



Developing and Implementing hands-on training on Open Science and Open Innovation for Early Career Researchers

D 5. 2. - Formulation of “Open Science and Open Innovation & Entrepreneurship training” joint strategic goals and relevant key performance criteria and perspectives

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List of acronyms and abbreviations

DC	Doctoral Candidate
DIOSI	Developing and Implementing hands-on training on Open Science and Open Innovation for Early Career Researchers
ECR	Early Career Researcher
EUA	European University Association
LERU	League of European Research Universities
OI&E	Open Innovation & Entrepreneurship
OS	Open Science
WP	Work Package

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Executive summary

In order to better adapt to the highly unpredictable labor market, the importance of acquiring transversal (also referred to as 'generic') skills and competences is increasingly emphasized, alongside the development of different research-specific skills. Accordingly, the main aim of DIOSI - Developing and Implementing hands-on training on Open Science and Open Innovation for Doctoral Candidates (DCs) and Early Career Researchers (ECRs) is to develop a common model for doctoral learning that integrates transferable skills as equally valuable as research-specific skills among the institutional partners of the project.

The main goal of the DIOSI project's Work Package (WP) 5 is to provide a measurable and actionable assessment of the impact of the DIOSI model for doctoral learning in general, and training on Open innovation and Entrepreneurship and Open Science in particular, through the development of the DIOSI Impact and Graduate Tracking Framework.

The Framework will include two time perspectives and three levels of tracking: short-term perspective, implying the individual graduate tracking level and long-term perspective, implying the overall training level and the level of stakeholders and impact on society.

This report focuses on defining the key performance criteria of Open Science and Open Innovation & Entrepreneurship training sessions. To that aim, the key areas for improvement across all four levels of the framework (reaction, learning, behavior and outcomes) are determined and specified in the report.

1. Introduction

The careers of doctoral graduates, as well as their employability and job security, have faced significant challenges in recent years. An increasing number of Doctoral Candidates (DCs) and Early Career Researchers (ECRs), a limited number of permanent academic positions at universities, as well as the increasing dependence of researchers on fixed-term contracts and external funding have led researchers to increasingly consider different career paths outside the academic environment. In 2018, 70% of DCs, postdocs, and tenure-track researchers have already had to seek employment outside academia.¹ According to Eurostat data, in 2020, more than half (55.4%) of full-time equivalent researchers in the EU worked in business enterprises, 32.6% in academia, and 11.1% in the government sector.² Boman et al. (2021) point to similar data. In a study conducted as part of the [DocEnhance project](#), they found that more than half of employed doctorate holders (52%) work outside academia: one in five (22%) work in the private sector, with the next most popular sectors being healthcare (10%), government and public sector (8%), non-sovereign education (6%), and the non-governmental sector (3%). Moreover, recent data show that less than 15% of PhD graduates pursue long-term academic careers.³ Accordingly, the OECD (2021) highlights the increasing precariousness of academic research careers. It points out that many postdoctoral researchers in academia have fixed-term contracts with limited opportunities for advancement (e.g., in Germany, 77% of postdoctoral researchers in higher education institutions and 72% in non-university research institutions have a fixed-term contract; 80% of scientific staff in Swiss universities have a fixed-term contract; in Finland, 70% of academics have a fixed-term contract; in the French Community of Belgium, 58% of university employees have those working in universities are on fixed-term contracts).

On the other hand, it is interesting and encouraging that most of those who leave academia are satisfied with the change in their careers. In particular, three-quarters are satisfied with their current employment, while only 18% of respondents continue to pursue academic careers (Vitae, 2016).

In order to better adapt to the highly unpredictable labor market and to better prepare DCs and ECRs for employment outside academia, there is an increasing emphasis on the importance of acquiring transversal (also referred to as "generic") skills and competencies, in addition to developing various research-specific skills. According to the League of European Research Universities (LERU), the modern doctorate is, at its core, defined by an interplay between professional research experience and personal development, the main outcome of which is an individual trained to have a unique set of high-level skills (LERU, 2010). Skills development is the cornerstone of the modern doctorate (Vitae, 2010). What is more, there is a growing awareness that entrepreneurial skills, knowledge and attitudes can

¹ <https://www.nature.com/articles/d41586-018-02696-6>

² https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_personnel

³ <https://www.chameleonsproject.eu/>

be learned and lead to the widespread development of an entrepreneurial mindset and culture that benefits individuals and society as a whole (Bacigalupo et al., 2016).

Furthermore, data-driven research for society and economy and data-based decision making are the engines of progress. Both are based on an open research culture (Nosek et al., 2015) and intelligent stewardship of data following the FAIR principles (Wilkinson et al., 2016). Therefore, open research and data skills are required and the demand on the labor market is high: By 2026, approximately 780.000 tech-specialists will be sought for instance in Germany and the need such "future skills" is growing. (Kirchherr et. al., 2018; Meyer-Guckel et al., 2021).

Accordingly, the main aim of DIOSI - Developing and Implementing hands-on training on Open Science and Open Innovation for Doctoral Candidates (DCs) and Early Career Researchers (ECRs) is to develop a common model for doctoral learning that integrates transferable skills as equally valuable as research-specific skills among partner institutions of the project.

An important part of the newly developed [DIOSI doctoral learning programme](#) is training courses for DCs and ECRs on Open Science (OS) and on Open Innovation & Entrepreneurship (OI&E). Through various project activities, a community of DIOSI trainers will be formed and the task of each trainer will be to conduct at least one training course in his/her home institution/university.

2. Joint strategic goals and relevant key performance criteria and perspectives

According to the Salzburg recommendations II (EUA, 2010), in order to be accountable for the quality of doctoral programmes, institutions should develop indicators based on institutional priorities such as individual progress, net research time, completion rate, transferable skills, career tracking and dissemination of research results for early-stage researchers, considering both the professional development of the researcher and the progress of the research project.

The main goal of the DIOSI project's Work Package (WP) 5 is to provide a measurable and actionable assessment of the impact of the DIOSI model for doctoral learning in general, and training on Open innovation and Entrepreneurship and Open Science in particular, through the development of the DIOSI Impact and Graduate Tracking Framework.

Despite the relatively good progress made with career development support for doctoral candidates in various universities, the use of doctoral candidates' careers as an indicator for assessing the quality of their doctoral programmes is less common. According to Byrne, Jørgensen & Loukkola (2013), only 23% of institutions report tracking the careers of doctoral graduates. More recent data indicate a somewhat better situation - 45% of universities track the career paths of their doctoral candidates in at least most doctoral programs, 29% in some doctoral programs, and 26% not at all (Hasgal et al., 2019). Moreover, although universities are responsible for awarding the doctoral degree, there were significantly fewer

quality assurance mechanisms for the doctoral degree compared to bachelor's and master's degrees (Metcalf, 2006).

The main **joint strategic goals** of the DIOSI model for doctoral learning, including the "Open Science and Open Innovation & Entrepreneurship" training courses are:

(1) enhancing the potential for innovation; (2) acquiring competencies in Open Science and Open Innovation & Entrepreneurship; and (3) enhancing the career opportunities and employability of doctoral candidates and early career researchers both within and outside academia.

The DIOSI Impact and Graduate Tracking Framework will include two time perspectives (1 and 2) and three levels of tracking (a, b, and c):

(1) the short-term perspective, which implies (a) individual training participation level; (2) the long-term perspective, implying (b) individual graduate career tracking level and (c) impact on the university, stakeholders, and society level.

The main objective of the **short-term perspective** and **individual training participation level** is to monitor the effectiveness of the specific programmes: Open Science and Open Innovation & Entrepreneurship training courses for individual development of DCs and ECRs. For each training course, a specific self-assessment questionnaire adapted to the course content will be constructed. In order to determine the impact of the training programmes as accurately as possible, each questionnaire will be applied before and after the training. Given that the responsibility of each trainer is to conduct at least one training course in his/her home institution/university, the pilot data collection and validation of the questionnaire will be organized in collaboration with the partner institutions of the DIOSI project.

The first part of the **long-term perspective** relates to the **individual graduate career tracking level** which will include the development of a methodology for longitudinal monitoring of indicators of individual career success and achievement.

The second part of the **long-term perspective** of graduate tracking refers to the **impact on the university, stakeholders, and society level**, which will include various "external" indicators.

According to the [European Commission \(2021\)](#), graduate feedback obtained through graduate tracking is crucial to ensure that the knowledge, skills and competences acquired by students are of high quality and relevant to the labor markets of today and tomorrow. In the DIOSI [WP 5 first report](#) comprising the review of existing impact evaluation systems, particular attention was paid to the Rugby Team Impact Framework (Rugby Team, 2008), an evaluation model for training and development activities specifically tailored to the context of training and development of researchers in higher education (HE). This framework includes 4 levels of outputs and outcomes: 1) Reaction (participant's response to the activity), 2) Learning (change in attitude, e.g. improved knowledge, increased skills), 3) Behavior (behavior change, e.g., thoughtful, confident, self-aware...), and 4) Outcomes

('external impact', e.g. better research, improved qualification rates). This framework will be the starting point for the development of the DIOSI Impact and Graduate Tracking Framework aimed for in this deliverable.

To define the **key performance criteria** of Open Science and Open Innovation & Entrepreneurship training sessions, the key areas for improvement across all four levels of the framework (reaction, learning, behavior and outcomes) are thus determined, which is shown in the following tables.

Table 1 Key performance criteria regarding the DIOSI Impact and Graduate Tracking Framework - short-term perspective

Training course	“Open Science”			“Open Innovation and Entrepreneurship training”		
Impact level	1: reaction	2: learning	3: behavior	1: reaction	2: learning	3: behavior
Measurement time	After the training	Before and after the training	Before and after the training	After the training	Before and after the training	Before and after the training
Learning outcomes / Key performance indicators	<p>Training satisfaction:</p> <ul style="list-style-type: none"> - applicability of the content presented - preparation and expertise of the trainer - personal benefit of participating in the activities - satisfaction with the activities 	<p>Knowledge & skills:</p> <ul style="list-style-type: none"> - understanding of the concepts and principles of open science - knowledge of different ways to make one's research more open in a responsible way (being aware of possibilities and limitations) - familiarity with some of the digital platforms, tools and services available for the practice of open science - the ability to search for and publish open access scientific articles - understanding the concepts and principles of FAIR data/ research data management (FAIR principles, policies, DMPs, documentation, archiving) - understanding of what is needed to enable research data sharing (data storage, archiving, publication, access control, institutional infrastructure) and how to responsibly reuse existing research data (being aware of legal aspects) 	<p>Attitudes & Intentions:</p> <ul style="list-style-type: none"> - self-awareness of the potential benefits and challenges of practicing open science - willingness to practice open science (and boost personal career by leveraging open science potential) 	<p>Training satisfaction:</p> <ul style="list-style-type: none"> - applicability of the content presented - preparation and expertise of the trainer - personal benefit of participating in the activities - satisfaction with the activities 	<p>Knowledge & Skills:</p> <ul style="list-style-type: none"> - understanding of the general processes of innovation and entrepreneurship - knowledge of the basics of intellectual property management - brainstorming ideas and creativity - understanding the basics of accounting - understanding the lean start-up concept and the use of the business model canvas - understanding the minimum viable product (MVP) - knowledge of key aspects of business strategy such as Porter's 5 forces and SWOT analysis - knowledge of key sources of funding for innovation - familiarity with innovation funding options for early career researchers - knowledge of how to present an innovative idea and attract funding, collaborations or customers 	<p>Attitudes & Intentions:</p> <ul style="list-style-type: none"> - attractiveness of the entrepreneurial career - entrepreneurial self-efficacy - entrepreneurial / intrapreneurial intention



Table 2 Key performance criteria regarding the DIOSI Impact and Graduate Tracking Framework - long-term perspective

Impact level	Impact level 4: outcomes	
Key performance indicators	Individual level: <ul style="list-style-type: none"> - early career research positions - employment situation - employment sector - occupation - monthly salary - job satisfaction - mobility (job-to-job & international) - type/precariousness of employment contract - career-related experience incl. statements about the value of the doctorate - extent to which content of current work is related to doctorate degree and respective transversal skills - the level of knowledge and skills required in the current job, horizontal and vertical (mis-)match - professional situation after 1, 3, 5 and 10 years 	University, Stakeholders & Society level: <ul style="list-style-type: none"> - number of applications for doctoral programmes - number of Open Access publications - growth in technology-based companies - number of spin-offs and start-ups - income from spin-offs and start-ups - number of invention disclosures - number of intellectual property licenses (patent filings, copyright and trademark registrations) & assignments - income from licenses & assignments - number of research collaboration agreements & research contracts with non-academic third parties - income from research collaboration agreements & research contracts with non-academic third parties



3. Conclusion

To better connect doctoral education system and make it more relevant to society, there is a need to develop a common model for doctoral learning with a monitoring system to help policy makers, educational institutions and researchers themselves to design appropriate curricula, provide career guidance or identify skill development needs.

The development and implementation of the DIOSI Impact and Graduate Tracking Framework will seek to answer several questions:

- Will the introduced trainings lead to learning and behavior change in DCs and ECRs?
- Are they acquiring the right set of competencies for their careers?
- Are they able to find the desired jobs with appropriate responsibilities and requirements after completing the PhD?
- What kind of data should be collected to determine the quality of the doctoral programme?

The DIOSI Impact and Graduate Tracking Framework will provide a number of other benefits, such as longitudinal data collection and cross-country comparisons, which in turn will allow for benchmarking, better targeting, assessment of development trends, and better review of the effectiveness of investments in third-level higher education system.

It should be noted that the Framework proposal will be aligned with the EU Research Assessment Framework and the recommendations of the YUFE Consortium.



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