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Creating research ethics and integrity country report cards: Case study from Europe

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ABSTRACT

Structures for and practices of research integrity (RI) and research ethics (RE) differ among countries. This study analyzed the processes and structures for RI and RE in Europe, following the framework developed at the World Conferences on Research Integrity. We present RI and RE Country Report Cards for 16 European countries, which included the information on RI and RE structures, processes and outcomes. While some of the countries are front-runners when it comes to RI and RE, with well-established and continually developing policies and structures, others are just starting their journey in RI and RE. Although RI and RE contextual divergences must be taken into account, a level of harmonization among the countries is necessary so that researchers working in the European area can similarly handle RI and RE issues and have similar expectations regardless of the organization in which they work. RI and RE Country Report Cards can be a tool to monitor, compare, and strengthen RE and integrity across countries through empowerment and inspiration by examples of good practices and developed systems.

Introduction

Creating optimal research and research ethics and integrity (RE and RI) governance framework is an important task for all stakeholders in research (Bouter 2018). Initiatives from all around the world addressing this issue have offered numerous recommendations for developing and implementing policies, structures, and procedures to promote responsible research practices and adequately handle research misconduct (Singapore Statement on Research integrity 2010; All European Academies (ALLEA) 2017; National Academies of Sciences, Engineering, and Medicine (NASEM) 2017; World Economic Forum (WEF) 2018; National Health and Medical Research Council (NHMRC) 2018). Moreover, different government agencies, advisory bodies, and scientific societies continually develop codes, guidelines, reports, and other documents addressing this topic (Komić, Marušić, and Marušić 2015; Aubert Bonn, Godecharle, and Dierickx 2017; Sčepanović et al.

2021; Hastings et al. 2022). However, a recent scoping review showed that the approaches to RI, although usually having a shared understanding of values and norms related to responsible research, often differ between countries and local contexts (Ščepanović et al. 2021). In that sense, efforts by different organizations, including the report by the European Science Foundation (ESF) "Fostering Research Integrity in Europe" (European Science Foundation (ESF) 2011), the Science Europe survey report on RI practices in European research organizations (Science Europe 2016), the European Code of Conduct for RI by All European Academies (ALLEA) (All European Academies (ALLEA) 2017), and the Mutual Learning Exercise (MLE) on RI (European Commission (EC) 2018), all recognized a variety of approaches to the promotion of RI and handling research misconduct across European countries, based on the differences in national and institutional policies, as well as differences in countries' traditions, structures, processes, and funding systems in research.

Given intensive collaborations between European researchers and research institutions, a common and harmonized understanding of RI is recognized as an essential step in the further development of RI in Europe (Hermerén et al. 2019; Marušić 2019; Roje et al. 2021). As emphasized in the ALLEA's European Code of Conduct for RI, creating a shared understanding of RI by respecting countries' differences involves acknowledging the legal and ethical responsibility of the research community in articulating principles and standards in research and defining the relevant criteria for responsible research behavior that enhance the quality of research (All European Academies (ALLEA) 2017). It also means that research institutions, which are recognized as having an important role in defining RI standards, should promote responsible research practices by offering tailored research ethics and integrity training, raising awareness of relevant codes and regulations, and handling research misconduct honestly and transparently (Mejlgaard et al. 2020). Different initiatives tried to address the responsibilities and roles of different research stakeholders to help them recognize and implement common essential steps on the journey of fostering and promoting RI. For example, the Global Science Report on RI from the Organization for Economic Co-operation and Development (OECD) emphasized the importance of research institutions' administrative bodies for handling research misconduct (Organisation for Economic Co-operation and development (OECD) Global Science Forum 2007). Similarly, the RePAIR Consensus guidelines outlined the primary responsibilities of research institutions in providing policies and personnel to ensure compliance with RI standards and establishment of RI culture within institutions (Collaborative Working Group from the conference "Keeping the Pool Clean: Prevention and Management of Misconduct Related Retractions" 2018). Further, the Bonn-Printeger Statement offered 13 recommendations to research institutions for

RI promotion, including providing information and training and raising awareness on RI, creating and fostering an open and trustworthy environment, and improving approaches to handling cases of research misconduct (Forsberg et al. 2018). Although RI governance frameworks should be able to provide common standards, translating global principles and standards of RI into different national policies, structures and practices is not an easy task. Having an overview of existing RI frameworks could help the research community get a step closer to fulfilling this task.

The idea for the creation of RI Country Report Cards emerged from the discussions at the 4th World Conferences of Research Integrity (WCRI) in 2015, where the representatives from countries around the world discussed the usefulness, feasibility, and content of Country Report Cards for RI and suggested the structure-process-outcome framework to describe the research environment and efforts to uphold and foster RI (Kleinert and Marušić 2016). Our study was inspired by this initiative, as well as the MLE on RI, where the participants from 14 European countries worked on creating a comprehensive set of information on RI in their countries (European Commission (EC) 2018). Since RI is continuously developing and evolving, together with RI frameworks, this study aimed to update the information on RI frameworks from 14 European countries that participated in MLE and 2 additional countries that participated in the *EnTIRE (Mapping Normative Frameworks for EThics and Integrity of REsearch)* project (CORDIS – Community Research And Development Information Service 2017; Embassy of Good Science (2022) and to compare the frameworks between these 16 countries.

Methods

Country report cards at the WCRI

At the 4th World Conferences on RI, during the Focus Track "Improving Research Systems: the Role of Countries, participants from 17 countries (Austria, Brazil, China, Croatia, France, Germany, Ireland, Japan, Kenya, the Netherlands, Norway, Saudi Arabia, Singapore, Slovenia, Switzerland, UK, and the USA) discussed how to organize information on RI practices, systems, and environments existing across countries, and for what purposes to use the mapped information (Kleinert and Marušić 2016). The product of the discussion was the idea of developing Country Report Cards – a tool for mapping existing RI practices and systems across countries. The aim of the Country Report Cards was to improve the monitoring, compare, and strengthen RI across countries through empowerment and inspiration by examples of good RI practices and developed RI systems. The participants in the Focus Track suggested three areas that should be captured in the report

Table 1. Areas and items for research integrity country report cards presented at the 4th World Conference on Research Integrity, 2015.

Areas	Items
RI structures	• demographic information about the research community in the country • resources spent on research in different sectors • existence of scientific strategy, laws, policies, and relevant bodies for RI • number of researchers involved in RI • structural elements of the research environment (percentage of postdoctoral researchers with paid positions. percentage of successful grants from national funders, level of hierarchy and rules on mentoring)
RI processes	• existence of the national codes and policies for RI (how codes and policies are disseminated and what is their influence in the country and internationally) • existing RI training and education activities • existence of bodies for investigating research misconduct cases • existence of bodies for providing advice and education on RI • the degree of cooperation between institutions • established protection of whistleblowers • existence of research into RI • existence of rules for mandatory registration for clinical trials
RI outcomes	• available research output-based incentives for institutions and individuals • incentives and awards for research collaborations • inclusion of RI in institutional quality assessment • public opinion and trust in the research community • discussion in the lay press about RI • efforts to reduce research waste

cards – structures, processes, and outcomes (Kleinert and Marušić 2016), following the quality framework in health care (Donabedian 1992). These three main areas consisted of different elements that participants defined as important for mapping (Table 1).

At the 5th WCRI in Amsterdam in 2017, RI Country Report Cards continued to be the focus of RI initiatives. The representatives from 4 countries (Croatia, Norway, UK, and the USA) presented their report cards and shared various experiences and approaches to RI (Engh 2017; Hammat 2017; Marušić 2017; Wager 2017).

Country report cards in MLE on RI

In the MLE on RI, 14 participating countries (Austria, Bulgaria, Denmark, Estonia, Finland, France, Greece, Ireland, Lithuania, Luxembourg, Moldova, Norway, Spain, and Sweden) used the Country Report Card approach, piloted in the EnTIRE project as a modification of the original proposal from the WCRI exercise (Marušić et al. 2018). The information to include in the Country Report Cards was searched in publicly available sources, upon which the report cards were sent to the MLE participant countries' representatives and additionally filled and revised with

Table 2. Areas and items for Research Integrity Country Report Cards modified during the mutual learning exercise of the European Commission, 2018.

Areas	Items
Structures	• total population of the country • gross domestic product • number of researchers and research institutions (universities and other research institutions) • gross expenditures on research • distribution of private, public, and charity funding • number of Horizon 2020 projects (participating in Horizon projects) • number of ERC principal investigators
Processes	• existence of scientific strategy in country • existence of national bodies for RI and research ethics (RE) • laws with implications for RI and RE • organizational structures for RI and RE • number of researchers and others involved in RI • percentage of postdoctoral students with paid positions • percentage of grant success • budget of funding agencies • existence of the national code of conduct and means of its dissemination • availability of training and education for RI • how and by whom investigations of research misconduct are handled • level of cooperation between research institutions in the context of RI and RE • availability of protection for whistleblowers • existence of RI offices or officers • annual meetings for RI • whether there is research into RI • whether registration of clinical trials is mandatory • the adoption of open data practices • whether research data are open • whether the country is a member of the European Network of Research Ethics Committees (EUREC) and the European Network of Research Integrity Offices (ENRIO).
Outcomes	• incentives for institutions and individual researchers based on research output • whether RI is a part of the institutional quality assessment • whether there is research impact assessment • public perception of RI, and whether RI is discussed in the lay press • whether there are rewards for collaborative science • whether there are measures to increase the value of research and decrease research waste • whether there are disincentives for RI • the existing resources for RI and RE training and implementation

information that could not be identified in the public domain. The main areas of the MLE Country Report Cards were the same as in the WCRI report cards, but the framework elements were adapted to the MLE exercise needs. The MLE exercise also included the information on research ethics (RE) frameworks, as the concepts of research integrity and ethics overlapped in many countries (Table 2).

Country report cards in the EnTIRE project

The initial version of the Country Report Cards developed by the *EnTIRE* project (*Marusic* et al. 2018), was further modified and developed to contribute to the The Embassy of Good Science, an online Wikimedia site for the research community to discuss about RI and RE questions, as well as to provide the comparison of RI and RE initiatives and efforts across European countries. RI Country Report Cards at The Embassy of Good Science are expected to be continually updated by researchers from individual countries – to monitor progress and have easily accessible information on RI and RE status quo across countries.

We used the information provided in the MLE report cards that were created for 14 countries that participated in the MLE and updated them in collaboration with the MLE country representatives. Moreover, we created Country Report Cards for two more countries (Croatia and the Netherlands) that participated in the *EnTIRE* project (Figure 1), to complete the overview of RI and RE in Europe (The Embassy of Good Science).

The Country Report Cards were adapted from the original WCRI structure to contain the elements presented in Table 3.

To fill in the Country Report Cards with the relevant information, we first conducted a search of the web pages of the European Network of Research
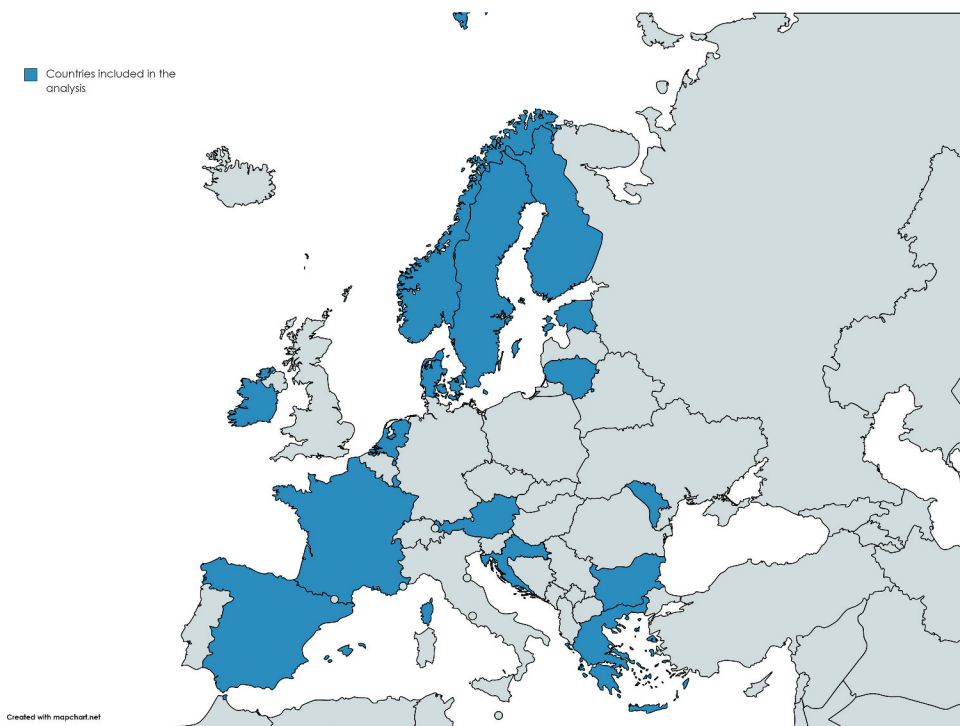
Figure 1. Countries included in the country report cards analysis.

Table 3. Areas and items for Research Integrity Country Report Cards in the EnTIRE project.

Areas	Items
Research infrastructure, funding, and research strategy	- number of higher education institutions (universities) and research institutions - number of full-time researchers - gross expenditures on research and development in public and private sectors - existence of the national research strategy
Research governance, compliance, and integrity structures	- national bodies for RI and RE - national RI and RE codes and guidelines for researchers - processes for handling research misconduct cases - protection of whistleblowers
Laws and regulations	existing laws and regulations concerning RI and RE
Measures to promote good scientific practices and open science	- availability of RI and RE training - communication with the public - RI and RE incentives

Ethics Committees (EUREC) and European Network of Research Integrity Officers (ENRIO). Further, we searched the internet using the Google search engine and search terms "research integrity" AND "name of the country." Apart from that, we searched national research councils and ethics committees, national agencies on RE/RI, national scientific funds, and national academies of science for each of the 16 countries. The search was conducted during 2020 through 2022.

This article used the information and methodological approaches from the MLE on RI and *EnTIRE* project to present the results on 16 European countries.

Results

Research infrastructure, funding, and strategy

With the first category – research infrastructure, research funding, and research strategy – we mapped the general research framework for each country. This data showed how much each country invests in research by the number of full-time researchers, the number of universities, the gross expenditures on research and development (R&D) as part of the countries' gross domestic product (GDP), and whether each country has an implemented research strategy. The analysis of these items showed differences across the 16 countries (Table 4).

Concerning research infrastructure, northern and some western European countries have a higher number of full-time researchers and universities. For

Table 4. Research infrastructure, research funding, and research strategy in analyzed countries.

| Country	Research infrastructure		Research funding		Research strategy
	The number of full-time researchers (year) / the number of full-time researchers per million inhabitants	The number of universities	Gross expenditures on R&D (year)	Part of the GDP	
Austria	52,554 (2019)/5,868	55	€11.518 billion (2017)	3.11%	Strategy for Research, Technology and Innovation for the next decade (2011)
Bulgaria	16,940 (2019)/2,419	51	€389 million (2017)	0.75%	National strategy for development of scientific research in the Republic of Bulgaria 2017–2030 (Better Science for better Bulgaria)
Croatia	11,801 (2016)/2,804	12	€76,231,740 (2018)	0.97%	The Strategy for Education, Science and Technology of the Parliament of the Republic of Croatia (2014)
Denmark	42,378 (2019)/7,342	8	€8.921 million (2017)	2.93%	Denmark – Ready for the Future (2018)
Estonia	4,968 (2018)/3,755	7	€452,97 million (2019)	1.61%	The Estonian Research and Development and Innovation Strategy 2014–2020 "Knowledge-based Estonia"
Finland	51,500 (2019)/9,309	14	€6.7 billion (2019)	2.79%	The Finland's Strategy and Roadmap for Research Infrastructures 2014–2020.
France	431,000 (2016)/6,664	116*	€51.8 billion (2018)	2.20%	The research strategy France Europe 2020 A Strategic Agenda for Research, Technology Transfer and Innovation
Greece	40,084 (2019)/3,827	24	€2,336.58 million (2019)	1.27%	National Research and Innovation Strategy for Smart Specialization 2014–2020.
Ireland	37,310 (2019)/7,641	8	€4.027 million (2019)	1.13%	The five-year strategy on research and development, science and technology, entitled Innovation 2020.
Lithuania	9,538 (2019)/3,456	18	€483.868 million (2019)	0.99%	The Lithuania's Progress Strategy "Lithuania 2030"
Luxembourg	3,158 (2019)/5,128	1	€704.5 million (2018)	1.17%	The "National Research and Innovation Strategy"
Moldova	2,466 (2018)/608	22	€34,4 million (2018)	0.25%	The National Development Strategy "Moldova 2030" (2018)
Norway	46,600 (2018)/8,729	10	€7.13 billion (2018)	2.06%	The first long-term plan for research and higher education in 2014
Spain	135,331 (2019)/2,895	75	€15.572 million (2019)	1.25%	The Spanish Strategy on Science, Technology and Innovation 2013–2020 (2013)
Sweden	91,172 (2019)/9,084	17	€16.8 billion (2019)	3.41%	Life sciences road map – pathway to a national strategy
The Netherlands	97,713 (2019)/5,715	18	€16.554 million (2018)	2.14%	2025 – Vision for Science choices for the future

*We mapped all public and private higher education institutions in France – universities, Grandes écoles, and specialized schools.

example, Scandinavian countries have the highest number of full-time researchers per million inhabitants. Finland leads in this parameter, with 9,309 researchers per million inhabitants in 2019. It is followed by Sweden with 9,084 (2019) and Norway with 8,729 (2018) researchers per million inhabitants. Eastern European countries have lower number of researchers employed full-time. The country with the lowest number of full-time researchers was Moldova, with only 608 full-time researchers per million inhabitants in 2018. The country with the highest number of universities is Spain ($n = 75$), followed by Austria ($n = 55$), and Bulgaria ($n = 51$). The country with the lowest number of universities is Luxembourg, with a single university. Of course, in interpreting these results we must take into account the country size, as larger countries will have more universities.

For the topic of research funding, we used the data concerning the gross expenditures on R&D for each country and calculated the percent of the country's GDP. The country with the highest investment in R&D is Sweden, which comprises 3.4% of its GDP, followed by Austria with 3.1%, and Denmark with 2.9%. Countries whose R&D gross expenditures are below 1.0% of their GDP are Croatia (1.0%), Bulgaria (0.8%), and Moldova (0.3%). All 16 countries have research strategies developed and implemented on the national level.

Research governance, compliance and integrity structures

For the next framework element, we used the data concerning national bodies for RI and RE, national codes for RI and RE, and guidelines for researchers, the practices for dealing with research misconduct, and the protection of the whistleblowers (Figure 2). We compared the data between all 16 countries (Table 5).
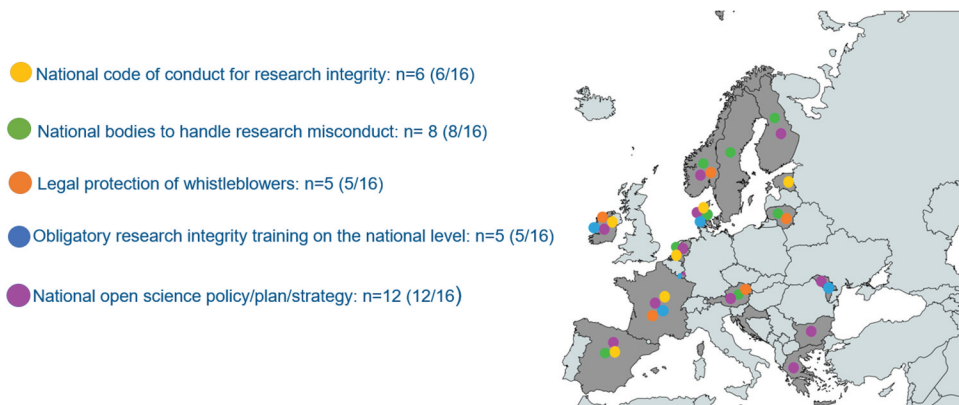
Figure 2. Overview of research governance, compliance, and integrity structures in countries included in the analysis.

Table 5. Research governance, compliance, and integrity structures in analyzed countries.

Country	The number of national bodies promoting RE/RI	Research governance, compliance, and integrity structures		
		Bodies that handle research misconduct	National Code of conduct for RE/RI	Legal protection of whistleblowers
Austria	5	Austrian Agency for Research Integrity	No	Yes
Bulgaria	3	Academic Ethics Committee	No	No
Croatia	1	Ethics committees in research institutions	No	No information
Denmark	6	The Danish Committee on Research Misconduct	Yes (The Danish Code of Conduct)	No
Estonia	4	Ethics committees in research institutions	Yes (The Estonian Code of Conduct for Research Integrity)	No
Finland	6	Finnish National Board on Research Integrity (TENK)	No	No information
France	8	Research institutions	Yes (National charter for research integrity)	Yes
Greece	3	Ad-hoc committees or research institutions performing organizations	No	No
Ireland	2	Research institutions perform investigations	Yes (Policy Statement on Ensuring Research Integrity in Ireland)	Yes
Lithuania	4	Office of the Ombudsperson for Academic Ethics	No	Yes
Luxembourg	4	Luxembourg Agency for Research Integrity (LARI)	No	No
Moldova	No official structure	Ethics committees at research institutions	No	No
The Netherlands	6	Boards at research institutions (advised by the Netherlands Board on Research Integrity/LOWI/)	Yes (Netherlands Code of Conduct for Research Integrity)	
Norway	6	The National Commission for the Investigation of Research Misconduct (GRU)	No	Yes
Spain	5	Ethics Committee of the Spanish National Research Council (CSIC)	Yes (Code of Good Scientific Practices of CSIC and the Spanish National Statement of Research Integrity.	No
Sweden	4	The National Board for Assessment of Research Misconduct	No	No information

National bodies for RI and RE

The majority of the countries included in this study have established policies and structures for RI and RE, but they differ in certain aspects. When it comes to RI and RE bodies, a great number of countries had an official national structure responsible for providing the RI and RE governance framework. France, for example, has eight national bodies that promote RI and RE, the highest among the countries in the study. These bodies have an advisory and monitoring role, or provide support to higher education and research institutions. France is followed by Norway, Finland, Denmark, and the Netherlands, with six RI and RE national bodies each, all with similar objectives. Apart from promoting RI and RE, national RI and RE bodies in some of these 16 countries also provide relevant information and discuss issues related to RI and RE, develop national guidelines on RI and RE, support the implementation of RI and RE policies, and facilitate collaboration. Moldova is the only country without an official RI and RE structure. The Moldovan National Authority for Integrity deals only with public servants and heads of institutes. It does not address RI and RE or researchers in general.

National codes for RI and RE and guidelines for researchers

Six countries (Denmark, Estonia, France, Ireland, Spain, and the Netherlands) have national codes for RI and RE. Although some Scandinavian countries (Finland, Norway, and Sweden) do not have national codes for RI and RE, institutions responsible for promoting RI and RE in these countries have developed various guidelines for researchers and other stakeholders involved in research. Among these countries, Finland has the highest number of guidelines addressing different RI and RE topics. For example, Finnish National Board on Research Integrity (TENK) has issued numerous guidelines, among them "Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity 2012" and "Responsible Conduct of Research (RCR) guidelines" available in Finnish, Swedish, and English (Finnish National Board on Research Integrity (TENK) 2012, 2021). Norway, with several national bodies for promoting RI and RE, also issued several guidelines and checklists regarding ethics and integrity across different research areas. The National Commission for Research Ethics in Science and Technology (NENT) developed Guidelines for Research Ethics in Science and Technology (Norwegian National Committee for Research Ethics in Science and Technology (NENT) 2016), the National Committee for Research Ethics in Social Sciences and Humanities (NESH) issued Guidelines for Research Ethics in the Social Sciences and Humanities (Norwegian National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) 2021), whereas the National Committee for Medical and Health Research Ethics (NEM) published various guidelines.

Sweden also does not have a national code for RI and RE, however, the Swedish Research Council has its ethical guidelines and internal Expert Group on Ethics which has published the book Good Research Practice (Swedish Research Council 2017), intended primarily for researchers.

Processes for handling research misconduct

The analysis of 16 European countries showed that they differ when it comes to institutions that handle research misconduct allegations and cases. Some of the countries have specific national bodies that handle cases of research misconduct (Austria, Bulgaria, Denmark, Finland, Lithuania, Luxembourg, Norway, Spain, and Sweden), whereas in other countries (Croatia, Estonia, France, Greece, Ireland, Moldova, and the Netherlands) research institutions, such as universities, are responsible for dealing with such cases. However, some of the research institutions that deal with research misconduct cases are affiliated with independent bodies that advise possible violations of the principles of RI and RE. For example, institutional Boards in the Netherlands are advised by the Netherlands Board on Research Integrity (LOWI) on this matter. Greece, on the other hand, apart from having research performing institutions that deal with the cases of alleged misconduct, sometimes has ad-hoc committees for handling research misconduct issues. Croatia has a national body for RE and RI, but it does not seem to be functional at the moment.

Legal protection of whistleblowers

The case analysis showed that countries also differ when it comes to the legal protection of whistleblowers in research. Austria, France, Ireland, Lithuania, Norway, and the Netherlands have specific legal acts for whistleblowers' protection. In the Netherlands, for example, scientific integrity counselors are appointed at universities for assisting both whistleblowers and those accused of research misconduct. On the other hand, Bulgaria, Denmark, Estonia, Greece, Luxembourg, Moldova, and Spain do not provide legal protection for whistleblowers. Resources that we searched for relevant information did not provide data for Croatia, Finland, and Sweden in this matter.

Laws and regulations

We mapped the existing laws and regulations concerning RI and RE and found significant differences between the analyzed countries (Table 6). First, the number of laws and regulations that we mapped differed between the countries. For instance, the Netherlands has 17 laws and regulations on RI and RE whereas Croatia has 2. Some Scandinavian countries have passed the laws laws that regulate ethics in research and examine research misconduct. For instance, Norway has Research Ethics Act and Research Ethics Regulation. Denmark has the Research Misconduct Act and Executive order of the Danish

Table 6. Laws and regulations concerning RI and RE.

Country	The number of laws	Laws that regulate ethics in research and examine misconduct	Protection of animals in research	Regulation of higher education institutions	Personal data protection
				Laws and regulations	
Austria	6	No	Yes	Yes	Yes
Bulgaria	15	No	No	Yes	
Croatia	2	No	No	Yes	
Denmark	6	Yes (Research Misconduct Act and Executive order of the Danish Committees on Scientific Dishonesty)	No	Yes	
Estonia	7	No	Yes	Yes	
Finland	8	No	Yes	Yes	Yes
France	5	No	Yes	Yes	
Greece	5	No	No	Yes	Yes
Ireland	9	No	No	Yes	Yes
Lithuania	10	No	No	Yes	
Luxembourg	6	No	Yes	Yes	Yes
Moldova	6	No	No	Yes	
Norway	11	Yes (Research Ethics Act and Research Ethics Regulation)	Yes	Yes	
Spain	10	No	Yes	Yes	Yes
Sweden	7	Yes (Act on responsibility for good research practice and the examination of research misconduct)	No	Yes	Yes
The Netherlands	17	No	Yes	Yes	Yes

Committees on Scientific Dishonesty, while Sweden has an Act on responsibility for good research practice and the examination of research misconduct. Eight countries – Austria, Estonia, Finland, France, Luxembourg, Norway, Spain, and the Netherlands – have laws that protect animals in research. All countries have laws on universities or higher education institutions in general. Moldova, for instance, has a law that regulates the organization of doctoral studies.

Measures to promote good scientific practices and open science

The category "Measures to promote good scientific practices and open science" in the Country Report Cards contained three sub-items – RI and RE training, RI and RE dialogue and communication, and RI and RE incentives. With these items, we captured the information related to the availability and types of RI and RE training and educational courses, open science initiatives, and communication initiatives (information related to informing society about RI and RE and research misconduct cases and organizations participating in the international RI and RE networks and initiatives), and research incentives (related to the incentives, evaluations,

and awards for institutions and individuals based on research output, as well as incentives for collaborative science and networks).

RI and RE training and education

We collected the information on whether there is training and education in RI and RE across countries. We explored the main characteristics of RI and RE training and education – the obligatory or non-obligatory nature, mode of delivery, and targeted audience. The obtained data showed a great diversity between countries regarding the compulsory and voluntary nature of RI and RE training and education. Moreover, this diversity is seen not only when comparing countries but within a single country, there are often differences between mandatory and non-mandatory RI and RE training. For example, in Austria, RI and RE training is mostly non-mandatory, however, at some doctoral programs and some universities, it is mandatory for those who want to qualify to an academic positions (professorship). In some countries, RI and RE training and education were mandated on the national level, i.e., the federal or governmental body has brought the decision, document, or law-making RI and RE training mandatory, such as in Denmark, France, Ireland, Luxembourg, and Moldova. In these countries, RI and RE training is mostly mandatory for at least doctoral students, post-doctoral researchers, and all publicly-funded research organizations.

The responsibility for delivering RI and RE training and education also differs between the countries. While in Austria, Ireland, and Luxembourg, the national RI and RE agencies and forums (Austrian Agency for Research Integrity, Luxembourg Agency for Research Integrity, and Irish National Research Integrity Forum) are responsible for training and educating researchers, in Denmark, France, Moldova, and the Netherlands this is usually the responsibility of research organizations. Spain also has a national document (National Statement of Scientific Integrity) (CSIC 2015) referring to RI and RE education; however, this document provides recommendations rather than imposing an obligation to research organizations to deliver RI and RE training. The search of the relevant data from other countries, i.e., Bulgaria, Croatia, Estonia, Finland, Greece, Lithuania, Norway, and Sweden, showed that RI and RE training also exists but is non-obligatory, and it is up to each researcher to decide whether to undergo the training or not, regardless of training being provided by research organizations or national RI and RE bodies.

The type or mode of delivery for RI and RE training and education also varies across European countries. RI and RE training is mostly provided face-to-face in the form of lectures, workshops, and seminars. In some countries, like Luxembourg, more emphasis is put on providing practical, interactive, and creative courses (Luxembourg Agency for Research Integrity (LARI) 2022). The overview of RE/RI training and education and characteristics across countries is presented in Table 7.

Table 7. Characteristics of RI and RE training and education across different European countries.

Country	Obligatory/non-obligatory	Type and delivery mode	Targeted population
Austria	Non-obligatory except for programmes funded by Austrian Science Fund, some PhD programs, at some universities for those who want to qualify as professors	Workshops, lectures, and train-the-trainer courses delivered by Austrian Agency for Research Integrity	PhD students, researchers, RI officers and ombudsmans
Bulgaria	Non-obligatory/unknown* (RE training is obligatory for members of ethics committees and Multi-Center Ethics Committee; some training is provided by Committee on Academic Ethics and Bulgarian Drug Agency)	Seminars and training sessions	Members of RE committees, researchers
Croatia	Non-obligatory (some elements of RI and RE are part of higher education programmes and there are initiatives to introduce RI and RE via elective undergraduate courses as well as to train researchers in the form of summer school programmes)	Lectures, workshops, and train-the-trainer courses	Undergraduate students, PhD students, researchers
Denmark	Obligatory (mandated by the Ministry of Higher Education and Science)	Lectures, workshops provided by research organizations	PhD students, postdoctoral researchers, researchers
Estonia	Non-obligatory (depend on research organization; all universities offer introductory courses in RE; Estonian Research Council provides some educational activities)	Lectures, workshops, seminars	Undergraduate students (RE), PhD students (RE), researchers
Finland	Non-obligatory (depends on research organization; some training for RE/RI advisers is provided by Finnish National Board on Research Integrity; some universities offer RE/RI training for PhD students and teachers)	Lectures, online courses	RE/RI advisors, teachers, PhD students
France	Obligatory (mandated by Ministry of Higher Education, Research and Innovation)	Lectures, workshops, seminars provided by research organizations; the MOOC "Research Integrity in Research Professions" lectures, workshops, discussions; educational courses provided by French Office for RI (for RI officers)	PhD students, researchers, RI officers

(Continued)

Table 7. (Continued).

Country	Obligatory/non-obligatory	Type and delivery mode	Targeted population
Greece	Non-obligatory (depends on research organizations; some elements of RI are part of higher education programme – Responsible Conduct of Research-Greece educates master's students at two universities; some education is provided by the Hellenic National Bioethics and Technoethics Commission, the Laboratory for the Research of Medical Law and Ethics, and Ethical Aspects in Research and Technology for Human Network; education is also provided at National technical University of Athens)	Lectures, seminars, training courses, train-the-trainer courses	Undergraduate students, PhD students, researchers, educators
Ireland	Obligatory for publicly funded researchers (the National Forum on Research Integrity has put training in place and research organizations have the autonomy to decide at which level the training will be implemented)	Online training course	Researchers and other academic staff, PhD students
Lithuania	Non-obligatory (some universities provide training, for example Vilnius University offers General Competence Skill Training related to publication ethics; some training is provided by the Office of the Ombudspersons for Academic Ethics and Procedures)	Training courses	PhD students, researchers, librarians, members of academic integrity committees
Luxembourg	Obligatory for PhD students	Educational, interactive, and creative sessions and workshops (delivered by Luxembourg Agency for Research Integrity); peer coaching programs (Luxembourg Agency for Research Integrity); training courses (University of Luxembourg): training and workshops (Luxembourg Institute of Health)	PhD students, researchers, RI coaches
Moldova	Obligatory for undergraduate and doctoral students (mandated by Ministry of Education, Culture, and Research)	Lectures, seminars	Undergraduate students, PhD students
Norway	Non-obligatory (RE training is made obligatory at research organizations by the Research Ethics Act)	Lectures, meetings	Researchers

(*Continued*)

Table 7. (Continued).

Country	Obligatory/non-obligatory	Type and delivery mode	Targeted population
Spain	Non-obligatory (some universities and research organizations have integrated a module about RI in their existing program on RE – Autonomous University of Madrid, University of Barcelona, University of Oviedo and National University of Distance Education; some members of CSIC Ethics Committee give lectures on RI and RCR; RI and RE training have been included as topics in CSIC management and Training Course for CSIC directors and managers)	Lectures	Students, directors and managers
Sweden	Non-obligatory (depends on research organizations; some education is also provided by Ethics Council, Swedish National Data Service, and National Quality Registers at the Swedish Association of Local Authorities and Regions, Regional Register Centres and related stakeholders)	Lectures, seminars, workshops, conferences, discussion forums, training events	PhD students, researchers
The Netherlands	Non-obligatory (depends on institutions; there are some mandatory training courses for PhD students and some elements of RI are part of university educational programmes)	Lectures, seminars, train-the-trainer programs, forums	Undergraduate students, PhD students, researchers

RI and RE dialogue and communication

For this framework element of the Country Report Cards, we collected the information on whether research and research data are usually open and whether there are existing national and institutional initiatives for making data open. Further, we obtained information on whether there are initiatives aiming at informing the general public about RI and RE issues and breaches and gathered information on whether there are other initiatives involving dialogue and communication between the research community and the general public, such as science fairs that serve as a place for disseminating research and bringing science closer to the general public. Moreover, we obtained information on the level of public trust in science and researchers.

Many countries developed and implemented national open science and open data policies, plans, and strategies. Further, for countries that still do not have national open science policies, plans, and strategies, we found information about other initiatives established in the research community, such as open science declarations that are adopted and promoted by universities and other research organizations. Moreover, there are also research organizations' initiatives and policies to promote and implement open access to scholarly publications. Public funding organizations usually have open access policies for ensuring open research publications and open data for publicly funded research. Many countries also have national forums and working groups that provide recommendations and guidance on various aspects of open science. Similarly, some countries established working task forces aimed at developing comprehensive implementation plans for open science. Another initiative often existing across the countries are national and institutional open repositories for depositing research publications and research data. Details on open science initiatives existing in 16 countries are available in Table 8.

The topic of informing the general public about RI and research misconduct is occasionally discussed in the lay press in most countries, and mostly when related to publicly funded research, research fraud, and corruption. In some countries, research misconduct cases are handled confidentially, and decisions are usually not available or discussed publicly, but anonymous statistics on handled cases are published (e.g., Austria and Finland). In some countries, research misconduct is often addressed and discussed in the lay press, which is used to raise awareness of RI and RE among the general public (e.g., Ireland and Norway). In most countries, there was a low public trust in science due to the frauds, scandals, and corruption in academia and science. However, we found that public trust in science is perceived high in Denmark, Finland, Ireland, Luxembourg, Norway, and the Netherlands. We identified different initiatives across countries aiming at bringing science and research closer to the general public. In Austria and Norway, members of national academies of sciences inform the general

Table 8. Open science initiatives available in different European countries.

Country	National open science policy/plan/ strategy	Other policies and laws	Other open science initiatives
Austria	Recommendations for the Transition to Open Access in Austria 2015	• Open Access Policy: Open Access to Research Data (Policy of Austrian Science Fund) • Open Access Regulations of Vienna Science and Technology Fund • Many universities and institutes have open access policies	• In 2012 the Open Science Network Austria was founded by Austrian Science Fund and Austrian University Conference – in charge for developing Open Access Strategy and Open Access and Open Data infrastructure • The Austrian Academic Library Consortium (KEMÖ) and the Austrian Science Fund (FWF) have concluded a number Open Access agreements with the publishers • 41 multidisciplinary and discipline-specific repositories • 53 Austrian Open Access journals • Open Science Network working group organizes workshops and training session for researchers and support staff
Bulgaria	National Open Science Plan (2020)	• National Strategy for Research development 2017–2030 (among strategic action point includes actions to promote and implement open science initiatives) • National Strategy for Development of Scientific Research in Bulgaria 2017 • National Roadmap for Research Infrastructure 2017–2023	• Network of Open Access Centres (established by the Bulgarian Academy of Sciences; provides support for organizations and researchers and organizes annual information days on open access) • Bulgarian Academy of Sciences promotes open access policies regularly through conferences and meetings; some universities have open access repositories and at the national level there is the Bulgarian Portal for Open Science and the National Repository for publicly funded research; • Bulgarian OpenAIRE Repository (for ERC funded FP7 projects in Bulgaria)

(Continued)

Table 8. (Continued).

Country	National open science policy/plan/strategy	Other policies and laws	Other open science initiatives
Croatia	No national policy/plan/strategy	• Croatian Open Access Declaration (supported by 19 institutions) • The Croatian Act on Scientific Activity and Higher Education (all higher education theses digital versions must be archived in library repository) • The Croatian Research and Innovation Infrastructure Roadmap 2014–2020 (addresses the promotion of open access to scientific publications)	• National repository infrastructure DABAR (compatible with Open AIRE Guidelines) • Portal of Croatian Scientific and Professional Journals (open access publishing platform) • Croatian Scientific Bibliography CROSBI (oldest OA repository; gathers information on publications published by Croatian authors)
Denmark	National Strategy for Open Access 2018–2025	• Some public and private funders have open access policies	• Open Access Indicator (produced annually by the Danish Agency for Higher Education; monitors the implementation of the Danish Open Access Strategy • All universities have Open Science Support Unit at university libraries
Estonia	No national policy/plan/strategy	• Open Science Expert Group of the Estonian Research Council Principles and Recommendations for Developing National Policy 2016 • Roadmap for an Open Science Policy Framework (Ministry of Education and Research)	• University of Tartu hosts Open Access weeks since 2010 for promoting open access and open research data • University of Tartu host various training courses that include open science (Introduction to Information Research, Research Data Management and Publishing, Research Integrity)

(Continued)

Table 8. (Continued).

Country	National open science policy/plan/ strategy	Other policies and laws	Other open science initiatives
Finland	Open access to scholarly publications – National policy and executive plan by the research community in Finland 2020–2025	• Declaration for open science and research 2020–2025 • Good practice in researcher evaluation – Recommendation for the responsible evaluation of a researcher in Finland 2020 • Recommendations on Open Access to scholarly publications for research organizations (2020) • Recommendation for publishing open educational resources (2020) • some funders have open science and open access policies	• Open Science activities are coordinated by the Federation of Finnish Learned Societies • Every university has Open Science Support Unit at libraries • national open science courses are held
France	National Plan for Open Science 2018	• French Law for a Digital Republic Act (2016; one article concerns scholarly communication and relates directly to open access/open data) • National Research Agency (ANR) Open Science Policy	• Science Ouverte France (dedicated open access website for researchers) • Doranum (website for researchers for research data) • Revues.org platform (hosts 192 open access journals) • Hyper Articles en Ligne (HAL) (national centralized repository)
Greece	National Plan for Open Science 2020	• Law 4310/2014 (supports open access for publicly funded research) • Some universities adopted open access policies • Declaration on Open Access in Greece	• National Open Science Task Force (produced National Open Science Plan • National Archive for PhD Theses (access to PhD theses from all higher education institutions in Greece • Athena Research and Innovation Center (webinars and training courses on open science) • HEAL-Link (supports green open access for preprints in institutional repositories)

(*Continued*)

Table 8. (Continued).

Country	National open science policy/plan/strategy	Other policies and laws	Other open science initiatives
Ireland	National Principles on Open Access 2012	• National Framework on the Transition to an Open Research Environment (published by National Open Research Forum; presents goals for enabling open access to research publications, FAIR research data, developing infrastructure for open access, building skills and competences, creating incentives for open science) • Some funding agencies and universities have open access policies	• RIAN (national portal for open access) • open access repositories are available at all universities • Dublin City University Press (open access university press) • National Open Research Forum (supports researchers and organizations in open science) • Open Knowledge Ireland (nonprofit organization that promotes open data open content)
Lithuania	No national policy/plan/strategy	• Guidelines on Open Access to Scientific Publications and Data (adopted in 2016 by the Research Council of Lithuania) • Law on Higher Education and Research of the Republic of Lithuania (publicly funded research must be announced publicly) • Some research institutions have open science policies	• Electronic Academic Library of Lithuania (eLABa) (national open access repository) • National Open Access Research Data Archive (MIDAS) (free and unrestricted Internet access to research outputs)
Luxembourg	Common principles on Open Access 2015	• Luxembourg National Research Fund (requires funding projects' publications to be open access; provides reimbursement of open access publishing costs) • University of Luxembourg Open Access initiative (requires all university members to deposit electronic copies of published manuscripts in the institutional repository and to deposit the bibliographic references of all scientific production)	• University of Luxembourg repositors ORBilu • Open Science Forum (educational seminars and practical sessions) • Open Science Quest (organized within Luxembourg Learning Centre for interactive sessions about open science practices)

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Table 8. (Continued).

Country	National open science policy/plan/ strategy	Other policies and laws	Other open science initiatives
Moldova	The National Strategy for the Development of the Digital Moldova Information Society 2020	• The Declaration on Open Science in the Republic of Moldova (2018; the government approved the Declaration and identified open science as a priority) • 11 institutions adopted open access policies • 12 institutions launched open access repositories	• The National Bibliometric Tool (digital repository for storing, classifying, and measuring publication data in national journals) • Optimizing Scholarly Communication in Moldova project (promoting and advancing national and institutional open science guidelines, policies, and incentives) • National Scientific Conference on Open Science (first held in 2018)
Norway	National goals and guidelines for open access to research articles 2017	• National strategy on access to and sharing of research data 2018 • Long-term plan for research and higher education 2019–2028 - Meld. St. 4. White paper (technology initiatives – e-infrastructure for open research) • All universities and most of the other research organizations have open access policies • Digitalization strategy for the higher education sector 2017–2021 (strategy for open access to research data; resources for calculation, analysis, storage, data curation, and communication; digitalization for cost-effective management of research publications)	• Official Norwegian Report NOU 2015:5 MOOCs for Norway New digital learning methods in higher education • Research output is reported in national Cristin system • National Library of Norway (digitalization of entire collection) • Norwegian open research archives (NORA) (harvests all institutional repositories) • Open Access to research web page (providing information and promoting open science)

(Continued)

Table 8. (Continued).

Country	National open science policy/plan/strategy	Other policies and laws	Other open science initiatives
Spain	State Plan for Research, Development, and Innovation 2017–2020	• Act 14/2011 (researchers must deposit final publications in an open access repository – for publicly funded research and research organizations)	• RECOLECTA (gathers all national scientific repositories in one place) • Spanish Foundation for Science and Technology (provides training and workshops for researchers, librarians, policymakers; organizes national workshops) • up to 57 universities and other research organizations have institutional open access repositories • Network of Spanish University Libraries (supports and promotes open access through organized events and educational courses)
Sweden	No national policy/plan/strategy	• Proposal for National Guidelines for Open Access to Scientific Information (2015; Swedish Research Council) • Swedish Research Bill (2016; publicly funded research should be open access) • Most of the funding organizations have open access policies (mandating open access to publications for research performing organizations) • all universities have policies recommending publishing research results in open access	• National Library of Sweden coordinates implementation of open access to publications • Swedish Research Council coordinates implementation of open access to research data • almost all universities have open access repositories • Swepub (search service for harvesting publications from institutional repositories)

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Table 8. (Continued).

Country	National open science policy/plan/ strategy	Other policies and laws	Other open science initiatives
The Netherlands	National Plan Open Science 2017	• public funders have open access to publications policies	• National Platform Open Science • SURF (collaborative organizations for universities and research institutes) • all universities have repositories • NARCIS (central portal for repositories) • the national open access website (provides information and news on open access across different universities) • Open Access Week (educational courses, seminar and symposiums for promoting open science) • Research Data Netherlands (provides courses for storing and preserving data)

public about important scientific insights. In all countries included in the analysis, higher education institutions communicate research to the public, which is often done at festivals, conferences, or public meetings. Future research conducted with the Country Report Cards could also include information on how organizations use social media communication to establish a relationship with public.

Incentives

The element of incentives in the Country Report Cards captured the information related to the awards and other incentives for institutions (universities) or individuals based on the research outputs, as well as for collaborative science and research networks. We also included the information about whether there are any incentives related to RI and RE and whether RI and RE are a part of the institutional quality assessment.

Awards and prizes for outstanding research contributions, innovations, exist in every country included in our Country Report Cards. These rewards are often awarded annually by research institutions (universities) or governments to further promote research and innovation. The awards and scholarships are also often provided for early career researchers and students to help them establish their collaborative networks and project early in their careers.

Some of the countries have special tax schemes that encourage research activities. These include, for example, lower tax for those who carry out research in the country (Austria), a special tax scheme for researchers recruited from abroad (Denmark), a research tax credit that supports business and research and development activities by providing tax assistance (France), income tax relief for investigating research and development sector (Lithuania), and tax relief in the research and development sector (Norway and Spain).

Regarding the collaboration initiatives in almost all countries, there are incentives for collaboration. For example, some countries are devoted to promoting the collaboration between research and business sectors, whether through providing funding to research-industry collaborative projects (e.g., Austria, Ireland, Luxembourg, Norway) or creating other national initiatives that will encourage industry to engage in more work with researchers. Regarding the latter, an example is the Lithuanian Ministry of Higher Education and Science, which allocated funding in 2010 to support the employment of researchers in industry and business enterprises. In Norway, the industrial doctoral program was established to promote and enhance cooperation and mobility between research and industry, increase research activities in the industry and equip researchers with the knowledge they will need to work in the industry and business sector. Besides incentives for establishing collaboration between research and industry, all countries offer various incentives that promote collaboration between research

institutions (universities), especially international collaborations. Some initiatives include paying membership fees in international societies to support international collaborative networks as it is done by the Academy of Finland, the Baltic Bonus scheme to promote cooperation between Lithuania, Latvia, and Estonia, and the France "Setting Up European or International Scientific Networks (MRSEI)" (French National Research Agency 2022) that supports the networks coordinated by French researchers and encourages their participation in European and international projects.

Regarding quality assessment and whether this process takes into account RI and RE, we found information that RI and RE are a part of quality assessment in some countries. However, for most of the countries we were unable to find the full information. Examples include Austria, where RI and RE are a part of quality assessment in some institutions (e.g., the Ombudsman Office at the University of Vienna is under the coordination of the Unit for Quality Assurance). In Croatia, research impact assessment and translation of research findings to the community is a part of the accreditation process for research and higher education institutions. In Denmark, RI and RE are a part of the institutional quality assessment as all research institutions had to adopt the Danish Code of Conduct for RI. In Finland, RI and RE are a part of institutional quality assessment, and universities have to organize international research assessments every 6 years to measure the quality of research. In Moldova, RI and RE are included as a part of the evaluation schemes for doctoral studies. Moreover, regarding the assessment of researchers in the Netherlands, the University of Ghent and the University of Utrecht introduced RI and RE requirements for evaluating researchers for career promotions.

Discussion

The analysis of RI and RE frameworks across 16 European countries showed the existence of a variety of approaches to RI and RE promotion and implementation. While some of the countries are front-runners when it comes to RI, with well-established and continually developing policies and structures, others are just starting their journey in RI and often using RE – the concept developed prior to RI and focusing on the moral perspective of research – policies and structures for handling RI issues. Although most of the analyzed countries are European Union (EU) member states, the analysis showed that there is a diversity of RI and RE frameworks, as well as that the level of development of RI and RE structures differ, although we could expect a certain level of uniformity within the EU. However, despite the different levels of development, our analysis showed that RI and RE have been continually developing and getting more and more attention. This is evident from the previously conducted analyses of RI and RE structures and our

study that shows that more and more European countries are actively working on establishing the bodies that will deal with RI and RE issues (Hermerén et al. 2019; Marušić 2019). However, a long path is ahead of some European countries that just entered the global RI and RE arena, which recognizing the importance of addressing and emphasizing the RI and RE issues within their research setting.

As shown in our general mapping of research frameworks within Europe and by the comparison of the statistics through the years, there is a rising number of people being employed in the public and private research sector, as well as more and more funds invested in research. Consequently, European countries are investing more resources (both financial and human) in establishing RI policies and structures which is evident from our analysis that showed that 15 out of 16 countries in our study have some sort of national establishment for handling RI. This means that the awareness of the importance of RI and recognition of its specifics compared to RE are being more and more recognized. We deliberately used the term "a sort of establishment" because the way the RI structures are organized is not the same in all countries. While some countries are more developed in this area, having the umbrella RI bodies that handle RI issues across organizations, in other countries, there are bodies at public universities and other public research institutions designated to handle RI and RE issues. The latter could also be prone to more discrepancies between how RI and RE cases, especially cases of research misconduct and other poor research practices are handled and could contribute to poor implementation of RI and RE standards. In that sense, the establishment of the umbrella RI bodies at the national level is something that European countries should strive for to ensure the equal implementation of RI standards in practice. Unfortunately, our analysis shows that even today, the increase in RI awareness is paralleled by a small percentage of countries in which RE committees handle RI issues, although it is well accepted today that RI and RE are similar but not the same concepts and that they have different aims and stakeholders involved. This is something that has not changed since the previous similar analysis conducted under the MLE for RI in 2018/2019 (Hermerén et al. 2019; Marušić 2019). This is also something that needs to be changed in the future – the distinction between these two concepts is necessary to handle both research ethics and integrity issues (Steneck 2006).

Concerning the RI and RE guidance, our analysis showed that some countries included in the analysis have some sort of guidance, such as codes and guidelines on the national level. However, creating the RI and RE guidance is today more emphasized as the task for research organizations. This is in accordance with some other studies that mapped existing RI and RE guidance for research performing and funding organizations. For example, a recent scoping review (Ščepanović 2021) showed there is a great

number of various types of guidance documents related to RI developed and implemented by research organizations. However, there are significant differences when the content of this guidance is examined, which warrants the conclusion that more harmonization in this aspect is needed. Moreover, the study exploring codes of conduct for RI across various European countries showed differences and divergences in guidance practices and standards, as well (Desmond and Dierickx 2021). One initiative to achieve harmonization was developed by the All European Academies and that is the European Code of Conduct for Research Integrity (ECoC for RI) – the European framework for regulating RI (All European Academies (ALLEA) 2017). The national guidance in Europe could in the future be developed based on the principles presented in the ECoC for RI and built upon its recommendations. This could ensure a certain level of uniformity and contribute to equal application of RI and RE standards and hence better avoidance of research misconduct and other poor research practices. Our study also showed that only a small number of European countries have established legal protection for whistleblowers, although it has been recognized across available literature that whistleblowers have an important role in diagnosing research misconduct and preventing future poor research behavior (All European Academies (ALLEA) 2017; Bouter and Hendrix 2017; National Academies of Sciences, Engineering, and Medicine (NASEM) 2017). Moreover, the lack of proper whistleblowers' protection is also found to be one of the negative factors that contribute to future research misconduct and hinder RI implementation. Having the right procedures in place, preferably legally recognized, for the protection of those who report observed research misconduct could help in encouraging people to report research malpractice without fear for their career and other negative consequences that whistleblowers are usually exposed.

In regard to the national laws and regulations concerning RI and RE, we saw that all countries in the have at least one law concerning different aspects of RI and RE. The number of specific laws or bylaws ranged from 2 (Croatia) to 17 (the Netherlands). We found that the area of data protection in research is mostly well established and regulated by national laws. This is due to General Data Protection Regulation (GDPR) provisions being mandatory in almost all countries included in the study, as they are EU member states. However, since the GDPR explicitly says that data protection should be more precisely defined by the member states laws, which also includes data protection in research, not all countries included in the analysis have such national laws or at least not developed enough (Croatia is an example). Another example of policies applicable across European countries is related to the European Commission funding program Horizon Europe. In 2021 Horizon Europe implemented the requirement for all grant applicants to declare compliance with RI standards and practices outlined in the European

Code of Conduct for Research Integrity (European Commission (EC) 2021). This made the European Code of Conduct for Research Integrity a "soft law" implemented across European countries.

The analysis of measures aimed to promote good scientific practices and open science focused on RI and RE training and open science initiatives. RI and RE training is recognized as being one of the initiators of better RI and RE implementation (Labib et al. 2021; Pizzolato and Dierickx 2021). In our analysis, we noticed a great diversity between the obligatory and non-obligatory nature of the RI and RE training that was not necessarily between the countries, but diversity exists also within the countries. The analysis showed that RI and RE training is still non-obligatory in many European countries and that the most targeted population are Ph.D. students. Although it is important to start to educate researchers on the RI and RE issues early in their career recent studies shows that more initiatives are needed also for educating senior researchers, continually since they are supervisors to early-career researchers who often look upon their research behavior and who learn from their senior colleagues and supervisors (Labib et al. 2021). This is recognized as being an important aspect of future initiatives in RI and RE education – to empower researchers of all career stages to engage in RI and RE training and translate the acquired knowledge for future generations of researchers.

As funders increasingly require open access to publications to ensure transparency and enhance verifiability of research open science has come into the spotlight. Although open science is much more than just publishing research in open access format (National Academies of Sciences, Engineering, and Medicine 2018), this aspect of open science, together with open data is the most addressed by existing policies within the analyzed countries. Our analysis shows that open science is well addressed by analyzed countries and their policies as most countries have national strategies for open science and well-established structures to ensure open access to publications, data, and other research products.

Recommendations for future RI and RE initiatives

Several recommendations can be made based on our study results:

(1) Although RI is gaining more and more attention, and is recognized today as a concept different from RE in many European countries, some countries still need to separate the policies and processes aimed at RI and RE. Having separate policies, processes, as well as bodies for handling specific RI or RE issues is important for the adequate promotion and implementation of RI.

(2) Although many organizations have different bodies for handling RI issues, a national umbrella body that will deal with RI and research

misconduct at the national level is important for achieving a level of harmonization and uniformity at the national level, as well as for systemic promotion of RI.

(3) Having national RI guidance and policies can contribute to achieving harmonization and uniformity in dealing with RI and research misconduct issues within a country. It will also help researchers to avoid confusion when it comes to what rules apply when they change research institutions.

Study limitations

Although national RI and RE frameworks are important for providing an overview of policies, practices, and processes implemented and promoted across European countries, our study did not take into account the organizational differences that may exist within a country. Hence the results of our study are limited to a broad and general overview of RI and RE structures and processes, as exploring the organizational nuances in this area was out of the scope of our study. However, we believe that having this general overview of RI and RE across European countries provides a glimpse into what we can expect from research organizations (universities and other research performing organizations) in each country in the context of RI and RE policies, practices, and processes. Another possible limitation of our study is that we took into account only publicly available information, hence there is a possibility that we did not included in our analysis and subsequently results all the possible aspects of research and RI. This means that we did not included information related to publicly unavailable organizational policies and process for RI and RE focused on researchers, as well as research administrators and managers that play an important role in the research process. However, we believe that we captured enough information for presenting a broad overview of how RI and RE are established, promoted, and implemented in different countries. Future studies could use our results as a basis to delve more in depth into RI and RE in each specific country.

Conclusion

Our exercise with RI Country Report Cards showed the existence of many initiatives aiming at RI and RE promotion and implementation across various European countries. However, the analysis also showed there are still great differences when it comes to promoting and implementing RI and RE standards into practice which is evident from, for example, the way RI and RE issues are handled or RI and RE education provided. This shows that RI and RE in Europe needs to continue its development and perhaps try to reach a certain level of harmonization so that researchers working in the European areas have the same

expectation and management of RI and RE issues in a similar way, regardless of the place of work. This is particularly important for research mobility, as it is promoted by national and European funders. RI Country Report Cards have an element of continual mutual learning exercise, designed to serve for sharing knowledge and experiences between stakeholders with more or less RI and RE experience, and can be used as an inspiration or motivation to those who work on the RI and RE promotion and implementation.

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Authors' contributions

APP conducted the search, extracted, updated, and analyzed the data, interpreted the results, and wrote and edited the manuscript.
RR conducted the search, extracted and analyzed the data for some Country Report Cards, interpreted the results, and wrote and edited the manuscript.
VT conducted the search and extracted the data for some Country Report Cards, and contributed to the revision of the manuscript.
AM developed the protocol for the study, interpreted the results, revised the manuscript and supervised the research.

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