Don't know
Intro course targeted at doctoral students/candidates (R1)				
Intro course targeted at PhD holders who are not fully independent, e.g. postdocs (R2)				
Intro course targeted at senior researchers (R3-R4)				
Intro course only for a specific group of researchers, namely				
Advanced course targeted at doctoral students/candidates (R1)				
Advanced course targeted at PhD holders who are not fully independent, e.g. postdocs (R2)				
Advanced course targeted at senior researchers (R3-R4)				
Advanced course only for a specific group of researchers, namely					

#	Indicator (description)	Rationale	Indicator type	Survey Question
4.5	Number of spin-offs (U-MULTIRANK)[18]	Company foundations are a direct translation of research into corporate activities, hence a reflection of science-industry linkage.	Output Qualitative	Please indicate the **number of new spin-offs** (NB: i.e. firms established on the basis of a formal knowledge transfer arrangement between the university and the firm) created in the calendar year XX by the university (per 1000 fte academic staff).
4.6	Existence of courses & trainings for first stage researchers (R1)[19] to get to know labour market options	It is an important step to connect early-stage researchers (R1, R2) and the "outside world of academia". On the one hand, this helps the academic world to understand the needs of external stakeholders (industry). On the other hand, this also helps those academics that want to leave academia to know what employments options they have.

If non-university actors are involved in setting up the training of doctoral programmes, the programmes are more likely to be directly linked to the needs and challenges of the external world. These kinds of jointly developed training thus counteract the mismatch between the skills | Process

Qualitative | Does your university offer **information and training** to PhD students/candidates (R1) to get insights in their **future career possibilities in various sectors** outside higher education (science, policy, industry, society)? *Please select all that apply (multiple answers possible).*
• Courses and/or workshops
• Organisation of career days
• Existence of career coach/advisor/mentor for career guidance
• Existence of (online) career platform
• Others, namely
• Don't know |
| 4.7 | Share of PhD students in joint doctoral programmes (industrial PhDs) | | Process Qualitative | What is the current share of PhD students/ candidates in **industrial doctoral programmes** in your university? Please leave blank if no data is available. |
| 4.8 | Involvement of external stakeholders in PhD training design. | | Process Qualitative rating of the status quo

Qualitative | Are external stakeholders/users currently involved in the **design of the PhD training program** at your university?
• Yes / No / Not yet but will be in near future (<2 years) / Don't know

Please give an example |

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[18] In the survey, this indicator will include a comment that this question is also asked within the U-Multirank ranking. Thus, universities who have participated in this ranking, can access the data to be answered.

[19] R1: First Stage Researcher (Up to the point of PhD) / R2: Recognised Researcher (PhD holders or equivalent who are not yet fully independent) / R3: Established Researcher (Researchers who have developed a level of independence) / R4: Leading Researcher (Researchers leading their research area or field) [Source: https://euraxess.ec.europa.eu/europe/career-development/training-researchers/research-profiles-descriptors].

#	Indicator (description)	Rationale	Indicator type	Survey Question
		of researchers and the labour market needs.		
4.9	% co-publications with industrial partners (U-MULTIRANK)13	Having co-publications with an industrial partner is likely the result of cross-sectoral collaboration. It likely concerns more application-oriented research, with enhanced potential for innovative research.	Output Qualitative	Please indicate the % co-publications with industry during the calendar year XX. (NB: publication with author of a for-profit business or private R&D unit, excluding for-profit hospitals and education organisations) (The percentage of a university's research publications that list an author affiliated to an address of a for-profit business enterprise or private sector R&D unit).
4.10	Income from regional sources (U-MULTIRANK)13	Income from regional resources suggests collaboration with regional partners or at least streamlining with their needs. It can imply research efforts that are geared towards the needs of regional stakeholders; hence possibly implying a societal contribution at the regional level.	Output Qualitative	Please indicate the income from regional sources during calendar year XX. (NB: Revenues from regional sources as a percentage of total revenues) (The proportion of external research revenues - apart from government or local authority core/recurrent grants – that comes from regional sources (i.e. industry, private organisations, charities).

4.5 TM 5: Mainstreaming of Open Science practices

Transformation Module 5 sketches the vision of a university which puts open science principles at the core of its activities. It postulates for example that a "transformed university" respects "open access principles with regard to publications, and other research outputs, research data management (FAIR principles) and citizen/societal engagement, research integrity. Incentives and rewards exist for individuals and teams that practice Open Science."

It becomes clear that different dimensions of "Open Science" need to be distinguished. It is suggested to follow the established differentiation[20] into the following categories

- **Open Access** to publications and other research outputs.

- **Research data/output management**, focusing on whether data and other research outputs are managed responsibly and in line with the FAIR principles (Findable, Accessible, Interoperable and Reusable).

- Citizen Science as one of the core dimensions of **Open Collaboration**, focusing on the facilitation of the participation of citizens in the scientific process: be it by observing, gathering, or processing data, by assisting in the monitoring, evaluation and feedback on initiatives and results, by involving citizens the formulation of research questions or agendas or by communicating research results in innovative ways to improve science literacy and public understanding of science. Nota bene: in TM6 further aspects of open collaboration are covered.

The following indicators are proposed to monitor the status quo and progress in these three dimensions.

Table 8   Core indicators of TM5: Mainstreaming of Open Science practices

#	Indicator (description)	Rationale	Indicator type
5.1	Existence of an open science policy, in the sense of a policy for producing FAIR and open digital research outputs including publications, data and software by researchers in the HEI	Institutional strategies give orientation and signal priorities of the institution leadership level; the existence of an open science policy encompassing both open access publishing and open data (i.e. all digital research outputs) therefore signals that Open Science and its core concepts such as the FAIR criteria (findable, accessible, interoperable, reusable) are an important topic for the institution itself.	Process Binary or qualitative scale on status quo
5.2	Existence of dedicated financial and non-financial support to researchers in publishing open access	An HEI with funding explicitly earmarked for supporting open access publications therefore directly sets suitable structures to facilitate open access publication. However, support to OA does not only relate to financial aspects. It is for example also supporting/training researchers so that sufficient IPRs are retained to enable them to publish OA and supporting the different ways in which OA can be enabled.	Process Binary or qualitative scale on status quo
5.3	% of academic publications published in open access journals	The central objective of strategies and support structures regarding Open Access is raising the number of open access publications. It is therefore a central indicator to be included in this indicator set. (Nota bene: this indicator is also part of the U-Multirank survey. HEIs with participation in U-Multirank are therefore encouraged to re-use data	Output Quantitative

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[20] See for example the Open Science Monitor of the European Commission. However, to achieve coherence with the ERA monitoring, a strict separation open publication and open data is not always useful. Rather a general view on "research digital objects" being FAIR and open is needed.

		collected for U-Multirank. However, re-using U-Multirank means the definition used there needs to be applied. Therefore, a more comprehensive approach to measuring open access publishing (such as measuring the percentage of publications available in open access **including** open archives and institutional repositories) is not possible. If this question is integrated into a specific survey, this broader definition is recommended.	
5.4	Existence of a person, unit, or other institutionalized structure responsible for data governance oversight and support for data management (data steward)	Increased digitization, use of (big) data as well as application of FAIR principles requires new roles and positions responsible for data management and data organisation at HEIs. These support structures are needed to realise the goal of increased sharing and re-use of data. This indicator measures whether this aspect is given attention at specific HEIs.	Process Binary or qualitative scale on status quo
5.5	Existence of a "Citizen Science Award" or Recognition (or similar) at the HEI level	Citizen Science principles need to be visible and recognized by the science community. Setting reward structures and promoting the visibility of citizen science activities is therefore an important step to create incentives to mobilise researchers to use their scarce resources (esp. time of researcher) for different types of "citizen science practices". This indicator proxies whether one concrete way to promote the importance of citizens science practices is used at an HEI level.	Process Binary or qualitative scale on status quo
5.6	Existence of training modules for researchers (at levels R1 to R2) on open science skills (e.g. sound data management, preservation of scientific information, research integrity, science communication, public engagement, participatory research methodologies, etc.)	Open science skills need to be acquired and trained; they are not built up "automatically". This indicator mirrors whether training on the different aspects of open science is available at a specific HEI.	Process Binary or qualitative scale on status quo
5.7	Assessment of whether researchers' activities with respect to open sharing of research outputs/open science has gained importance in recruiting and promoting research staff	Alternative approaches to assessing researchers' achievements – departing from relying on publication metrics only – are setting important incentives for researchers to engage in open science. Open science needs to be recognised by the "science system" in order to set incentives to engage in open science practices; without appropriate reward structures scarce resources (esp. time of researcher) are used for different activities.	Process qualitative

Different indicators in other transformation modules are also related to dimensions of open science. This is – for example – the case in TM 6 on aspects of citizen science which can (see definition above also be seen as part of Open Science practices). When analysing progress in this dimension these other indicators also need to be taken into account.

4.6   TM 6: Involving and engaging citizens, civil society, and public authorities in R&I

Transformation module 6 aims at the engagement and involvement of citizens / civil society and the public sector (cities, regions, etc.) in the entire R&I cycle as important stakeholders with experience and knowledge for solving societal challenges. This TM is highly relevant as it is directly linked to achieving greater societal impact and – in an ideal case – increasing the trust of diverse stakeholders in science.

The indicators of TM6 can be split into different themes:

- Facilitating and encouraging the involvement of citizens in R&I activities through structures that support engagement (#1). The necessity for this involvement can be linked to the fact that citizens can become active in defining R&I questions/problems, collecting data, participating in experiments, etc. (#3, 4, 6)

- Training HEI staff to be skilled and able to include citizens in the R&I cycle (#2, 5, 10)

- Public engagement on issues related to science, research, and innovation, with the aim to increase R&I thinking (#7)

- Promoting the SDGs, climate and biodiversity objectives, and respective activities of students and researchers in helping respond to them (#8)

- Transferring knowledge systematically to policymakers at regional, local and/or municipal level (#9)

Table 9   Core indicators of TM6: Involving and engaging citizens, civil society, and public authorities in R&I

#	Indicator (description)	Rationale	Indicator type
6.1	Existence of a department, centre, lab, network, testbeds, or other structures / spaces set up to support citizen/end-user engagement (including science shops, maker spaces, fablab, living labs, etc.)	The interaction with and engagement of citizens, civil society and local communities is the basis for achieving improved excellence, greater societal impact, and increased trust in science. Citizens can make meaningful contributions to and participate in research, e.g. in problem definition, data collection, participatory experiments, dissemination, and volunteered thinking. It is ultimately one of the solutions to start a dialogue and motivate citizens to participate in research. Collaboration with these different groups of quadruple/quintuple-helix actors is very complex and needs specific support. The 3rd indicator follows up on governance and structures but is a measurement of how much this is followed up in practice.	Process Binary / rating of the status quo
6.2	% of researchers that have attended trainings, webinars, courses that have a significant proportion of the content devoted to the skills needed to engage societal actors (e.g. citizen science) and learn about approaches to co-creating innovations with society		
6.3	Systematic or regular dialogues, meetings, workshops, or other events set up to promote citizen/end-user engagement in co-design, co-creation, and co-evaluation (excluding one-off events, such as focus groups, science slams, open seminars, science weeks, cooperation with museums, etc.)		Output Binary
6.4	Staff appointed with responsibility to initiate, monitor, evaluate or advise on citizen/end-user engagement and/or with responsibility for training, mutual learning and sharing of tools and good practice on citizen/end-user engagement	Diverse teams, involving actors such as students, citizens, and researchers, can comprehensively tackle challenges as they need to combine their different interests, work methods, time horizons, etc. Nevertheless, most HEIs are still centred on monodisciplinary structures/teams. In order for this to change, different teams to come and work together, new support structures need to be in place. Diverse teams enrich the academic perspective by identifying and/or structuring (global, regional) problems based on their own diverse stakeholder needs.	Process Binary / rating of the status quo
6.5	a) Research(er) assessment recognises and rewards citizen engagement (such as citizen science), collaboration with non-scientific stakeholders, and communication to non-scientific audiences, as core aspects of open science practices		Process Binary / rating of the status quo

#	Indicator (description)	Rationale	Indicator type
	b) Existence of incentives regarding citizen engagement, open collaboration with non-scientific stakeholders, and science communication to non-scientific audiences	Engagement is unlikely to become widespread if it is not recognised in research(er) assessment, and with adequate rewards/incentives in place.	
6.6	Existence of challenged-based / mission-oriented R&I activities such problem-based learning modules / projects with municipalities, citizens, etc.		Output Binary / rating of the status quo
6.7	Existence of activities that encourage young people to choose a science career (informative activities at schools, sport clubs, etc.)	There is a need to enable young citizens to play an active role in the R&I process from its beginning.	Process Binary / rating of the status quo
6.8	Implementation of activities that are aimed at reaching the SDGs (e.g. the deployment of a zero-pollution strategy for the HEI, including a sustainable food strategy for HEI catering, change of car policy in a sustainable mobility plan, preservation of rural areas etc.)[21]	Tackling the sustainable development goals cannot only be covered by researching / educating on them. The implementation of practices that are aimed at reaching the SDGs begins at the HEIs themselves, thus applying sustainability measures in the day-to-day activities.	Output Binary / rating of the status quo
6.9	Participation in activities/settings that allow the transfer of (academic) knowledge into policy making (such as regional strategic boards, strategy development processes at national or global level, etc.)	HEIs play a central role in knowledge generation, creating evidence-based, trustworthy, scientific knowledge and thinking critically.	Output Binary / rating of the status quo
6.10	% of credits for community service learning (U-MULTIRANK)	CSL is a powerful approach to create societal impact by offering practical experience in the non-profit sector.	Output Qualitative

5   Findings regarding content and methodological approach of the test run

This chapter presents the results of the survey-based testing of the developed methodology (Sections 2.1 and 4).

- In Section 5.1, the methodological considerations and practicalities of the testing are outlined (who was the test group and how was the testing conducted).

- Secondly (5.2), the content-related results of the testing and the collected data are presented and contextualised. Thus, the analysed data gives the opportunity to understand how the involved universities have developed in the tested transformation areas.

And finally (5.3), the methodological results are outlined, delineating where the testing has shown weaknesses in the methodology and how these weaknesses need to be addressed. It will thus be explained what needs to be changed in the survey as a result of the testing.

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[21] The Times Higher Education Impact Rankings measure global universities' success in delivering the United Nations' Sustainable Development Goals. For the translation of this indicator into a survey, the ranking could be considered (see Times Higher Education, 2020).

5.1 Testing the methodology

In order to assure that the developed indicators and respective methodology is coherent and clear, the indicators for TM2 "Sharing capacity, infrastructure and resources", TM3 "Strengthening human capital" and TM4 "Reinforcing cooperation in R&I with other sectors" were translated into an online survey to test the methodology.

Test group

This testing was conducted with the 124 HEIs of the first generation of the **European Universities Alliances**. As those Alliances are ambitious transnational unions of HEIs developing long-term structural and strategic cooperation, they were identified as the ideal testbed of this methodology. The Alliance are to become "a source of inspiration for institutional change" (EC, 2020a) and can showcase how cooperation, as well as new governance models, might work in this new knowledge society. As the Alliances and their respective constituent HEIs are potentially frontrunners of all European universities, they are most likely to have advanced in relation to the transformation modules and thereby show change/progress when answering the survey.[22] Another reason for choosing the Alliances is that many of the alliances are currently receiving funding for the "accelerating and catalysing processes of institutional change" under the **Science with and for Society** (SwafS) Call (EC, 2020b). Thus, they are receiving additional (financial) support for focussing on as well as implementing institutional changes that allow for joint research and innovation activities in the long run.

The nature of the test group needs to be taken into account when interpreting the results. As mentioned above, the surveyed Alliances are (potential) frontrunners in institutional transformation processes among HEIS. Furthermore, they often (although not always) are research-intensive and relatively large universities. Developments identified in this group are therefore not necessarily also applicable to other HEIs around Europe.

Testing

The defined indicators (column "description") were translated into survey questions and combined with clear definitions and examples. The questions are targeted at higher education representatives at a strategic level (being sent to rectors, policy strategists and the Alliance representatives of the HEIs). As the indicators and respective questions are diverse, the survey is a combination of closed (yes/no and 3- and/or 5-point Likert scale) and open (text, e.g. examples) questions. A draft survey was reviewed and discussed in detail with diverse representatives of the European Commission. The actual testing of the indicator-based methodology was done with the 1st generation of EUAs (124 HEIs) with the survey being open from October 19th to November 17th, 2021. Two reminders were sent after respectively 3 and 4 weeks. The survey collected 74 valid responses, which represents 60% of the universities. 72 out of 74 universities that started filling out the survey reached the end of the questionnaire.

The online survey was created, conducted, and processed with the Qualtrics survey software. Qualtrics provides possibilities to export results to statistical software. The statistical software program SPSS, IBM statistics SPSS version 27, was used to do statistical analyses. SPSS is a widely used program for statistical analysis in social sciences. To analyse the survey data, we used descriptive statistics such as frequencies, descriptive and open coding on indicating main results and trends in the replies.

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[22] "Where possible and relevant, the European Universities are expected to find ways to spread the solutions, successful practices, and cooperation models, in order to ensure that lessons learnt, and benefits will not be limited to the alliances alone. To ensure scale-up, European Universities are asked to clearly disseminate the model used for their cooperation and governance alignment." (EC, 2020a).

5.2 Content-related results

In the following, we report the key descriptive results of the survey carried out, structured by transformational modules.

5.2.1 TM 2: Sharing capacity, infrastructure, and resources

Inventories & consideration of user's needs

Most universities in our survey sample (41 out of 68, 60.3%) have an up-to-date inventory of research infrastructures (e.g. scientific equipment, archives, computing systems, etc.) which are or can be shared with other universities. However, there is also a high proportion of universities which still do not have this kind of inventories (27, 39.7%). Since we consider the internal knowledge management (in the sense that the university strategy level is sufficiently aware of the resources and capacities of the university to design suitable cooperation strategies) as one important prerequisite for designing effective cooperation strategies with other universities, there seems to be room for improvement in this respect.

On the other hand, the vast majority of universities are to some extent aware of the research infrastructure needs of other universities (i.e., potential cooperation partners inside the higher education system). Around one fourth of universities (23.9%) report to be slightly aware, close to 40% somewhat aware and nearly 30% moderately aware of these needs. Only 5.6% of universities are not aware of other universities' needs.

Figure 6   Awareness of research infrastructure needs of other universities
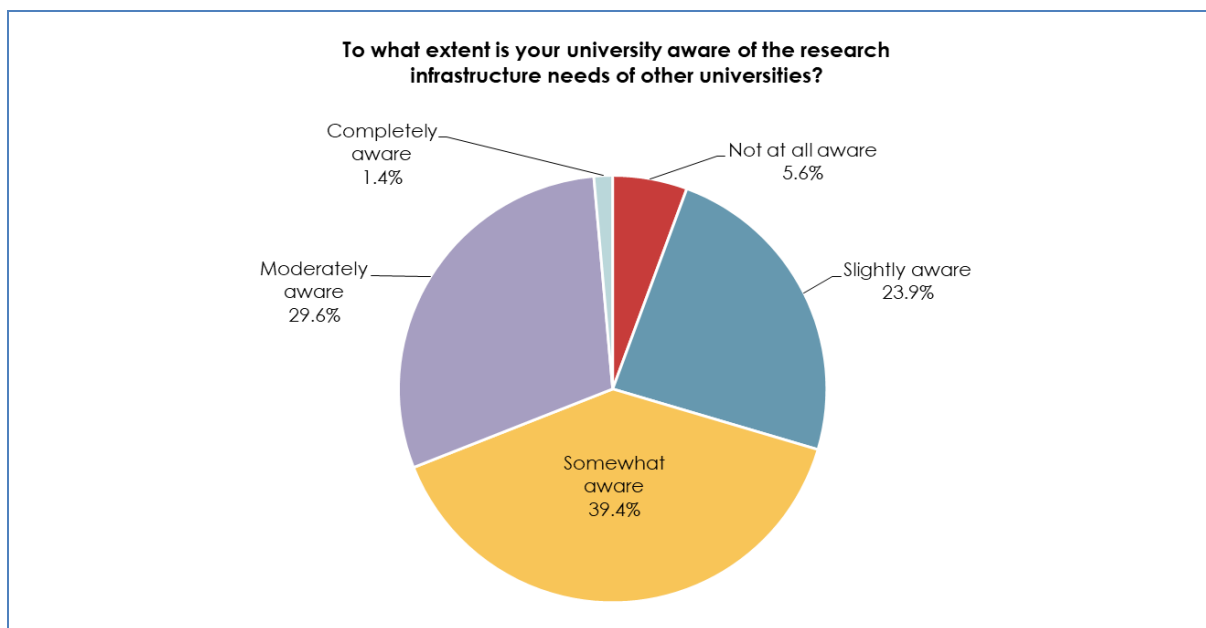
Note: Indicator 2.2; Percentages based on 71 responses

Policies and guidelines

Most universities either currently have or are preparing policies and/or guidelines to regulate access by other universities to its shared research infrastructures (38.2% and 39.7%, respectively) while slightly more than 20% of universities do not have nor are preparing these guidelines at the moment.

Among those universities which currently have or are preparing guidelines to regulate access by other universities to its shared research infrastructures, less than 10% report to currently apply the guidelines provided by the 'European Charter for Access to Research Infrastructures' in order to share its research facilities. 40.5% are considering the application of these guidelines.

It, therefore, seems that the "call for openness" for universities and the related needs to organise policies and guidelines to make open collaboration possible, has shown some results, with the large majority already having rules for this or currently preparing them.

Figure 7   Existence of policies to access shared infrastructures

Does your university have policies and/or guidelines defining how it regulates access by other universities to its shared research infrastructures?

No 22.1%

Yes 38.2%

In progress 39.7%
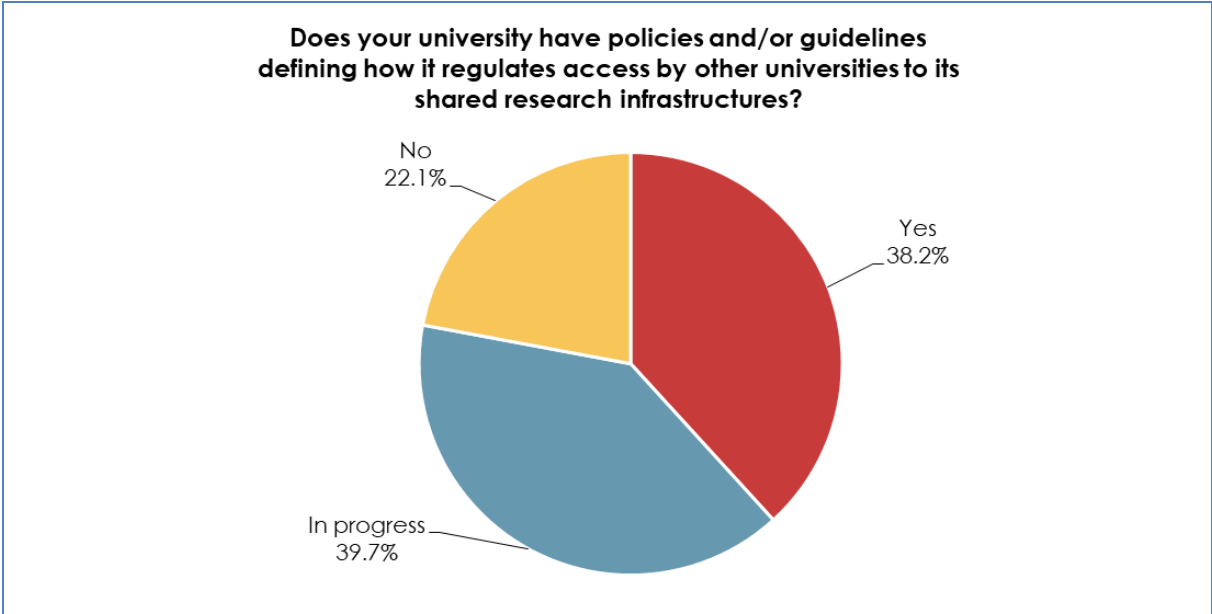
Note: Indicator 2.3; Percentages based on 68 responses

Figure 8   Application of the European charter of access for research infrastructures

Does your university apply the guideliness provided by the *European Charter for Access to Research Infrastructures* in order to share its research facilities?

Yes 9.5%

No answer 29.7%

Under consideration 40.5%

No 20.3%
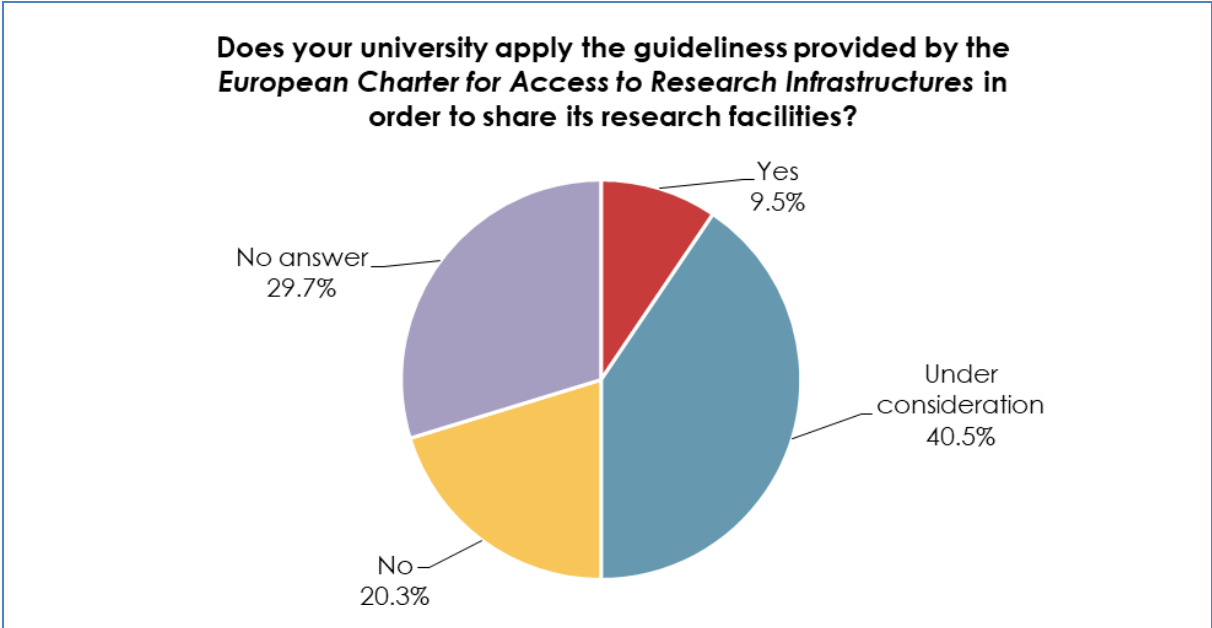
Note: Indicator 2.4; Percentages based on 52 responses (and 22 without answer)

Tracking users & future shared infrastructures

The share of universities keeping track of the number of users of its shared infrastructures coming from other universities (51.9%) is very similar to that of the universities not keeping track of them (48.1%), while 27% of universities did not provide an answer to this question.

Only a small number of universities (7 universities) among those keeping track of the number of users of its shared infrastructures were able to indicate an (approximate) number of users. The answers provided suggest that most universities lack a system to register the number of users of their shared facilities or were not able to easily report this number in a survey/monitoring instrument like the one tested in this project. This seems

to imply that data availability/quality in this area is still a challenge with implications for the options to design out evidence-based policies in this area.

The development of shared research infrastructures together with other universities seems to be highly relevant to most universities in our sample. 86.8% declare to be currently developing such plans as compared to 13.2% of universities that are not developing these plans. This is certainly a high share and builds on the long-standing tradition of cooperation between scholars in different HEIs. This tradition now more and more seems to spill over to research infrastructure planning, i.e., already *ex-ante* in the strategy development phase. Specifically for this question, it needs to be kept in mind that the respondents for this survey are members of the European Universities Alliances. These specific HEIs are *per se* committed to setting up plans for future cooperation in different areas. The positive results in this testing exercise are therefore not representative of the situation of HEIs in Europe in general.

5.2.2 TM 3: Human capital aspects of higher education

Human resource management

Human resources, i.e. the scholars working on the scientific breakthroughs of the future as well as the administrative staff supporting them, are probably the most important factor to make the HEI system fit for the challenges of the future. Most universities in our sample (51 out of 71, 71.8%) have already implemented a human resource strategy or action plan for human resource management (an example is the Human Resources Strategy for Researchers (HRS4R)). Furthermore, the universities report that the HR strategy actually has implications for the operational work within the HEI: The HR strategy or action plan is assessed by 44 out of 48 universities as(very) important for the day-to-day management of those universities.[23]

An HR strategy or action plan is currently under development in 16 (22.5%) of the responding universities. Only 4 universities (5.6%) are at the moment not involved in (the development of) an explicit strategy or action plan for HR.

71% (49 out of 69 responses) of the universities currently use open transparent and merit-based recruitment practices, as defined in the OTM-R Package, for their research staff recruitment processes. 1 out of 4 universities (24.6%) are currently working on this.

Gender equality

Gender equality is a highly important topic in the societal and policy debates and therefore also taken up as a topic among universities. More than half of the universities (45; 63.4%) report having a gender equality strategy and/or gender equality plan. 33.8% of the universities are currently developing this. Given the long time that gender equality has been on the political agenda (e.g. since 2012, 'gender equality and gender mainstreaming in research' has been one of the priorities in achieving the European Research Area), these results seem to be somewhat sobering as almost a third of the surveyed HEIs is only currently developing them. On the positive side, however, there is almost no responding HEI which does not have this topic on its agenda.

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[23] 37.5% (n=18) assess the HR strategy/plan as very important; 54.2% (n=26) as important; 6.3% (n=3) as moderately important and 2.1% (n=1) as slightly important

Figure 9   Existence of Gender Equality Plan or Strategy within universities

Does your university have a gender equality strategy and/or a gender equality plan?

No
2.8%

Under development
33.8%

Yes
63.4%
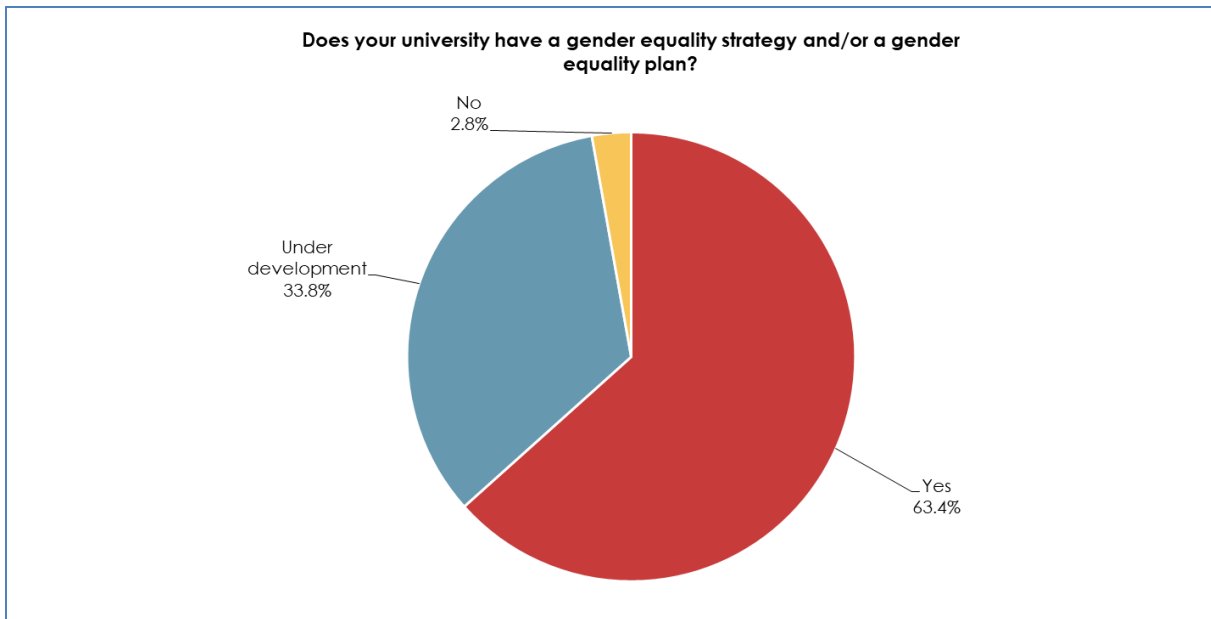
Note: Indicator 3.2; Percentages are based on 71 responses

88.4% of the universities indicate that their formal gender equality plan or strategy was published on the university website and was signed by the top management. In most universities (83.7%) resources and expertise is available to implement the gender equality plan strategy. In 3 out of 4 universities (76.7%) gender data is collected and monitored on a regular basis. Almost 70% of the universities offer their staff members awareness-raising training on gender equality as well as unconscious bias.

Figure 10 Statements on gender equality plan that apply to universities

Which of the following statements about your gender equality plan apply to your university?

A formal GEP document is published on university website and signed by top management — 88.4%

Commitment of resources and expertise in gender equality is available to implement the GEP — 83.7%

Sex/gender disaggregated data on personnel is collected and regularly monitored — 76.7%

Awareness raising training on gender equality and unconscious gender bias is offered to staff members — 69.8%

Note: Indicator 3.2b, Percentages are based on 43 responses, 2 universities did not reply

As shown in the figure below the share of female researchers in the universities of our sample is on average close to 50% among first stage researchers up to PhD (R1). At the level of recognized researchers, PhD holders or equivalent who are not yet fully independent (R2), the share of women is around 45%. Among the senior researchers, established and leading researchers (R3-R4) the share of females is the lowest, around 35%. It should be noted that almost one third of the universities could not answer this question as gender data was not available on the various researcher positions. In general, this pattern confirms findings from other surveys, showing that the share of women in more senior career stages often declines as compared to earlier (PhD) stages.

Figure 11 Share of female researchers in universities at various positions

What is the current share of females in your university within various positions?

Universities have developed and implemented various support structures for female researchers. A gender equality office or unit is the most often reported support structure at universities. 64.9% of the universities have dedicated offices dealing with gender equality and in 12.2% of the universities, this is under development. Almost half of the respondents have developed Gender Equality Networks[24] in their universities. Mentoring programmes for female scientists are becoming popular supports structures in the near future as 1 out of 5 universities are currently developing those programmes. The existence of training programmes and scholarships for female scientists are only reported by respectively 17.6% and 12.2% of the universities. For the latter two support structures, it should be noted that roughly 24% of the universities did not provide an answer.

Figure 12 Support structures for female researchers

Does your university have specific support structures for female researchers?
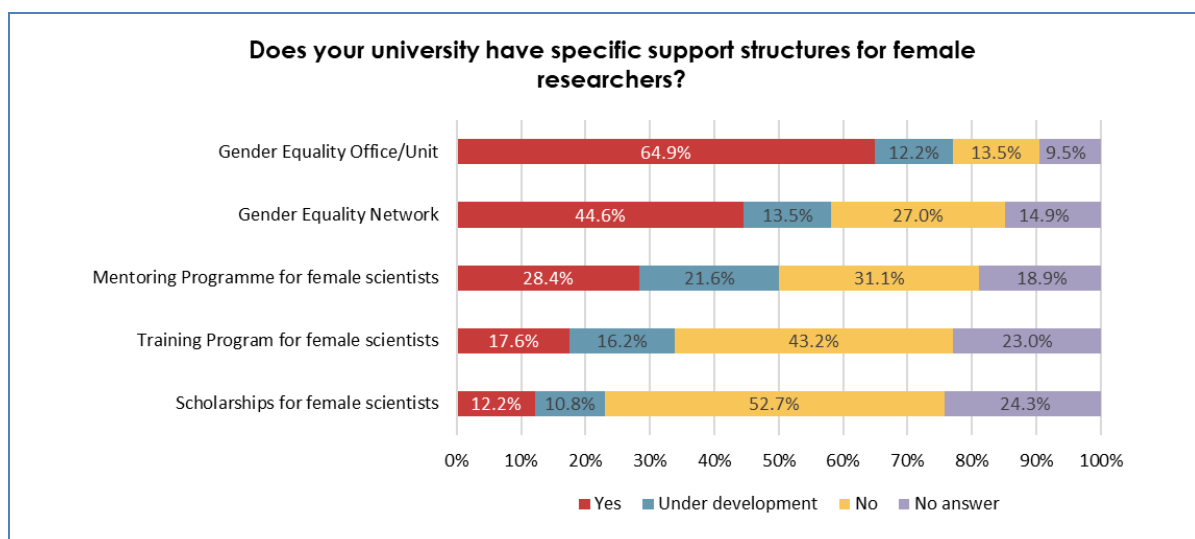
Note: Indicator 3.5, Percentages based on 74 responses.

Diversity

Diversity, defined in the survey as ethnicity, sexual orientation, health, religion, socio-economic background, are generally addressed by the universities. Almost two thirds of the universities (63.8%) have a diversity strategy or work plan and 23.2% of the universities are currently developing this. At this moment only 13% of the responding universities do not have a diversity strategy or work plan.

Figure 13 Existence of Diversity Strategy or work plan within universities
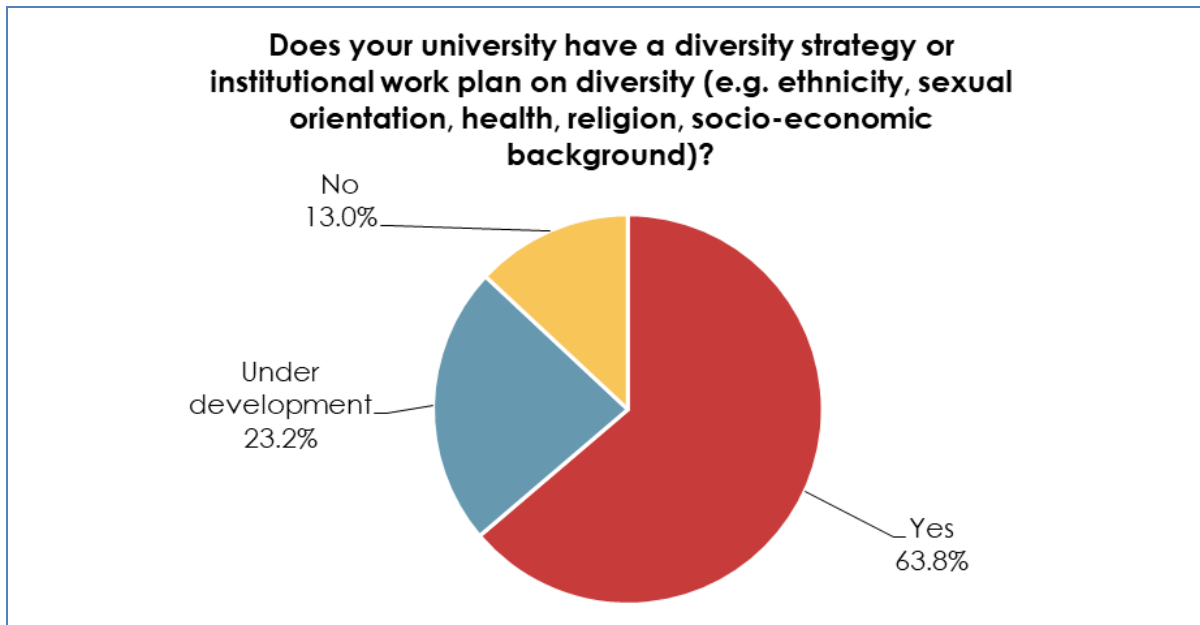
Note: Indicator 3.3, Percentages based on 69 responses.

Universities have already developed and implemented various *support structures for diversity.* A diversity office or unit is the most often reported support structure at universities. 62.2% of the universities have a dedicated office dealing with diversity policy and in 8.1% of the universities, this is under development. This means that in most universities there is both a gender equality office and a diversity office. In addition, half of the respondents offer training, for instance on the topic of implicit bias to raise awareness in their universities. Those trainings are becoming popular support structures in the near future, 18.9% of universities are currently developing those programmes. Diversity networks and a buddy or mentor program are mentioned by one third of the universities as support structures. It should be noted that 15-19% of the universities did not provide an answer to this question.

Figure 14 Support structures for diversity policy

Does your university have specific support structures in relation to policies about diversity?

	Yes	Under development	No	No answer
Diversity Office/Unit	62.2%	8.1%	18.9%	10.8%
Training (e.g. implicit bias)	50.0%	18.9%	14.9%	16.2%
Diversity Network	35.1%	12.2%	37.8%	14.9%
Buddy or Mentor programme	33.8%	12.2%	35.1%	18.9%
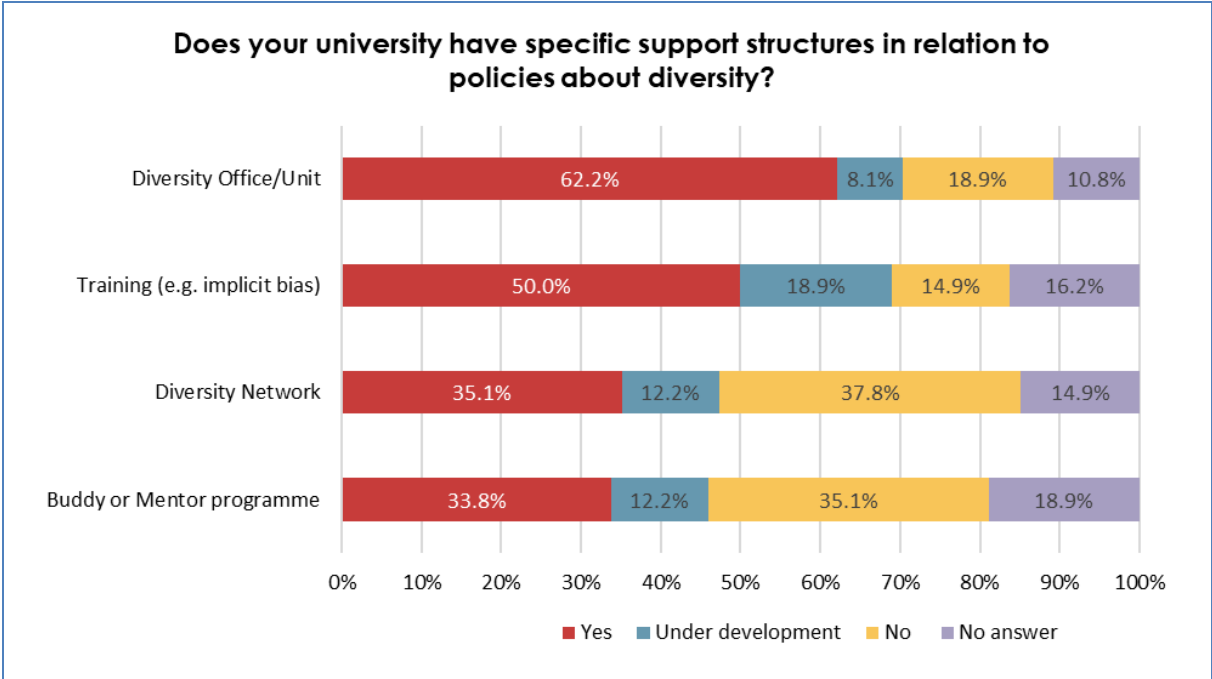
Note: Indicator 3.4, Percentages based on 74 responses.

Transversal competences and skills of researchers

In order to enhance the employability and support the inter-sectoral mobility of researchers, most universities in our sample have implemented a training policy on transversal competencies and skills. In the majority of the universities, the focus of these transversal skills training is on the development of early-career researchers (R1 & R2).

Figure 15 Existence of training policy on transversal competences and skills

Does your university have a training policy on transversal competences and skills to enhance employability and support inter-sectoral mobility of researchers?

	yes	Under development	No	Don't know
Doctoral students/candidates (R1)	66.2%	16.2%	9.5%	2.7%
PhD holders who are not fully independent (e.g. postdocs R2)	41.9%	29.7%	16.2%	8.1%
Established and leading researchers (R3-R4)	32.4%	23.0%	28.4%	9.5%
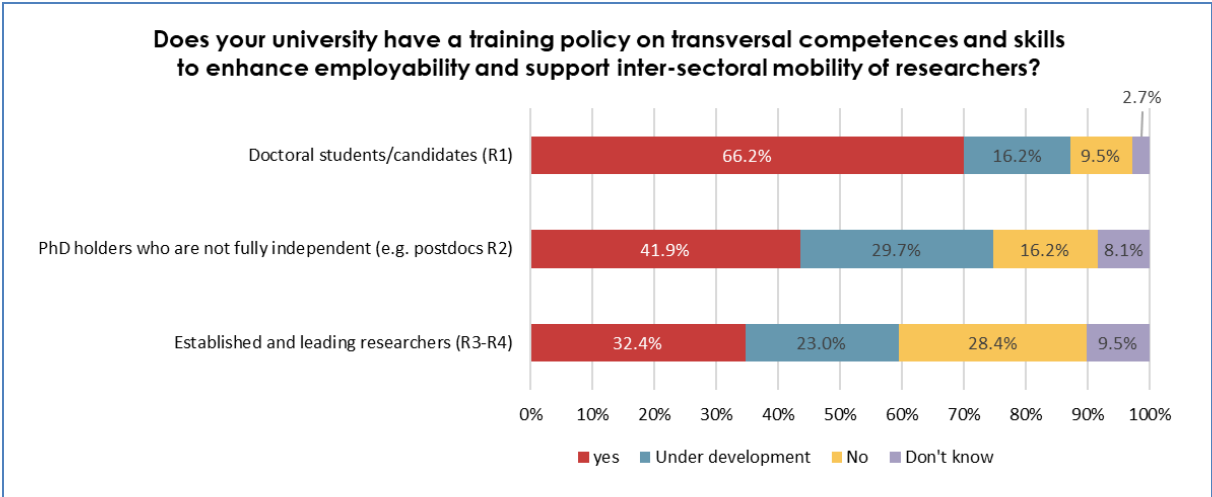
Note: Indicator 3.7, Percentages based on 74 responses.

Mainly early career researchers are attending training modules on transversal competencies and skills. In 1 out of 3 universities, it is reported to be even compulsory for PhD students/candidates to take this type of training. Results on the uptake of training offers by senior researchers (R3 and R4) should be taken with care as 38.1% of the universities has not collected data on this.

Figure 16 Uptake of training offers on development of transversal competences and skills

What is the uptake of trainings offers on the development of transversal competences and skills in your university?

Doctoral students/candidates (R1): Attended by only a few 12.8%, Attended by the majority 42.6%, Compulsory 36.2%, Don't know 8.5%

Early career post-PhD researchers (R2): Attended by only a few 47.8%, Attended by the majority 21.7%, Compulsory 4.3%, Don't know 26.1%

Established and leading researchers (R3-R4): Attended by only a few 45.2%, Attended by the majority 11.9%, Compulsory 4.8%, Don't know 38.1%

Legend: ■ Attended by only a few ■ Attended by the majority ■ Compulsory ■ Don't know

Note: Indicator 3.9, Percentages based on 47 responses for R1; 46 responses for R2; 42 responses for R3.

Overall, the answers to question 16 show that mentoring and/or employment guidance is given mainly to early-stage researchers (R1 and R2) in order to improve their skills and advance their academic or non-academic careers. These numbers of training go down gradually with rising seniority levels. It should be noted that 20-21% of the universities did not provide an answer to this question when asked about the existence of mentoring and guidance at the level of senior researchers.

Figure 17 Existence of mentoring and/or employment guidance

Does your university offer mentoring and/or employment guidance for researchers at diverse career levels in order to improve their skills and advance their academic or non-academic career?

R1: Yes 63,5%, Under development 16,2%, No 8,1%, No answer 12,2%

R2: Yes 51,4%, Under development 21,6%, No 9,5%, No answer 17,6%

R3: Yes 36,5%, Under development 17,6%, No 25,7%, No answer 20,3%

R4: Yes 27,0%, Under development 16,2%, No 35,1%, No answer 21,6%

Legend: ■ Yes ■ Under development ■ No ■ No answer

Note: Indicator 3.8, Percentages based on 74 responses.

Reforming research assessment

The survey results suggest that research assessments are taking into account results other than pure publication numbers (i.e. other types of research outputs, impact-related assessment approaches) are taken up (although to different degrees) by the majority (81%) of the responding universities. 1 out of 3 universities indicate that they have both

a policy/strategy and an action plan to adapt research assessments frameworks to reflect the value of various research outputs. Universities were asked in the survey to briefly explain the assessment, i.e. what kind of incentive and for what kind of activity. However, none of the universities responded to this.

Figure 18 Existence of policy strategy or action plan for assessment of the values and impact of research
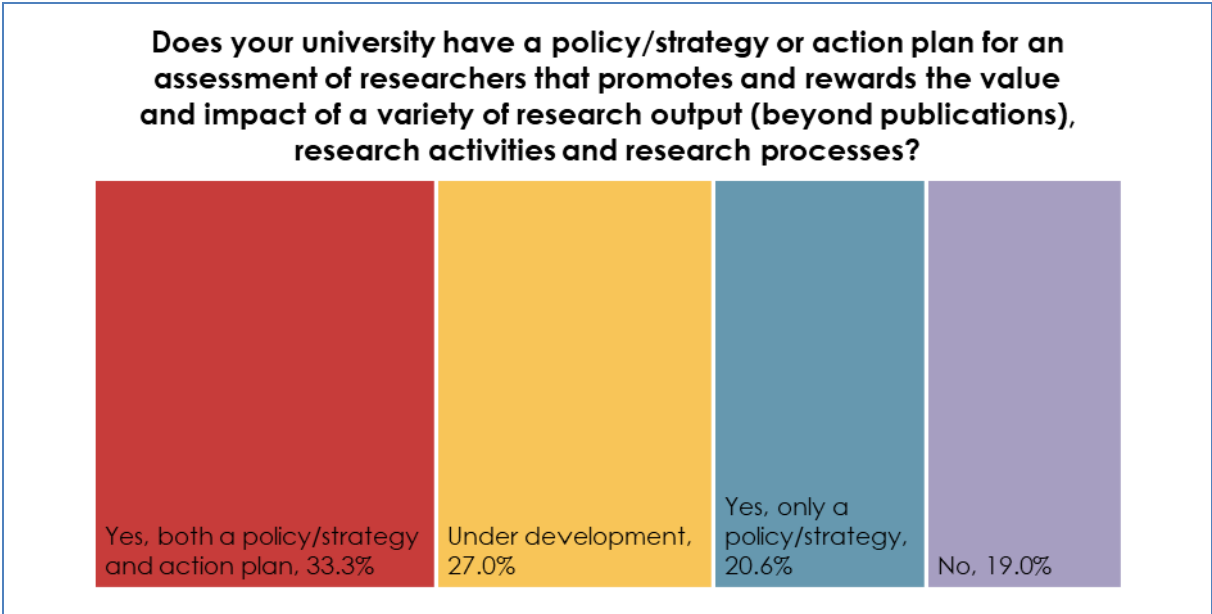
Note: Indicator 3.11, Percentages based on 63 responses.

More than half of the responded universities (54.5%) are currently using metrics other than traditional, quantifiable output indicators for recruiting, retaining, and promoting research staff. 34,9% are planning to do this in the near future (2-5 years). 31 universities reported examples of these so-called non-traditional indicators. The top 3 most mentioned indicators are in the field of education, dissemination/outreach of research and third mission.

Figure 19 Use of non-traditional metrics for recruitment and promotion of researchers
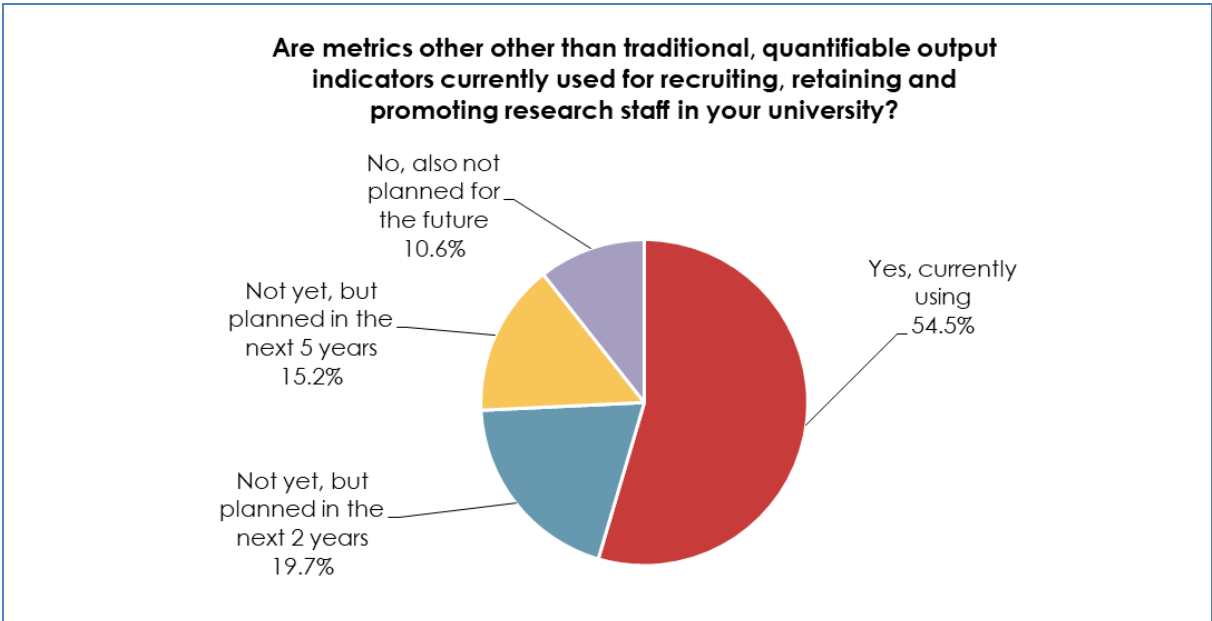
Note: Indicator 3.12; Percentages based on 66 responses.

Internationalisation

Overall, universities report having a share of 23.3% of international staff members among their overall staff. The percentage of international researchers is the highest at the level of PhD students/candidates (32,8%). However, results should be taken with care as the standard deviations are high. In addition, data was only available for half of the universities in our sample.

Table 10 Percentage of international staff members at universities

	R1	R2-R4	Overall
Average %	32.8	25.5	23.3
SD	24.7	27.5	26.0
Number of respondents	39	35	34

Note: Indicator 3.13.

More than one third of the research staff at the responded universities has international experience. PhD students/candidates have the highest percentages, on average 42.1% of the R1 researchers spent more than 3 months abroad. However, results should be taken with care as the standard deviations are high. In addition, only 14-16 universities have the requested data available.

Having this limitation in mind, in comparison with other data on researcher mobility (especially the MORE 4 study)[25] it seems that researchers at the European Universities approached for this survey are more internationally mobile than members of the "average university" in Europe. This is a plausible result, given the high international connectedness of the European Universities – in their European University Networks and beyond.

Table 11 Percentage of research staff with international experience at universities

	R1	R2-R4	Overall
Average %	42.1	35.9	36.9
SD	34.9	37.7	39.1
Number of respondents	16	14	14

Note: Indicator 3.14; Note: International experience = >3 months abroad.

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[25] More 4 data showed that 23% of the R1-R2 researcher has international mobility of >3 months during PhD. International mobility in post-PhD stages: 27%. https://cdn5.euraxess.org/sites/default/files/policy_library/more4_final_report.pdf

5.2.3 TM 4: Co-operation of universities with their surrounding ecosystem

(Formal) collaboration partners

Exchange with partners from other sectors is important for universities in order to (dis)cover relevant themes and jointly solve challenges. While HEIS play an important role in creating new knowledge, they must integrate their various innovation activities into a more coherent ecosystem including the industry, society, and the public sector. Having a mapping of the existent partners from diverse sectors can thereby lead to an easier, faster identification of needed partners. Overall, the survey results show that the cooperation of universities with their surrounding ecosystem and its respective actors is an activity taken up by the majority of universities. 66.7% of the respondents indicate that they have an inventory of the collaboration partners (e.g. a mapping of cooperation agreements) with all sectors (private firms, public sector, society). Those universities that do not have an inventory for all sectors, but for individual ones, show a prioritisation of R&I partners of 1) other research and education organizations (19,7%), 2) private firms (15,2%) and 3) public sectors organizations (13,6%). The number of universities having an inventory of R&I collaboration partners from the 3rd sector/society is significantly lower (1,5%). Cooperation with society is often ad hoc and does not take a formal agreement format, thus these types of partnerships either escape mappings/inventories or are not yet very common (connection to TM 6, Chapter 4.6).

Figure 20 Existence of mappings/inventories of R&I collaboration partners from different sectors
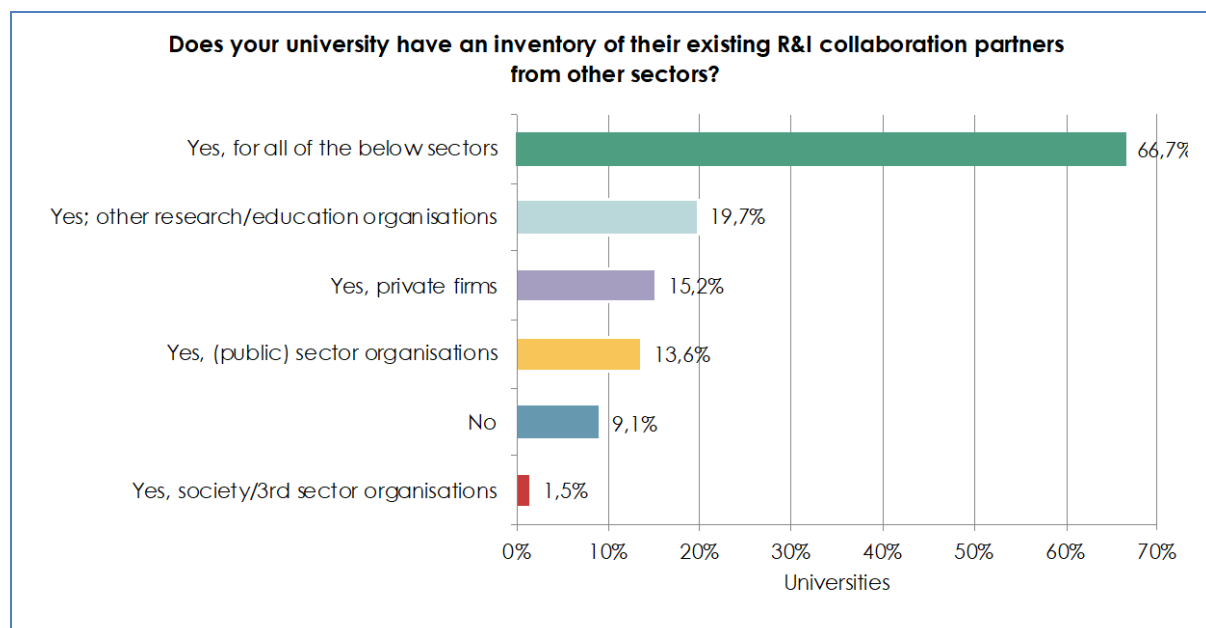
Note: Indicator 4.1; Percentages based on 65 responses.

Having co-publications with industrial partners is often the result of collaborative activities between actors from both sectors (for example as the result of a joint PhD programme or the development of a solution to an industrial problem). The respective data shows that 88% of the 65 universities indicate that the share of co-publication with industrial partners is between 0% and 10%. Only 8 universities indicate that the share of co-publications is higher than 10% (with one university indicating it is as higher as 19%).

Income from regional resources can be a sign of collaboration with regional partners or conducting R&I work in the interest of regional stakeholders. A high share of external, regional research revenues can therefore imply that research efforts are geared towards the needs of regional stakeholders. 54% of the respondents of this question indicate that the share of external research revenue from regional sources is between 0-10%, while only 13% indicate that the share is above 50%.

Figure 21 Percentage of co-publications of your university with industrial partners[26]

Co-publications with industry
(% of all university research publications)

- 0-5% - 5-10% - 10-15% - 15-20%
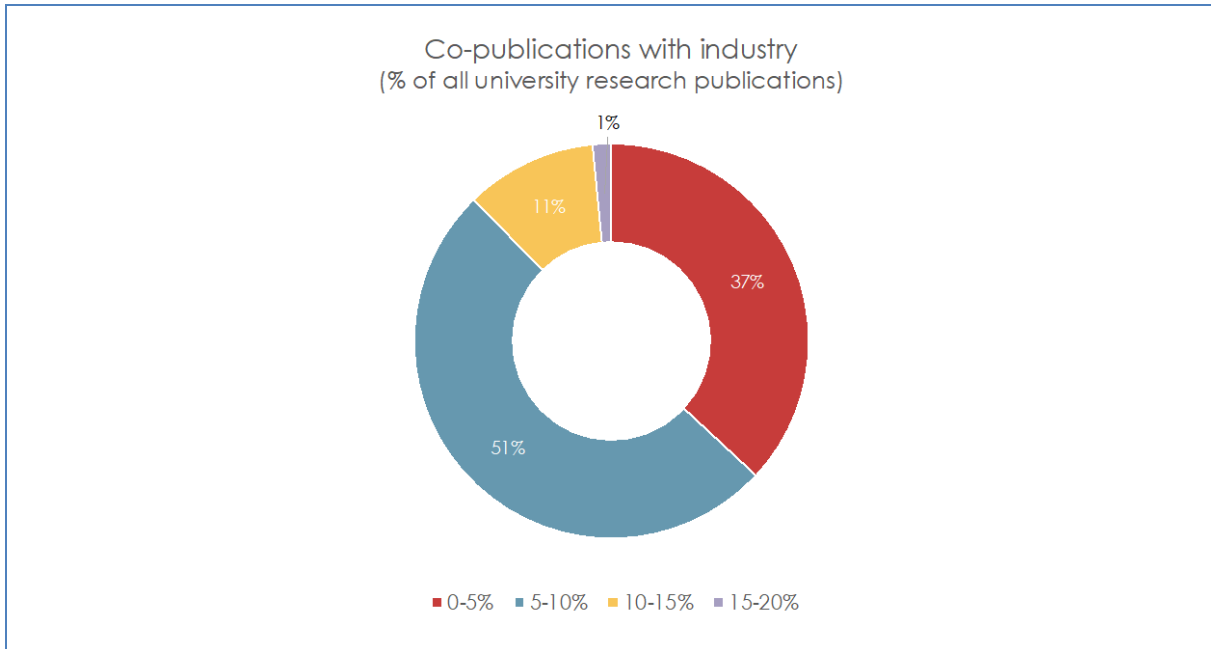
Note: Indicator 4.9; Percentages based on 65 responses.

Figure 22 Income from regional sources excluding governmental income(U-Multirank)[21]

Income from regional sources excluding
governmental income (%)

- 0 - 1%-10% - 10%-20% - 20%-30% - 30%-40% - above 50%
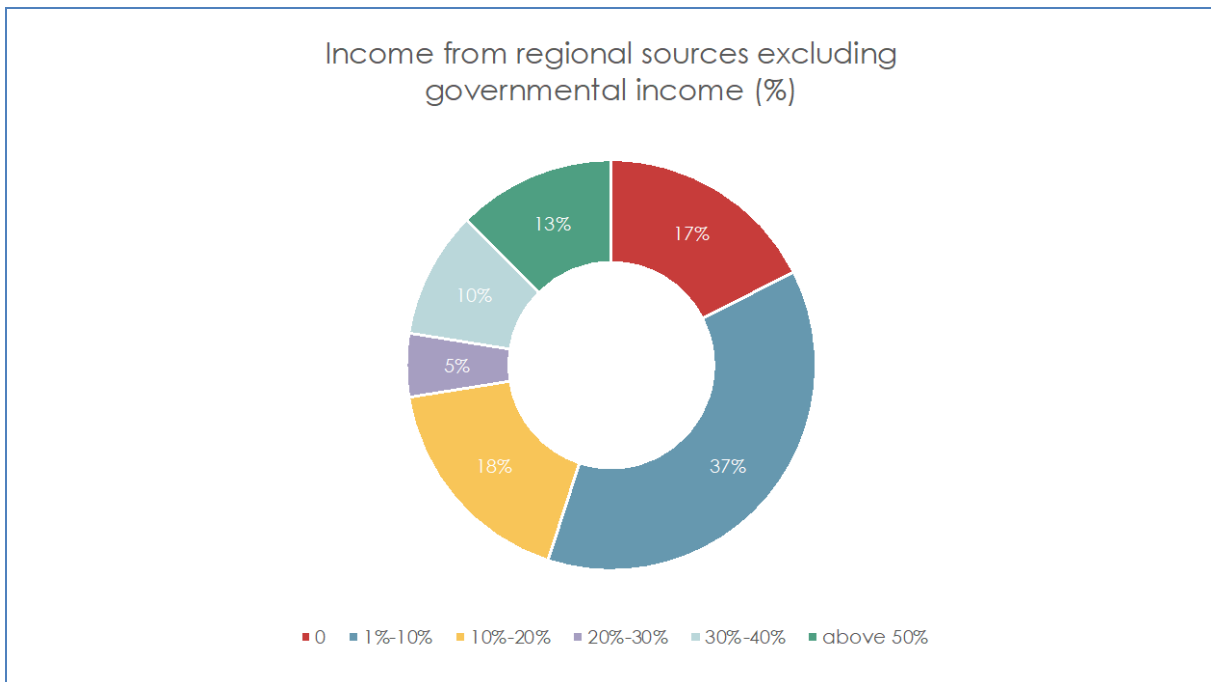
Note: Indicator 4.10; Percentages based on 40 responses.

Collaboration spaces and initiatives

A rather high number of universities have confirmed the existence of collaboration spaces (e.g. innovation labs, hubs, science parks) and collaboration initiatives (e.g. networking platforms, business lunches) that encourage engagement with actors from outside their university. At the same time, another 16.4% and 13.6% indicated that collaboration spaces and collaboration initiatives are under development. This is a clear sign of universities

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[26] The data collected through the test survey was inconsistent and therefore could not be used. Accordingly, data used and presented in Figure 21 and Figure 22 was collected from the U Multirank data base, considering only the 74 universities that participated in the survey.

taking collaboration serious by developing physical spaces and initiatives to engage with outside partners.

Figure 23 Existence of collaboration spaces and initiatives
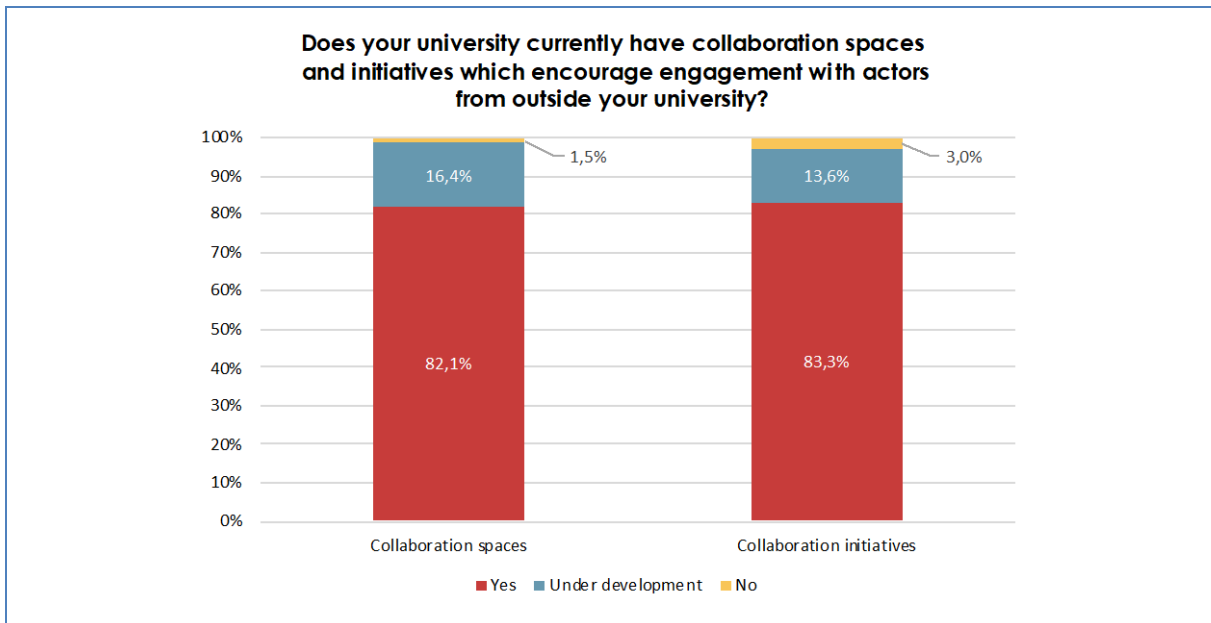
Note: Indicator 4.2; Percentages for collaboration spaces based on 67 responses; Percentages for collaboration initiatives based on 66 responses.

R&I cooperation support structures

There is a need for a professionalisation of R&I support/interface services and structures as researchers do not have the resources to cover these types of activities/tasks within the current, "traditional" academic setting. Thus, the existence of different types of support / interface services and structures allow academics to realise R&I activities (with actors from other sectors) alongside their academic duties. The numbers for R&I support structures are generally very high, with an elevated number of respondents indicating that they have support structures for a) consultancy/collaborative agreements, b) IP protection, c) company creation and d) liaison with external stakeholders (in this order). In comparison, a reduced number (42.6%) of respondents indicate that they have the possibility of accessing venture funds co-provided/ organised by their universities – therefore opening a potential field of development. Respondents have highlighted other/additional support structures such as innovation advisors that verify/validate entrepreneurial ideas, support in accessing external/third party funding (such as proof of concept funds), and annual competitions for business ideas.

Figure 24 Existence of R&I collaboration support structures
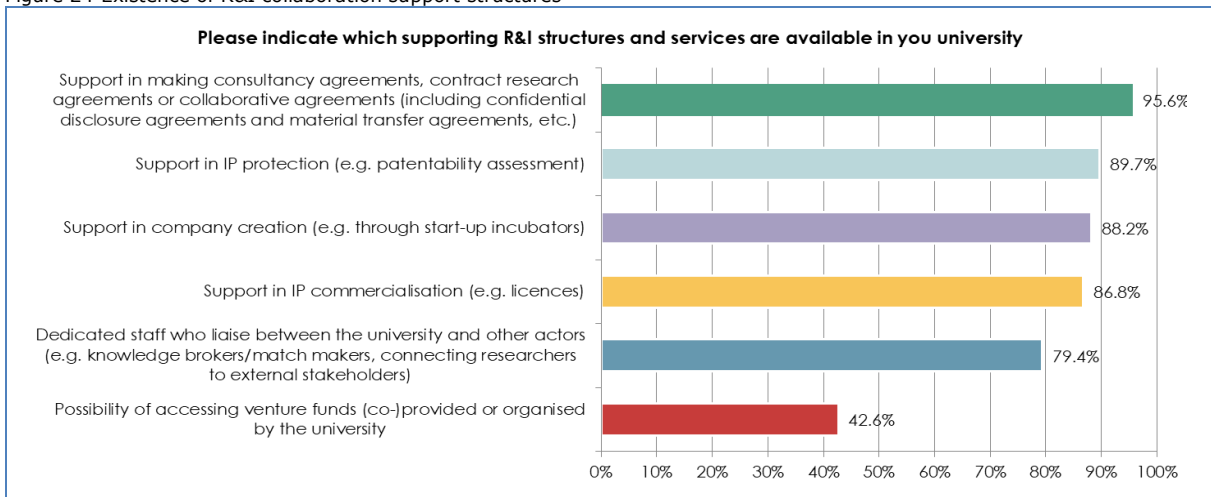
Note: Indicator 4.3; Percentages based on 68 responses.

Entrepreneurial training & spin-off companies

Academic entrepreneurship (and as a result university spin-offs/outs) are important channels for innovation and knowledge transfer. Thus, training academics to develop an entrepreneurial mindset, but also making sure academics have the adequate knowledge, skills, and resources for entrepreneurial activities are highly important. Entrepreneurial training is aimed at ensuring that researchers have (access to) the necessary tools and skills to research and implement innovation. Overall, the data displays that entrepreneurial training is offered predominantly to early-stage researchers (85.9% of the respondents offer introductory courses for doctoral candidates, 56.1% offer advanced courses for doctoral candidates). These numbers of training descend gradually with rising hierarchy levels. Thus, senior researchers are offered less entrepreneurial training (51,8.2% introductory courses, 28.3% advanced courses). These findings are expected, as the focus on entrepreneurship is often concentrated on young, early-stage researchers. Nevertheless, the data also shows that there is room for development within universities in that senior researchers bear the potential to translate their advanced knowledge and skills into new entrepreneurial ideas.

Figure 25 Entrepreneurial training offers
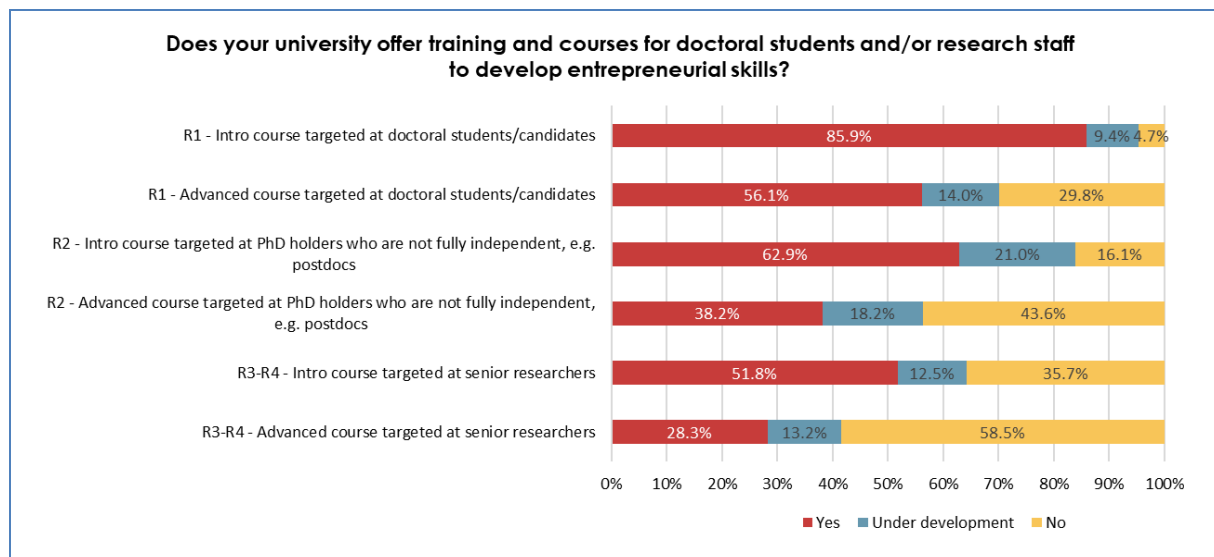
Note: Indicator 4.4; Percentages based on actual number of responses in each category (R1 – intro: 64; R1 – Advanced: 57; R2 – intro: 62; R2 – Advanced: 55; R3-R4 – intro: 56; R3-R4 – Advanced: 53).

Figure 26 Number of new spin-offs (nr/1000 fte) (U-Multirank)[27]
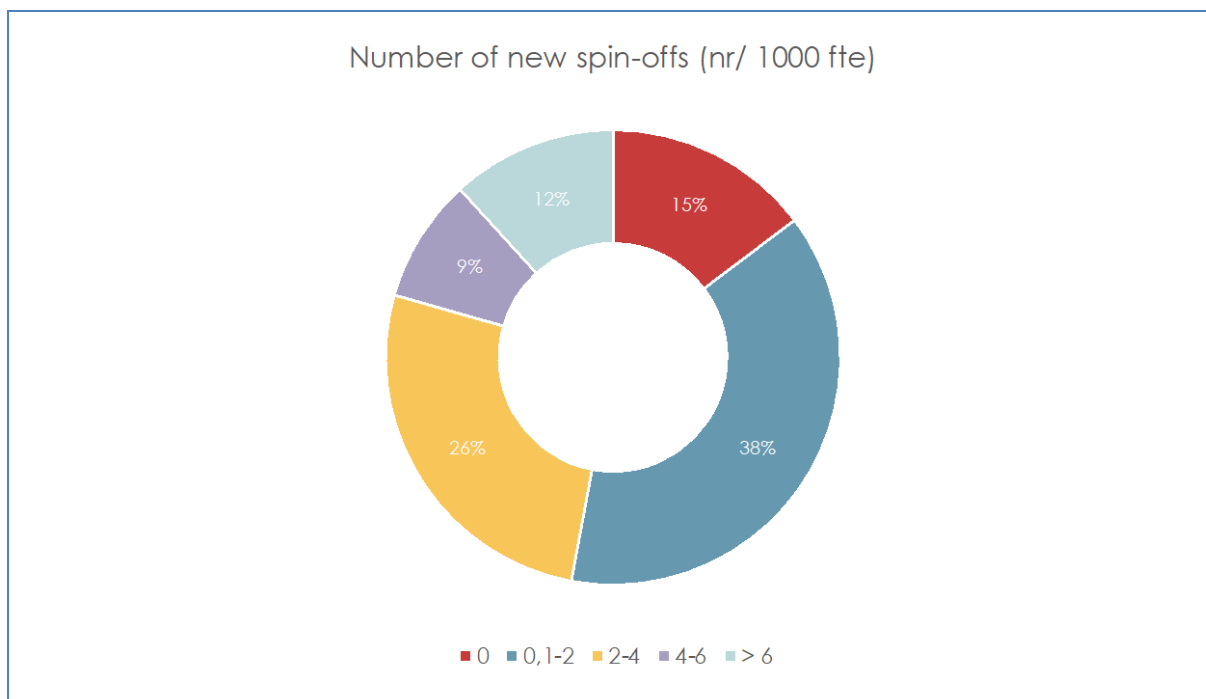
Note: Indicator 4.5. Numbers based on 34 responses.

Career opportunities outside the higher education sector

Connecting early-stage researchers (R1 & R2) to the "outside world of academia" has been described as an important task of universities. On the one hand, this connection enables the academic world to understand the needs of external stakeholders (such as industry). On the other hand, this connection also enables academics to know what employments options they have outside academia. Courses and workshops as well as career days are the most frequently used methods to showcase to PhD students/candidates (R1) future career possibilities in sectors outside higher education (policy, industry, society). As personal career backgrounds and developments can be very diverse, the method of individual career coaching/mentoring could be considered more within universities (66.7% indicate they use this method). Additional entries by respondents (field "other") refer to advanced training courses of the HR Development Department, transferable skills training, and PhD Career Design Programmes involving diverse actors from the university (such as professors, PhD programme directors, PhD students, national and international employers, etc.).

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[27] The data collected through the test survey was inconsistent and therefore could not be used. Accordingly, data used and presented in Figure 26 was collected from the U Multirank data base, considering only the 74 universities that participated in the survey.

Figure 27 Information/training on career opportunities outside higher education

Does your university offer information and training to PhD students/candidates (R1) to get insights in their future career possibilities in various sectors outside higher education (science, policy, industry, society)

- Courses and/or workshops: 86.4%
- Organisation of career days: 81.8%
- Existence of career coach/advisor/mentor for career guidance: 66.7%
- Existence of (online) career platform: 30.3%

Note: Indicator 4.6; Percentages based on 66 answers / multiple answers possible.

Conducting PhD research together with stakeholders from sectors outside the university poses the opportunities to get to know challenges/missions that "need" research and innovation support as well as the possibility to get to know future employers. Nevertheless, the respondents of the survey have shown clear difficulties in indicating the share of industrial doctoral programs as well as the share of PhD students with part-time internships/secondments. Of 74 universities that have participated in this survey, 51 (thus almost 70%) have not answered the question on industrial PhD programs, while 60 (thus above 81%) did not answer the question on part-time internships. The received responses are therefore very limited in their validity/significance.[28]

As stated, involving external stakeholders in the design and implementation of PhD training assures that the developed skills, competencies, and knowledge of the PhD candidates are relevant for sectors outside the university. Potential future employers (public organizations, companies, etc.) involved in the design of PhD training can thus take part in the assessment of the needs for career intervention for PhD students and thereby promote aspects such as lifelong employability and sustainable careers.

The data shows that of the 74 survey respondents, 54 have answered the question on involvement, 56,4% indicating that they are either involving external stakeholders or are planning to do so in the near future. The rather high number of 42,6% indicating that they do not involve external stakeholders shows that the usefulness of involving external stakeholders is not visible to universities/stakeholders or that the process is rather complicated and therefore not executed.

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[28] Of the limited answers received, 12 universities indicated that 0-5% of doctoral programs are industrial, 5 universities indicated that 6-10% of their PhD programs are industrial doctoral programmes and 6 indicated that above 10% of their PhD programmes are industrial doctoral programmes.

Figure 28 Involvement of external stakeholder sin PhD training

Are external stakeholders/users currently involved in the design of the PhD training program at your university?

- No 42.6%
- Yes 46.3%
- Not yet but will be in near future (<2 years) 11.1%
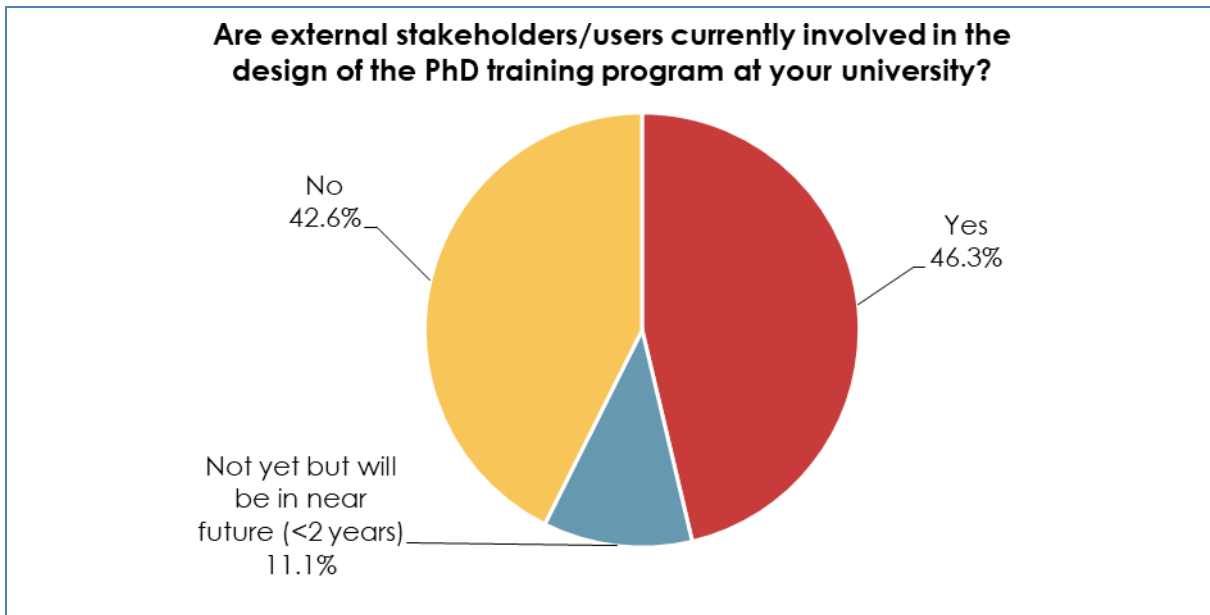
Note: Indicator 4.8; Percentages based on 54 answers.

5.3 Methodological results and implications for the methodology

5.3.1 General

Apart from getting insights into transformation among the HEIs of the European Universities Alliances, the survey carried out for this project aimed to finetune the methodological approach for a monitoring instrument regarding transformation among HEIs in Europe.

Information regarding necessary adaptations of the survey was captured directly and indirectly. Regarding the latter, an analysis of response rates, response patterns etc was carried out. Results are reported further down in this report.

The direct feedback was captured in the survey itself. In total 30 out of 74 respondents (41%) filled in the survey question asking for methodological/general feedback. 11 universities provided overall, generic positive feedback, focusing on the survey design and/or interface. Examples for such positive feedback are: complete questionnaire, clear design, good approach, good balance between multiple choice and open questions, manageable length of the survey, user-friendly interface. Some universities emphasised the usefulness of the survey as an opportunity to reflect on their own practices stating that the survey made them consider what they have achieved as a university and as an alliance as well as considering where further improvement needs to be undertaken.

Other universities (20) reported specific feedback which can be used to optimize the methodology. This feedback is displayed in Table 12, distinguishing between different categories/topics and outlining whether/how these recommendations could lead to a subsequent change in the overall methodology.

Table 12 Changes in the methodology due to proposed alterations

Topic	Comments by respondents	Suggested changes in methodology
Diversity of questions / themes	Respondents report that in order to answer the questions accurately several professionals from the universities were needed/involved. This elevated the internal coordination effort. Respondents report that it was time-consuming to fill in quantitative questions ("how many…", "what is the percentage of …"), they did not always know where to find the answers.	Due to the nature of the survey and the 6 diverse transformation areas, we see no way the diversity of the questions can be minimised. To facilitate the forwarding of different parts of the survey to different respondents within the same institution, a word version of the question was provided. This way, the person who submits the answers digitally collects written answers in one document. In a future survey, personal login/access to the online survey could be provided. This would allow the completion of the survey from various individuals in parallel. Furthermore, more time would need to be given to universities to consult various persons/units within the organisation.
Nuances of answers	Respondents report that for some questions it was difficult to answer "yes" or "no", and that they would have preferred a more nuanced selection of answers.	We do not recommend including more nuances as this would limit the way the results can be processed for visualisation purposes and effectively communicated (e.g. in a dashboard). Too much detail would be counterproductive. Another additional option would be to include an open text field for some questions. This could give respondents space for comments and explanation (e.g. explaining that some data is only available for some areas of activity, but not comprehensive or university-wide). Again, giving room for explanations significantly elevates the resources needed for analysis and therefore needs to be a conscious choice.
Data availability	Data that is publicly available (such as the U Multirank data) could be collected automatically.	The project team rejects the collection of publicly available since not all universities participate in U Multirank (and other rankings). Thus, the data of those universities would be missing in the results.
Timing	The complexity of the survey questions results in universities needing a significant amount of time in completing the survey.	In the future, the survey could be open for an even longer time frame (during the testing run, universities were given 4 weeks to answer). Universities could be alerted several months in advance regarding the timing of the survey.
Others	The alliance on fine arts academies is a special case and the survey methodology is not appropriate for them.	Universities with specific thematic and methodological foci need to be embraced or targeted by specific survey versions.
	Construction of a few short and topic-specific questionnaires which could be sent to relevant experts within the university to acquire more accurate results. Avoid constructing overarching questionnaires.	We support the inclusion of expert views and qualitative data regarding institutional developments. This would be in line with the suggested triangulation of the survey data with case studies (see Section 2.1 and 6.2).

5.3.2 Specific changes

In Table 13 we outline recommendations regarding more specific changes, often being related to either specific questions or methods used. The table outlines those questions tested in the survey that have very low response rates (30% or higher of non-response rate) or were responded in a very diverse manner, making it impossible to cluster and compare answers. The high non-response rates indicate that universities found it either hard/impossible to answer and/or would have needed more time to collect the respective data. We give concrete suggestions to solve those challenges and assure the next survey would include higher numbers of responses. The diversity of answering opportunities can be minimised by adapting the wording of the question (including clearer instructions) and by including limitations regarding the response options of the survey fields. The respective questions and suggestions for improvements are outlined below.

Table 13 Changes in the methodology due to low response rates

TM: Question	NNR[29]	Suggested changes in methodology
TM2: Please indicate the number of users of your shared research infrastructures coming from other universities during the calendar year 2020.	73%	Although the non-response rate is very high, answers are diverse and respondents pointed out that the numbers are not easily accessible (they are often collected at different departments / by the infrastructures), we suggest **keeping** the indicator. The reason for keeping an indicator that is not easily tested is that this indicator is the key answer to transformation area 2. Additionally, we assume that having more time to answer the survey will enhance response rates.
TM3: What is the uptake of training offers on the development of transversal competencies and skills in your university?	36,5%-43,2%	This question is a qualitative follow-up question that is only asked when answered positively to "Does your university have a training policy on transversal competencies and skills to enhance employability and support inter-sectoral mobility of researchers?". It is therefore aimed at getting additional insights/measuring progress. A lower response rate is considered acceptable. We suggest **keeping** the indicator, also assuming that more time to answer the survey will enhance the response rate.
TM3: What is the percentage of the international research staff at your university at various levels?	47,3%-52,7%	We suggest **keeping** the indicator, assuming that more time to answer the survey will enhance the response rate.
4: Does your university offer training and courses for doctoral students and/or research staff to develop entrepreneurial skills?	13,5%-58,1%	Response rates vary between introductory and advanced courses as well as between R1-R4. We suggest **keeping** the indicator as it would not be reasonable to only keep those parts of the question with good response rates.
TM4: Please indicate the approximate number of newly founded spin-off companies per year.	N.A.[30]	The survey question needs to be adjusted/finetuned. Since the question is related to the U Multirank ranking, it should be exactly the same as in the ranking (including explanatory text elements): **Please indicate the number of new spin-offs (NB: i.e. firms established on the basis of a formal knowledge transfer arrangement between the university and the firm) created in the calendar year XX by the university (per 1000 fte academic staff).**
TM4: What is the current share of PhD students/ candidates in industrial doctoral programmes in your university?	68,9%	Although the non-response rate is high and respondents pointed out that the numbers are not easily accessible (they are often collected by the different departments / individual PhD supervisors, etc.), we suggest **keeping** the indicator. The reason for keeping an indicator that is not easily tested is that this indicator is a key answer to transformation area 4. Additionally, we assume that having more time to answer the survey will enhance response rates. PhD programmes conducted together with industry are getting more popular (receiving more funding) and thus numbers are expected to rise.
TM4: Are external stakeholders/users currently involved in the design of the PhD training program at your university?	37%	We suggest **keeping** the indicator (same argumentation as for the Industrial PhD Programs)
TM4: What is the percentage of co-publications of your university with industrial partners?	60,8%	The survey question needs to be adjusted/finetuned. Since the question is related to the U Multirank ranking, it should be exactly the same as in the ranking (including explanatory text elements): **Please indicate the % co-publications with industry during the calendar year XX**

[29] non-response rate
[30] The data collected via the survey did not seem reliable (e.g. the average number of spin-off companies founded by students and doctoral candidates was twice as high as the total number of newly founded spin-off companies).

TM: Question	NNR[29]	Suggested changes in methodology
		(NB: publication with author of a for-profit business or private R&D unit, excluding for-profit hospitals and education organisations) (The percentage of a university's research publications that list an author affiliated to an address of a for-profit business enterprise or private sector R&D unit).
TM4: Please indicate the external research revenues coming from regional sources.	60,8%	Responses to this question include percentage data, full numbers (with and without currency identification), decimal numbers, text responses. The survey question needs to be adjusted/finetuned. Since the question is related to the U Multirank ranking, it should be exactly the same as in the ranking (including explanatory text elements): **Please indicate the income from regional sources during calendar year XX** **(NB: Revenues from regional sources as a percentage of total revenues) (The proportion of external research revenues - apart from government or local authority core/recurrent grants – that comes from regional sources (i.e. industry, private organisations, charities).**
TM3: Which of the following statements about your gender equality plan apply to your university?	69,8%	Very high non-response rate (over 50%) and a rather specific question. We suggest **eliminating** this indicator/survey question.
TM3: Which percentage of your research staff has spent more than 3 months abroad?	78,3% - 81%	The non-response rate to this question is very high and respondents reported that this data is often not available to universities (not even to HR managers). We suggest **eliminating** the indicator.
TM4: What is the current share of PhD students/candidates with part-time internships/secondments during their PhD trajectory?	81,1%	The non-response rate to this question is very high and respondents reported that this data is often not available to universities. We suggest **eliminating** the indicator.

NB: Percentages in red indicate a non-response rate over 50%; Percentages in green indicate a non-response rate between 30-50%.

6 Dashboard Concept

6.1 *Background on dashboards and examples*

Policy dashboards (or observatories)[31] have become important tools for monitoring developments in a wide range of fields like economic development or SDGs. They are useful instruments that can address different actors and have various functions. Most of them provide **information** by visualising complex data collected specifically for the dashboard or coming from existing databases. Thereby they make information more comprehensible to the public, which contributes to the idea of inclusive and open science and policymaking. In form of a digital monitoring platform, this information can be updated continuously by adding new findings and displaying progress accordingly.

Another function of dashboards is the **communication** of information, including interaction with stakeholders or a relevant community. Such dashboards usually use tools like blogs or news sections, where they share information by stakeholders. The collection of stakeholders' inputs as part of the data collection process is another way of interaction with stakeholders especially used by international dashboards.

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[31] The terms „dashboard" and „observatory" are often used interchangeably for a monitoring tool or platform. However, one could differentiate that "observatory" stresses the function of continued monitoring while, "dashboard" rather points to the at-a-glance visualisation of the monitored data. In the following we use the latter.

The formats and tools of dashboards usually depend on the users, whose needs they should address. Potential users with different needs are policymakers, stakeholders (like HEIs), and/ or the public on regional, national, or international level.

Today, many private and especially public institutions like the European Commission, UN organs, the OECD etc. use different kinds of dashboards and make them publicly available. For the conception of a **dashboard on the transformation/ institutional development of universities** they can serve as an inspiration and need to be taken into account to avoid duplicating existing work.

In the following, a selection of existing dashboards/ observatories are presented as examples for structure and visualisation (for an overview, see Table **14**). The examples have been selected to explore different designs of dashboards regarding goals, tools, (data collection) and creative data visualisation.

The first example is the **UN Secretariat Gender Parity Dashboard**. It is a good model for a simple information tool for the public that fulfils transparency and accountability standards. The dashboard displays on a single page the latest gender balance data of international staff in the UN Secretariat. The user can filter interactively the data on gender balance by entity or job level for displaying respective charts. The dashboard however does not illustrate progress and contains only the latest available data. Its limited function (informing the public in accordance with transparency commitments) makes this tool a clean and easily accessible instrument.

Some dashboards already exist in the area of higher education policy as well. Most of them display rankings, e.g., U-Multirank, THE World University Rankings (and very similar Shanghai Ranking), and CWTS Leiden Ranking. These dashboards have in common that they display ranking lists of universities and their scores (e.g., of teaching, research, SDG impact, or as an aggregated score). Interactively these lists can be filtered or sorted by different criteria. In U-Multirank for instance it is possible to personalise many aspects of the ranking by selecting specific categories like size and status of institution, countries, or fields of study. Leiden Ranking's selection options (i.e. geographical position, indicator type) are presented more compactly and can be adjusted easily. THE offers only geographical and subject-related filters. HEI dashboards usually share rather abstract information on their indicators and do not visualise their data in graphs or charts: U-Multirank uses simplified grades (A to E) for ranking universities, THE and Shanghai Ranking operate with a single aggregated score (and options to see the values of separate indicators) – all present their data in a list.

A special case of university ranking dashboards is the Leiden Ranking. In contrast to the others, it does not aim to support students or researchers in their decision for an institution but to inform policymakers, researchers, and the public on the scientific performance of universities. Leiden Ranking also visualises the position of universities in three forms: in a list, chart, and map view. However, all discussed HEI dashboards focus on ranking individual universities and none of them provides aggregated data (visualisation) on groups of universities, for example for all universities in France, or developments over time. In addition, indicators are not visualised separately, which makes it difficult to monitor and compare separate areas of development (as transformation modules).

Figure 29 Exemplary snapshot of comparative visualisation of various universities within U Multirank

Source: U Multirank (2021)

Such requirements are usually met in more complex dashboards, which monitor progress and include comparing elements. Typical examples are dashboards that inform on the current state or progress of the Sustainable Development Goals (SDGs), for instance, the **SDGs Benchmarking Tool** by the European Spatial Planning Observatory Network (ESPON). Its goal is to support regional governments in achieving the SDGs by comparing regions to each other. For this purpose, it can display the values of an indicator of a specific SDG in a selected region and the values of its benchmarking group at once. The dashboard offers three types of visualisations:

- (1) a geographical map showing the current indicator values of the selected region and the benchmarking group,

- (2) a distance to target visualisation for displaying a region's performance compared to measurable goals of four indicators (cf. Figure 30), and

- (3) a progress-over-periods-visualisation in a timeline (compared to the benchmark group).

Additionally, relevant initiatives to the selection of SDG and region can be explored in a separate library. With regard to the concept of a **university transformation dashboard**, especially the latter two modes of visualisation of the SDG Benchmarking Tool could be a model. Similar to SDG indicators, the developed indicators per transformation module could be part of such an interactive tool. Instead of regions, universities and respective benchmarking groups could be the second selection option. A corresponding dashboard would inform universities on their transformation progress by comparing them to benchmark groups.

Some other dashboards on the progress of the SDGs use similar illustrations, but most of them are less sophisticated or less user-friendly. E.g., the dashboard on Youth SDGs of the Office of the Secretary-General's Envoy on Youth uses maps and charts to display indicators of youth-relevant SDGs over time and per country. However, this dashboard offers fewer options for interaction and illustration.

Figure 30 Example of a distance to target visualisation in the ESPON SDG Benchmarking Tool
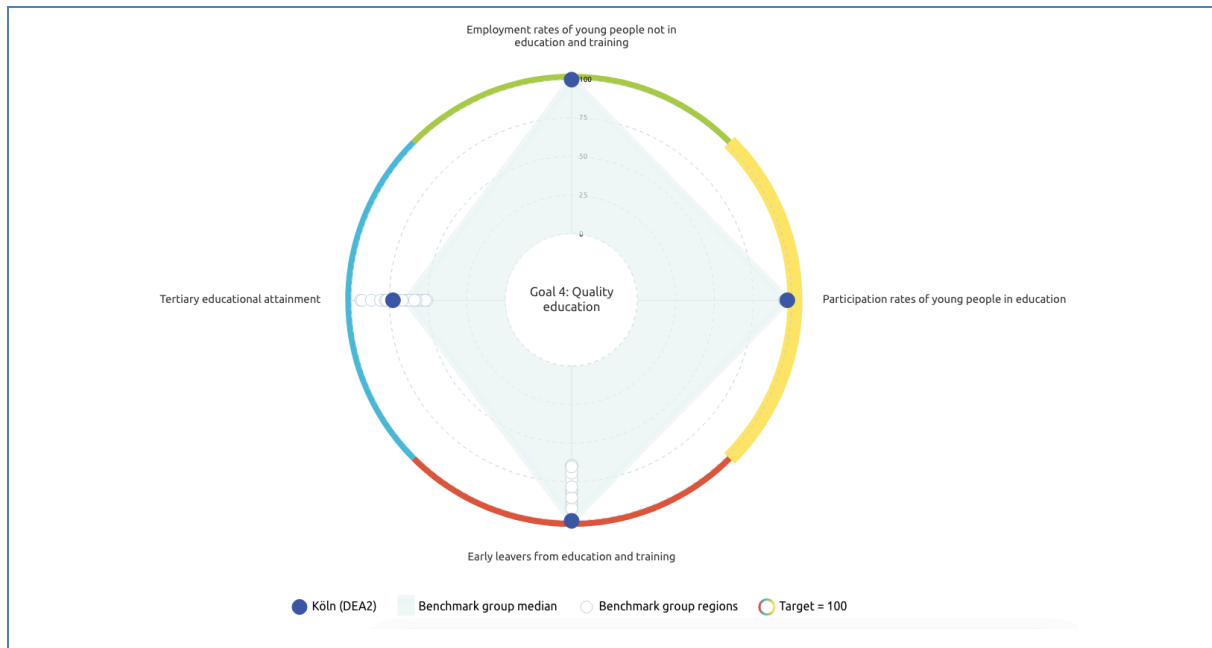
Source: ESPON SDG Benchmarking Tool (2021)

Other useful and publicly available dashboards are provided by the OECD, e.g., the Going Digital Toolkit, the AI Policy Observatory (OECD.AI) and the STIP Compass. Similar to ESPONS' SDG dashboard, the **Going Digital Toolkit** addresses primarily countries. It aims to support governments in decision making by informing them about their state of digital transformation. The material is structured along the seven policy dimensions of the respective strategy, the Going Digital Integrated Policy Framework. Values of indicators of each dimension can be illustrated per country. They are illustrated in

- a) an interactive graph that includes all indicators at once,

- b) as leading, lagging and fastest-changing indicators in this country, and

- c) in a graph on progress over a selected period of time of all indicators in this country (see **Figure 31** for b and c).

Compared to the SDG benchmarking tool, this dashboard emphasizes the function of supporting decision making stronger. It clearly breaks down information on relevant indicators and offers additional data and publications on specific topics. Furthermore, it is planned to integrate innovative policy practices as additional assistance. Similar to the Going Digital Toolkit, a university transformation dashboard should be structured by the transformation areas/modules and integrate visualisations of all indicators at a glance for a good overview. To support universities in their transformation, the inclusion of additional qualitative information in the form of good practices could be a viable option.

Figure 31 Example of the visualisation of progress over time and leading an lagging indicators in the Going Digital Toolkit (OECD)

Source: OECD Going Digital Toolkit (2021)

In contrast to the dashboard on digitalisation, the OECD **AI Policy Observatory** does not only provide information on countries' development in Artificial Intelligence policies. This dashboard collects more **qualitative information** on the context of AI policies in OECD countries and in various policy areas. Each information page (of a country or a policy area) illustrates respectively policy instruments, online news, responsible organisations, and quantitative data (e.g., budget ranges) in interactive graphs and tables[32]. OECD.AI is characterised by its goal to not only inform, but also provide an inclusive platform for dialogue among stakeholders. This has also implications for the collection of information: the data is provided by OECD partners as well as "all stakeholder groups". For the option of a rather communicative and interactive university transformation dashboard, it could be an interesting approach to integrate news and other qualitative data provided by stakeholders.

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[32] See for an example of the visualisation of categories of policy instruments. Instruments can be explored in detail by clicking on a category.

Source: OECD.AI (2021)

According to its self-description, the OECD **STIP Compass** serves as a portal or platform for STI policy research and advisory support. This dashboard displays its data on STI policies on separate pages by countries, themes, policy instruments and target groups using interactive graphs – like in OECD.AI. However, it follows a different data collection approach. This dashboard is based on survey data to continually monitor STI policies of OECD countries. Additionally, third-party open-source data is used to facilitate data collection – similar to the presented approach of collecting indicators of the transformation modules. Apart from the visualisation section and other portals, STIP Compass specifically supports further exploitation, replication, and extension of its data analysis in the STIP Data Lab. It offers data stories and downloads. In contrast to the aforementioned dashboards, explicit addressees are not only governments but also analysts and scholars.

Another dashboard on STI, the **UNESCO Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN)**, collects information on countries' policies (not limited to the OECD). The data is explicitly based on a regular survey among countries, whose active participation is required. To support them in filling out the survey and in designing or implementing policy instruments, UNESCO even provides training for participants. Generally, the communication function is stressed, and GO-SPIN is supposed to be a platform not only for decision-makers but also researchers and the public. However, the dashboard is less user-friendly than the others, qualitative data like policy instruments, are provided in a list rather than in an interactive chart.

Table 14 Features of dashboard examples with relevance for an dashboard on transformation in HEI

Dashboard	Relevant features
UN Secretariat Gender Parity Dashboard	• Clean and basic information dashboard for public on one page
ESPON SDG Benchmarking Tool	• Focuses on comparing/ benchmarking indicators • Visualises progress over time (in comparison)
OECD Going Digital Toolkit	• Information structured along strategy • Visualisation of all indicators at a glance • Supports decision making (additional data like publications on designing policies)
OECD.AI	• Information and communication function (platform for all stakeholders)

Dashboard	Relevant features
	• Displays quantitative and qualitative data (policy instruments, news, publications etc.) • Includes many resources
OECD STIP Compass	• Qualitative and quantitative data • Includes (continuously updated) survey and third-party open-source data
UNESCO GO-SPIN	• Includes regular survey data • Provides active support for filling out the survey and designing/ implementing policy instruments

6.2 Conceptual ideas for a dashboard on institutional transformation of European universities

Considering the observatory/dashboard examples presented in 6.1, in this final task of Work Package 5, the study team proposes a basic **concept of a data dashboard on transformation in Higher Education in the field of research and innovation.** This dashboard is to present the data that will be collected through the monitoring methodology proposed. The concept needs to be coordinated and aligned with other existing and planned dashboards/observatories in the area. Thus, it might, for example, "inspire/be plugged in" to the ERA Scoreboard or the future Higher Education Sector Observatory[33]. Accordingly, we discuss different considerations, options, and ideas on how the data collected through the WP5 monitoring methodology could be presented in the future.

Overall, the **goals of the data dashboard** are to track the progress of the participating HEIs in their institutional transformational paths and to provide empirical evidence about the implementation of the institutional transformation agendas in the field of R&I. Next to the display of the collected quantitative data, we propose that the dashboard should also include a **qualitative data**, **best practice examples** (as indicated in Chapter 0) and links to strategies, (European Commission) policy papers. Considering that universities face unique national contexts and historical backgrounds – which translate into different opportunities and challenges – and moreover find themselves at different stages of institutional development, the purpose of the dashboard is not to label the individual or collective developments as "good" or "bad". Rather, the dashboard aims to help different users to:

i) take stock of institutional arrangements of universities regarding the transformation areas,

ii) take stock of the institutional development regarding the transformation areas (status quo and changes/processes over time),

iii) take stock of the outcomes / results of institutional transformation in different areas,

iv) consider what individual, institutional changes need to be encouraged/initiated at/by the universities to progress,

v) consider what national / regional policies and funding instruments may be needed to maximise institutional transformation.

In the following, three **types of users** that potentially use/access the dashboard on institutional transformation of universities are considered. These different users not only have different needs regarding the dashboard but also different goals of why to reflect on the data presented in the dashboard.

Policymakers could mainly use the dashboard as an **inventory taking** tool, accessing comprehensive data on the (institutional) development of individual universities and

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[33] The details of the ERA Dashboard and the Higher Education Sector Observatory are still uncertain as both are still in development (the Higher Education Sector Observatory is announced under the European Strategy for Universities, ES4U).

collecting data on all universities within their countries and/or regions. Figure 33 shows an exemplary dashboard visualisation that takes stock of all the indicators related to gender quality. The visualisation shows an inventory of various indicators at one glance, which together form a picture for the sub-topic in question (gender equality). Additionally, the dashboard gives policymakers the option to **compare** individual universities with each other or compare the university development of their country/region with another country/region in Europe (**Figure 34**). Both options would enable policymakers to understand the degree of university transformation as well as the strengths and weaknesses of their universities. This knowledge would allow policymakers to address weaknesses by adapting regional/national policies and/or funding schemes. The dashboard could thus serve as a valuable tool during the **design, evaluation, and modification** processes of **policies** and/or **funding schemes**.

- **Universities** are the second user of the dashboard to be considered. The dashboard offers them a tool to **take stock of their own development**, accessing data on the status quo and development over time. This gives them an option to see where they are standing regarding their individual institutional transformation within the six transformation areas. Secondly, universities can **compare** themselves to other European universities and their respective developments. This opens the floor for **institutional learning**, being able to identify those universities that are particularly successful in their institutional transformation and learning from their development(s). Particularly relevant in this regard are the proposed best practice elaborations (or links to respective landing pages) within the different transformation areas or subtopics. Again, both options (stocktaking and comparing) open up the possibility to universities to initiate internal change processes and introduce new policies with the aim of undergoing specific transformations.

- The **general public** could be considered a third potential user of the dashboard. This user group would most likely be interested in getting general information on universities (in their region or country) and their respective transformation processes. Again, different display options that allow comparing universities and countries or the development within particular themes (**Figure 33**) could transform the dashboard into an interesting **information tool.** An additional reason for the usage of the tool might be the consideration of individual universities as future employers. Thus, outstanding development within a particular theme (e.g. within the area of gender equality) can indicate that a specific university is more advanced and thus could be considered a better employer. In times of tough competition for excellent researchers among research organisations around the world, this could be an additional way for HEI to showcase their dedication to specific transformational areas (for example in gender equality or diversity).

Text Box 2: Considerations regrading anonymity of individual university data

In the last as well as the following sections we assume that the data included in the future dashboard will not be anonymised and therefore comparing individual universities would be an option. This needs to be clearly communicated when collecting the data and might not be in the interest of individual universities. A solution to this challenge could be that the function of accessing individual data is restricted to policymakers only (e.g. with individual/personal logins) to design suitable policies and approaching universities that need support in specific categories.

Figure 33 Exemplary mock-up of a dashboard visualisation of the subtheme gender equality
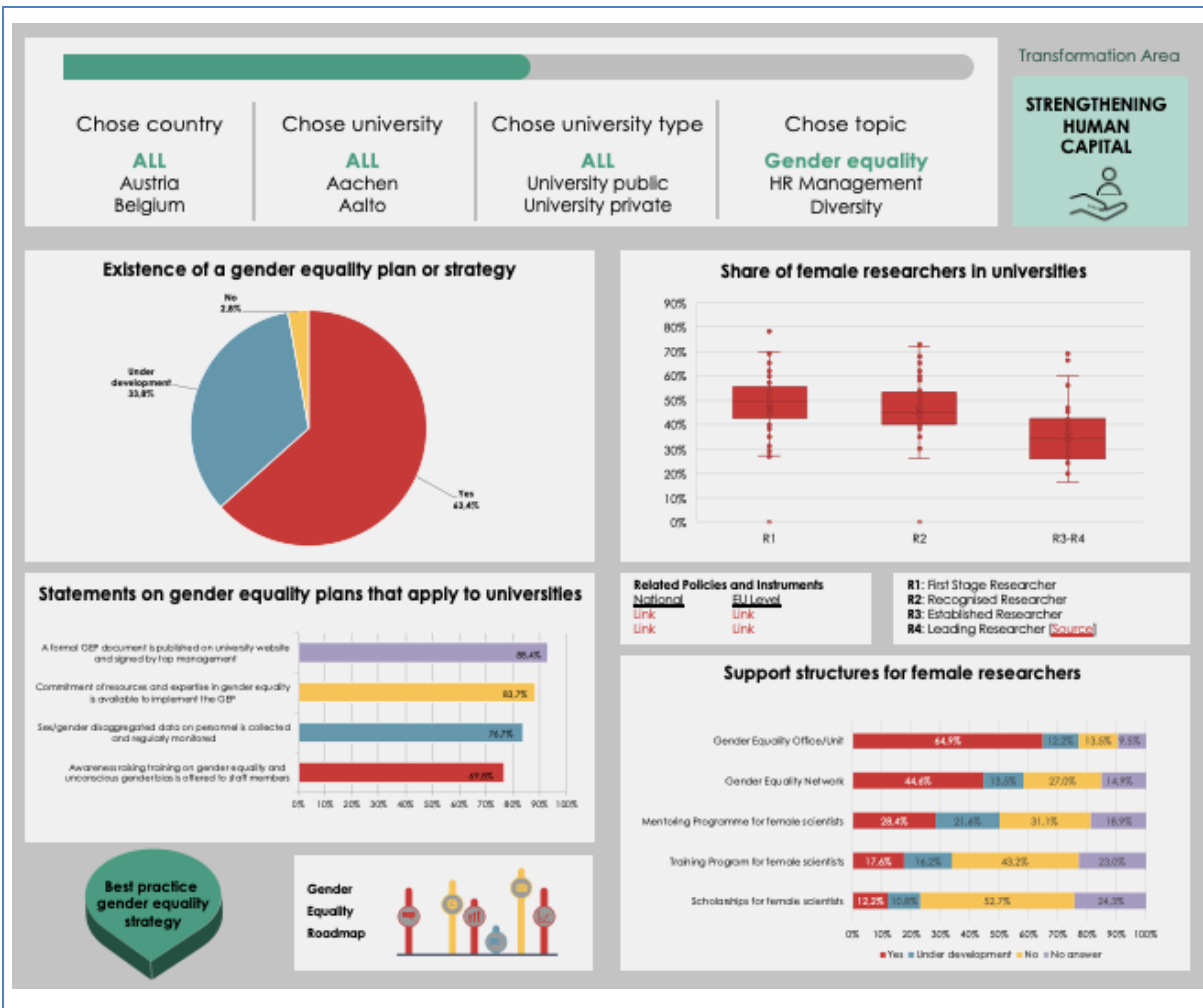
Source: Technopolis; Figures based on the actual survey data.

Figure 34 Exemplary mock-up of a dashboard visualisation comparing two countries within the transformation area on cooperation with other sectors
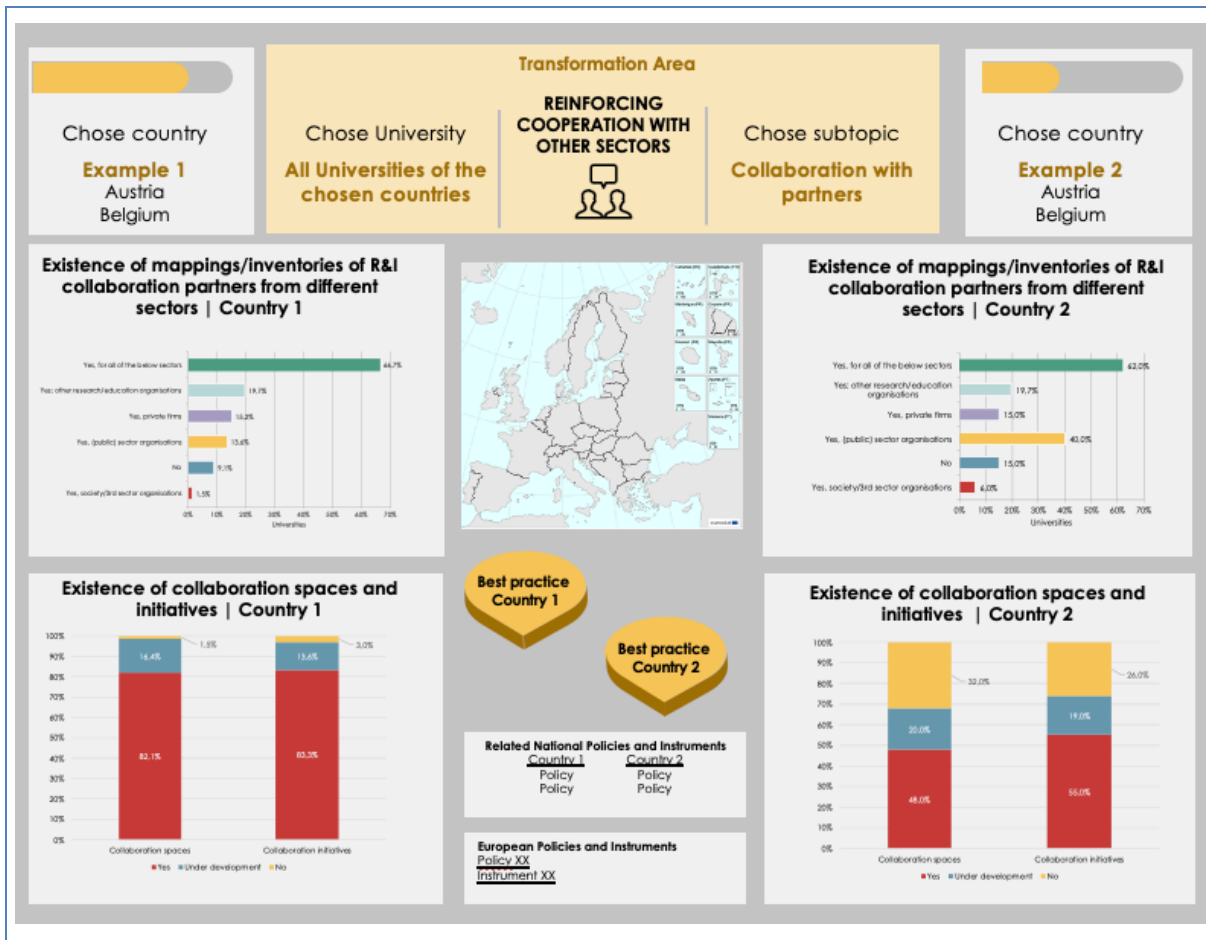
Source: Technopolis; Figures based on exemplary data.

In the following, we reflect on **functionalities** as well as **presentation/display options** and choices that need to be considered and are relevant for easy understanding and accessibility of the future dashboard.

- **Interactivity**: Interactive dashboards allow users to explore and use the data presented through visualisations that aggregate diverse aspects. Thus the dashboard allows comparing data across several dimensions (see next points). Providing various selection options – between widgets, indicators, etc and thereby letting the user choose his/her priorities – has proven to be a useful methodology, enhancing engagement.

- **Time frames:** In the first round of the survey, the data can only be displayed as a status quo/snapshot of time. After the second round, data could also display the development of the individual indicators over time. This could be configured via diverse methods such as changing interactively the timeframe or by displaying line diagrams (see **Figure 31**).

- **Geography:** In order to enable the comparison across countries (possibly even regions), the visualisation and selection of data according to geographical criteria should be taken into account. As can be seen in the exemplary dashboard visualisation (**Figur**e **34**), this could comprise using maps in order to visualise geographical choices.

- **Units of analysis:** The visualisation of the development of individual universities and possibly groups of universities (by type) would allow users the comparison and the identification of best practice examples (see Text Box 2). Thus, a university that

wants to advance within a specific transformation area/subtopic, could search for the "top" universities within the specific theme, analyse the data of that specific university and find best practices (see Figure 29).

- **Benchmarks:** For those transformation areas and subthemes where either individual countries or the European Commission define concrete / measurable goals and/or benchmarks (or benchmark groups), these could be included (e.g. via bullet diagrams). This can be seen in Figure 30 where the distance to the target (outside circle) can be extracted.

Some overall aspects that can be described as **operational success factors** of a dashboard should be considered when developing the final concept and translating it into reality:

- The dashboard needs to be based on regular surveys and updated accordingly. As indicated above, the first version will be a snapshot of the status quo, but the next versions need to be able to capture the picture of institutional progress and development. The longer and the more detailed the survey will turn out to be, the earlier universities will need to be informed.

- In the operation of the survey, dedicated supervisors need to take ownership of the different sections/themes and should be responsible for its functioning. On top of that, a dedicated group of individuals need to provide oversight (including quality control).

Finally, it needs to be kept in mind that the objective of this specific work package was the development of a first **basic conceptual idea for a dashboard in the field of R&I**, to inspire a potential future "Higher Education Sector Observatory". We have done so by showcasing an approach that seems both feasible and purposeful at this point (November 2021) for collecting and visualising data on transformation in Higher Education (specifically research and innovation aspects in HEI). As mentioned before, the dashboard might, for example, "inspire/be plugged in" to the ERA Scoreboard or the future Higher Education Sector Observatory[34]. Only once the approach of these observatories is clearer, more details on the conceptualisation and the technical implementation of the proposal made in this report can be elaborated.

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[34] The details of the ERA Dashboard and the Higher Education Sector Observatory are still uncertain as both are still in development (the Higher Education Sector Observatory is announced under the European Strategy for Universities, ES4U).

APPENDIX A: RESULTS RELATED TO PARTICIPATION IN

EUROPEAN UNIVERSITY ALLIANCES

As part of the survey the participating universities were asked to evaluate whether being part of a European University Alliance has helped them developing in regard to the respective transformation areas. Overall, feedback is neutral and/or positive:

- In transformation area 2 (sharing capacity, infrastructure, and resources) 38% of the universities consider being part of an Alliance as either very helpful or helpful while 46% consider it somewhat helpful.

- For transformation area 3 (strengthening human capital) 45% consider being part of an Alliance as either very helpful or helpful and 44% consider it somewhat helpful.

- For transformation area 4 (reinforcing cooperation in R&I with other sectors) 39% consider being part of an Alliance as either very helpful or helpful and 54% consider it somewhat helpful.

Although the differences between the three transformation areas are minimal, cooperation with other universities through the Alliances seems to be the most relevant for TM4.

Figure 35 Role of the participation in Alliances for institutional transformation
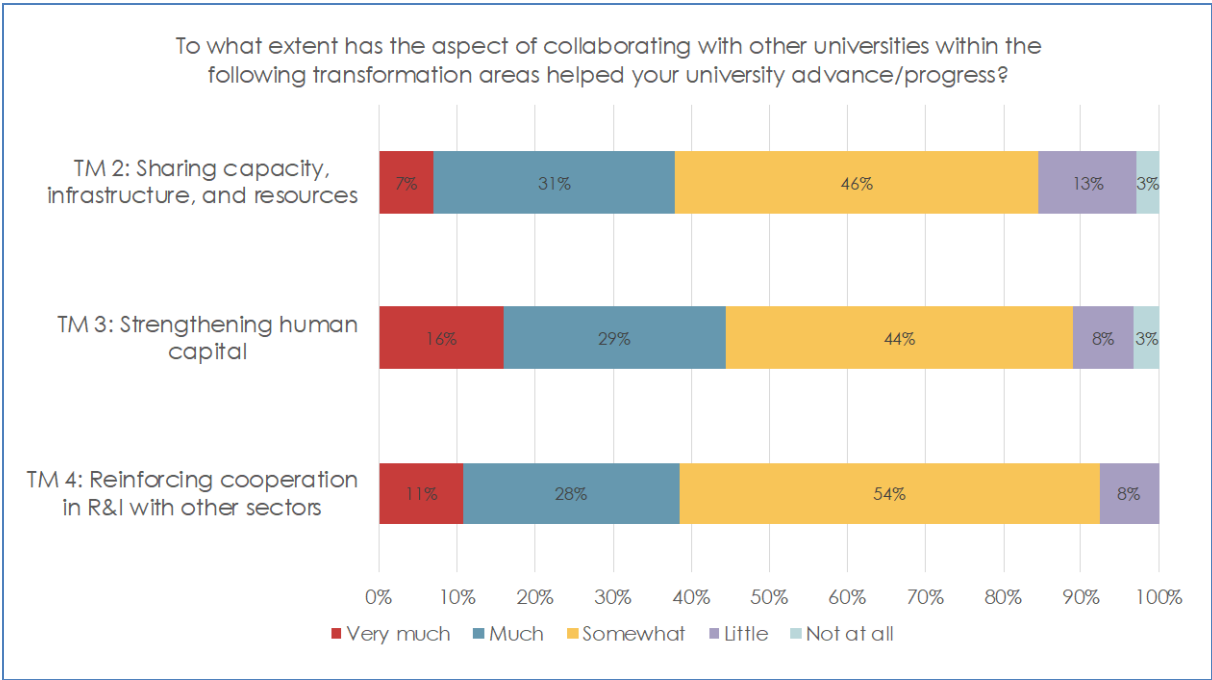
Note: TM2 percentages based on 71 answers; TM3 percentages based on 63 answers; TM4 percentages based on 65 answers.

APPENDIX B: ADDITIONAL INDICATORS

For the sake of completeness, we list the following indicators as **additional indicators** that could be used at later stages. At this point we do not recommend including them in a monitoring approach for different reasons:

- **Long-term relevance:** The indicators are mirroring aspects which are reached only in later stages of the transformational in higher education institutions. Reaching this level of progress will only be possible in the long term and thus the indicators should rather be used at later points in time. This is an important point because currently many HEIS are only starting to establish new processes which can be monitored. Outcomes of the established processes are not likely identifiable. These indicators could be included in later circles of data collection.

- **Limited accessibility:** The indicators are not easily accessible and would thus result in a significant effort by the HEI to collect. Thus, they result in a questionable ratio of cost (of collecting) versus value (of analysis). At later points in time (for example when data availability improves or internal monitoring at universities brings along synergies) they could be taken on.

- **Limited additional value:** different aspects listed below are already addressed via the core indicators proposed above. They would thus shed light on some very specific additional aspects but are not necessary to analyse the overall transitional developments. In order to create a survey which can be answered in a reasonable amount of time we decided to deprioritise them.

Table 15 Additional Indicators of TM1

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
1	Existence of an overview/mapping of the capacities, skills, and competence areas 1. of the respective HEI 2. of cooperating HEIs (possibly in an alliance) 3. of the partners of the respective HEI (companies, NGOs, authorities, etc.) 4. of the partners of the cooperating HEIs (companies, NGOs, authorities, etc.	A common R&I agenda can only be reached if the respective HEIs are aware of the competences, skills, and excellence/competence areas of other HEIs (in the alliances) as well as of other partners (such as companies, authorities, NGOs, etc.). Thus, in order to tackle common challenges, these different stakeholders need to share and build on their (interoperable-e) capacities.	Limited accessibility & long-term relevance: These mappings are a rather advanced next step after having a strategy / action plan. In the co-creation workshops it was indicated that this information would not be available. In the sort-term.
2	Number of European trans-national joint R&D programmes (RISIS-JOREP)	These programs imply research collaboration with foreign partners.	Long-term relevance: Any trans-national joint R&D programmes in place right now are most likely not the result of recent strategies

Table 16 Additional Indicator of TM2

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
	Existence of incentives for sharing infrastructures with other actors outside the HEI (linked to KPIs, indicator-based funding etc)	Incentive setting - both internally in the HEI as well as with external stakeholders like research ministries - can supplement, but not substitute intrinsic motivation of researchers to cooperate	Limited additional value

Table 17 Additional Indicator of TM3

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
	% PhDs degrees awarded to international candidates	Having international PhD graduates is a result (and possibly a further inducement) of international researcher mobility, fostering diversity in human capital	Limited additional value: internationalisation dimension already covered by core indicator "% of staff from foreign countries" (see core indicators)
	% of programmes offered in a foreign language	Offering programs in foreign languages attracts staff and (PhD) students from different geographical areas, hence stimulating researcher mobility and fostering diversity in human capital	Limited additional value, internationalisation dimension already covered by core indicator "% of staff from foreign countries" (see core indicators); however, this indicator would add a layer of information on the education dimension
	Existence of mentoring programmes for early career researchers with non-university mentors	Mentoring programs have been shown to be helpful in exposing individuals to other experience/contexts. They help to widen the mind set - in this case from the academic to the non-academic field and thus to bridge gaps between HEI and societal actors	Limited additional value: indicator about acquisition of transversal skills and intersectoral mobility included above
	Existence of Joint Doctoral Programmes with non-university actors; Industrial Doctorate Programmes or similar

Percentage of doctoral students enrolled in these programmes | Exposure of early career researchers to non-university sector is often best realised "on the job". Doctoral programmes in cooperation with industry or other societal groups as well as doctoral programmes with obligatory internships (or similar) will help building skills relevant for the non-academic word

Asking for the share of doctoral students enrolled in these programmes would give the opportunity to monitor developments/growth | Limited additional value: indicator about acquisition of transversal skills and intersectoral mobility included above |

Table 18 Additional Indicator of TM4

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
	Quality of the support services/infrastructures	See TM4 core indicator #3	Limited accessibility
	Existence of scheme for piloting activities for a) promoting collaboration with research and technology organisations or business sector, b) supporting networking and mentoring programmes for researchers. c) matching innovative ideas with investments	Researchers need to be able to test their ideas and match those with potential investors. This is not an easy process (esp. in the current academic setting) and thus there needs to be an institutional scheme to support these types of processes/activities	Limited accessibility
	% of theses in cooperation with private organisations (U-MULTIRANK)	Research conducted in the context of theses in cooperation with private organisations is done in collaboration with this organisation or is at least streamlined with the needs of this private organisation.	
	Income for research from industry in € (Times Higher Education)	External research income generally implies collaboration or at least streamlining with needs of external partners. It often concerns more application-oriented research, tailored to the need of external stakeholders. It enhances the potential to select innovation opportunities.	
	Number of patent families filed by the institution (REUTERS World's Most Innovative Universities)	University patenting is commonly used as a proxy for science-industry linkage	Limited additional value & limited accessibility: Core indicators 9 & 10 are output indicators for TM4. These could be replaced, but due to a limited number of qualitative indicators, we chose to focus on the chosen ones.
	% of co-patents with industrial partners (U-MULTIRANK)	Having co-patents with an industrial partner is likely the result of a cross-sectoral collaboration. The fact that the result is patented can imply that the research led to innovative insights / developments.	
	Hours of contact with work environment / practical experience (U-MULTIRANK)	Contact with work environment / practice can pave the way for further interaction between the university and its surrounding (corporate) texture. It can raise awareness of application-oriented needs, possibly enhancing the potential to detect innovation opportunities.	
	% of external research incomes (U-MULTIRANK)	External research income generally implies collaboration or at least streamlining with needs of external partners. It often concerns more application-oriented research, tailored to the need of external stakeholders. It enhances the potential to detect innovation opportunities.	

Table 19 Additional Indicator of TM5

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
	Existence of a structured approach to define training needs regarding Open Science Skills	Open access and open data management skills need to be trained; guidance or standards need to be defined in order communicate good practice or "expectations" researchers would need to match	Limited additional value, question about training modules for researchers (at levels R1 to R2) on open access, open data and citizen science approaches included above
	Inclusion of criteria regarding Open Science approaches in selection processes for researcher at all levels		Limited accessibility: respondents can probably not answer this question, as recruiting processes are highly decentralised

Table 20 Additional Indicator of TM6

#	Indicator (description)	Rationale	Reason for deprioritisation at this point
	Rules, standards, guidelines or other frameworks established to ensure that citizen/end-user engagement is taken into account in institutional R&I processes (excluding rewards/incentives and assessment)	High-level documents, policies, governance roadmaps/statements etc that have an overarching influence through a university.	Most likely included in the R&I strategy (TM1), thus no direct need to ask twice.
	% of researchers that have attended trainings, webinars, courses that have a significant proportion of the content devoted to the skills needed to engage societal actors (e.g. citizen science) and learn about approaches to co-creating innovations with society	Researcher training as an important variable, with the important aspect being the % of the workforce that has undergone training, rather than existence of training.	Universities have limited accessibility to this data.
	Mapping of engagement infrastructures within other regional institutions (municipalities, innovation parks, etc.)	The interaction with and engagement of citizens, civil society and local communities is the basis for achieving greater societal impact and increased trust in science. Citizens can make meaningful contributions to and participate in research, e.g. in problem definition, data collection, participatory experiments, dissemination, and volunteered thinking. It is ultimately one of the solutions to start dialogue and motivate citizens to participate in research. Collaboration with these different groups of quadruple/quintuple-helix actors, is very complex and needs to be supported.	Limited accessibility & long-term relevance: This mapping is a rather advanced next step after having a strategy / action plan for cooperation.

APPENDIX C: CO-CREATION WORKSHOPS

C1: Workshop programmes

Table 21 Agenda of Workshop I (09.09.2021 / 9h-13h)

Time	Item	Participants
9.00	Welcome & Presentation of the goals of the workshop	Technopolis
9.25	Discussion TM1: "Common R&I agendas/strategies"	Discussion in two break-out sessions (max 10 Pax each)
10.05	Merging / finalising the results of TM1 discussion	Plenum
10.20	Discussion TM4: Reinforcing cooperation in R&I with other sectors	Discussion in two break-out sessions (max 10 Pax each)
11.00	Merging / finalising the results of TM4 discussion	Plenum
11.15	Break	
11.30	Discussion TM6: Embedding citizens and society	Plenum
12:10	Merging / finalising the results of TM6 discussion	Discussion in two break-out sessions (max 10 Pax each)
12:25	Finalising the methodology & open discussion	Plenum

Table 22 Agenda of Workshop II (10.09.2021 / 9h-13h)

Time	Item	Participants
9.00	Welcome & Presentation of the goals of the workshop	Technopolis
9.25	Discussion TM2: "Sharing capacity, infrastructure and resources"	Discussion in two break-out sessions (max 10 Pax each)
10.05	Merging / finalising the results of TM2 discussion	Plenum
10.20	Discussion TM3: Strengthening human capital	Discussion in two break-out sessions (max 10 Pax each)
11.00	Merging / finalising the results of TM3 discussion	Plenum
11.15	Break	
11.30	Discussion TM5: Mainstreaming of Open Science practices	Plenum
12:10	Merging / finalising the results of TM5 discussion	Discussion in two break-out sessions (max 10 Pax each)
12:25	Finalising the methodology & open discussion	Plenum

C2: Miro boards Workshop I

C3: Miro boards Workshop II

-

The Vision of Transformational Module 2
Sharing capacity, infrastructure and resources

HEI develop a strategy towards sharing resources and infrastructures across the transform consortia and involved research systems, incl. identification of legal and financial barriers and enablers to improve governance of scientific and innovation cooperation among research systems; deployment of the strategy; sharing capacity.

TM 2
Sharing capacity, infrastructure and resources (10 indicators)

Ok, but...

Application of the European Charter for Access to RIs

Specify indicators more > to broad

New indicators

The Vision of Transformational Module 4
Reinforcing cooperation in R&I with other sectors

The HEI deploy human resources strategies, enriching research and career evaluation systems that mainstream Open Science practices, foster diversity and inclusiveness, including gender equality, in research, as well as strategies for balanced circulation of knowledge and researchers, promoting intersectoral/interdisciplinary mobility of researchers.

Comment and remark

TM3
Strengthening human capital (21 indicators)

Existence of explicit action plans at HEI level to improve HR management in research
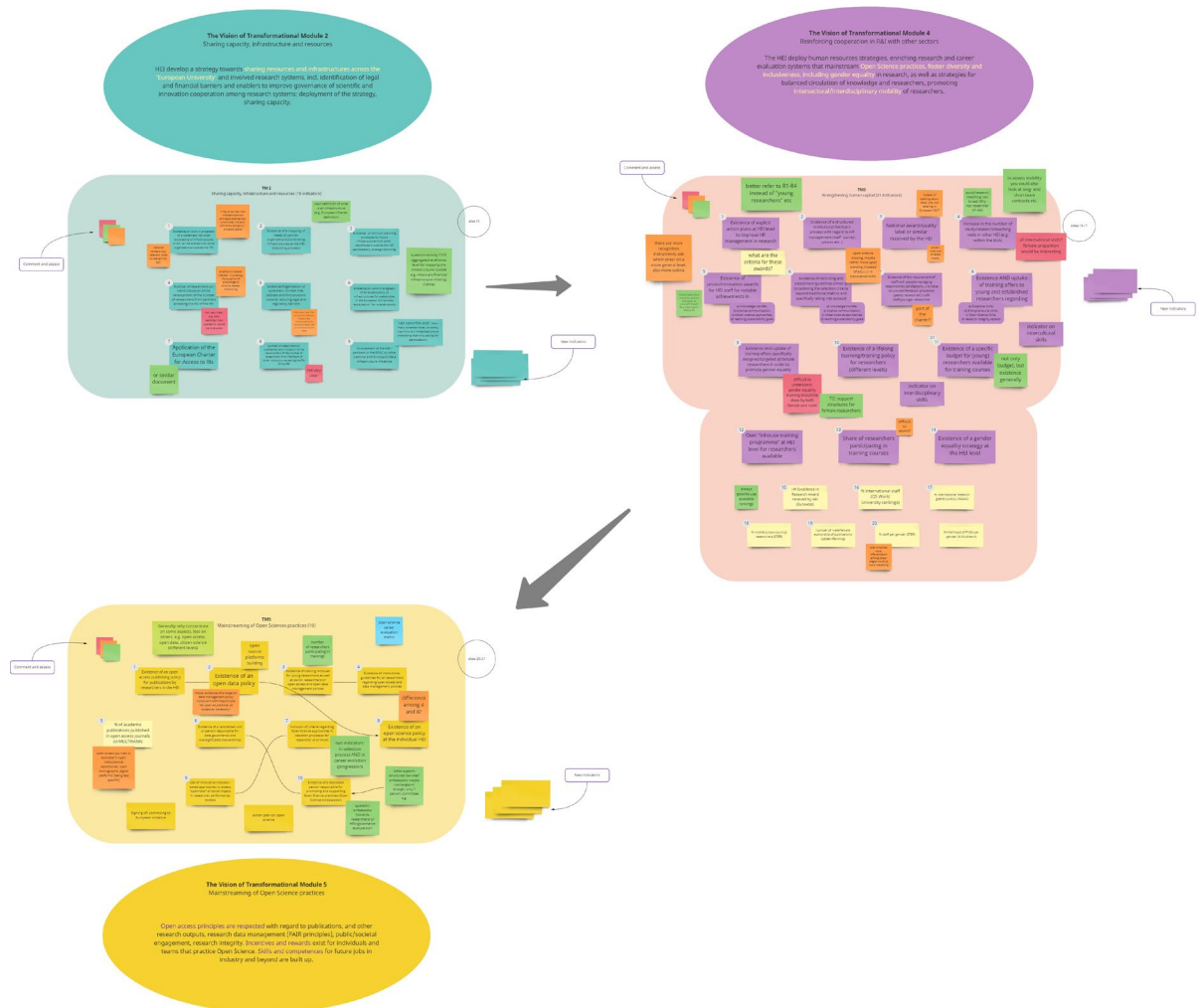
Existence of prizes/innovation awards for HEI staff for notable achievements in...

National award/quality label or similar received by the HEI

Increase in the number of study/research/teaching visits in either HEI (e.g. within the EU)

Existence R&D schema of training offers to young and established researchers regarding...

Mentoring by academic and non academics

Existence of a lifelong learning/training policy for researchers (different levels)

Existence of a specific budget for young researchers available for training courses

not just about training

Alumni + continuing links to industry > needs to be qualitative

Own "inhouse training programme" at HEI level for researchers available

Share of researchers participating in training courses

Existence of a gender equality strategy at the HEI level

Number of incubators / entrepreneurship on TM 4

Inter-national staff (QS World University rankings)

% internation-al staff (Times Higher Ed)

% international papers going (HESA/TRAC)

% enabled (overcome barriers) TCR

Number of staff/firmes authorship publications (same formg)

% inactive gender (CFO)

% headcount of PI (by per gender (Influencer)

The Vision of Transformational Module 5
Mainstreaming of Open Science practices

Open access principles are respected with regard to publications, and other research outputs, research data management (FAIR principles), public/societal engagement, research integrity. Incentives and rewards exist for individuals and teams that practice Open Science. Skills and competencies for future jobs in industry and beyond are built up.

TM5
Mainstreaming of Open Science practices (18)

Missing: the "societal engagement" part

Existence of an open data policy

Evidence of an open access publishing policy for publications by researchers in the HEI

Ask for challenges regarding the TM + open question in the end!

% of academic publications published in open access journals (+ MULTIRANK)

Existence of an open science policy at the individual HEI

Inclusion of Open Science in the overall HEI Strategy + check with TM1

TM3 > performance review / recruitment processes

APPENDIX D: SOURCES

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FOREU1 (2021c). Transformational Module: Driving Regeneration, Sustainability and Climate Protection, with focus on institutional, organizational and cultural approaches.

FOREU1 (2021d). Digital Transformation. Challenge and opportunity for the European Higher Education Sector: the case for European Universities.

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APPENDIX E: EXISTING INDICATORS MATCHED WITH THE TRANSFORMATION MODULES

Indicator	Theme	Subtheme	TM
ratio strategic partnerships / all academic staff	research	partnership	TM1
% examinations using innovative assessments	infrastructure	facilities	TM2
amount for IT budget	infrastructure	facilities	TM2
amount for laboratory facility budget	infrastructure	facilities	TM2
encouragement for innovative, inclusive teaching methods (ethics, integrity)	societal contribution	institutional change	TM2
hours of bedside teaching	infrastructure	facilities	TM2
% online degree programmes	infrastructure	facilities	TM2/TM3
% international graduates	education	international dimension	TM3
% international research grants	research	international dimension	TM3
% international staff	research	international dimension	TM3
% international students	education	international dimension	TM3
% mobile (cross-country) researchers	research	international dimension	TM3
% PhDs to international candidates	research	international dimension	TM3
% programmes offered in a foreign language	education	international dimension	TM3
a composite of international incoming exchange students, outgoing exchange students and students in international joint degree programmes.	education	international dimension	TM3
number of Erasmus students	education	international dimension	TM3
number of international programmes	education	international dimension	TM3
% graduates per gender	societal contribution	gender	TM3
% likelihood of PhDs per gender	societal contribution	gender	TM3
% staff per gender	societal contribution	gender	TM3
% students per gender	societal contribution	gender	TM3
income from CPD (continuous professional development)	global ratings	budget	TM3
number of male/female authorship of publications	societal contribution	gender	TM3
% triadic patents (USPTO, EPO, JPO)	valorisation (3rd mission)	international dimension	TM4
number of patent families filed by the institution	valorisation (3rd mission)	innovation	TM4
number of spin-offs	research	innovation	TM4
ratio for number of companies newly founded by graduates per 1000 graduates	valorisation (3rd mission)	impact	TM4
ratio granted patents / patent applications	valorisation (3rd mission)	performance level	TM4
% co-patents with industrial partners	collaboration	industry linkage	TM4
% co-publications with industrial partners	collaboration	industry linkage	TM4

Indicator	Theme	Subtheme	TM
% theses in cooperation with private organisations	collaboration	industry linkage	TM4
hours of contact with work environment / practical experience	education	industry linkage	TM4
number of student internship positions in the region	societal contribution	regional engagement	TM4
% external research incomes	collaboration	industry linkage	TM4
income from regional sources	societal contribution	regional engagement	TM4
EU-FP participations / use	research	international dimension	TM4
income for research from industry in €	collaboration	industry linkage	TM4
number of European trans-national joint R&D programmes	research	international dimension	TM4
% publications published in open access journals	research	scholarly output level	TM5
encouragement for re-usable data & data platforms (?)	societal contribution	institutional change	TM5
encouragement for citizen science activities and publications	societal contribution	public science awareness	TM6
number of alumni prizes	education	performance level	TM6
rating for graduates' reputation (by employers)	education	quality	TM6
% credits for community service learning	education	international dimension	TM6
inclusion of United Nations' Sustainable Development Goals (SDGs)	global ratings	impact	TM6

Source: INCENTiM (KU Leuven)

This report outlines the results of work aimed at developing a monitoring methodology to keep track of institutional change progress among universities in Europe, as part of the study entitled Knowledge Ecosystems in the new ERA, conducted by Technopolis Group. It focuses on the challenges universities are facing in adapting their institutional arrangements to new societal and institutional challenges in research and innovation. The monitoring covers six so-called "transformation modules" relevant for the ERA, ranging from infrastructure sharing and human capital development to collaboration with business and open science. The methodology defines around 60 indicators, co-created and tested with representatives from European Universities alliances. The report covers mainly methodological approaches, but also first content-related results of a monitoring test run.

Research and Innovation policy