Human-Centred Research & Design for Inclusive Mobility. Section D–Ethical Considerations

Bako Rajaonah

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Section D–Ethical Considerations

Dr. Bako Rajaonah
UPHF, CNRS, UMR 8201-LAMIH
SHV Department

General contents

Introduction

This document is the fourth part of a five-part work on human-centred research and design for inclusive mobility intended for future research candidates at Université Polytechnique Hauts-de-France (UPHF)[1] and INSA Hauts-de-France[2], as well as the PhD students of the Laboratory of Industrial and Human Automation control Mechanical Engineering and Computer Science (UPHF, CNRS, UMR 8201-LAMIH)[3]. The aim of the whole work is to help students understand the principles of human-centred design of technologies and services.

Indeed, according to the European Union (EU), the European industry will better serve society by complementing the techno-economic vision of Industry 4.0 (digitalization, AI technologies, efficiency and flexibility of production) with the perspective of Industry 5.0, which focuses on human centricity, sustainability and resilience (Renda et al., 2022).

Source: Breque et al., 2021, p. 13

The first two parts present UPHF and LAMIH—in particular, the research strategies and the platforms and projects related to mobility and the maintaining of mobility – as well as two human-centred theoretical approaches to technology design[4]. The third part presents the qualitative and quantitative research approaches[5]. The next part (the present document) addresses the issue of ethical research. The fifth and final part will conclude with the writing of scientific papers.

[1] https://www.uphf.fr/en
[2] https://www.uphf.fr/insa-hdf/en/presentation/insa-hauts-france
[3] https://www.uphf.fr/lamih/en
[4] https://hal.science/hal-03726812
[5] https://uphf.hal.science/hal-04093130

Contents of Section D—Ethical Considerations

Human-Centred Research & Design for Inclusive Mobility. Section D—Ethical Considerations

The purpose of this document is to introduce students to the main ethical issues in research.

Research aims to produce knowledge that can be useful to society (e.g., Grønhaug & Olson, 1999) and the environment (e.g., Yañez-Figueroa et al., 2021). This perspective implies involves that some moral values underpin research, even if only the respect for the other in all its forms (ALLEA, 2017, 2023) and responsibility for nature (e.g., Jonas, 1973).

Morality refers to a set of norms and values that lie between (i) ethics[6], which reflects a questioning of rules, obligations, interdictions and priorities and (ii) ethics[7], which are applied (e.g., Ricoeur, 1989, 2000).

However, in science and research, both morality and ethics can be related to integrity (Stoeklé, Ivasilevitch, & Hervé, 2023). The present document addresses the issues of ethics and morality through the single concept of integrity in science and research (ALLEA, 2023; ANR, 2019; CNRS Ethics Committee, 2020); it covers the existing rules and procedures for ethical conduct in science and research.

Integrity in science and research contributes to increasing citizens' trust in science, in researchers and, more generally, in the research system and research results (Albert & Shines, 1994; ALLEA, 2023; Bouter, 2023; COMETS, 2020; Haven et al., 2022; Ofis[8]). As shown in Figure 1, integrity applies to many aspects of science and research; the figure also shows that integrity is a two-level concept, as these aspects concern either researchers or research.

Note that scientific integrity in France is enshrined in the French Research Code[9] (Articles L211-1 to L211-2).

[6] Functioning as singular: "the philosophical study of the moral value of human conduct and of the rules and principles that ought to govern it" (https://www.collinsdictionary.com/dictionary/english/ethics)
[7] Functioning as plural: "a social, religious, or civil code of behaviour considered correct, especially that of a particular group, profession, or individual" (ibid.)
[8] The French Office for Research Integrity: https://www.ofis-france.fr/en/ (accessed on 21 August 2023)
[9] https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006071190/ (accessed on 13 Dec. 2023)

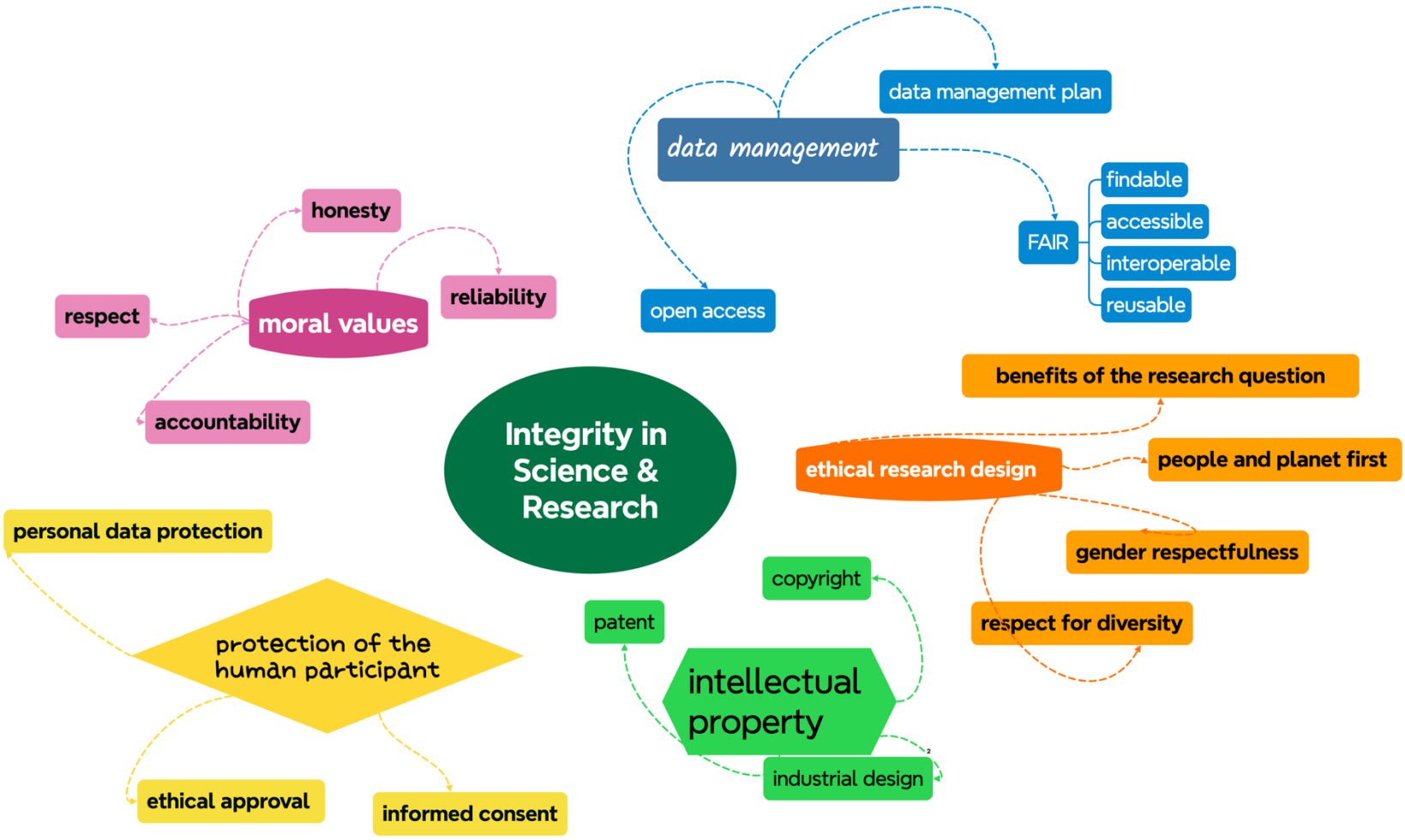
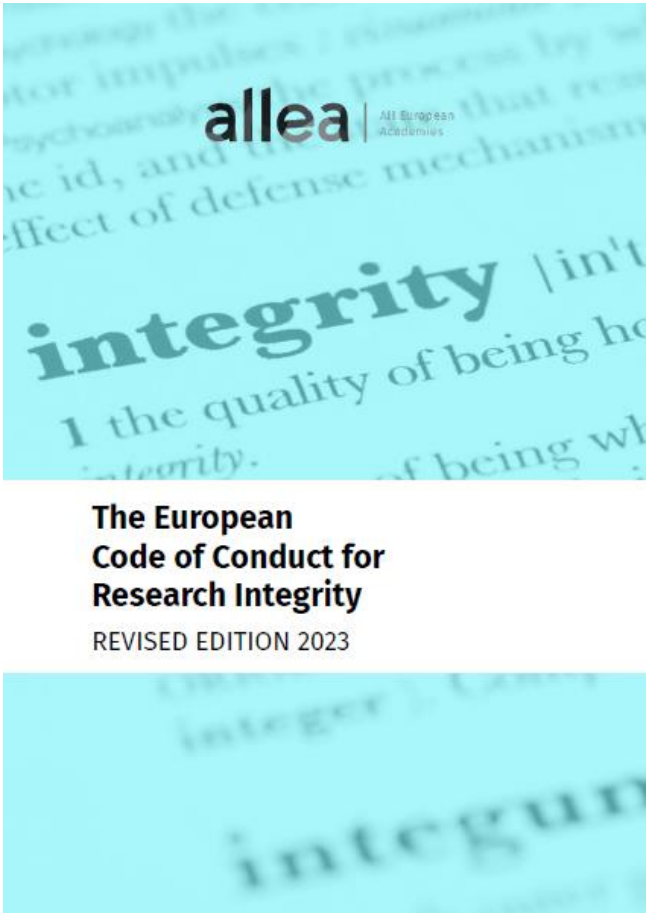


Figure 1 The many facets of integrity in science and research (Xmind)

• Researchers are defined as "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, as well as in the management of the projects concerned[10]." Research institutions are at this level. The role of institutions includes: ensuring a culture of research integrity; promoting values of inclusion and equity; supporting infrastructure for the generation, management and protection of data, in particular with regard to its reproducibility, traceability and accountability (ALLEA, 2023).

• Basic research is "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view," while applied research is directed primarily towards a specific, practical goal or objective (OECD, 2015). As COMETS (2020) reminds us, the value and benefits of research depend crucially on the integrity of the research.



Source: https://allea.org/

Our work is primarily concerned with human-centred technologies and services for inclusive mobility, but the ethical considerations are relevant to all fields of research. Chapter 1 explains integrity through the researcher, including good practice and misconduct. Chapter 2 deals with the integrity of research itself, through the ethical design and conduct of research (§ 2.1), the management of research data and publications (§ 2.2), the management of research involving human participants (§ 2.3), and the management of intellectual property (§ 2.4) (Figure 2).

[10] OECD (2023), Researchers (indicator). doi: 10.1787/20ddfb0f-en (accessed on 22 August 2023)

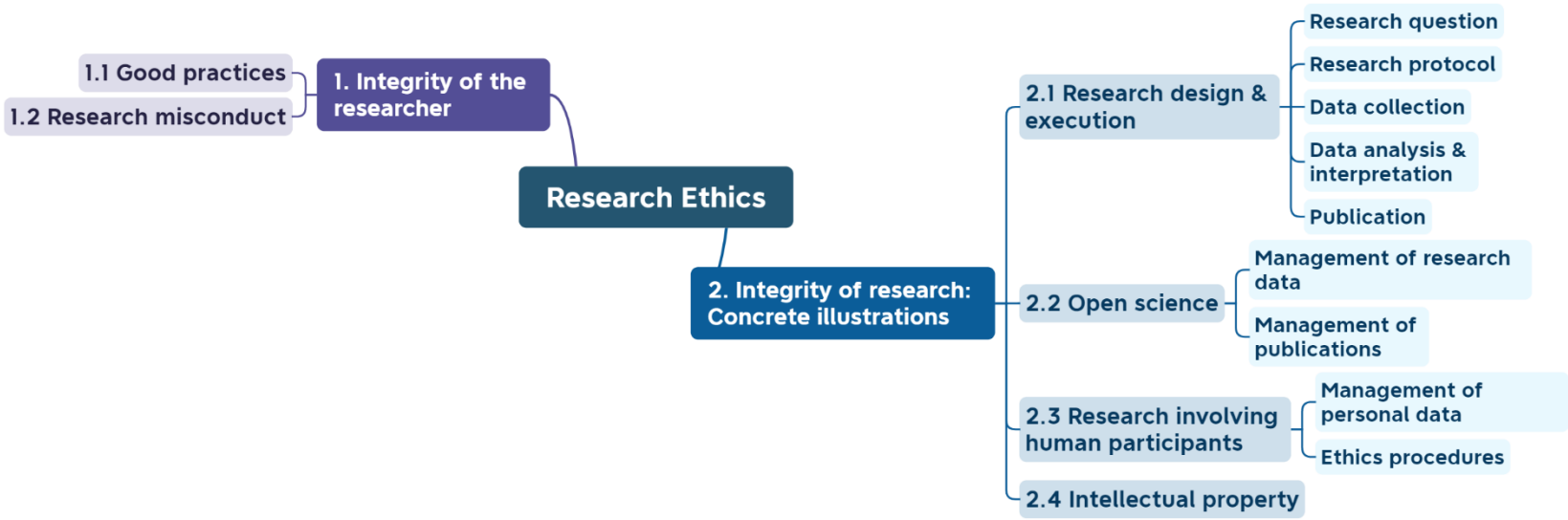


Figure 2 Main contents of Section D (Xmind)

1 Integrity of the Researcher

The dictionary definition of integrity is "adherence to moral principles" (Collins, 2018). Research integrity is defined in the French Research Code (Article L. 211-2) as "the set of rules and values that mist govern research activities in order to guarantee their honest and rigorous nature" (Ofis[8]). Scientific integrity is also "the refusal to allow scientific values to be corrupted by financial, social or political pressure" (COMETS, 2020, p. 4). Such definitions focus on the researcher, as it is noted by Helgesson and Bülow (2023). For example, the Code of Conduct for Research Integrity published by the European Federation of Academies of Sciences and Humanities states that good research practice relies on the following principles: reliability, honesty, respect, and accountability (ALLEA, 2017, 2023), which are human qualities. According to Broad and Wade (1987), the researcher's personal ethics are not so far removed from the moral rules that govern societies. Such moral qualities are required along the researcher's activities.

According to ALLEA (2023):

- Accountability means to be responsible for research from idea to publication and for its wider societal impact;
- Honesty is about being honest "in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way";
- Reliability is about ensuring the quality of research at the levels of design, methodology, analysis, and use of resources;
- Respect is about showing respect to "colleagues, research participants, society, ecosystems, cultural heritage and the environment."

The principles of the 2018 Netherlands Code of Conduct for Research Integrity[11] include the following two "virtues" (p. 13).

- Scrupulousness, that is, "using methods that are scientific or scholarly and exercising the best possible care in designing, undertaking, reporting and disseminating research";

[11] https://doi.org/10.17026/dans-2cj-nvwu/ https://www.nwo.nl/en/netherlands-code-conduct-research-integrity (accessed on 7 Sept. 2023)

- Independence, that is, "not allowing the choice of method, the assessment of data, the weight attributed to alternative statements or the assessment of others' research or research proposals to be guided by non-scientific or non-scholarly considerations […]".

***

Let us now examine the two facets of researcher integrity, good practice and misconduct.

1.1 Good practice

Firstly, ALLEA states that researchers—whoever they are, from the most junior to the most senior level – should benefit from training in ethics and research integrity.

We strongly recommend that students read the twenty-page European Code of Conduct for Research Integrity (ALLEA, 2023). It contains guiding principles for researchers and research institutions; some of which are presented below.

- Complying with codes, guidelines and regulations;
- Using research funds properly and conscientiously;
- Recognizing the potential harms and risks associated with their research and its applications, and mitigating the potential negative impacts of their research;
- Designing, conducting, analysing and documenting research in a transparent way;
- Designing research protocols that are respectful of differences (i.e., culture, religion, worldview, ethnicity, social class, etc.);
- Handling research participants and their data with respect and care;
- Informing them of how their data will be used, reused, accessed, stored and deleted in accordance with the European General Data Protection Regulation;
- Reporting "results and methods, including the use of external services or AI and automated tools, in a way that is compatible with the accepted norms of the discipline and facilitates verification or replication, where applicable" (p. 7);
- Ensuring the FAIR (Findable, Accessible, Interoperable, Reusable) principles for data management (§ 2.2.1.1);

- Agreeing on the order of authorship, recognizing that authorship is based on: making a substantial contribution to the study under considered (research design, data collection and analysis, interpretation), drafting and/or reviewing the manuscript; approving the final version; agreeing to be responsible for the content of the publication, unless otherwise stated in the publication;
- Being accurate and honest in their communication with colleagues, policy makers and society at large.

The Cape Town Statement on Fostering Research Integrity through Fairness and Equity makes 20 recommendations[12] (Horn et al., 2023), including the following:

- Researchers should recognize the value of working with colleagues from different disciplinary, geographical, cultural, and ethnic backgrounds and should strive to achieve this diversity, especially when conducting research in contexts and environments that are different from their own.

The implementation of these good practices is illustrated in Chapter 2 with § 2.1 on integrity of research design, § 2.2 on data management, § 2.3 on research involving human participants, and § 2.4 on intellectual property.

The integrity of the researchers can also be examined through their misconduct; the consequences of some of which can distort knowledge (e.g., Finelli, 2009) and can be very costly to society (Faucheux et al., 2019).

More specifically, the rest of the chapter is devoted to misconduct in research, which is a well-documented issue worldwide (e.g., Al-Adawi et al., 2016; Alfaro-Toloza et al., 2013; Bak, 2018; Dubois et al., 2013; El Bairi et al., 2022; Khezr & Mohan, 2022; Hosseinpur et al., 2023; Hugues & McCabe, 2006; Okonta & Rossouw, 2014; Olesen et al., 2018; Patnaik, 2016; Singh & Remenyi, 2016; Tanimoto et al., 2013; Tavare, 2011; Vasconcelos et al., 2023).

[12] Word Conferences on Research Integrity: https://www.wcrif.org/guidance/cape-town-statement (accessed on 4 September 2023)

1.2 Research Misconduct

First of all, it should be noted that research misconduct is not limited to plagiarism, nor the fabrication and falsification of data and results, but, as emphasized by the CNRS Ethics Committee (COMETS, 2020), fabrication, falsification and plagiarism (FFP) are internationally considered as scientific fraud.

- "Plagiarism is the misappropriation of somebody else's idea or content (text, images, tables, graphics, etc.) in part or as a whole without the permission of the author or without correctly referencing the source" (COMETS, 2020, p. 24). The Finnish guideline on research integrity clarifies this definition: "plagiarism can be direct, modified or paraphrased" (Keiski et al., 2023, p. 17). The US Office of Research Integrity does not consider self-plagiarism to be research misconduct[13]; however, ALLEA (2023) specifies that using parts of one's own previous publications requires that the original work be acknowledged or cited. This issue of plagiarism will be discussed in more detail in Section on writing.
- Accessed the Elsevier website, on the Author services page[14]: Fabrication is "about making up research results and data, and reporting them as true. This can happen when a researcher, for example, states that a particular lab process was done when, in fact, it wasn't. Or that the research didn't take place at all, in the case of a study results from previous research copied and published as original research."
- And: "Falsification essentially involves manipulating or changing data, research materials, processes, equipment and, of course, results. This can include altering data or results in a way where the research is not accurate. For example, a researcher might be looking for a particular outcome, and the actual research did not support their theory. They might manipulate the data or analysis to match the research to the desired results"[14].

According to the OECD Global Science Forum, misinterpreting data to achieve desired results, doctoring images in publications, and producing false data or results under pressure from a sponsor are all part of FFP (OECD, 2007, p. 3).

[13] The US Office of Research Integrity: https://ori.hhs.gov/about-ori (accessed on 28 August 2023)
[14] https://scientific-publishing.webshop.elsevier.com/manuscript-review/research-fraud-falsification-and-fabrication-research-data/ (accessed on 25 August 2023)

The Finnish research system distinguishes between research misconduct (i.e., FFP) and disregard for good research practice (Keiski et al., 2023), while Martinson et al. (2005) found that some questionable practices were not considered as FFP and yet could be sanctioned, see these authors' top ten practices from in Table 1.

FFP and misconduct in general have serious consequences for researchers, research participants, institutions, research fields and society (Science Europe, 2015). These consequences can be expressed in terms of costs such as in the work of Faucheux et al. (2019) in the Horizon 2020 project "Define the global and financial impact of research misconduct" (DEFORM)[15] or in the 2012 iThenticate report[16], which identifies individual costs (e.g., loss of jobs, revoked PhDs, revoked awards), brand costs (e.g. damage to reputation), capital costs (legal costs, investigation costs, etc.), and human costs (think of the medical harm that can be caused by inaccurate information in the medical literature, see Steen, 2011). Note that an unintentional violation does not "absolve researchers of ethical responsibility" (Kromrey, 1993).

Source: © J. GERNIER for CNRS News (https://lejournal.cnrs.fr/articles/sept-cas-celebres-de-scientifiques-accuses-de-fraude, accessed on 28 August 2023)

Table 1 provides examples of research integrity violations, taken verbatim from the following sources: ALLEA (2023), COMETS (2020), WHO (2019), Science Europe (2015), and Martison, Anderson and de Vries (2005), who conducted a study with North American scientists, using concrete examples of "questionable practices" by scientists. The examples of misconduct we have chosen are those relevant to students learning about research on and design of human-centred technologies and services for inclusive mobility.

[15] DEFORM: https://cordis.europa.eu/project/id/710246
[16] iThenticate: https://www.ithenticate.com/resources/papers/research-misconduct (accessed on 5 Sep. 2023)

Table 1 Examples of Research Misconduct

Research misconduct	Sources
Allowing funders, sponsors, or others to compromise the independence and impartiality of the research process	ALLEA (2023), p. 10
Misusing seniority to encourage violations of research integrity or to advance one's own career	"
Delaying or inappropriately obstructing the work of other researchers	"
Misusing statistics, for example to inappropriately suggest statistical significance	"
Hiding the use of AI or automated tools in creating content or drafting publications	"
Withholding research data or results without justification	"
Chopping up research results with the specific aim of increasing the number of research publications	"
Citing selectively or inaccurately	"
Unnecessarily expanding the bibliography of a study to please editors, reviewers, or colleagues, or to manipulate bibliographic data	"
Manipulating authorship or denigrating the role of other researchers in publications	ALLEA (2023), p. 11
Establishing, supporting, or deliberately using journals, publishers, events, or services that undermine the quality of research ('predatory' journals or conferences and paper mills)	"
Participating in cartels of reviewers and authors who collude to review each other's publications	"
Misrepresenting research results, data, involvement, or interests	"
Maliciously accusing a researcher of misconduct or other violations	"
Ignoring alleged research integrity violations by others, or covering up inappropriate institutional responses to misconduct or other violations	"
Denying colleagues access to data	COMETS (2020), p. 11
Insufficiently documenting experimental protocols in manuscripts, making it impossible for other teams to reproduce the experiments	COMETS (2020), p. 13
Overestimating the applicability of research findings	COMETS (2020), p. 14
Deliberately misrepresenting findings or research carried out by competitors	"
Deliberately omitting contributions by other authors in the references	"
Misrepresenting the progress of one's own work in the references	"
Including "guest" authors in the list of authors as a favour	"
Omitting from the list of authors of persons who have made a significant contribution to the project	"
Mentioning co-authors without their consent	"
Republishing parts of previous publications without citing the original source	"

Falsifying or "cooking" research data[17]	Martinson et al. (2005), p. 737
Ignoring important aspects of human subject requirements	"
Avoiding certain minor aspects of human subject requirements	"
Using someone else's ideas without permission or proper credit	"
Using without authorization confidential information in connection with one's own research	"
Failing to present data that contradict your own previous research	"
Overlooking others' use of flawed data or questionable interpretation of data	"
Changing the design, methodology, or results of a study in response to pressure from a funding source	"
Publishing the same data or results in two or more publications	"
Inappropriate attribution of authorship	"
Withholding details of methodology or results in papers or proposals	"
Using inadequate or inappropriate research designs	"
Omitting observations or data points from analyses based on a gut feeling that they are inaccurate	"
Inadequate record keeping related to the research project	"
Inadequate research protocol development	WHO (2019), p. 3
Failure to disclose or take action on declared conflict of interest	"
Poor management of a research project	"
Sabotage—copying of ideas, data or text (or various combinations of the three) without authorization or acknowledgement	"
Piracy—deliberate use of data from others without authorization	"
Failure to follow accepted procedures or exercise due care to avoid unreasonable risk of harm to humans, animals or the environment	"
Mismanagement or inadequate preservation of data and/or primary materials	WHO (2019), p. 4
Misappropriation of data	"
Improper conduct of peer review	"
Misrepresentation of involvement or authorship	"
Failure to protect or the inappropriate use or disclosure of confidential or proprietary information, or the misuse of intellectual property	"
Improper handling of allegations of wrongdoing	"
Failure to preserve primary data	Science Europe (2015), p. 5
Misuse of research funds for unauthorized purchase or personal gain	"
Insensitivity to social or cultural norms	"

[17] Cooking data is defined as creating a set of observations that will produce a known result, so this experiment appears to be a case of trimming data. Trimming data is defined as selecting data to make results look better (source: https://ori.hhs.gov/education/products/niu_authorship/mistakes/03mistake-c.htm, accessed on 4 September 2023)

In accordance with the French decree of 26 August 2022[18], training in scientific integrity is compulsory for UPHF PhD students, and is provided by the UPHF Doctoral School[19]. Furthermore, at the end of their defence, all new PhD candidates in French universities must take an oath of research integrity at the end of the defence. The following text is pronounced individually:

"*In the presence of my peers. With the completion of my doctorate in [research field], in my quest for knowledge, I have carried out demanding research, demonstrated intellectual rigour, ethical reflection, and respect for the principles of research integrity. As I pursue my professional career, whatever my chosen field, I pledge, to the greatest of my ability, to continue to maintain integrity in my relationship to knowledge, in my methods and in my results.*"

(French Office for Research Integrity: https://www.ofis-france.fr/faq-2/, accessed on 14 Nov. 2023).

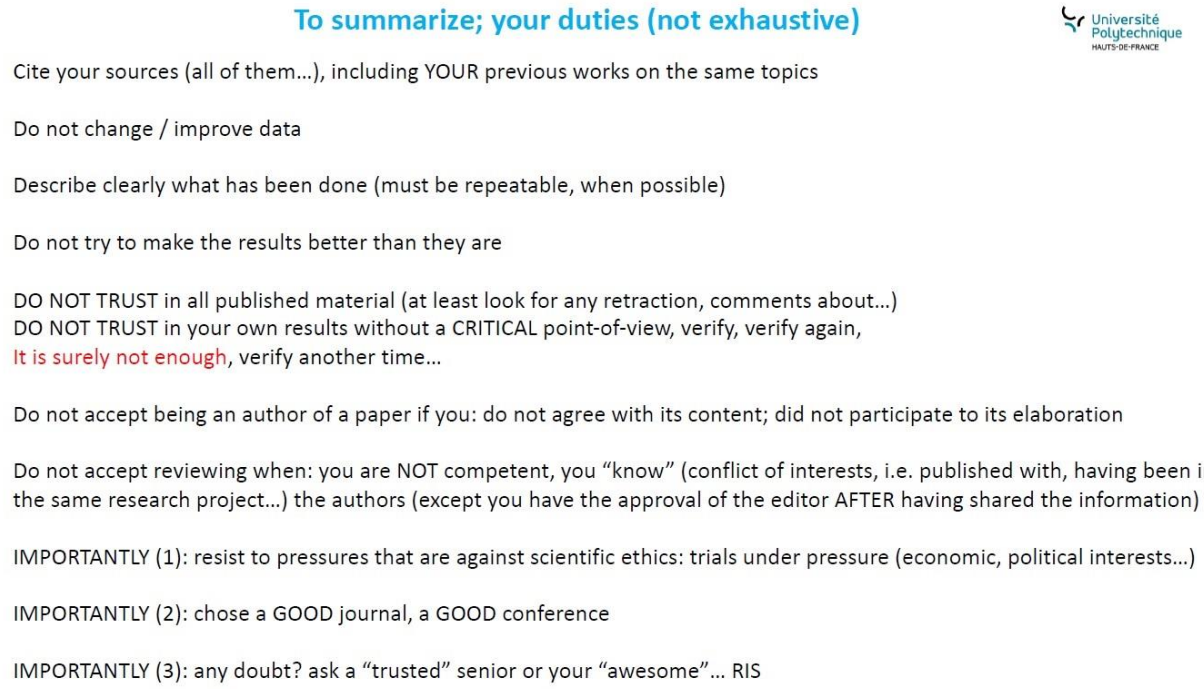


Figure 3 Copy of a slide from the PhD course on scientific integrity at UPHF (Source: T. GUERRA, research integrity officer of UPHF)

In case of suspicion of a breach of scientific integrity, the contact is the university's research integrity officer. At UPHF, the contact is ris@uphf.fr.

[18] https://www.legifrance.gouv.fr/jorf/id/JORFARTI000046228972
[19] UPHF Doctoral School: https://www.uphf.fr/en/research/doctoral-school (accessed on 15 Nov. 2023)

2 Integrity of Research: Concrete Illustrations

Research integrity is concretely illustrated by guidelines, regulations and procedures applied to the activities of researchers.

Chapter 2 deals with research design and conduct (§ 2.1), data management (§ 2.2), research involving human participants (§ 2.3), and intellectual property (§ 2.4) (see Figure 2).

2.1 Research Design & Execution

The research design is the set of strategies and actions that are planned to make concrete an idea of research (Cheek, 2008), it is the logical plan to get from the questions to the answers to the questions (Yin, 2014). The research design then guides the selection of guidelines, regulations and procedures to be followed from the initial questions to the conclusions (Creswell & Creswell, 2018). The design and implementation of such a plan should, of course, follow the principles of research integrity. We consider here the design of the research question (§ 2.1.1) and the research protocol (§ 2.1.2), data collection (§ 2.1.3), data analysis (§ 2.1.4), and, last, the activities of publication and reviewing (§ 2.1.5).

2.1.1 Research Question

Generating the questions for research means addressing research integrity from the first step of the plan, that is:

- Think in terms of putting people and planet first (UN Environment Programme, 2023);
- Identifying for whom the research question matters most (Calia et al., 2019, The University of Edinburgh[20]);
- Ensure that the research question does not lead to unresolvable ethical problems (Bernard, 2006);
- Consider the potential harms and risks associated with the research under consideration and its applications, and mitigate any potential negative impacts (ALLEA, 2023);

[20] The University of Edinburgh–An Ethical Research Journey: https://www.ethical-global-research.ed.ac.uk/toolkit/research-journey (accessed on 11 Sept. 2023)

- Considering together ways to address or minimize potential harms and maximize potential benefits of the research question (Calia et al., 2019, The University of Edinburgh[20]). This is particularly important when the participants are vulnerable, such as older people are (Szala-Meneok, 2009);
- Considering the potential legacy of the research question in the future (Calia et al., 2019, The University of Edinburgh[20]);

Source: pngegg.com

- Identifying the stakeholders who may have different vested interests in the research (ibid.);
- Remembering that "there are plenty of research questions that won't put you into a moral bind" (Bernard, 2016, p. 82).

2.1.2 Research Protocols

- Designing protocols that take into account differences between research participants (age, gender, culture, religion, geographical location, etc.) (ALLEA, 2023)
- Consider whether there is a conflict of interest between the benefit to the researcher and the research participants (Calia et al., 2019, The University of Edinburgh);
- Consider the issue of the recruitment and compensation in relation to human participants[21];
- In terms of the 'people and planet first' principle, designing protocols that respect the environment[22] (Calia et al., 2019). For example, the US University of New Hampshire has proposed the 5—R'S Framework for environmental responsibility in research: 1/**R**ecognize that all research has environmental impacts; 2/**R**efine questions and methods to minimize these impacts, for example, by using open-source data and coding platforms; 3/**R**educe the amount of resources consumed (travel, energy for scientific equipment, etc.); 4/**R**eplace methods, techniques and materials with more sustainable options, e.g., options that

[21] The University of Edinburgh– Ethical Action in Global Research: A Toolkit. https://www.ethical-global-research.ed.ac.uk/6-data-collection-begins (accessed on 12 Sept. 2023)
[22] The University of Edinburgh– Ethical Action in Global Research: A Toolkit. Ethical principles and values: https://www.ethical-global-research.ed.ac.uk/toolkit/ethical-principles-and-values (accessed on 13 Sept. 2023)

contribute to lower greenhouse gas emissions; and 5/**R**estore the environment as it was before the study, e.g., by removing equipment (Murray et al., 2023);

- Distinguish ethical procedures for adults from those for children and adolescents[23] (Calia et al., 2019);
- Acknowledge that there are mandatory legal procedures for research involving human participants and that related research protocols must be approved by research ethics committees. This point is addressed in § 2.3.

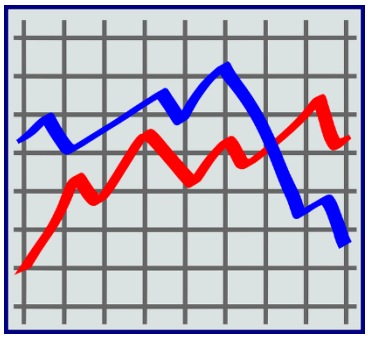
2.1.3 Data Collection

- Minimizing risks to the participants, which implies that the researcher understands these risks (Resnik, 2018), that is, "the potential physical or psychological harm, discomfort or stress to human participants that a research project may generate" (The British Psychology Society, 2014, p. 13). Such risks include simulator sickness;
- Fully informing participants of potential risks (Mark, Eyssel, & Campbell, 1999);
- Consideration of the cost-benefit ratio when the risk to the participant cannot be reduced without compromising the integrity of the study; however, this approach has its limitations and depends on the nature and level of the risk; moreover, the benefits may be overestimated while the risks are underestimated, and "those who bear the costs may not reap the benefits" (ibid., p. 49);
- Paying attention to 'impostor' participants, e.g., in online surveys in Ridge et al. (2023);
- Ensuring that the data collection process is likely to produce valid data consistent with the stated intent of the project[21] (Calia et al., 2019);
- Ensuring that the research team follows the ethical protocol (Calia et al., 2019, The University of Edinburgh[20]); the team includes the PhD and Master students;
- Informing research participants about how their data will be used, stored and deleted, in line with the European General Data Protection Regulation (ALLEA, 2023);
- And, of course, asking for permission before recording audio and video data from participants;

[23] https://rtc-cea.cepal.org/en/document/protocol-collection-and-dissemination-data-children-and-adolescents-participating-studies (accessed on 12 Sept. 2023)

- And respecting the rights and privacy of the sources of web data collected for research;
- In experimental studies, not stopping or continuing data collection based on the *p*-value (Chevassus-au-Louis, 2016/2019, Chapter 4 on research for results);
- Keeping raw data, not destroying them;
- Not inventing data (this is a serious case of fraud, that of 'fabrication' (Ofis[8]; COMETS, 2020; ALLEA, 2023).

2.1.4 Data Analysis & Interpretation



Source: pixabay.com

- Not to invent results (serious fraud of fabrication, see above);
- Not to select or manipulate analysis data according to the desired results: this is a basic rule in research. Otherwise, it is a matter of fraudulent falsification (Ofis[8]; COMETS, 2020; ALLEA, 2023);
- Similarly, not to alter or discard data that appear anomalous (Kromrey, 1993, p. 25);
- Not to withhold research data or results without justification (ALLEA, 2023);
- Keeping the original unprocessed image data file secure and unchanged (ibid.);
- Apply statistical procedures without concern for a favourable outcome (Kromrey, 1993, p. 25);
- Not to misuse statistics – e.g., to inappropriately suggest statistical significance (ALLEA, 2023);
- Not to confuse the level of probability with the strength of relationships (ibid.);
- Considering "negative" results –i.e., results that do not match expectations or hypotheses (Chevassus-au-Louis, 2016/2019); "identifying blind alleys can be as important as unlocking new doors" (Wilcox, 2014, p. 165);
- Not presenting a post hoc hypothesis as if it were an a priori hypothesis (see Kerr, 1998, on "HARKing," i.e., Hypothesing After the Results are Known);
- Not suppressing contradictory results (Kromrey, 1993, p. 25);

- Not changing results in response to pressure from a funding source (Martison et al. (2005);
- Considering the best way to present results that will benefit as many people possible[24] (Calia et al., 2019);
- Thinking about immediate, short term and long term impacts when considering how to interpret the results (ibid.);
- And thinking beyond the scientific community, for example, how these results may affect the lives of participants and their communities (ibid.).

2.1.5 Publication

This section provides guidelines for publishing and reviewing. Publishing deals with the preparation of manuscripts, the issue of authorship, and the issues related to the selection of a journal for manuscript submission. Reviewing articles deals with the task itself and will not be developed, as the present document is primarily aimed at students.

Source: pixabay.com

2.1.5.1 Publishing

Most of the guidelines are taken from Table 1 (ALLEA, 2023; COMETS, 2020; WHO, 2019; etc.). Other sources are mentioned.

- Report the software used to collect and/or analyse the data;
- Mention any use of AI – e.g., ChatGPT – in the manuscript preparation (Rahimi & Abadi, 2023; Thorp, 2023);
- Not to copy parts of others' ideas, texts, results, images without authorization or acknowledgement (plagiarism);
- Do not withhold details of methodology or results;
- Do not copy results from your own previous articles without mention of them;
- Do not publish the same data or results in two or more publications;

[24] https://www.ethical-global-research.ed.ac.uk/8-data-analysis-and-interpretation (accessed on 14 Sept. 2023)

- Not slicing the research results to multiply publications (e.g., Eva, 2017);
- Not to beautify images (Cromey, 2010);
- Not to overstate the applicability of research findings (COMETS, 2020);
- Not misrepresent research achievements, data, involvement or interests;
- Not to cite selectively or inaccurately;
- Not expanding the list of references to please reviewers or colleagues;
- Meeting at least one of the following criteria for authorship: substantial contribution to the research design, data collection, data analysis and/or interpretation; drafting and/or critical reviewing of the manuscript; approval of the final publication; agreeing to be responsible for the content of the manuscript (e.g., ALLEA, 2023, p. 8);
- Agreeing on the order of authorship;
- Not manipulating authorship or denigrating the role of other researchers in publications;
- Do not omit the contributions of other authors in the list of authors;
- Not adding honorary authors to the list as a favour;
- Properly disclose any conflicts of interest;
- Properly disclose sources of support for the research or the publication (ALLEA, 2023);
- Paying attention to the so-called hybrid journals on the issue of article processing charges to be published on open access by a subscription-based journal, which is thus a form of double payment for the article (CNRS, 2019; CNRS, 2022[25]);
- Paying attention not to submit to predatory academic journals or conferences. Figure 4 shows the characteristics of predatory journals, from the InterAcademyPartnership (IAP, 2022). IAP also provides the characteristics of predatory academic conferences.

Grudniewicz et al., (2019). Predatory journals: no definition, no defence. *Nature*, vol. 576, p. 211

The definition

The consensus definition reached was: "Predatory journals and publishers are entities that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information, deviation from best editorial and publication practices, a lack of transparency, and/or the use of aggressive and indiscriminate solicitation practices."

[25] The CNRS encourages its scientist to stop paying to be published, an interview of Prof. Alain Schuhl, April 07, 2022: https://www.cnrs.fr/en/cnrsinfo/cnrs-encourages-its-scientists-stop-paying-be-published (accessed on 28 Sept. 2023)

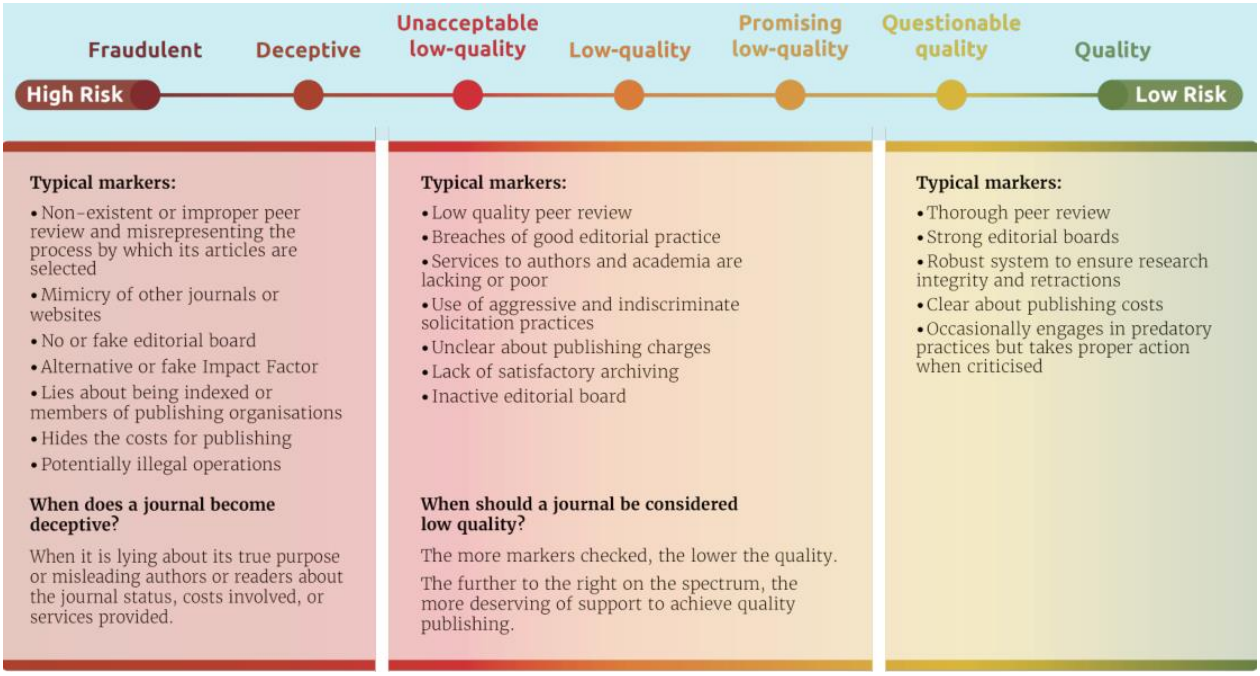


Figure 4 The IAP's Spectrum of predatory behaviours for journals. Source: IAP, 2022, p. 7

- Use preprint servers to deposit manuscripts submitted to journals (e.g., hal.science[26], arXiv[27]). This is required for research projects founded by national and European research agencies;
- Promptly notifying journal editors "when authors discover significant errors or inaccuracies in their own published work" and cooperating to correct the paper or retract it[28].

2.1.5.2 Reviewing

- Decline invitations to review in case of conflict of interest or feeling of being unqualified to review;
- Declining invitations to review for predatory journals or conferences;

[26] https://hal.science/
[27] https://engineering.library.cornell.edu/database/arxiv-org/
[28] Open Edition Journals. *Question de Communication. Publication Ethics and Malpractice Statement*. https://journals.openedition.org/questionsdecommunication/11404#tocto2n14 (accessed on 29 Sept. 2023)

- Not uploading a submitted manuscript, or any part of it to a generative AI tool[29], as it may infringe the authors' rights and/or the GDPR if the article contains personal data;
- Do not use generative AI or AI-assisted technologies to assist in the reviewing activity;
- Being alert to potential ethical issues including similarities or overlap between the manuscript and other published articles.

2.2 Management of Research Data & Publications

The management of research data follows two different rationales: open data with open science and mandatory data archiving. From a legal perspective, the latter is in France an application of the French Heritage Code (*Code du patrimoine*[30]), as it is explained by Henry (2023). It is important to understand that temporary or long-term storage is not archiving; "storage includes data persistence, identification, indexing and optimization of access for frequent intensive processing whereas archiving involves the preservation of data for legal or historical reasons" (CNRS, 2021, p. 4).

Research data are defined by Pampel et al. (2013)—within the framework of research data repositories)—as "digital data being a (descriptive) part or the result of a research process; research data also include source codes and software (CNRS, 2019).

Research archives consist of all the documents and data produced or received as part of the research process; they are public archives and no one has the right to delete them without the consent of the archives department of the university. The researcher is responsible for them until they are deposited in the archives department when he/she no longer needs them.

Data archiving is managed at UPHF by the Service of Archives (archives@uphf.fr).

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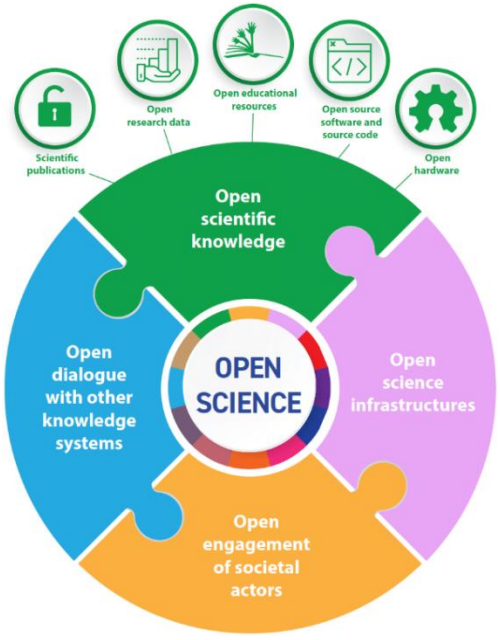
[29] Elsevier. Publishing ethics—Duties of reviewers. https://beta.elsevier.com/about/policies-and-standards/publishing-ethics?trial=true#3-duties-of-reviewers (accessed on 29 Sept. 2023)
[30] Code du patrimoine: https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006074236/

Open science is a broad international movement in the world of scientific research. It has started more than 30 years ago but its development has been accelerated with the development of the web (CNRS, 2019). The European Open Science Cloud (EOSC) is precisely one of the actions of the policy agenda 2022–2024 of the European Research Area[31]. According to the Second French Plan for Open Science[32], "open science refers to the unhindered dissemination of results, methods and products for science research" in order to: "democratize access to knowledge," be "a lever for scientific integrity" and "build citizen trust in science" (p. 7). In concrete terms, open science allows, under specific conditions, the access, reuse, repurposing, adaptation and dissemination of scientific publications, research data, metadata, educational resources, software, and source code and hardware, immediately or as soon as possible, free of charge and regardless of location, nationality, income, career stage, discipline, language, disability, migration status, etc. (UNESCO, 2021, p. 9.) Clearly, implementing open science benefits both science and citizens. Table 2 provides a general overview of the 12 measures for open science described in the Second French Plan[32]; full descriptions can be found in the Plan. Table 2 shows that open science has many facets, but in the present work we focus on the openness of both publications and research data.



Source: UNESCO (2021), p. 11

Table 2 The main measures of the 2021 Second French Plan for Open Science

Generalizing open access to publications	Generalizing the obligation to publish in open access all articles and books resulting from publicly funded calls for proposals
	Supporting open access economic publishing models that do not require the payment of articles or books processing charges
	Encouraging multilingualism and the circulation of scientific knowledge by translating publications by French researchers

[31] https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en (accessed on 20 Oct. 2023)
[32] French Ministry of Higher Education, Research and Innovation (2021). *Second French Plan for Open Science*. Retrieved from: https://www.enseignementsup-recherche.gouv.fr/en/second-french-plan-open-science-87949 (accessed on 4 Oct. 2023)

Structuring, sharing and opening up research data	Implementing the obligation to disseminate publicly funded research data
	Creating the federal National platform for research data Recherche Data Gouv
	Promoting widespread adoption of data policies that cover the whole lifecycle of research data to ensure the FAIR principles
Opening up and promoting source code produced by research	Recognizing and supporting the dissemination under an open source licence of software produced by publicly funded research programmes
	Highlighting the production of source code from higher education, research and innovation
	Defining and promoting an open source software policy
Transforming practices to make open science the default principle	Develop and value open science skills throughout the educational and career pathways of students and research staff
	Value open science and the diversity of scientific productions in the assessment of researchers, of projects and of universities and research performing organizations
	Triple the budget for open science through the National Fund for Open Science and the Investments for the Future Programme

Like many universities, the Université Polytechnique Hauts-de-France and INSA Hauts-de-France have developed their own open science policy[33], as it was required in the first National Open Science Plan in 2018[34].

The open science resources available at UPHF are managed by the Research Support Department of the Common Documentation Service of the university[35].

The Data steering committee of UPHF has defined the UPHF policy on the management of research data (including research personal data). Specifically, this policy informs or reminds researchers, teaching researchers, engineers, technicians, as well as PhD candidates and postdoctoral researchers (contractual staff), of their rights, responsibilities and roles with respect to the production and management of research data. The policy also provides the necessary information about the services that manage each step of the data cycle at UPHF, as well as the legal references on which the committee relies.

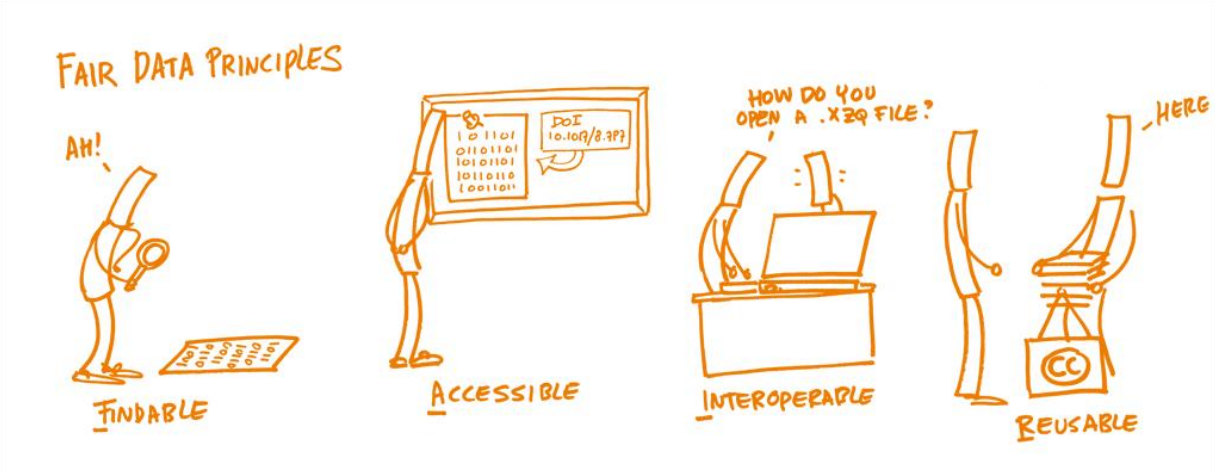
[33] UPHF and INSA Hauts-de-France Open Science Plan: https://www.uphf.fr/en/research/uphf-and-insa-hauts-france-open-science-plan (accessed 12 Oct. 2023)
[34] French Ministry of Higher Education, Research and Innovation (2018). *National Plan for Open Science*. Retrieved from: https://cache.media.enseignementsup-recherche.gouv.fr/file/Recherche/50/1/SO_A4_2018_EN_01_leger_982501.pdf (accessed on 4 Oct. 2023)
[35] UPHF–DAREC: https://bu.uphf.fr/opac/article/appui-a-la-recherche/f_appui_a_la_recherche (accessed on 19 Dec. 2023)

2.2.1 Management of Research Data for Open Science

Open research data means that there are no restrictions on access to the data, so that anyone can use them[36]. The means that enable such openness are described below through the FAIR data principles that underpin the openness of research data (§ 2.2.1.1), through data management plans that describe how research data are managed along research projects (§ 2.2.1.2) and finally through research data repositories that store research data (§ 2.2.1.3).

2.2.1.1 FAIR Data Principles

Data can be easily reused for the benefit of different stakeholders if they are easy to find, accessible and interoperable (Mons et al., 2017). These four so-called FAIR principles (data findability, accessibility; interoperability, and reusability) are related, although independent and inseparable (Wilkinson et al., 2016).



Source: P. HOCHSTENBACH (University of Gent, Belgium). In Bezjak et al. (2018, p. 22). https://open-science-training-handbook.github.io/Open-Science-Training-Handbook_EN/ (accessed on 3 Oct. 2023)

[36] https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/open-science-monitor/facts-and-figures-open-research-data_en (accessed on 12 Oct. 2023)

Each of these foundational principles is broken down into guiding principles. For example, one of the guiding principles of the "reusable" foundational principle is "R1. meta(data) are released with a clear and accessible data use licence."

A brief overview of the four principles is provided below, based on Wilkinson et al. (2016) and GO FAIR[37].

2.2.1.1.1 Findable

Findable means that data and metadata[38] are easy to find by both humans and machines, thanks to machine-readable, unique and persistent identifiers (e.g., a DOI is a digital object identifier).

2.2.1.1.1 Accessible

Accessible means that data and metadata are preserved for the long term, are easily retrievable using standardized protocols[39] and that metadata remain available even if the data are no longer accessible.

2.2.1.1.2 Interoperable

Interoperable means that data and metadata can be easily exchanged between computer systems, thanks to openness and widely shared languages and formats.

2.2.1.1.3 Reusable

Reusable means that data and metadata are richly described for both humans and machines in terms of their source, original context, licence, etc., so that a machine is able to decide whether a digital resource is relevant, whether it can be reused, and under what conditions.

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[37] GO FAIR: https://www.go-fair.org/fair-principles/

[38] "Metadata are the set of structured data describing physical or digital resources. They are an essential link in the chain for sharing information and ensuring the interoperability of electronic resources. They are traditionally divided into descriptive, administrative or structural metadata". Retrieved from: INIST−CNRS (2016). Glossary. White Paper—Open Science in a Digital Library, p. 2. https://doi.org/10.4000/books.oep.1653

[39] A communication protocol can be defined as the set of rules that govern the exchange of information between processes in a communication system and it is realized by the software and hardware of the system (Shiratori et al., 1982, p. 403)

Compliance with the FAIR principles ion relation to the data in a research project is one of the points of the data management plan.

2.2.1.2 Data Management Plans

A Data Management Plan (DMP) describes how all data related to a research project will be handled throughout the data lifecycle, that is, from before the data are produced until after the project has ended. It is a formal document that is mandatory for publicly funded research projects, such as those financed by the French National Research Agency (ANR) or Horizon Europe.

The templates available on the website of DMP OPIDoR[40] show that most of DMPs contain many fields requiring detailed information. However, to give the reader with an idea of what is expected, we have chosen to present only the core requirements for data management plans proposed by Science Europe[41]. Science Europe considers that these requirements should serve as a homogeneous basis for all DMPs, in order to align data management policies across funding agencies, research organizations, and research communities. Figure 5 shows the six core requirements and the 15 related questions. Science Europe (2021) then details how to translate the core requirements into a DMP template, which we do not reproduce in the present document.

DMP OPIDoR hosts many templates, including those for the ANR and Horizon EUROPE projects, at https://dmp.opidor.fr/public_templates[42].

A DMP is often one of the deliverables of a research project and will need to be regularly updated as the project progresses; for these reasons, it will be monitored and evaluated by the funding organization.

[40] DMP OPIDoR: https://dmp.opidor.fr/static/examples (accessed on 17 Oct. 2023)
[41] Science Europe: https://scienceeurope.org/about-us/ (accessed on 18 Oct. 2023)
[42] Accessed on 18 Oct. 2023

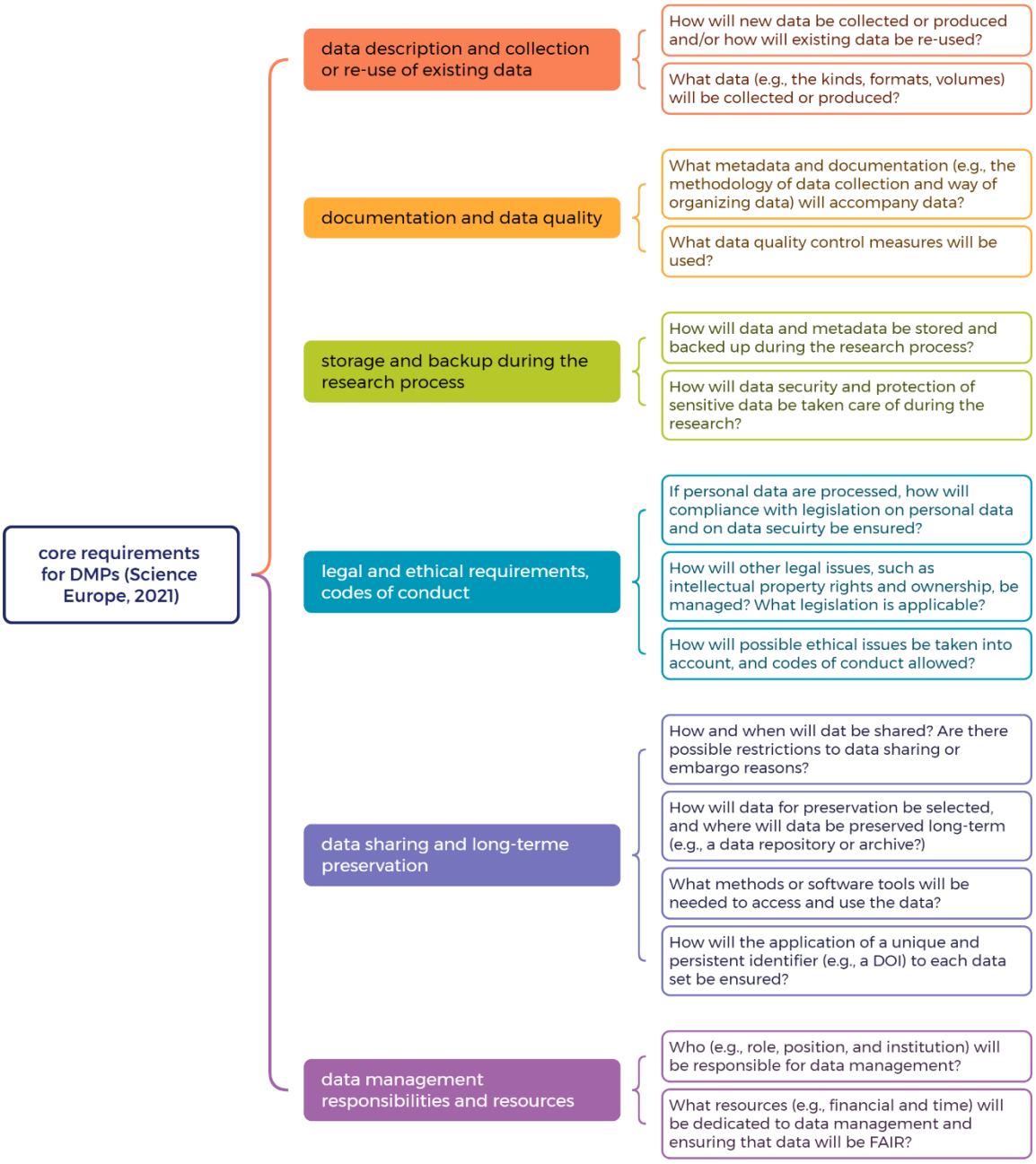


Figure 5 The Core Requirements for Data Management Plans according to Science Europe (Source: Science Europe, 2021, pp. 9–10). Xmind

2.2.1.3 Research Data Repositories

Figure 5 illustrates the importance of data repositories through the issues of long-term preservation, sharing and reuse of research data. A research data repository is a "subtype of sustainable information infrastructure which provides long-term storage and access to research data" (Rücknagel et al., 2015; Strecker et al., 2023). Some data repositories may house software source code and software products under an open source licence. See Open Science (2022) on the openness of source code and software.

A registry of research data repositories covering different disciplines has been developed and made available online by re3data.org[43]. It is intended for researchers, funding organizations, publishers, and scientific institutions to help them choose a repository. The repositories are finely described, including meaningful icons that facilitate the first step in selecting a research data repository (Figure 6 from Pampel et al., 2013).

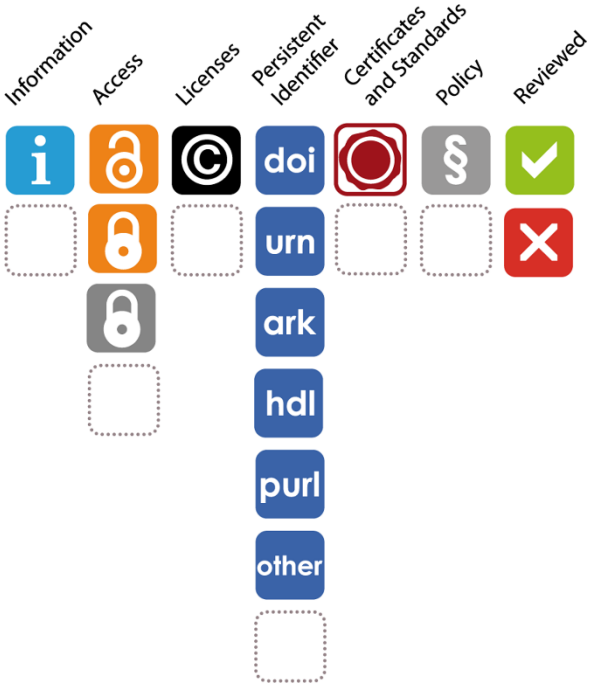


Figure 6 The re3data.org icon system depicting all possible values for each icon (Source: Pampel et al., 2013, https://doi.org/10.1371/journal.pone.0078080)

The key element of a research data repository is metadata. A list of the metadata used by re3data.org to describe repositories are described in Strecker et al. (2023); they also provide a classification of the disciplines and sub-disciplines that are covered by the repositories.

Zenodo[44] is one of the research data repositories approved by Open Research Europe[45]. Figure 7 is a screenshot from re3data.org showing Zenodo and the repository that follows Zenodo on the list, the Open-source Scientific Software and Service Repository (OSSR). Note the icons in the top and middle right of the figure (Figure 6), which provide basic information at a glance: both Zenodo and OSSR provide open access to their data, as well as the terms of use and licences for the data, and

[43] www.re3data.org (accessed on 19 Oct. 2023)
[44] Zenodo: https://about.zenodo.org/ (accessed on 19 Oct. 2023)
[45] Open Research Europe: https://open-research-europe.ec.europa.eu/

both use DOI to make data persistent, unique and citable. Figure 7 also shows at a glance the disciplines covered by Zenodo and OSSR.

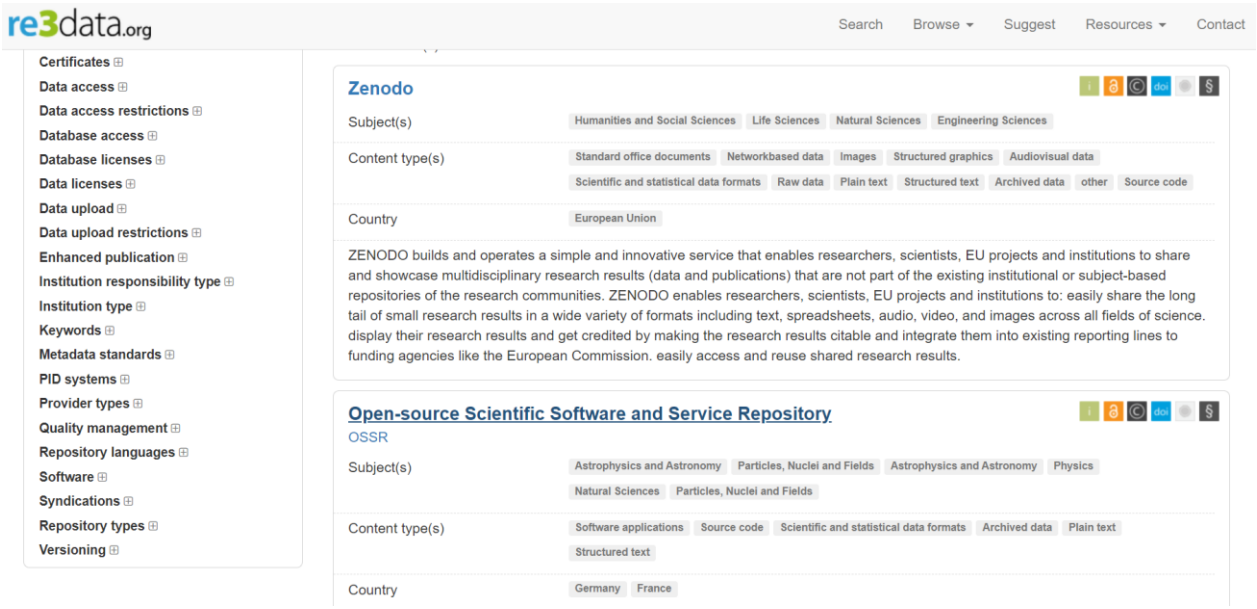


Figure 7 Screenshot of a webpage of re3data.org about Zenodo and OSSR (Source: https://www.re3data.org/search?query=zenodo, accessed on 19 Oct. 2023)

The French data repositories Recherche Data Gouv[46] and CNRS Research Data[47] are, of course, registered on re3data.org.

Recherche Data Gouv is part of the Second French Plan for Open Science[32] (Table 2) This multidisciplinary "ecosystem for sharing and opening research data" includes data management clusters throughout France[48]. It aims to be a service of the European hub of research data, tools and services for innovation and education, namely the European Open Science Cloud (EOSC)[31,49]. The Recherche Data Gouv repository is concerned with: curating[50], depositing and publishing approved final scientific data; verifying deposited metadata and data files; opening, sharing and making data available for reuse. In addition, Recherche Data Gouv offers researchers the opportunity to make

[46] Recherche Data Gouv: https://recherche.data.gouv.fr/en (accessed on 19 Oct. 2023)
[47] CNRS Research Data: https://entrepot.recherche.data.gouv.fr/dataverse/cnrs (ibid.)
[48] https://recherche.data.gouv.fr/en/page/data-management-clusters-generalist-services-throughout-france (accessed on 20 Oct. 2023)
[49] EOSC: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/european-open-science-cloud-eosc_en (ibid.)
[50] i.e., "checking the metadata and data files deposited in the repository and, if necessary, suggesting modifications to improve the quality of the datasets": https://recherche.data.gouv.fr/en/glossary (ibid.)

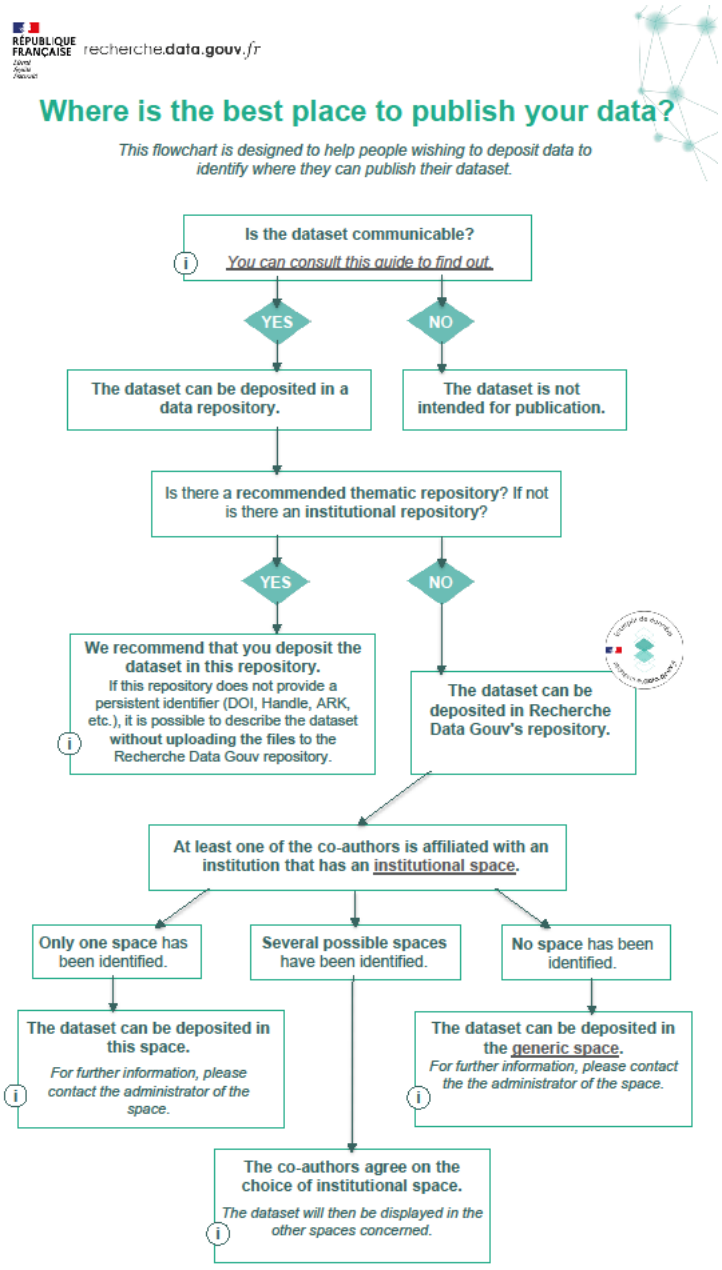
their research known to a wide audience by periodically highlighting datasets on the repository portal[51]. Note that Recherche Data Gouv involves data management clusters throughout France, including the UPHF institutional repository.

The CNRS Research Data repository is part of the CNRS Research Data Plan (CNRS, 2021a). It is a space within Recherche Data Gouv, dedicated to the researchers who produce or co-produce data within a framework supported by CNRS and who do not find a thematic or institutional repository adapted to their research field[47].

At UPHF, the contact regarding data management and stewardship is the Research Support Department of the Common Documentation Service of the university[52] (donnees-recherche@uphf.fr), and for the units of CNRS, the CNRS Research Data Support Team (cnrs-researchdata@cnrs.fr).

The openness of research data may be required by publishers; it may be a way to combat the research misconduct (see Table 1).

[51] https://recherche.data.gouv.fr/en/page/valuing-your-datasets (accessed on 19 Oct. 2023)
[52] https://www.uphf.fr/en/research/uphf-and-insa-hauts-france-open-science-plan (accessed on 20 Oct. 2023)



Flowchart proposed by Recherche Data Gouv to help researchers deciding where their data can be deposited. Source: https://s3.fr-par.scw.cloud/rdg-portal/uploads-guides/EN-Logigram_depositdata_white_dec23.pdf (accessed on 10 Jan. 2024)

2.2.2 Management of Publications for Open Science

In addition to the openness of research data, the openness of publications is a key component of open science (UNESCO, 2021; the European Union's open science policy[31]; the Second French Plan for Open Access[32]; the 2019 CNRS Roadmap for Open Science; and the UPHF and INSA Hauts-de-France Open Science Plan[33].

According to these institutions, the openness of publications means: generalizing the obligation to publish in open access the articles and books resulting from research funded between 50% and 100% by public funds; supporting the diamond model of open access economic publishing models, i.e., publications are free of charge for authors and readers; and promoting multilingualism in communications and publications to facilitate the dissemination of scientific knowledge.

This chapter deals with open access publishing, but also with open archives. Researchers and PhD students are encouraged to use both opportunities to make their work available to their communities and to the public.

2.2.2.1 Open Archive

An open archive is an infrastructure where deposited articles can be consulted without authentication and without fees. They are either thematic (e.g., arXiv[27]) or institutional, such as HAL open science[26]–a non-commercial, multidisciplinary platform open to researchers worldwide. Preprints are one type of deposit in HAL; a preprint (or prepublication or author's version) is the version of a manuscript submitted to a journal prior the peer-review process. A work that has not been submitted to a journal can be deposited in HAL as a working paper. Note that there are many other open archives for preprints: for example, Preprint.org[53] is also a platform covering all research disciplines, and preprints are also posted online free of charge. Preprints.org requires the research data associated with a submission to be available (unless there are legal or confidentiality issues). For a discussion about preprints and examples of other platforms, see COPE Council (2018).

Source : https://hal.science/

HAL also accepts poster communications, proceedings, books and book sections, scientific blog posts, reports, theses, software[54], and manuscripts accepted for publication. Self-archiving may require an embargo from the publisher: see the publisher's open access policies and/or the Sherpa Romeo portal[55]. However, as both the European Union (EU) and, in France, the 2016 French Law

[53] https://www.preprints.org
[54] For more information on the openness of software, refer to Open Science, 2022
[55] https://www.sherpa.ac.uk/romeo/ (accessed on 24 Oct. 2023)

for a Digital Republic[56] limit the embargo to 6 months in science, technology and medicine, and 12 months in the human and social sciences [57]for publications resulting from publicly funded research, according to cOAlition S, such publications should be made immediately available via open access repositories without embargo[58], with effect from 2021.

To return to HAL, visual and audio data produced in the course scientific research can be deposited in mediHAL[59]. Most of deposits in HAL, mediHAL, HAL SHS[60] (dedicated to humanities and social sciences), HAL Thèses[61] and its institutional portals (e.g., HAL-UPHF and its collections[62]) are checked before being published online. More details can be found in the HAL[63].

Note that Open Research Europe[45] is a platform that publishes open access articles resulting from projects funded by Horizon 2020 or Horizon Europe, based on rapid and transparent peer review of the published "preprint," open peer review, indexation of articles (Scopus, etc.), editorial support and no author fees.

Depositors in open archives need to be aware of the different types of Creative Commons (CC) licences (Table 3), which are free of cost and available online legal tools.

Table 3 Creative Commons Licences. Source: https://creativecommons.org/share-your-work/cclicenses/, accessed on 24 Oct. 2023

CC BY	BY: credit must be given to the creator	
CC BY-SA	BY: credit must be given to the creator SA: Adaptations must be shared under the same terms	
CC BY-NC	BY: credit must be given to the creator NC: Only noncommercial uses of the work are permitted	

[56]LOI n° 2016-1321 du 7 octobre 2016 pour une République numérique : https://www.legifrance.gouv.fr/loda/id/JORFTEXT000033202746 (accessed on 24 Oct. 2023)
[57] https://doc.archives-ouvertes.fr/en/legal-aspects/
[58] https://www.coalition-s.org/about/ (accessed on 25 Oct. 2023)
[59] https://media.hal.science/
[60] https://shs.hal.science/
[61] https://theses.hal.science/
[62] https://uphf.hal.science/, https://uphf.hal.science/LAMIH, https://uphf.hal.science/LARSH, https://uphf.hal.science/INSA-HAUTS-DE-FRANCE, etc.
[63] HAL Documentation: https://doc.archives-ouvertes.fr/en/homepage/

CC BY-NC-SA	BY: credit must be given to the creator NC: Only noncommercial uses of the work are permitted SA: Adaptations must be shared under the same terms	
CC BY-ND	BY: credit must be given to the creator ND: No derivatives or adaptations of the work are permitted	
CC BY-NC-ND	BY: credit must be given to the creator NC: Only noncommercial uses of the work are permitted ND: No derivatives or adaptations of the work are permitted	

2.2.2.2 Green, Gold, and Diamond Open Access Publication[64]

❖ Depositing a postprint in an open archive – making it available for free to the general public, either immediately or after the respect of an embargo period – corresponds to what is known as Green Open Access.

❖ Hybrid Open Access refers to "classic" journals[65] that offer the possibility of open access publication if the manuscript is accepted, but with article processing charges (APCs). The model is then based on the institution's subscription plus the payment of APCs by the authors or their institution.

❖ Gold Open Access corresponds to the free online access to articles submitted to a fully open access journal, with or without APCs: the model is based either on the university library subscription (and authors do not pay) or on APCs paid by the authors (or their institution). In fact,

[64] Open access is multicoloured, see Barnes (2018), https://doi.org/10.11647/OBP.0173.0089
[65] i.e., articles are available via either institutional subscription to the journal publisher or unit purchase by the reader (or the institution)

what is known as Diamond Open Access refers to open access publication without APCs. Institutions recommend this model (cOAlition S[66]).

❖ It is important to know that the Directory of Open Access Journals (DOAJ)[67] lists more than twenty thousand high-quality peer-reviewed open access research journals, two thirds of which being published without APCs[68].

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To conclude § 2.2, openness of research data, as well as self-archiving in open archives and open access to high quality peer-reviewed journals that do not charge authors or readers, are essential components of the integrity of research ecosystems:

- Researchers and PhD students may be impressed and attracted by a journal's impact factor, but, in reality, this quantitative metric will never reflect the quality of their work, nor does it even ensure the quality of a journal. For example, predatory journals (always golden open access with APCs) may use artificial impact factors: high impact factors do not mean that these journals publish high quality articles. Note that DOAJ does not approve the use of impact factors to candidate[69];
- The Declaration on Research Assessment (DORA)[70,71] and the European Coalition for Advancing Research Assessment – see the Agreement on Reforming Research Assessment (CoARA, 2022) and the Leiden Manifesto (Hicks et al., 2015) – are working on qualitative indicators to assess scientific performance and to address the inappropriate use of quantitative metrics such as journal impact factors and *h* index[72] (as well as the

Source: https://sfdora.org

[66] https://www.coalition-s.org/diamond-open-access/ (accessed on 25 Oct. 2023)
[67] https://doaj.org
[68] On 25 Oct. 2023, 18:20 (Paris time zone): 13,477 journals among 20,029 were journals without APCs
[69] https://doaj.org/apply/guide/
[70] DORA: https://sfdora.org
[71] DORA Strategic Plan 2023-2026: https://sfdora.org/wp-content/uploads/2023/03/DORA-Strategic-Plan-2023-2026-FINAL.pdf
[72] Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*. https://doi.org/10.1073/pnas.0507655102.

rank of research organizations), which do not reflect the quality of research practice at the level of individuals and research units, nor the scientific, technological, cultural and societal impacts of research activities. Good practice for research integrity extends to research evaluation.

Source: https://coara.eu

Note that UPHF and CNRS are signatories of the CoARA's Agreement on Reforming Research Assessment;

- To return to the integrity of the researcher (§ 1), abandoning the importance attached to quantitative metrics to refocusing on the production of useful and high quality knowledge can reduce the pressure on researchers, which may reduce the temptation of research misconduct and help improve the quality of research impacts.

2.3 Research Involving Human Participants

We have seen in Rajaonah (2022, 2023) that the design of human-centred technologies and services, human-machine systems, or socio-cyber-physical systems requires the human (end users, operators and/or other stakeholders) at almost all levels of the design process (Figure 8).

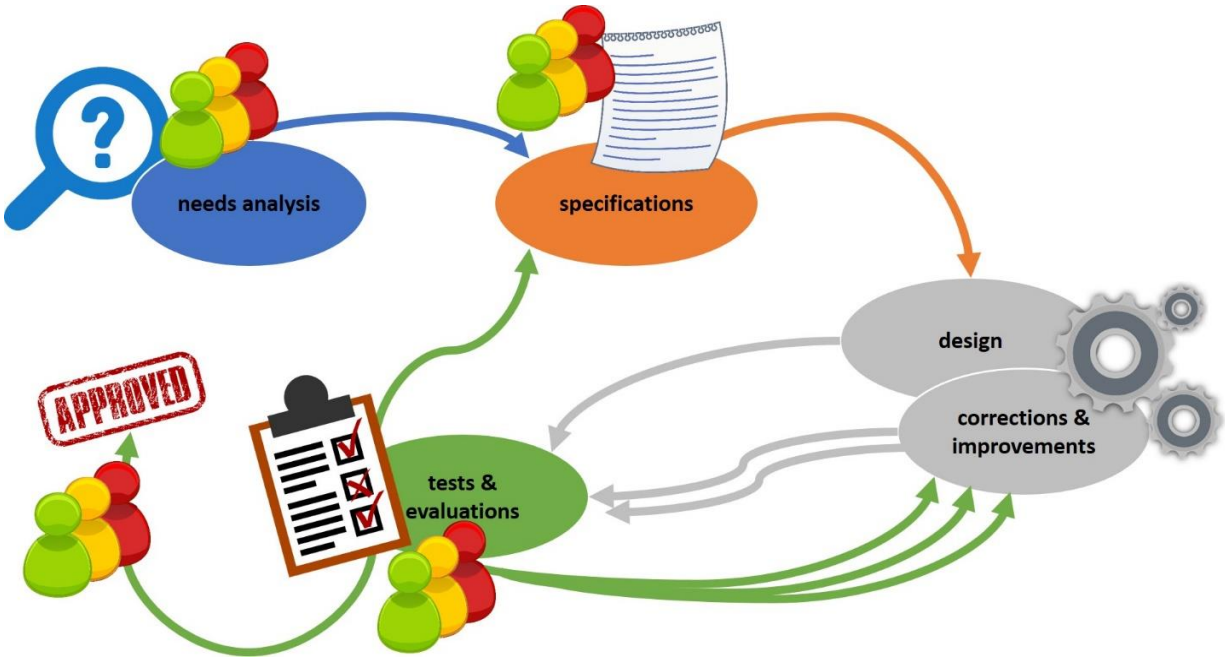

Figure 8 Human-centred approach: the human is at almost all the steps of the design process (Source: Rajaonah, 2022, p. 33)

In the present work, we focus on the human participant in non-biomedical research; a participant is "the person who serves as a data source for research" (Oates et al., 2021, p. 5). In any research study involving such participants (for example, at needs analysis or tests & evaluations stage in Figure 8, through questionnaires, interviews, computer simulations, eye tracking, etc.), two issues need to be considered. One is the protection of the person in general, which in the European Union is derived from the European Charter of Fundamental Rights[73] (European Commission, 2013). The other issue is the protection of personal data in particular, which in the European Union is regulated by the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)[74]. The management of these two issues is taken into account in the ethics approval of research involving humans. European Commission (2021) provides a guide that help applicants to EU projects to check all the ethical issues related to a particular research project; the document is useful for the researcher concerned by any study involving human participants, even if he/she does not intend to apply for a European project.

2.3.1 Management of Personal Data: The GDPR

Personal data are defined by the European Parliament and the Council of the European Union in the context of the General Data Protection Regulation (GDPR) as:

- "Any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person" (GDPR, Article 4 (1)).

The GDPR aims to give to European Union citizens more control over their personal data; it protects them from breaches and violation of the privacy, confidentiality and security of their

[73] Charter of Fundamental Rights of the European Union: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012P/TXT (accessed on 31 Oct. 2023)
[74] GDPR: Official Journal of European Union, 4 May 2016, L 119/1: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0679&from=EN#d1e1489-1-1 (accessed on 30 Oct. 2023)

personal data. In France, it is the French Commission on Information Technology and Liberties (CNIL)[75] who manages the compliance with both the French Loi Informatique et Libertés[76] and the GDPR.

Specifically, the protection of personal data in research[77] means that researchers and/or their institution must (i) inform the participants why personal data are being collected and what will happen to these data, (ii) ensure that the data are properly protected, minimized and destroyed when no longer needed, (iii) ensure that the compliance of data processing with the GDPR can be demonstrated at any time if it is requested by the participants, funding agencies or data protection supervisory authorities (European Commission, 2018).

- Data processing refers to "any operation or set of operations performed on personal data or on sets of personal data, whether or not by automated means, such as collection, recording, organization, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction" (GDPR[74], Article 4 (2)).
- The data controller (natural or legal person, public authority, agency or other body) determines the purposes for which and the means by which personal data are processed (why and how), while the data processor (natural or legal person, public authority, agency or other body) processes these data, on the behalf of the data controller.
- Personal data can be anonymised, i.e., personal data are converted into anonymous data by irreversibly removing all personal identifiers so that an individual cannot be identified from the data; data are considered as anonymous when they are anonymous to everyone, including the owner of the data sources. Pseudonymisation consists in replacing a personal identifier with non-identifiable data (e.g., replacing a name with a number or an alias), but the participant can still be identified with additional information (e.g., date of birth), so the additional information must be kept separate from the data file to prevent from unwanted re-identification; pseudonymisation is not irreversible: data protection obligations still apply. Pseudonymisation is necessary when de-anonymisation may be required over time.

[75] CNIL: https://www.cnil.fr/en
[76] https://www.cnil.fr/fr/la-loi-informatique-et-libertes (accessed on 30 Oct. 2023)
[77] For example, the steps of needs analysis and tests & evaluations of the human-centred design process (Figure 8) are often based on the collection of data that may be personal: such data fall under GDPR and, in France, the French Loi Informatique et Libertés

The Belgian University KU Leuven provides detailed information anonymisation and pseudonymisation techniques for research data – including concrete examples, at https://www.kuleuven.be/rdm/en/guidance/legal-ethical/anonymise-pseudonymise#techniques (accessed on 6 Oct. 2023).

- Data minimization is part of the measures that could achieve data protection by design: it consists in collecting only the data necessary to fulfil the research objectives and methodology (European Commission, 2018).
- Another measure is encryption, especially when it comes to processing large amounts of personal data. For more details on personal data and encryption in the framework of the GDPR, see Spindler and Schmechel (2016) and also KU Leuven[78].

In terms of data security, the European Commission (2018) recommends:

- Not to expose personal data to unauthorized access or use when accessing them remotely—for example, with using unsecured Wi-Fi connections or travelling to countries where devices may be inspected.
- Comply with both the GDPR and the national laws of non-EU member states where personal data are collected, for example, in the case of collaborative research.
- Inform participants in advance that their personal data will be transferred to a non-EU state if this is envisaged in a project, in order to obtain their explicit consent.
- Ensure that third-party services, such as survey tools, cloud storage and data analytics are incorporated in an EU member state or are legally represented in the European Union in accordance with the GDPR.

CNRS (2021b) recommendations include:

- Not use online survey tools hosted outside the European Union (e.g., Google Forms).
- Not exchange files containing so-called sensitive personal data by e-mail without message encryption.

[78] See also KU Leuven: https://admin.kuleuven.be/icts/english/research/datamgmtpract/ape/encryption (accessed on 6 Nov. 2023)

- Share personal data in the context of open science only after anonymisation or with the consent of the data participants (for an example of consent for the collection of personal data, see CNRS (2021b, p. 30).

The European Commission provides a useful and practical online tool to help researchers to determine whether or not their research project falls under the GDPR: https://ec.europa.eu/assets/rtd/ethics-data-protection-decision-tree/index.html (accessed on 7 Nov. 2023).

For any question relating to the application of the GDPR, the contact at UPHF is the Data Protection Officer (dpd@uphf.fr); UPHF Web portal regarding the protection of personal data: https://www.uphf.fr/en/protection-personal-data (accessed on 15 Nov. 2023). Note that the archiving of research personal data is governed by both the GDPR and the French Heritage Code; the UPHF contacts are dpd@uphf.fr and archives@uphf.fr.

It is important to note that the CNIL[75] offers a free massive open online course (MOOC) on the GDPR[79], which not only students but also researchers can follow to better understand the challenges of data protection and the applications of the GDPR. They can also follow the MOOC offered by the French Cybersecurity Agency (ANSSI)[80] to understand and learn about cybersecurity-related risks and threats[81]. These MOOCs are in French. Note that the European University for Customised Education EUNICE[82], of which UPHF is a member, proposes a virtual course in English on cybersecurity[83].

2.3.2 Informed Consent

We have seen in the previous chapter that the participants in a research project need to be informed about why their personal data will be used if it is the case, and how these data will be managed. In fact, the involvement of human participants implies another obligation, such as obtaining their written informed consent to participate in the research. Note that informed consent is also required

[79] The MOOC 'L'Atelier RGPD' is in French; register at https://atelier-rgpd.cnil.fr/login/index.php
[80] ANSSI: https://cyber.gouv.fr/en/about-french-cybersecurity-agency-anssi
[81] The MOOC SecNumacadémie is in French; register at https://secnumacademie.gouv.fr/auth/login
[82] EUNICE: https://eunice-university.eu/ (accessed on 27 Nov. 2023)
[83] https://eunice-university.eu/course/cybersecurity/ (ibid.)

in non-biomedical research and even in a survey-based study. If the study involves potential risk, the risk must be mentioned in the consent form, e.g., the risk of simulator sickness in a driving simulator-based study. The document must include at least a statement that the participant's participation is voluntary and that he/she may withdraw their participation at any time.

2.3.3 Ethical Assessment of Research Project Involving Human Participants

For research conducted in France, the French Public Health Code distinguishes between two categories of research involving human participants: research that extends biological or medical knowledge and research that does not. The first case refers to as 'RIPH' (in French, *Recherche Impliquant la Personne Humaine*), while research that involves human participants which does not aim to increase biomedical knowledge can be referred to as 'non-RIPH' (see Amiel et al., 2021). RIPH can be categorized into RIPH−1 (i.e., interventional research[84] that is not without risk to the participant), RIPH−2 (with low risk), and RIPH−3 (without risk). Detailed information on these categories can be found in Amiel et al. (2021). Amiel et al. highlight the fact that research in behavioural sciences (including psychology) is not necessarily RIPH, but it cannot be conducted without the supervision of a doctor with appropriate expertise; and although research in neuroscience is in a sort of grey area between RIPH−3 and non-RIPH, the use of sensors does not mean that the research falls under RIPH.

All non-RIPH projects do not require an ethics assessment prior to the start of the project, but ethics approval may be requested by journal editors; in which case, a favourable ethical advisory opinion on the study may be required from a CER.

In France, two types of institutional organizations are involved with the ethical evaluation of research projects.

[84] Avec actes pratiqués sur la personne

- The Committees for the Protection of Persons (CPP) are responsible for RIPH and do not deals with non-RIPH. Their role is to assess the ethical dimensions of research protocols and decide whether or not the protocols can be ethically approved. A favourable opinion is mandatory for all RIPHs.
- The Committees for Research Ethics (CER) assess the ethical aspect of non-RIHP projects. The role of a CER is to give an ethical advisory opinion on a research protocol. A list of French CERs is provided by the Federation of Committees (FF-CER)[85].

Researchers at UPHF can send their research protocols to: ethique-administration@univ-lille.fr. The protocol will be examined to decide whether it will be evaluated by a CER or a CPP.

Note that there are 39 CPPs in France, but the researcher does not have a choice: the CPP is assigned by lot (http://www.comite-de-protection-des-personnes-nord-ouest-iv-lille.sitew.fr/Depot_d_un_dossier_Avis_CPP.C.htm, accessed on 8 Nov. 2023).

Note that, in addition to obtaining ethics approval from a CER or a CPP, any research involving human participants and collecting personal data in France must follow the CNIL procedures[86] (the contact at UPHF is dpd@uphf.fr).

[85] https://www.federation-cer.fr/la-federation-des-cer/cer-affilies-a-la-federation/liste-des-cer,26362,43244.html (Accessed on 8 Nov. 2023)
[86] References in French: https://www.cnil.fr/sites/cnil/files/atoms/files/recherche-hors-sante_principales-references-juridiques.pdf (acc. on 9 Jan. 2024) and https://www.cnil.fr/fr/recherches-dans-le-domaine-de-la-sante-la-cnil-adopte-de-nouvelles-mesures-de-simplification (acc. on 10 Jan. 2024)

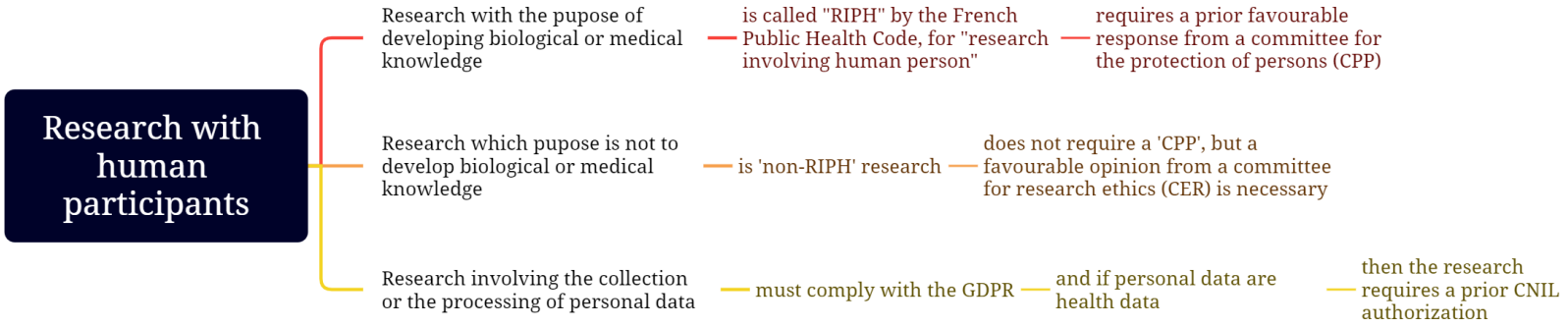

Figure 9 Research involving human participants in France: the obligations of researchers, in addition to their responsibility

2.4 Intellectual Property

In the academic field, intellectual property is the legal aspect of research and experimental development (R-D) activities, which include "creative and systematic work undertaken in order to increase the stock of knowledge (including knowledge on humankind, culture and society) and to devise new applications of available knowledge" (OECD, 2015). See Rajaonah (2023) for the different types of R-D activities according to the Frascati Manual 2015.

The main reference in this chapter is the World Intellectual Property Organization (WIPO)[87], a United Nations[88] agency with 193 member states. The goal of WIPO is to lead the development of an intellectual property ecosystem that promotes creativity and innovation throughout the world, for the benefit of all. It does this by working with member states, international organizations, such as the World Trade Organization (WTO)[89] and national organizations (for example, in France, INPI[90] and the agencies of Technology, Transfer and Acceleration− the SATT network[91]).

Source: WIPO (2020)

Intellectual property (IP) refers to creations of the mind[92], such as literary, artistic and scientific works, computer programs, inventions or industrial designs. IP is protected by law. IP rights are divided into i) author's rights − also called copyright in WIPO (2020)—which protect the creative expression of ideas in many different forms (e.g., text, sculpture, computer program) and ii) industrial property, which protects inventions, industrial designs, trademarks, geographical indications, and trade secrets (WIPO, 2020). **Software can be protected, either by copyright or by patent, the former protecting the content of the software and the latter protecting the technical invention that results from the software**. Figure 10 shows at a glance those different facets of intellectual property (note that there may be differences between countries). Indeed, IP is

[87] WIPO: https://www.wipo.int/portal/en/index.html
[88] United Nations: https://www.un.org/en/
[89] WTO: https://www.wto.org/index.htm (accessed on 10 Nov. 2023)
[90] INPI: https://www.inpi.fr/en/ (accessed on 10 Nov. 2023)
[91] SATTs (Tech Transfer Acceleration Companies): https://www.satt.fr/en/societe-acceleration-transfert-technologies/ (accessed on 10 Nov. 2023)
[92] of the human mind

governed by international and national laws, and, within the European Union, by EU legislation[93], but a work published by the European Parliament comparing national copyright laws in the EU[94] shows that author's rights do not have the same content for all Member States. Note that the WIPO web portal has a section dedicated to universities on intellectual property, particularly in relation to knowledge transfer to the business sector (https://www.wipo.int/about-ip/en/universities_research/index.html, accessed on 10 Nov. 2023).

In principle, copyright protection when the work is created, but a copyright notice may be placed on the work, such as '" all rights reserved" or the © symbol[95]. The concept of author's rights is very important for ethical research: this legal concept explains why copying text without acknowledging the source, omitting the contributions of other authors in the references, and manipulating authorship (Table 1) are violations of research integrity.

The European Parliament "considers that works autonomously produced by artificial agents and robots might not be eligible for copyright protection, in order to observe the principle of originality, which is linked to a natural person, and since the concept of 'intellectual creation' addresses the author's personality"; the Parliament "recommends that ownership of rights, if any, should only be assigned to natural or legal persons that created the work lawfully and only if authorization has been granted by the copyright holder if copyright-protected material is being used, unless copyright exceptions or limitations apply" (The European Parliament, 2020)[96].

The contact point regarding intellectual property rights at UPHF is the Research and Valorisation Department (DRV): https://www.uphf.fr/en/research/research-uphf/valorization-research (accessed on 13 Nov. 2023). CNRS units can contact the CNRS Hauts-de-France office.

[93] https://europa.eu/youreurope/business/running-business/intellectual-property/index_en.htm (accessed on 14 Nov. 2023)
[94] European Parliament (2016). Copyright Law in the EU. https://doi.org/10.2861/025158
[95] https://europa.eu/youreurope/business/running-business/intellectual-property/copyright/ (accessed on 14 Nov. 2023)
[96] European Parliament (2020). P9_TA (2020)0277: Intellectual property rights for the development of artificial intelligence technologies. European Parliament resolution of 20 October 2020 on intellectual property rights for the development of artificial intelligence technologies (2020/2015(INI)). Retrieved from: https://www.europarl.europa.eu/doceo/document/TA-9-2020-0277_EN.html (accessed on 15 Nov. 2023)

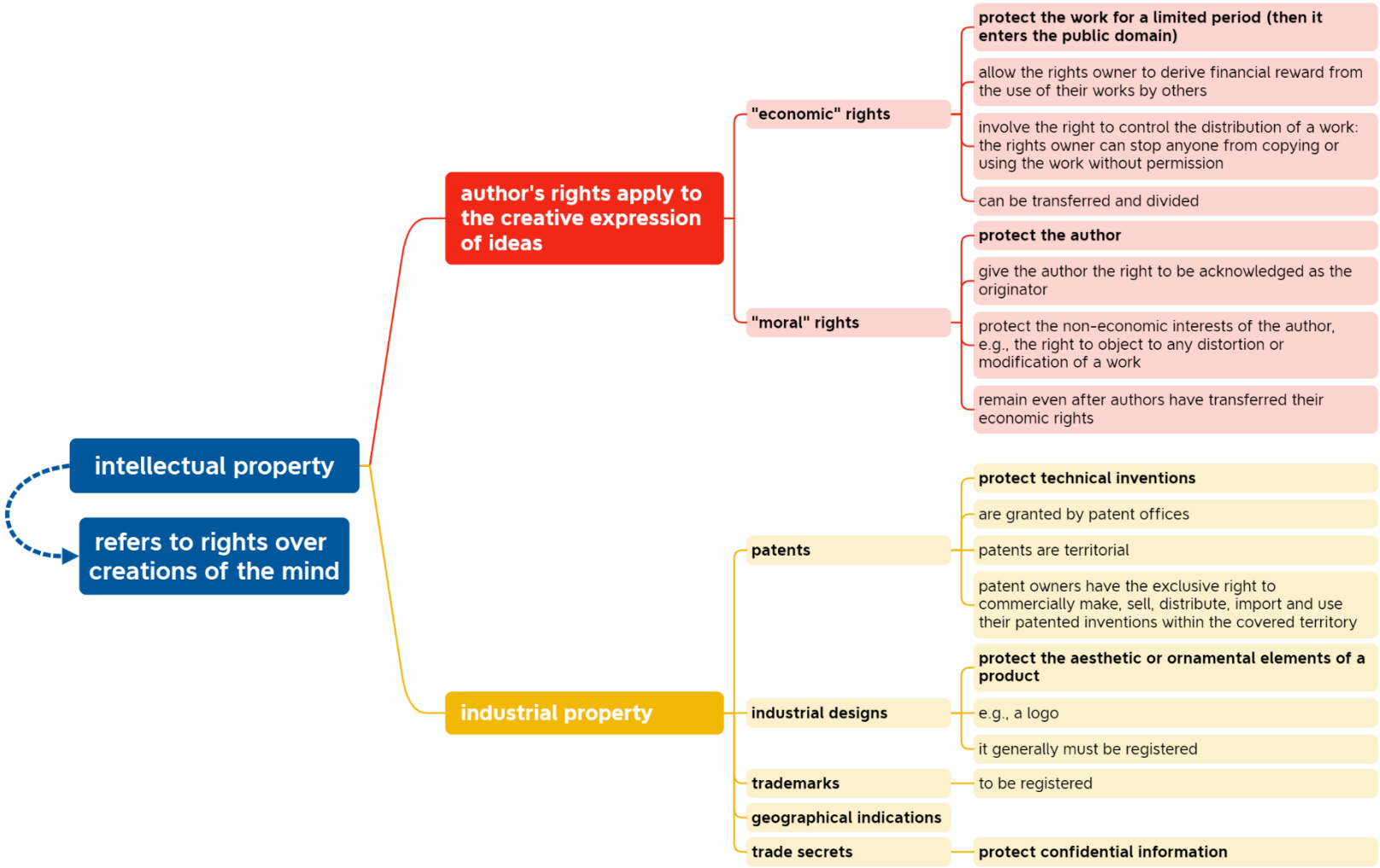

Figure 10 Intellectual Property according to the World Intellectual Property Organization (WIPO)

Both UPHF and CNRS Hauts-de-France work in partnership with SATT Nord. Indeed, the mission of SATTs is to support researchers by investing in the transformation of research results into a future product or service, to find the best strategies for intellectual property and industrial transfer, and to guide research project towards the creation of a start-up[97].

As soon as a research project has the potential to generate an invention or a patentable software at UPHF, SATT Nord is involved. As the present document is primarily addressed to students, it mainly deals with the case of a UPHF student as inventor: in addition to SATT Nord and UPHF–DRV or the CNRS Hauts-de-France regional office of[98], the actors in a patent application project are the inventors (the student and the supervisor-s) and the employer (UPHF, CNRS or a company) (Figure 11); the owners of the intellectual property rights are determined according to the student's status (Figure 12).

It is important to know that publishing the research results that led to the invention may jeopardize the patent application.

Finally, we draw the attention of UPHF students to the fact that the Hubhouse welcomes them to answer their questions about entrepreneurship and business creation; and that they can be coached: https://www.uphf.fr/en/training/business/hubhouse (accessed on 23 Nov. 2023).

https://www.uphf.fr/en/training/business/hubhouse

[97] https://www.satt.fr/en/researchers/ (accessed on 22 Nov. 2023)
[98] https://www.cnrs.fr/en/cnrs-regional-offices (accessed on 23 Nov. 2023)

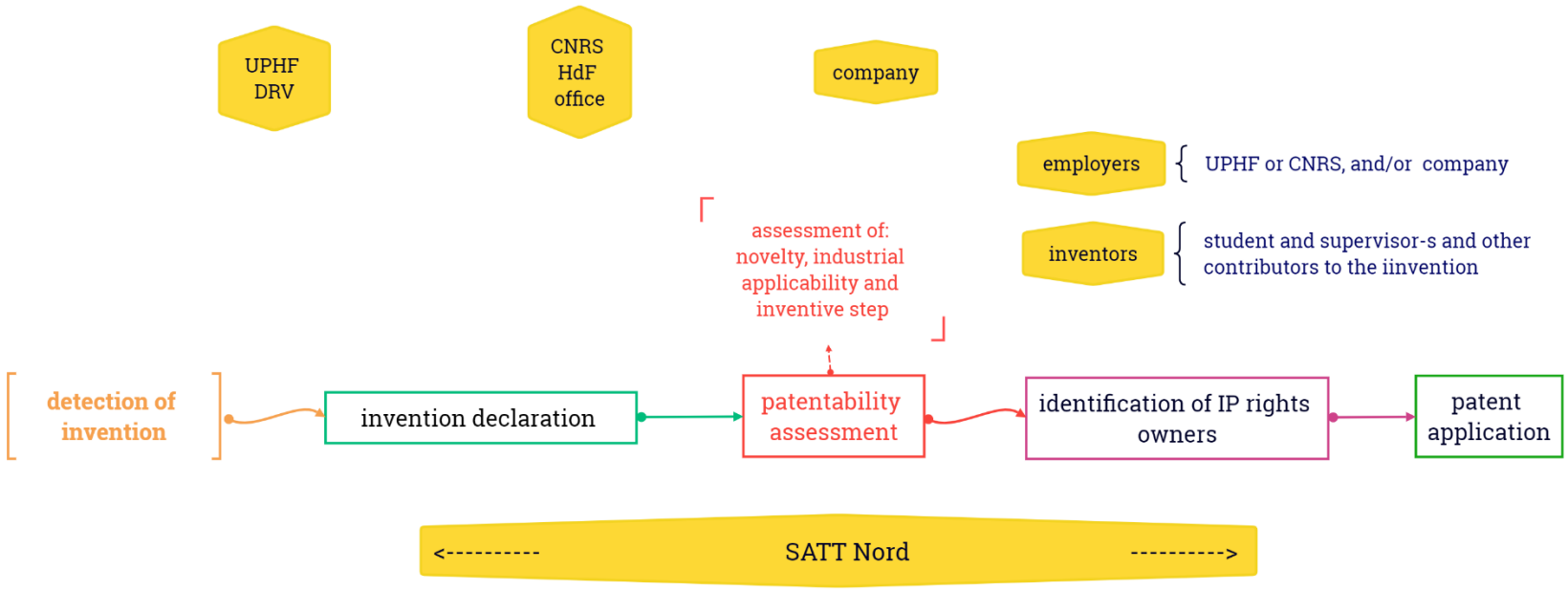

Figure 11 The main steps of a patent filing project at UPHF, with the main actors in yellow boxes

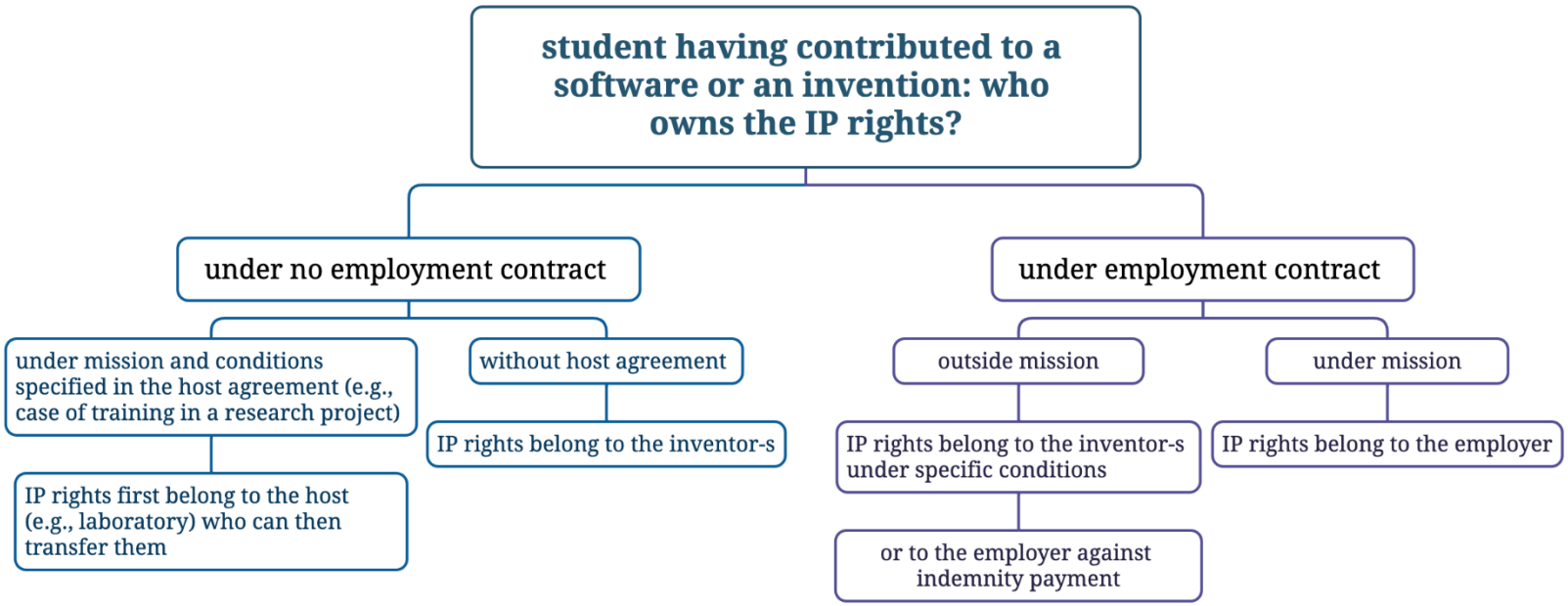

Figure 12 Who owns the intellectual property rights over an invention?

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[99] OFLIS's page directory of Research Integrity Officers: https://www.ofis-france.fr/page-directory-of-research-integrity-officers-ris/ (accessed on 14 Nov. 2023)

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DIRECTION GÉNÉRALE - SERVICE DES ARCHIVES
Sylvie Hannesse, responsable du service (poste 1017)
Marie Hernu, assistante archiviste (poste 1011)
archives@uphf.fr