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IANUS

Deliverable 2.1 – Comprehensive Analysis of the Research and Policy Landscape

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List of abbreviations used in the document

GMO: Genetically Modified Organism
NGO: Non-governmental Organisation
RFO: Research Funding Organisation
RPO: Research Performing Organisation
RRI: Responsible Research and Innovation
SciComm: Science Communication
STI: Science, Technology and Innovation
STS: Science and Technology Studies
T: Task
WP: Work Package

Executive Summary

Deliverable 2.1 is based on a number of internal documents as well as an extended research effort. These materials are available for internal use and, when appropriate, will be revised and published as academic output. For this deliverable, work package 2 (WP2) conducted 5 tasks (T2.1-T2.5). Below, you can find an executive summary organised per task.

The aim of T2.1 was to harvest the most salient results and lessons learnt from earlier research projects. The T2.1 analysis consisted of a study of eleven projects with a focus on research ethics and integrity as well as responsible research and innovation (labelled here as RI+RE projects) and nine projects with a science communication focus. Specific attention was given to the conceptualisation of (individual or public) trust in science, the factors influencing trust and distrust outlined in these projects, as well as on the methodological approaches used in the projects and methodological suggestions for the advancement of trust in science. The projects analysed did not explicitly define trust in science as their main focus, however, the tools developed to facilitate accountable conduct of research as well as more effective science communication can be viewed as means for maintaining or building trust both on individual and societal level. The RE+RI projects emphasised the fragility of public trust: that trust can be easily undermined by scientific misconduct. Projects with a focus on science communication saw as the main challenge of science communicators how to maintain the trustworthiness of scientific information in this new information-saturated digital media environment, since it is rife with (sometimes deliberate) dis- and misinformation.

The aim of T2.2 was to survey the landscape (academic discourse, policy documents, media) to gain insights into the current state of knowledge on trust and confidence in STI. Trust is an issue which has been addressed from multiple perspectives and by multiple disciplines in recent years (e.g., technology assessment, philosophy, social science, STS, science communication, etc.). Research misconduct can be defined as a breach in research integrity, which writ large is the fundament on which trustworthiness in science is based. A key objective of IANUS is to bring these results and insights together in a comprehensive approach allowing us to open up evidence-based and informed pathways towards strengthening trust in science. T2.2 thus focused on three contentious issues of relevance to fostering trust in science. These issues are: the current shift in discourse on research misconduct from penalising individuals to strengthening ethical research culture on the institutional level; the problem of overpromising in research; the challenges posed by research collaborations with industry.

Under T2.3 public opinions were explored relating to trust and distrust in science as well as science, technology and innovation (STI) issues and controversies to be featured in the (historical) case studies of T4.1. The historical case studies focus on the following STI topics: climate science & climate change; genome modification & genome editing; artificial intelligence in social media (algorithms); nanotechnology. The qualitative and semi-quantitative analyses show that trust in science is heavily influenced by both engrained, long-term cultural context, as well as short-lived political trends. Moreover, trust or distrust in science is sometimes overlaid by the more overarching notion of trust or distrust in governments or ‘experts’ in general.

T2.4 produced an overview of contemporary approaches to science communication and a critical analysis of the relation between science communication and trust in science. Science communication is a broad and evolving field that includes diverse encounters of diverse publics with science or scientific issues; T2.4 contributes to a shared understanding of the state-of-the art of science communication for all project partners. More importantly, T2.4 furthers one of the core IANUS objectives, i.e., to evaluate a number of frequently repeated assumptions about trust in science. The overview produced by T2.4 shows that science communication is a mediated and mediating activity that is unavoidably entangled with trust in science: a presumed trust deficit has motivated reforms and innovations in science communication while science communication is often expected to foster trust in science. This trust objective, however, has conceptual and normative limits: it can be contradictory, paradoxical, corroborating a trust deficit, indiscriminately promoting trust or be perceived as self-serving, persuasive, or promotional. These limits necessitate a discriminative approach to trust as well as reflection by the scientific and science communication community about the desired outcomes of science communication efforts to promote trust in science.

The IANUS team of T2.5, entitled 'Stakeholder Consultation', organised three consecutive workshops (i.e. Workshop I and Workshop II as in-person workshops, Workshop III as an online workshop), in order to identify and consult a diverse group of societal experts (prominent stakeholder representatives); the stakeholder attendance varied slightly during the three workshops, providing opportunities to critically review the interim results of the previous workshops and adding aspects to their discussion, without having to repeat the organisational details, aims and objectives. Aiming to map the landscape of trust in science and its underlying forces and attractors, the team ensured a strong connection to both the (historical) case studies investigated in WP4, and to the qualitative and semi-quantitative survey-analyses of T2.3. The workshops foresaw a distinction between the 'trust/distrust in science as an institution/discipline' versus the 'trust/distrust in scientists'; it turned out that it was not easy to uphold this distinction and clarify differences pertaining to different level of trust/distrust directed towards these two different objects, because of the triggers of trust/distrust, and the many different roles that a single person takes on, when answering questions on the matter. In this course, the stakeholders in the room were always torn between talking about trust/distrust in science/scientists as a spokesperson of laypeople's concerns, or as learned, informed experts, who were– in this role – both object and subject of trust/distrust. All the evidence shows that there is confidence and trust in science and scientists. The Mertonian description of the ethos of the scientific enterprise is subject to challenges in contemporary times. All three IANUS Expert Workshop discussions highlighted some of these challenges.

1. Introduction

IANUS's WP2 aimed to foster convergence of previous and ongoing projects and research in general relevant for strengthening trust in science. This serves two purposes: 1) to avoid overlaps and determine gaps in previous and ongoing research and 2) to form a basis for most other work packages in the IANUS project. This report summarises the efforts of the tasks under WP2.

Much work has already been conducted on the topic of trust in science. Relevant materials exist in the shape of previous project outcomes, academic literature, specific historical cases, experiences in science communication and the knowledge and experience of expert stakeholders. To enable a useful convergence of extant knowledge and experience, WP2 generated a clear overview of the topics addressed in previous projects, their successes and hurdles, as well as the concepts, frameworks and methods they developed, traceable through relevant academic publications.

WP2 developed an integrative comprehensive overview of what has been achieved so far, in combination with involvement of representatives from other projects. The ensuing sections consist of five executive summaries, based on the five internal deliverables that have been produced for the project. The five internal deliverables are meant for project internal use and form the basis for many activities in other WPs.

2. Lessons learned from previous projects (T2.1)

T.2.1: *Harvesting and analysing lessons and results from previous projects on trust, integrity, science communication and science education* [CEUT, EUR, RU; KIT, ISI, UNIROMA1, AUTH] (M1-M11).

The aim of T2.1. was to harvest the most salient results and lessons learnt from earlier research projects that focus(ed) on research ethics and integrity or on responsible research and innovation more generally (labelled here as RE+RI projects) or on improving science communication. Specific attention was given to the conceptualisation of (individual or public) trust in science, the factors influencing trust and distrust outlined in these projects, as well as on the methodological approaches used in the projects and methodological suggestions for the advancement of trust in science. The following research questions were posed for the analysis of projects: 1) How is (dis)trust defined and who are the stakeholders involved in the trust relationship?; 2) Which factors influence (dis)trust and what recommendations are made based on this assumption?

2.1 Sample and methodology

The list of the projects included in the analysis was combined from the original list of relevant EC-funded projects focusing on analysis and assessment of innovative methodological approaches developed by other projects to enhance trustworthiness and trust in the project proposal, which was later complemented by the project members in coordination with task 5.1. From the combined lists, based on the preliminary scan the projects that did not include any references to trust in science were eliminated. In the final sample, thematically, the 20 projects fell into two broad categories: eleven projects focusing foremost on research ethics and integrity (or more broadly on responsible research and innovation framework) (ENERI, EnTIRE, GRRIP, iRECS, PANELFIT, PRINTEGER, RRING, SIENNA, TechEthos, TRUST, SHERPA) and nine projects with science communication focus (ENJOI, CONCISE, I-CONSENT, PARCOS, QUEST, RETHINK, SYNERGENE, TRESCA, VERITAS).

All the analysed projects were EU Horizon projects and the data was gathered from openly available sources from CORDIS. In average 4-5 sources per project was used, always including the *Objectives* section from the CORDIS Fact sheet to get the general overview of the defined focus of the project. Other documents (e.g., deliverables or academic articles) presented under the projects' *Results* sections on CORDIS and were selected after a brief preliminary scan for the topic of trust within the document. Additionally, the project websites were consulted for identifying any additional tools created by the analysed projects for either enhancing research ethics and integrity or RRI culture, or advancing science communication. For the analysis, a coding scheme was developed including the main focus of the project; conceptualisation of trust and the main focus on trust relationship; factors influencing trust and distrust in science; the assumption about the level of trust or distrust towards science in the society; methodological approaches to enhance trust in the project; The documents were coded using the *Taguette* qualitative research software (https://www.taguette.org/).

2.2 Results

As was evident already from the pilot study, with few exceptions (e.g., TRESCA, iRECS and VERITAS) enhancing trust in science was not defined as the main focus for either projects working on RE+RI or those working on science communication. The projects working on RE+RI focused on the analysis and improvement of the understanding and consequently promotion of research ethics and integrity within the scientific community. The main aim appeared to be the advancement of RI and ethics in scientific conduct and its regulation. The way to achieve this was predominantly by creating a range of regulations and guidelines and learning tools for research institutions and individual researchers.

Maintaining and enhancing public trust in science, if defined as a separate aim, was seen as the residual outcome of appropriate scientific practices. In this context the main focus was on the fragility of public trust, which can be easily undermined by publicised cases of misconduct. At the same time, certain distrust towards emerging technologies appeared to be seen as justified, as developments in these fields pose a challenge to existing ethical standards. A common trait with the projects with a science communication focus is the emphasis on the need for more transparency and open access to research data and results. Other trust relationships highlighted in the projects with RE+RI-focus are 1) the trust relationship between the scientists themselves within the scientific field, as a prerequisite for the conduct of scientific work, and 2) the trust relationship between the researcher and research participant/research subject that is grounded in informed consent; a feeling of deception due to lack of transparency can threaten this trust relationship and jeopardise further participation. In relation to research subjects, experience of historically occurred abuse towards vulnerable communities can also affect their trust towards the researchers.

In the RE+RI-focused projects the starting assumption was that the level of trust in science among the wider public is generally high - though easily compromised by cases of scientific misconduct. Science communication -focused projects are alarmed by the dangers posed by the rise of disinformation and (sometimes deliberate spreading of) misinformation. This is especially the case for concerns about social media. A growing challenge is perceived for science communicators who must compete with their messages in an information-saturated digital media environment. This is specifically a concern since the public is understood to be increasingly exposed to contradictory and inconsistent information. Thus, projects with a science communication focus aim to face this challenge by making the communication more effective through increased transparency (credibility and responsibility) or engagement and interaction with the public. Establishing and maintaining (or rebuilding) trust in scientific experts and institutions through better science communication is mentioned as the ultimate goal on few projects, though, in some of the projects, trust is treated rather as means, as a prerequisite for quality science communication that enables the public to be more aware, enjoy and understand science better, and consequently make also better-informed decisions.

Trust in science in the science communication projects appears to be discussed mainly in terms of ‘perceived trustworthiness of specific scientific messages or outputs’. Compared to the RE+RI-focused projects, the focus is on the trustor and the messages delivered by different mediators or communicators. Scientists figure principally in the role of communicators, also in the context of conducting research (communicating with research participants). While communicating, trustworthiness can be influenced by the trustor's previous beliefs, knowledge, and attitudes towards the specific scientific topic, personality traits and values, as well as pre-existing trust in the source or channel of communication. The trusted sources, can, however differ from topic to topic, especially in the case of politicised topics, e.g., climate change or vaccines. Similarly, transparency and engaging presentation of scientific results influences message credibility. For research participants, the importance of personal interaction with the scientist and continuous relationship throughout the project is seen as the key factor for building trust.

Projects from both camps used (consultation or co-design) workshops with stakeholders and experts as the most popular methods for collecting data and validating results. Most of the projects also included participatory data collection and co-creating workshops with wider publics, e.g., public consultations, public forums, citizen panels, engagement workshops and co-creation labs, engagement of the local community, as well as experimental engagement with science communication videos.

The guidelines, tools and other outputs developed by projects do not specifically deal with enhancing trust, but more generally with enhancing RE+RI in scientific conduct (or RRI culture more generally) and its regulation or facilitating more effective science communication. The tools from projects with RE+RI focus (including web-based tools, handbooks, guidelines, manuals, action plans, etc) are foremost targeted at science producers both on individual and institutional level, but also to science governing bodies and regulators, as well as financiers. Only few other stakeholders are targeted, e.g., NGOs, ethics experts and schools. The tools with science communication focus (including digital support tools, toolkits, a massive open online course (MOOC), guidelines and best practice resources, quality measures, policy briefs, explanatory videos and a few new stakeholder networks) are mostly targeting different communicators: researchers, but also science journalists, museums, citizen scientists, science communication students, etc.

2.3 Conclusion and take-home messages/highlights

Despite the scantness of direct focus on trust in science in the analysed projects, all recommendations and tools developed in the projects to facilitate accountable conduct of research as well as more effective science communication can be viewed as means for maintaining or building more trust both on individual and societal level

Three main take home messages can be derived from the analysed projects in relation to trust in science:

1. *Increasing transparency and accessibility of scientific data*

   One of the key messages from the projects with both RE+RI and science communication focus is the need to increase transparency in the communication of scientific data. Publicly funded research results and databases should have open access, but also data about privately funded research that is of high public relevance needs to be more easily available to eliminate qualm concerns of potential biases. At the same time, simple availability of research results and data is not enough, extra steps need to be taken to make these actually accessible to the wider public. Science communication projects provide a range of different guidelines and tools for science communicators to increase interactivity and comprehensibility of scientific data, including participant-directed activities, engagement and visualisation tools, and good practices in social media communication. The role of science institutions is also emphasised both in supporting researchers to present scientific data in a more accessible way, as well as in building relationships with schools and community centres and organisations in the region to engage them in various science communication activities. In order to better answer the needs and views of different segments of the population, the scientific and media organisations themselves should work on diversity of their membership.

2. *Promoting a more integrous research organisation culture*

   In maintaining public trust in scientific institutions, integrity of the research process is another core component. The key message from the RE+RI projects is to avoid further individualisation of RE+RI activities (in the form of surveillance, detection, exposure and punishment of individual deviance) but rather work towards their institutionalisation, i.e. integration of the wider RRI principles into the organisational culture, including gender equality, diversity and inclusion, social engagement, open science, science education and ethics. This should also be a key focus in the designing of educational tools for future research.

3. *Increasing the quality of communication practices with research participants*

   The third topic mostly in focus in the science communication projects, but also in some RE+RI projects is the building and maintaining of a trust relationship with (potential) research participants throughout preparatory and actual research phases. Researchers should take their time to build a trust relationship with the community from which research participants will be recruited before the actual research begins (especially in case of vulnerable communities with experience of previous mistreatment). To overcome distrust in research, potential participants should be educated about the principles of research ethics to overcome possible prejudices. Research participants prefer personal communication with the scientists, preferably with the same person (or team) throughout the research period. The key tool for establishing trust is informed consent: not just the written document, but the whole process of informing the research subject.

3. Surveying the landscape (T2.2)

T2.2 *Survey of the landscape (academic discourse, policy documents, media): The current state of knowledge on trust and confidence in STI* (EUR: ISI, RU, LSE, CEUT) (M1-M11)

Trust is an issue which has been addressed from multiple perspectives and by multiple disciplines in recent years (e.g., technology assessment, philosophy, social science, STS, science communication, etc.). Research misconduct can be defined as a breach in research integrity, which writ large is the fundament on which trustworthiness in science is based. A key objective of IANUS is to bring these results and insights together in a comprehensive approach allowing us to open-up evidence-based and informed pathways towards strengthening trust in science.

3.3 Three issues

Task 2.2 focused on three contentious issues of relevance to fostering trust in science:

1. The current shift in discourse on research misconduct from penalising individuals to strengthening ethical research culture on the institutional level. Responsible research and transparency concerning possible conflict of interests in the case of impact-driven research must be seen as institutional responsibilities. This also implies a shift from a defensive approach (focused on repairing reputational damage) towards a proactive approach (providing researchers and research groups with tools to address, prevent, and deliberate integrity challenges)
2. Overpromising as a "pandemic" in research, with the associated complementary problem of media sensationalism. As a pathway towards change, we propose responsible promise management notably on the institutional level (which includes both research performing and research funding organisation expectation management) and epistemic humility.
3. Collaboration with industry and how motivated research changes perceptions of and trust in science. How to balance the aspiration to interact with society and include other sources of knowledge, while maintaining institutional independence, scientific integrity, and academic freedom?

3.4 Results

The first chapter of the internal deliverable for T2.2 investigated how research misconduct is often framed as an anomaly that does not represent institutions, or as emerging from faulty institutional oversight. A systemic approach requires us to consider more carefully the interplay between institutional pressures and demands. Institutions are not helpless, and trust in science can be better fostered not through fear of punishment, but through strengthening bonds of interaction between actors in institutions.

Concern for and interest in research integrity has increased significantly during recent decades, both in academic and in policy discourse, but until recently, the tendency has been on detecting and punishing individual deviance. More recent contributions to the integrity debate focus more explicitly on environmental factors, e.g., on the quality and resilience of research ecosystems, on institutional rather than individual responsibilities, and on the quality of the research culture.

While universities want their research to be societally relevant or even impact-driven, for instance, the question emerges how to safeguard independence and critical distance at the same time. The "bad apple" approach does little to minimise violations of research ethics in the future. As long as perverse incentives are in place, individual researchers will look for opportunities to push the boundaries of what is seen as permissible. Addressing such issues should not only focus on individual responsibilities, but first and foremost on institutional responsibilities as well as new approaches to integrity education. Building on lessons learned from case studies and from previous EU projects, we argue that fostering research integrity should be informed by practice, by integrity work in every-day research settings. In other words, rather than on surveillance, detection, exposure and punishment of individual deviance, the focus should be on promoting care and concern for research ecosystem quality.

In the next chapter of the internal deliverable, we zoomed in on the challenges involved in promise management. Already during the preparation of research proposals, researchers and research teams often feel pressed by funding agencies to inflate the outcomes of their research. And while research performing organisations are entitled to proudly present their novel findings, emphasising their societal significance, over-enthusiastic reporting may take the public on a rollercoaster ride of questionable claims that become ever more bombastic. Starting with the Human Genome Project (HGP), a series of publicly funded -omics research endeavours gave rise to a promissory discourse ('promisomics') that runs the risk of becoming inflated and may entail loss of credibility for science. Science involves tedious work, often with unpredictable outcomes and although basic research in the long run may have beneficial outcomes for health care or sustainability, often such effects are difficult to link directly to concrete research endeavours.

Building on a series of case studies we argue that responsible promise management requires us to move away from seeing research as an arena of acceleration and competition towards a slow science approach that encourages reflection on the societal values of research findings in an interactive manner. Examples of promise inflation are not isolated problems but rather represent incentive structures that serve neither the public's interest, nor science. RPOs and RFOs should therefore consider a bottom-up restructuring of such incentives, to shift from hype to genuine relevance, allowing research to become more responsive to societal values, needs and concerns.

Finally, we zoomed in on integrity challenges involved in collaboration with industry. Public-private collaborations are often regarded as a badge of honour as well as a vital source of income for enabling research. For example, business schools are ranked in part according to the profile and number of the industry ties they hold. While such partnerships can be useful in certain circumstances, they may endanger the independence and trustworthiness of research. In this chapter we discussed a number of case histories that tell us that involvement of the tobacco industry, the agri-food industry or fossil fuel industry may result in producing false consensus or fostering an attitude of denial (e.g., concerning the detrimental impact on human health of smoking). Even in a post-truth era, science is still seen by many not as just another opinion, but as a baseline of truth. Therefore, scientific consensus is valuable to industries, sometimes so valuable that they expend substantial coin to influence or even capture what stands as consensus.

Finding firewalls between science and industry is necessary to ensure the proper functions of both. To deal with the need for funding for science, scientists and research institutions should not feel forced to accept partnerships that endanger the independence and trustworthiness of research. While there are legitimate reasons for independent scientists to partner with industry, the mounting evidence is that many of these relationships can be damaging to the quality and authority of science. The core of science is lost and with it, public trust. In many areas of research, collaboration with industry is beneficial or even inevitable, and industry may have a lot to offer in terms of knowledge and experience, not only in applied research, but also on a fundamental level. The research capacities of tech companies dwarf the capabilities of most universities in areas such as digitisation. At the same time, this knowledge is intimately connected with power. It is remarkable that integrity codes available for researchers and research institutions often have little to say about how to assess the normative intricacies of collaboration with industry. Guidelines, based on mutual learning and informed by practice, could offer a scaffold for institutional deliberations on the basic conditions that should determine when and when not to collaborate with industry, but the experience of many researchers is that current guidelines are too general to offer normative support. In research, transparency is crucial, but this especially applies to industry-funded science. Collaborations with companies may be of crucial importance to make research more inclusive and comprehensive, but transparency is of utmost importance to ensure impartiality and social credibility and acceptability of the research process and results.

3.3 Take home messages/highlights

- Societal trust in science hinges on many factors, including the cohesion of scientific consensus on a given topic, the role science is assigned by government and policymakers, the over-extension (or sobriety) of media reports on preliminary research results, and the dilution of scientific objectivity and political neutrality through industry funding and interest conflicted science. While collaboration with societal stakeholders and industry is part of interactive research, allowing science to broaden its knowledge base, safeguarding transparency and academic independence are important dimensions of trustworthy interactive research.

- When scientific misconduct occurs, the most long-lasting solution is to examine the forces which made such misconduct possible. This allows institutions to re-calibrate the opportunities for misconduct. This 'broken window' view of research misconduct suggests that research misconduct is akin to opportunistic crime - misconduct most often occurs only when the social ecology permits at various stages the slippery slope of misconduct. Decisive is not the occurrence of misconduct per se, but the response of research performing organisations to misconduct: can they move away from a defensive focus on minimising reputation damage towards a proactive approach, opting from prevention by strengthening the resilience of the research ecosystem.

- Expectation management is also an important element in creating or eroding public trust in science. Reining in researchers over-enthusiastic about preliminary findings and media interests in sensationalism will be key to keep from rising and then dashing public hopes for silver bullet cures, discoveries, and innovation.

- Influenced science conducted to promote a given ideological or financial interest creates cognitive dissonance for the public, leading to a disbelief in science as an arbiter of truth. Relativism (for every expert view there is a diverging expert view) then science becomes a mixture of opinions. While acknowledging epistemic pluralism and plurality of knowledge forms, the distinction between validated knowledge and *doxa* must be retrieved and restated in a post-truth era. When research is conducted to serve ideologies, companies, or industries, trustworthiness of research *as such* becomes endangered.
- Operationalizing public trust in science requires attending to institutional enabling and constraining factors, tempering over-promising, and keeping scientific investigation from becoming just another lobbying tool.
- According to many, science has become a competitive enterprise. To become responsible and responsive, research may have to slow down, opting for epistemic humility rather than overpromising, for institutional responsibilities rather than reputational damage control, from penalising individual deviance towards fostering a responsible research culture.

4. Engaging with the Eurobarometer and other surveys (T2.3)

T2.3: *Engage with Eurobarometer outcomes and other quantitative/qualitative research* (LSE, AUTH, LSE, CEUT, AIST (M1-M14)

4.1 Methodology

Under T2.3, the partners involved explored public opinion relating to trust and distrust in science, as well as, technology and innovation (STI) issues and controversies to be featured in the (historical) case studies of T4.1. The STI topics identified include artificial intelligence, genome editing, climate change and global warming, and nanotechnology. The historical case studies were planned to include time series analysis of public opinion of the STI and to relate the evolution of public opinion to specific events, such as health scares, accidents, regulatory developments, that may have fostered trust or created distrust. However, with the exception of GMOs from 1990 to 2010, it became evident that comparable longitudinal data on the extent of public trust in science of technological innovations was not available.

In discussions with the POIESIS sister-project (https://poiesis-project.eu/) it became evident that analysis of public opinion was of considerably greater scope and resourcing than initially expected. The IANUS T2.3 team learnt that the POIESIS study would be conducting secondary data analysis on Eurobarometer surveys from 1997-2021 and - in addition - a variety of national science barometers. The resources committed to this work within the POIESIS project amounted to the equivalent of a 3-year post-doctoral fellow. This led to changes in the Task's study plan, yielding two research approaches:

- First, qualitative assessments of relevant public opinion data and secondly, a detailed analysis of the responses in the Wellcome Global Monitors for 2018 and 2020, surveys that included questions about trust in science, scientists, scientific knowledge, the motivation of scientists in universities and companies, advice on medical and health issues from government and medical professionals. These surveys document widespread trust in the scientific enterprise in the European Union, but doubts about the trustworthiness of some governments and journalists. From the public opinion data some of the possible antecedents of trust and distrust in the individual STIs are described and problematic issues arising from globalisation and regulatory arrangements that have a bearing on trust are identified.
- Second, to avoid replicating research to be undertaken in POIESIS, it was thus agreed that T2.3 should focus on the topics featured in the historical case studies of specific topics in science, technology and innovation (STI) to be conducted in T4.1 of the IANUS project. The term "historical" denotes that the case studies include an aspect of longitudinal analysis of the public opinion of the STI in question, in order to analyse trends in public opinion over time, and cross-examine them through overlays of specific events that may have impacted the public opinion (e.g., public health scares, news stories, scientific of technical breakthroughs, or accidents related to an STI). While it was initially hoped that

such a time-resolved, longitudinal analysis could be conducted based on historical survey data, such as that of the Eurobarometer, the T2.3 team found that no single STI was sufficiently well identified and tracked in public opinion polls to provide data for a reliable quantitative longitudinal analyses. The historical case studies are therefore largely focused on qualitative analyses, based on the collation of the relevant public opinion data.

The historical case studies focused on the following topics in STI:

- Climate Science & Climate Change (provided by RU)
- Genome Modification & Genome Editing (provided by LSE and AIST)
- Artificial intelligence in Social Media (Algorithms) (provided by AUTH)
- Nanotechnology (provided by LSE)

4.2 Results

For each STI topic of the historical case studies, relevant public opinion data were assembled and analysed. Before reporting STI-specific findings, findings from the Wellcome Trust Global Monitors (Wellcome GMS) for 2018 and 2020 are presented. These have the advantage of questions arising out of theories and concepts of the processes of trust and distrust. In particular the questions capture the three expectations underlying trust as theorised by Barber (1983). Briefly, these are value compatibility, competence and fiduciary responsibility, meaning that the trustor believes that the trustee shares their values, is competent and will act in the interest of others and not themselves.

The majority of the Wellcome GMS questions have five response alternatives. Here is a question and the possible responses: “How much do you trust scientists in this country?”; A lot, some, not much, not at all, and don’t know. From these responses an index of a trust surplus or a trust deficit is computed. For each country we combine the percentages of respondents saying ‘a lot’ or ‘some’ trust and subtract from this trust total the combined percentages of saying ‘not a lot’ or ‘not at all’ trust’. A positive score indicates that there is more trust than distrust – a trust surplus, while a negative score shows there is more distrust than trust – a trust deficit. A large positive number shows widespread trust in the target; equally a high negative number shows widespread distrust.

From the 2020 Wellcome GMS substantial trust surpluses are found for all EU Member states plus Switzerland, Norway, Iceland and the United Kingdom for science, scientists in this country, the trust of scientific findings and the commitment of scientists to the public interest. Responses to questions about the national government and journalists, key organisations in the scientific ecosystem paint a contrasting picture. In eleven EU Member States there is a trust deficit for the national government. For journalists, four Member States have trust deficits and a further eight have very modest trust surpluses.

The Wellcome GMS 2018 provides more granular assessments of trust with questions concerning scientists in universities and colleges and separately ‘do their work with the intention of benefiting the public’. The former have a trust surplus at the EU aggregate level of 67, and for the latter – scientists working in companies there is a lower trust surplus of 40. In neither case is any EU country registering a trust deficit.

Further questions concern trust in sources of advice on medical/health issues. Here the targets are the national government and those employed in the medical world. The latter carry a substantial trust surplus of 82, while government reaches 42. Note that the finding of lower trust in government precedes the Covid-19 pandemic. Whether this generalises to any scientific issues is open to question.

Overall, the Wellcome Global Monitors of 2018 and 2022 depict science as meeting Barber's expectations for trust – value compatibility, technical competence and fiduciary responsibility. However, across Europe there are mixed opinions about trust in national governments, in governments' advice on medical and health issues and in journalists.

The historical case studies to be reported in T4.1 capture some of the specific issues that affect public trust and may under-mine it. Concerns about artificial intelligence include the opaqueness of algorithms, the loss of personal agency, the misuse of personal data and fears of surveillance and manipulation, at variance with more or less all the key requirements of the EU's HLEG (High-Level Expert Group on Artificial Intelligence) guidelines. Genome-edited crops and plants attract more support than the GMOs of the 1990s but on the condition that they offer societal and/or sustainability benefits. Public concerns centre on unintended consequences, the use of genome editing for animals, and many expect to see labelling to support consumer choice. Curative genome editing, i.e. bringing those with health issues back to a 'normal' functioning, attracts support but enhancement beyond the normal is rejected. At a more general level, three issues of significance emerge: the legacy of past controversies; the globalisation of risks; and the slow pace of regulation.

The development of genome edited plants and crops, so-called precision breeding, receives qualified support in a number of countries. That support is conditional on there being benefits to people and/or society. By implication if the only beneficiaries are of a commercial nature, that would be unacceptable. Such a position reflects the legacy of years of controversy over genetically modified crops which, in failing to deliver consumer benefits, gave putative risks more salience.

Artificial intelligence, human genome editing, and climate change share a common feature; they pose risks at the global level. Regulatory responses by a single government may be applauded but are unlikely to protect their public. In the absence of global agreements on risk mitigation, global society will be exposed to risk. Calls have been made for a global agreement restricting human heritable genome editing, but the history of the International Panel on Climate Change shows just how difficult it is to reach an effective global consensus.

Both transgenics and nanotechnology were described as base technologies that would introduce widespread beneficial innovations in many areas of life. In Europe, transgenics has been the object of considerable controversy from the mid 1990s to the present day including a recent ruling by the CJEU – Europe's supreme court. By contrast, while those involved in the development of nanotechnologies were fearful of hostility from sections of the public, it turned out, and continues to be, a non-issue. A significant difference between the trajectory of these two technologies is that the regulation of nanotechnology anticipated its development. By contrast the regulatory lacuna for GMOs fed media and public interest prompting negative views, images of Faust and

Frankenstein. Popular resistance to GMOs was shown to be related to the absence of benefits to individuals and society, paralleled by NGOs painting a fear of the unknown risk narrative.

4.3 Take home messages/highlights

1. *The (historical) case studies show that trust in science is heavily influenced by both engrained, long-term cultural context, as well as short-lived political trends*. The historical case study on genome editing, artificial intelligence and climate change shared the common feature that, on the one hand, there was widespread concern expressed by scientists and sections of the public that regulation was necessary to mitigate short- and long-term risks, while, -on the other hand, regulation at the national or even the European levels would not protect the public of the global risks emerging from these three technologies. In the absence of global risk governance actions by individual or regional governments would fail to protect the public.

2. *Trust or distrust in science is sometimes overlaid by the more overarching notion of trust or distrust in governments or 'experts' in general*, as science and scientists are either directly 'used' by policy-makers to justify specific decisions, or indirectly implicated in that they are perceived as being part of an elitist club of few decision makers.

   This is not a balance that is purely influenced by two factors, though, since the media, too can play an important role on how trust/distrust in science and governments can be distributed in any one surveyed group of people: for most surveyed groups, the declared trust/distrust in science/scientists adheres to a similar distribution pattern to the simultaneously declared trust/distrust in the responsible government; surveyed groups of people that do not adhere to this pattern form interesting cases that can often be related to special role of the media. This phenomenon needs to be more closely studied, however.

5. Science communication - state of the art (T2.4)

T2.4 *Science communication: the state of the art* [RU, CEUT, UNIROMA1, RCL] (M1-M14)

Science communication (SciComm) is a broad and evolving field that includes diverse encounters of diverse publics with science or scientific issues. Using desk research and argumentation, T2.4 produced an overview of contemporary approaches to SciComm and a critical analysis of the relation between SciComm and trust in science. As such, it contributes to a shared understanding of the state-of-the art of SciComm for all project partners. More importantly, Task 2.4 furthers one of the core IANUS objectives, i.e., to evaluate a number of frequently repeated assumptions about trust in science.

This section outlines the different findings of T2.4. Below you can find an overview of the three sections of the internal deliverable 2.4 (cf. subsection *Overview*) as well as a summary of the analysis of our findings (cf. subsection *Analysis*).

5.1 Overview

In Section 1, we offer a short overview of the field of SciComm, as generated by means of a (traditional) literature review. We provide a brief introduction to the notion of SciComm, an extensive overview of different models of SciComm and a compilation of motives and objectives typically attributed to SciComm. Our overview of paradigm shifts in SciComm reveals that these shifts were partially motivated by an assumed trust deficit. Our compilation of the frequently attributed goals of SciComm further testifies that promoting or repairing trust is an expected outcome of SciComm and a strong motivation to engage in it. The scene thus having been set, the remainder of the internal deliverable 2.4 critically examines this trust objective.

Section 2 looks into SciComm as a proxy for trust in science. The emphasis is on SciComm as a mediated communication activity, the credibility of which affects the credibility of science. We also conclude that the credibility of a communication activity is affected by all its constituent elements. This includes the source and audience of a SciComm initiative, the channel or format used, the content of the message, and the context in which the SciComm initiative occurs. Having showcased the diversity of factors at work, we recommend some caution towards the aspiration to *design* a communication for trust. Thinking of SciComm as *mediating* one's relation to science also highlighted the role of trust intermediaries, such as journalists or social media. We therefore stress that present discussions on trust in science and SciComm must acknowledge the social context of a highly digitised and networked society.

Section 3 takes a critical look into the widespread assumption that SciComm should foster trust in science. We search for the limitations of SciComm as a trust repair mechanism and for possible adverse effects of a deliberate effort to foster trust. Two conceptual limitations and three negative implications of the trust objective of SciComm are discussed in more detail in the following subsection.

5.2 Analysis

When SciComm involves the communication of scientific information, two conceptual limitations emerge. Firstly, instilling trust by means of dissemination is *contradictory*, for trust involves an incapacity to evaluate information independently. This aligns with a general preference for participatory forms of SciComm. Secondly, reducing distrust by means of dissemination is *paradoxical*, for distrustful audiences already have a negative disposition toward the communicator, whose perceived lack of credibility will affect the credibility of the communicated context. Therefore, situations of distrust will require trust repair mechanisms other than or in addition to SciComm, while a departure from a continuous appeal to trust may be advisable.

Three negative implications of the trust objective of SciComm were discussed in detail. First, a trust objective *corroborates* a trust deficit. Yet, sustaining a rhetoric of deficits may prevent the scientific community from reflecting about their own role in the trust relationship. A focus on "replenishing" trust may also divert from valuable opportunities for mutual learning. Second, a trust objective *indiscriminately* promotes trust. It fails to distinguish between excessive trust (undesirable), scepticism (desirable but not stimulated) and unwarranted distrust (undesirable but not countered properly). This results in missed opportunities to develop appropriate and societally relevant SciComm interventions. Third, a trust objective is a potentially untrustworthy motive, for it can be perceived as *self-serving*, *persuasive*, and *promotional*. The question of who benefits from an effort to foster trust in science is relevant, while the possibility of an internal conflict of interest must be reflected upon. Furthermore, if a SciComm initiative has a promotional or persuasive dimension, then it should be conducted ethically.

While critical, our analysis does not conclude that SciComm is not worth-pursuing or that SciComm cannot contribute to a trustful relation between science and society. Rather, we call for more reflection by scientists and SciComm initiators about their motives and desired outcomes, when aspiring to promote trust in science. What is the trust issue at hand? Is more trust the proper resolution to the situation? Why do we aspire to promote trust in science in the first place? What is our ideal trustful relationship with society? As the IANUS scholars are directly involved in an institutionalised research effort to foster trust in science, these questions are pertinent to our practice too.

5.3 Take home messages/highlights

- SciComm is a broad and evolving field that includes diverse encounters of publics with science or scientific issues. These encounters are often but not always initiated by scientists or science communicators.
- SciComm theory and practice have undergone a noticeable shift towards more dialogical and participatory modes of engagement. The deficit mode of SciComm is considered defunct, largely due to its failure to secure public support for science.
- Effective and credible communication of scientific issues remains relevant, e.g., as an enabling factor for participation. Besides, publics continue to encounter science in various outlets, including mainstream and online media.
- SciComm is unavoidably entangled with trust in science. A presumed trust deficit has motivated reforms and innovations in SciComm while SciComm is frequently attributed with the explicit objective to foster trust in science.

- SciComm is often understood as a proxy for trust in science: for many citizens, science is only accessed indirectly. In practice, this often introduces an extra intermediary in the trust relationship, the credibility of which will affect the credibility of science.
- In the case of social media, their role as an intermediary and their impact on the trust relation deserve close consideration. Present discussions on trust in science and SciComm must acknowledge the social context of a highly digitised and networked society.
- SciComm is a mediated communication the effectiveness and credibility of which is affected by all its constituent elements. Well-crafted communications that are tailored to their audiences and context are essential but may not suffice for building trustful relations or may not address all trust issues at hand.
- The trust objective of SciComm has conceptual and normative limits. This challenges the widespread assumption that SciComm should deliberately strive to foster trust in science.
- When SciComm involves the communication of scientific information, two conceptual considerations emerge: instilling trust by means of dissemination is contradictory for trust involves an incapacity to evaluate information independently; reducing distrust by means of dissemination is paradoxical for distrustful audiences will already have a negative disposition toward the communicator, whose perceived lack of credibility will affect the credibility of the communicated content.
- Three normative considerations were identified and examined in depth: the trust objective corroborates a trust deficit; the trust objective indiscriminately promotes trust; the trust objective is a potentially untrustworthy motive for it can be perceived as self-serving, persuasive, or promotional.
- The limits of SciComm as a trust repair mechanism necessitate a discriminative approach to trust, i.e., one that differentiates between trust and distrust and between warranted and unwarranted expressions of trust or distrust. Awareness of and attentiveness to these distinctions should result in more effective SciComm interventions that prevent excessive trust, promote critical thinking, or properly counter distrust.
- The limits of SciComm as a trust repair mechanism necessitate reflection by the scientific and SciComm community about the motives and desired outcomes of SciComm efforts to promote trust in science. The possibility of an internal conflict of interest, in particular, should be reflected upon. Moreover, this process of reflection should include a consideration of whether there are, in fact, lessons to be learned from a public's withholding or withdrawal of trust.

6. Stakeholder consultation (T2.5)

T2.5: *Stakeholder consultation* [AIST, RU, KIT (& LSE)] (M1-M14)

The IANUS team of T2.5 received support from LSE. The team organised three consecutive workshops (i.e. Workshop I and Workshop II as in-person workshops, Workshop III as an online workshop), in order to identify and consult a diverse group of 8 to 12 (attendance varying per workshop and timeslot, following availability) societal experts (prominent stakeholder representatives, cf. Box 1); the stakeholder attendance varied slightly during the three workshops, providing opportunities to critically review the interim results of the previous workshops and adding aspects to their discussion, without having to repeat the organisational details, aims and objectives. Aiming to map the landscape of trust in science and its underlying forces and attractors, the team ensured a strong connection to both the (historical) case studies investigated in WP4, and to the qualitative and semi-quantitative survey-analyses of T2.3.

BOX 1: Overview of the backgrounds, work context and research themes of the expert stakeholders attending the three T2.5 workshops.

Diversity of science backgrounds:

- physics, synthetic biology, computer sciences, biomedicine, chemistry

Contexts of the stakeholders' work:

- biosafety research, philosophy of technology, science journalism & science communication, ethics, public engagement, STS, social psychology

Diversity of the stakeholders' research themes:

- epistemic corruption
- contested expertise
- psychology of science communication
- stakeholder interactions
- safety by design
- science and public policy (responsible innovation, co-creation, open science)

Workshop I was organised as a 'cooperative discourse'-debate, for which an 'Agent Trust'- and an 'Agent Distrust'-group were first allowed to slip into and identify with their chosen roles and sides in the debate, and then challenged to hold the debate with the opposing group true to their agency.

The debate showed that it was a lot more difficult for the 'Agent Trust'-group to defend its position; this was assumed to be an effect of the offset that all participants are always also sceptical individuals, while very few had the expertise to simulate emotive responses to questions of distrust as these exist in society. Moreover, scientists consider 'healthy scepticism' a positive aspect of science, while non-scientists regard any form of scepticism or distrust as a negative aspect. This misunderstanding was found to sit at the heart of the sometimes perceived impossible communication between those who defend trust in science and those, who vehemently distrust science/scientists.

Workshop II aimed to look at the topic of trust and distrust in science in light of three specific scenarios, based on the (historical) case studies that are to be further investigated in WP4, and that were used for the analyses in T2.3. It was noted by the discussion that 'trust' could be understood as a default state, while 'distrust' is the outcome of a learning process or an experience that moves the original trustee away from fully trusting; the result can be a total distrust, or a case-specific distrust. In this context, it was suggested that it might be better to talk about 'confidence', instead of trust.

An important outcome of Workshop II was that scientists, too, have values and intentions, and that these need to be made more transparent (together with those values and intentions of the media reporting on science).

It was acknowledged that science (as a discipline) had both fostered the discussion on trust/distrust in science, and inadvertently allowed triggers for mistrust to occur (e.g. overclaiming of impacts, identifications of rogue scientists); although scientists themselves often defend the occurrence of triggers for mis-/dis-trust in science as a proof that the inbuilt self-control mechanism of science was working, the public discussion of such cases had obtained its very own dynamic, and was now used by some vehement critics against science and scientists themselves. It was recognised that an increasing politicisation of public debates and the news and messages fed into them had caused the discussion to become more polarised and hardened; in recent times, and increasingly during the enforcement of COVID-19 prevention measures, such politicised and polarised arguments had fuelled demonstrations and sometimes lead to physical violence (against scientific institutions and individual scientists).

Quotes:

> *There is an important tendency to already ignore the 2 percent of the population who radically distrust science.*
>
> *Distrust in government might be closely related to distrust in science, seen the way science is used by political actors.*
>
> *Weaponisation of science as a political instrument: it is used very much to differentiate between different political positions.*

It was acknowledged that science communication had become much better in recent years, but that the deficit model still too often prevailed.

The meeting discussed the concept of the 'deficit model' and agreed that 'bridging the knowledge gap' is useful, but certainly not the only necessary action that will ultimately foster trust in science.

Instead of this rather ‘absolute’ approach, one should think of the requirements that lead to **trust in science as a broadening of the toolset**. It was that it was especially difficult to **communicate (scientific) uncertainties**, without losing trust even further.

Quotes:

> *Whether people understand science holds no relation to whether people trust or distrust science.*
>
> *Whether people are better informed about science also holds no relation to whether people trust or distrust science*

The workshop discussions stressed that the psychological factors (incl. political orientation/ideology) needed to be better understood, since these determined how people respond to specific information. The role and ‘unity’ of ‘the public’ was questioned: ’30 years ago, there had been such a thing as ‘a public sphere’; today, however, not least social media has distorted that (perceived) homogeneity. It was noted that ‘distrust in science’ used to be a left-wing thing (in the ‘60s and ‘70s (largely based on dual-use concerns)), while today, it is associated with conservative and ‘right’ political orientations.

Workshop III aimed to review the intermediate results of the first two workshops, namely the conditions that are conducive to trust in STI (Science, Technology and Innovation) and the contemporary threats leading to a lack of, or even distrust, in STI. The workshop also provided an opportunity to add missing issues and aspects to the discussion.

6.1 Take home messages/highlights

1. *It is a lot more difficult to defend a position of trust in a debate than to argue in favour of distrust*; this was assumed to be an effect of the offset that all participants are always also sceptical individuals, while very few were trained as scientists and communication experts that could answer emotive questions of distrust.
2. *The very discussion of the concept of ‘trust in science’ itself creates a distance between scientists and non-scientists*, thereby enhancing the polarisation of a debate, before it even starts: scientists consider ‘healthy scepticism’ a positive aspect of science, while non-scientists regarded any form of scepticism or distrust as a negative aspect. This misunderstanding was found to sit at the heart of the sometimes perceived impossible communication between those who defend trust in science and those, who vehemently distrust science/scientists.
3. *All the evidence shows that there is confidence and trust in science and scientists*. The Mertonian description of the ethos of the scientific enterprise is subject to challenges in contemporary times. The IANUS Expert Workshop discussions highlighted some of these challenges.

Suggestions for further research:

- Recognise that the trust issue is the outcome of contemporary systemic limitations in politics, governance and science.
- Investigate specific examples of STIs and identify the common denominators of success and failure.
- Are there lessons from the AAAS Science Scholarship Scheme (https://www.aaas.org/fellowships)?

7. Conclusion

The topic of public trust in science appears to be high on the agenda for many different stakeholders. The analyses of project outcomes, academic literature, specific historical cases, experiences in science communication and the knowledge and experience of expert stakeholders enables convergence of extant knowledge and experience for the project's future endeavours. The overview generated by WP2 addressed previous projects, their successes and hurdles, as well as the concepts, frameworks and the methods they developed, traceable through relevant academic publications.

WP 2 provided for a comprehensive analysis of the research and policy landscape. The different tasks under WP2 were timed in such a way that the results yielded can serve as a strong basis for the further efforts of the IANUS project. WP2 approached its analysis from multiple angles, and with a variety of methodologies. These included desk research of academic and policy literature, analyses of policy documents, analyses of surveys and workshops. Apart from these, input was generated through a number of project internal meetings, live as well as online. Collaborations were forged between institutes and organisations with different, complementary expertise and networks, thus furthering the evolution of the different tasks under WP2. These collaborations also contribute to productive interactions across WPs.

Deliverable 2.1 provides for an integrative comprehensive overview of what has been achieved so far, in combination with involvement of representatives from other projects. Deliverable 2.1 is the result of an analysis of previous and ongoing projects and research on the topic of 'trust in science'. D2.1 serves to avoid overlaps with extant research in past and ongoing projects, as well as determining gaps or under-represented areas, questions and topics related to trust in science. The resulting analyses and insights form a basis for the work conducted specifically in WP 4 and 5, but also in other WPs in the IANUS project. An option for a direct pathway between WP2 and WP4 emerged through the use of historical case studies, while WP2 work further transpired in unplanned but productive connections across tasks and WPs. Consider for example the investigation of research misconduct in T2.1, T2.2 and T5.3, the concerns about the role of social media explored by both T2.1 and T2.4, or the call for a discriminant approach to trust in both T2.4 and T3.1. Next, the relevance of WP2 findings for policy is currently being investigated in collaboration with WP6; among others, findings that relate trust in science to a broader societal context (cf. T2.3, T2.5) are worth highlighting. Although each WP2 task produced a separate, dedicated and extensive internal deliverable, this report summarised the efforts of the tasks under WP2 in a comprehensive manner for wider communication and dissemination.

References

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