PRO-RES

Deliverable 6.2

Validation of the demands of the civil society in terms of tools to restore confidence in the knowledge economy : an analysis of existing data and map of market's expectations/comprehension in terms of research results misuse avoidance strategies of practices, considering the level of observation of the latter (Macro/Meso/Micro level and granularity.

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I. Context and methodology

The context of the second phase of the study carried out within ProRes was to validate the demands of the civil society in terms of tools to restore confidence in the knowledge economy.
As a reminder, during the previous phase, these new tools were technically delimited both in their form (from the analytical report to the rating system) and in their substance (the actors involved). The main conclusions of this approach are synthesised in the infographics (Figure 1).

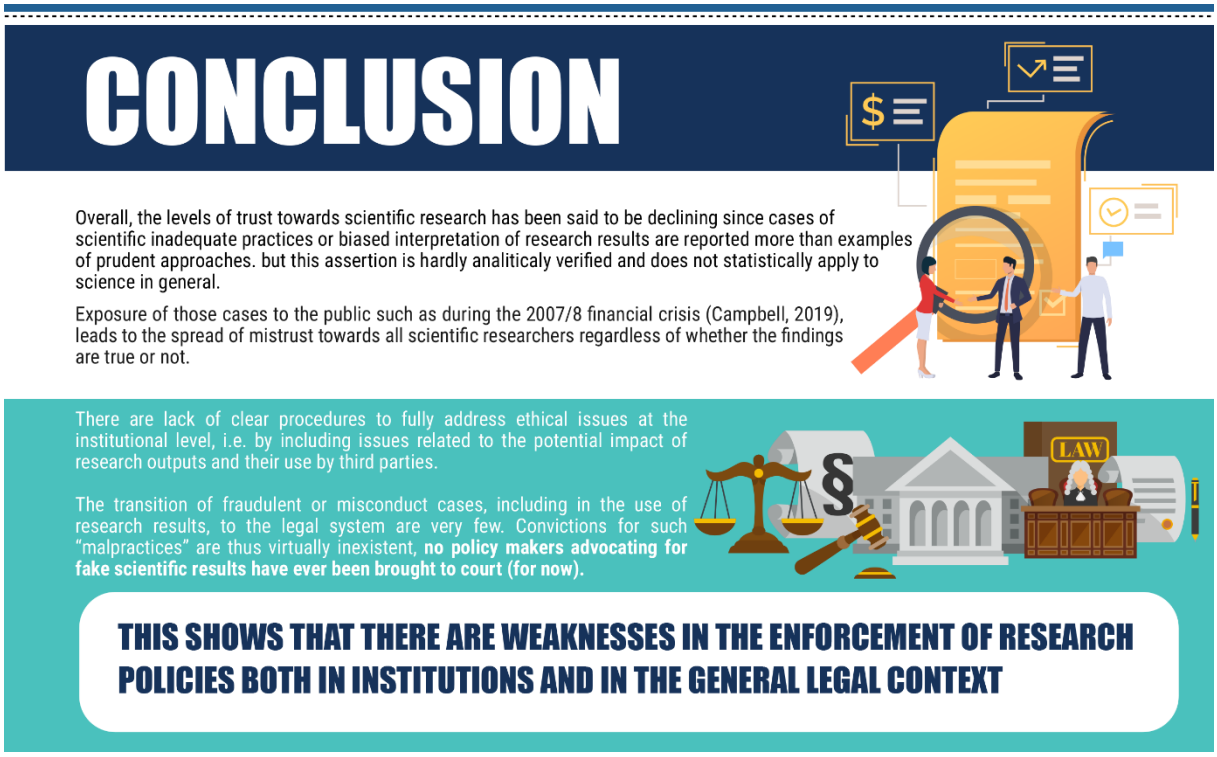


Figure 1 : reminder of the main conclusions of D.1

THE ISSUE OF TRUST ALSO ARISES AS A RESULT OF SOCIETAL DEMANDS.

Countries compete to obtain positions in international rankings as this is paramount to their attractiveness and competitiveness.
To do this, it is necessary to mass publish (global scientific output doubles every nine years, Van Noorden 2014) which is known to have serious issues on research outputs quality (Altbach & de Wit, 2018)

Some of the plausible interventions suggested as a response to ethical failures in the treatment of Research results include :

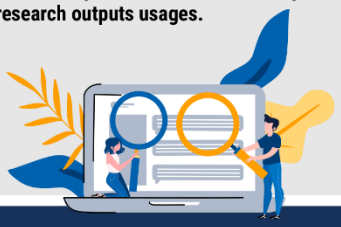
- Whistleblowing,
- The establishment of ethical guidelines,
- The creation of robust governance structures.

Whistleblowing by individuals involved in the research framework brings attention to problems before findings are put to any application, thus reducing the likelihood of mistrust in the general public.
However, the method has a weakness : there is the risk that such actions might adversely affect the WB career & personal life. or that reason, some choose not to speak out.

In the context of the establishment of **ethical guidelines**, clearly defined policies are essential in giving instructions to all actors of the research chain in terms of how findings should be treated. However, the principal limit of guidelines is that:
=> most of them **do not cover the issue of research outside the institution (impact of research use)** or even establish sanctions in the event of fraudulent communication.
In the recent case of a deliberately misleading interpretation of climate change by a radio host, NASA did not even ask for a right of reply, allowing fanciful interpretations to flourish on the subject.

=> most institutions poorly implement them leading to adverse practices, which lead to distrust.

There are no properly defined governance structures to regulate at **supra-national level research policies and most importantly research outputs usages.**



Notwithstanding all these situations, which harm the world of research more than science itself, it is perhaps also in the fact that the knowledge industry is not statistically approached in its entirety that the problems of trust in the scientific ecosystem are nested.
Our case study thus shows that the problem of trust also arises with regard to the transmission of knowledge, which constitutes nother important aspect of academic activity

AS SUCH, IT MIGHT BE WITHIN THE LIMITS OF THE CURRENT SITUATION THAT MAY ALREADY REST THE FIRST STEPS TOWARDS A SOLUTION. THREE RECOMMENDATIONS COULD THUS BE MADE

- consider the "knowledge industry" as a whole when analysing situations and attempting to provide solutions,

- extend to the use - in particular for policy-making purposes - of research results, the operating rules already applied to make such investigative processes transparent, by providing for systematic procedures in the event of misuse of research outputs (in particular for post-truth cases), which would be all the simpler as the rules already exist (public corrigendum, etc.),

- set up a recommendation tool rating the trust that can be placed in a given research governance and results use process, based on objective criteria, such as the ethical ratings set up by VigeoEiris.

BUT FOR THIS TO BE EFFECTIVELY IMPLEMENTED, IT NEEDS TO BE TAKEN OVER BY THE RESEARCH ECOSYSTEM, WHICH WILL BE EXPLORED WITHIN THE PROJECT.

In this new phase, it was therefore up to us to test the acceptance potential of our different proposals. To do this, we constructed a step-by-step survey whose the objective was to identify the following:

- ✓ what stakeholders and the civil society understood to be the knowledge economy

- ✓ what stakeholders and the civil society understood to be the components of the knowledge economy
- ✓ the trust placed in the various players making up the knowledge economy
- ✓ the perimeter of the lack of trust
- ✓ methodologies and tools for rebuilding trust and confidence
- ✓ adherence to these solutions.

Our survey was deliberately designed to be brief (yet precise in its logic and title). Indeed, the literature suggests that a better response rate is achieved with a short survey (Sahlqvist et al., 2011), although this is discussed in the medical field where participant's (patient) interest in perimeter information sometimes overrides brevity. However, this is a peculiarity that can only be seen in the medical field (Lund & Gram, 1998), which is precisely what ProRes does not do.

In addition, we designed our survey in both English and French to cover a broad linguistic scope. If we develop our analysis further, we will deploy the questionnaire in Spanish and German. There is therefore bias in our approach since, according to Eurostat, only 54% of Europeans speak a language other than their mother tongue (Eurobarometer, 2017). We have taken this situation into account in the analysis of our results. Annexed to the present document are the surveys in French and English. A public preview of the questionnaires is available in following the weblink below.

https://survey.zohopublic.eu/public_preview/OTcyZDFiNTUtYmQ5OC00YmI3LTk2MGYtZjI0NjlmMTcyZGU4. To visualize the different survey pages, please access them page by page through the selection menu at the top right of the page (Figure 2 below).

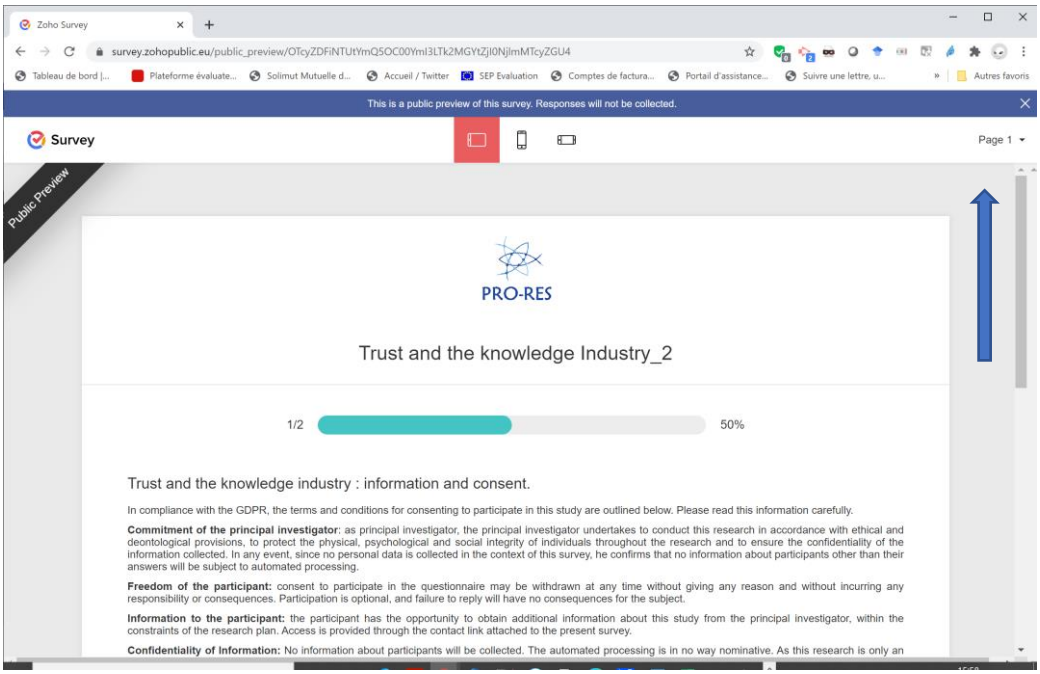


Figure 2 Survey Public Preview

I.1 Sample metrics: population, size.

When it comes to measuring global adherence to societal solutions, it seemed important to us to try to reach not specialists in the field (i.e., for example, researchers alone) but the entire European population of not only the member states countries but also third parties countries (such as the UK or Israel) whose activity may be in one way or another impacted by the

knowledge economy. Moreover, we have chosen to reach only those populations least likely to be influenced by their ecosystems, whether because they are too young (Fisher, 2005) or too old (Comijs, Dik, Deeg & Jonker, 2004).

Our semi-randomized cohort thus comprised 1688 adults of age, with an annual household income of 20,000 Euros or more, of whom 596 come from France, 550 from Germany and 542 from other member countries. This over-representation in relation to the population of the latter two countries has been weighted so that the results from each member country have the same relative weight as their population.

It should also be noted that the response rate to our surveys was 87.61% (1688 invitations issued; 1479 replies received). To avoid various societal biases, we've chosen not to go further in the specifics of our panel.

Our sample size – the number of complete responses received for our survey, i.e., the portion of our target population whose opinions on remediation tools to enhance trust in the knowledge society is 1479.

This was calculated to fit our need for adequacy according to the European population level (513 500 000 –Eurostat, 2019), out of which our voluntary outliers were deducted (population under 18, that is 102 905 400 individuals and population over 75, that is 56 844 450 individuals). Hence our population size N was of 353 750 150 individuals.

To reflect the opinion of this population with a margin of error of 3.5%, i.e., the positive and negative deviation between the opinions of our respondents and the opinion of the entire population within a 99% confidence level (how often our respondents lie within the boundaries of our margin of error), we had to be certain we were targeting the right amount.

Hence, to calculate what would be an acceptable sample volume, we used the well-known statistical sample size formula:

Equation 1: statistical sample size formula

$$\frac{\frac{z^2 * p(1-p)}{e^2}}{1 + (\frac{z^2 * p(1-p)}{e^2 N})}$$

For N = the population size

e = margin of error (percentage in decimal form) that is the percentage indicating how likely our survey results are to reflect the opinion of the overall population.

z = z-score, that is the number of standard deviations of a given proportion from the mean. This score is given in a pre-existing table ("Standard Normal z-table" commonly used to test hypothesis) according to the sought-for level of confidence. For the 99%, we request the score would thus be 2,58

p = the population proportion expressed in decimal in the context of a normal distribution (application of the CLT or central limit theorem that implies that when independent random variables are added in given situations, their normalized sum tends toward a normal distribution even if the original variables themselves are not normally distributed. As a common prerequisite, we ignored the ^p (hat p) noise.

In the end, the minimal requested sample was of 1359 individuals which were covered by the sample detailed above.

I.2 Delivery process.

As always, the distribution of the questionnaire was the longest and the most complex stage of this new phase of research. In a first iteration, we used the "usual" distribution channels (networks, database of alumni) with a nearly negligible result despite the given response time (1 month and two reminders by emailing). Given the lack of statistically viable returns (it must be remembered that we needed more than 1300 responses), we used social pooling tools (SurveyCircle, etc.) which proved to be just as inadequate for us in the collection of statistically viable responses. In the end, we chose to distribute the survey through professional panelists who allowed us to complete a second iteration in a few weeks and thus validate our observations (subject to the different weightings mentioned in this document) in a statistically convincing manner. These panelists are on the one hand ZohoSurvey (https://survey.zoho.eu/) and on the other, Prolific (https://app.prolific.co/).

I.3 Raw data collection and preparation: data splitting.

Our data was collected in both text and numeric (for rankings) formats. For consistency and analysis ease, we proceeded to preparation work (data prep.) on the dataset which consisted of:

- ✓ transforming all the text strings into numerical strings using equivalences,
- ✓ splitting the strings into single values for analysis purposes (especially in the context of multiple responses).

A python DF. Function was created to convert all values into numbers (see below) and apply to the set. All splitting operations were done using Python standard functions split().

Values associated with each result for questions 1 to 3 are listed below in Table 1. Of note, question 4 is a ranking from 0 to 5, 0 standing for the absence of an answer, 1 for the lowest confidence level and 5 the highest. Furthermore, we have integrated the possibility of not answering questions that result in a 0 in the data frames.

Table 1 Numerical equivalences to Txt strings Q 1 to 3

Text results	Numerical value
Has not answered	0
Industrial research alone	1
Innovation in general	2
Education (higher education & vocational training)	3
End-users of research and innovation outputs & results	4
Research at the university (academic research)	5
Lobbyists	6

Table 2 Numerical equivalences to Txt strings question 5.

Text results	Numerical value
The researchers,	11
Teachers & trainers	12
Innovative project leaders	13
Public research & innovation policymakers (ministries, research organisations)	14
Private research & innovation principals financers	15
Private financers	16
Public financers	17
The users/end-users of research and innovation who may misuse their outputs/results	18

Table 3 Numerical equivalences to Txt strings question 6

Text Results	Numerical value
More transparency in the processes of establishing public research and innovation policies	21
More transparency in the use of research & innovation results	22
More transparency in companies' research programmes	23
Tools for rating transparency in research & innovation	24
Evaluation and scoring tools to establish the care given to the potential uses of research & innovation	25
A dedicated law	26

Table 4 Numerical equivalences to Txt strings question 7

Text results	Numerical value
A focus on funders	31
A focus on the existence of controversies in the given domain	32
A focus on the raw data used to establish the facts and their origin	33
A focus on which the research has been deployed	34
A focus on the care taken to identify possible misuses of the outputs/results (provided the definition of misuse is clear).	35

Table 5 Numerical equivalences to Txt strings question 8

Text results	Numerical value
An indicator with precise and transparent criteria,	41
A recommendation/rating system with precise and transparent criteria,	42
An annual report in an accurate and transparent form,	43
A financial document assessing the impact on the accounts/finances of a player in the knowledge-based economy of problems related to research and innovation,	44
An impact document in a precise and transparent form.	45

Table 6 Numerical equivalences to Txt strings question 9

Text results	Numerical value
To all organizations carrying out research and innovation	51
To all players in the knowledge industry	52
To the results/outputs of all research/innovation projects.	53

Table 7 Numerical equivalences to Txt strings question 10

Text results	Numerical value
It was used in the evaluation of projects,	61
It was used in project funding decisions: institutional decisions at the policy or corporate strategy levels for example,	62
It was used in the financial analysis of companies,	63
It was serving in judicial processes,	64
It was used in the evaluation of insurance premiums.	65

II. Results

II.1 Defining the understanding of the knowledge economy by stakeholders and the civil society.

II.1.1 Testing for bias

The first analysis focuses on the volumes of responses given by the participants to this original question. This approach is fundamental because it allows us to measure the tendency of participants to respond thoughtfully or unthinkingly. Thus, a too large a volume of systematically multiple answers is a potential sign of a backlash (Guess & Coppock, 2018), though not necessarily of a misunderstanding of the question itself (Couch, Hubbard & Brassil, 2018).

Table 8 Number of answers per respondents.

Respondents	Number of provided answer(s)	Graph Category
54	6 answers	1
96	5 answers	2
162	4 answers	3
307	3 answers	4
225	2 answers	4
457	1 answer	6
175	No answer	7

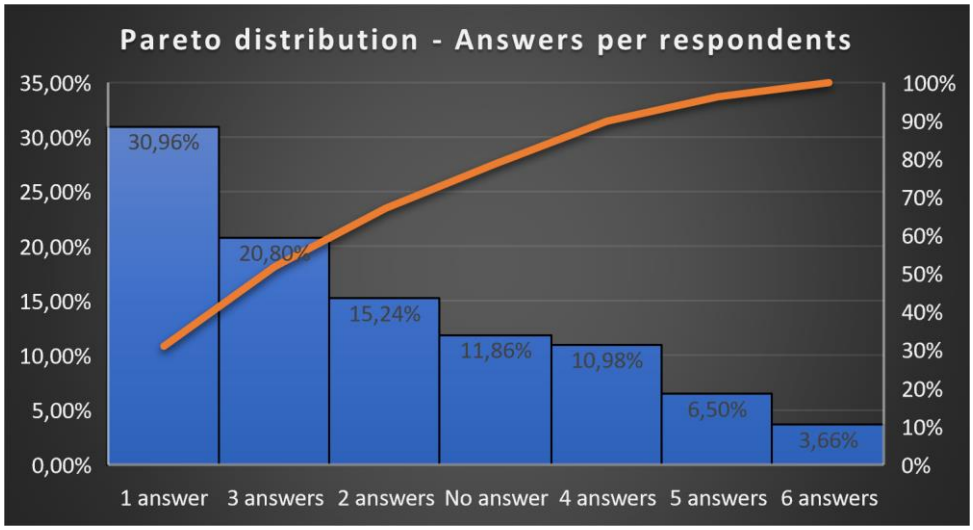


Figure 3 Pareto distribution - Answers per respondents

Table 8 above shows that most of the participants provided only one answer, but this is far from significant. If we apply a Pareto analysis (Figure 3) to this data, it becomes clear that most of the participants thoughtfully included up to 3 responses. As a reminder, the Pareto analysis is a technique used to identify the factors that have the greatest impact on a given result**.** Here we have thus a frequency of occurrence of one to three answers of more than the 2/3 rd of the respondents (average of 2,22 responses per respondent).

While this may indicate a vision with some form of limited granularity (which will need to be validated by a Gaussian analysis of the results, participants only considered 31.7% of the possibilities: Figure 3 does not give any indication as to the thematic approach of the participants in this case of their vision or whether or not their vision may be biased (Parry & Crossley, 1950).

We, therefore, set out to see whether the granularity (precision) of the results could be considered acceptable and whether the results did not favour one definition or approach over another.

In multiple-choice questionnaires, individuals tend to move quickly and instinctively towards the answers closest to them, and then gradually move away from this "comfort and comprehension zone". In this context, the response capacities are exhausted quickly, which is a first demonstration of the "sincerity" of the data collected (Meade & Craig, 2012). In this instance, as mentioned above, most of the participants confined themselves to three responses (when six were possible). We can therefore safely say that the data collected about the understanding of the knowledge economy are sincere and therefore usable. But while this approach can determine

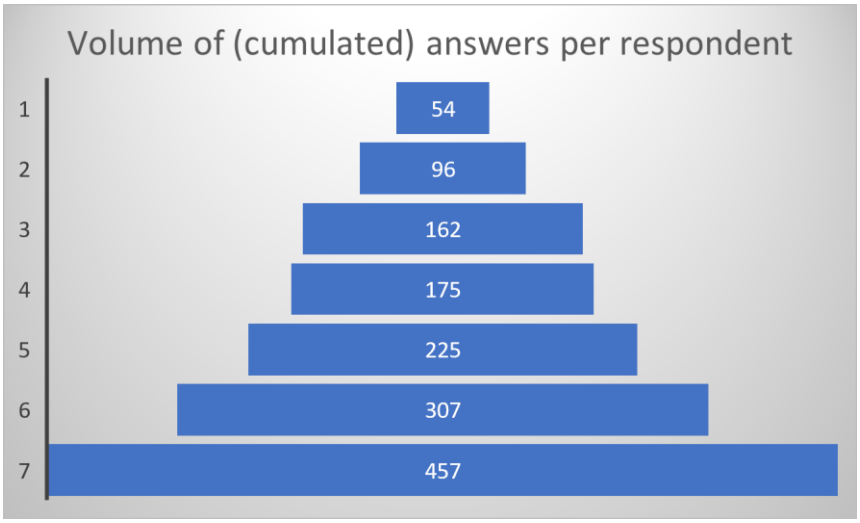


Figure 4 Volume of (grouped) answers per respondent

whether there is a deliberate bias in the way people respond, it says nothing about the influence potentially felt by the population, or whether each response influences the next.

We postulate that there is no inference, regardless of population, in favour of any one component of the knowledge economy. As such, on a given question, with identical populations, the answers will have to be analysed as random. In other words, the chances that, in an identical context, a respondent will provide the same answers in the same order are low. The risk of first instance alpha bias in the answers is therefore limited. If this was not the case, there would be a suspicion of presuppositions in the answers, on the one hand, and of interrelation between the answers, on the other (for each respondent, the answer given affects the next answer). Each pair of interrelationships was thus tested.

To do so, we used the existing statistical and data science tools and implemented state of the art python-based approach for this kind of needs. In compliance with the COVID-19 research charter and open-access science principles, the notebook, codes and data used are available on the dedicated deliverable Git that has been created to host all related information to ease access and use of the code(s) and datasets: https://github.com/TZoneProRes/ProResD2/projects (please copy and paste the address or you won't be able to access the files – a Git account is required to access the project).

This first analysis was conducted using P value and two-sided Ztesting. The Python scipy.stats package was used to implement calculations and analyse results. As a reminder, the P value, or calculated probability, is the probability of finding the more extreme (observed) results when the null hypothesis (H0) of a study question is true, the definition of 'extreme' being dependent on how the hypothesis is being tested. P is also described in terms of rejecting H0 when it is true.

The null hypothesis is a hypothesis postulating the equality of statistical parameters (generally, the mean or variance) of two samples assuming that they are taken from equivalent populations. It is always tested against an alternative hypothesis that postulates either a difference in the data (two-tailed test in this case) or an inequality (smaller than or larger than) between the data (one-tailed test). The use of the two-tailed test is standard practice as the only situation in which one-sided P value can be considered when a large change in an unexpected direction, which would have absolutely no relevance to our study. As detailed above, we wanted to test the link between respondents (population bias to test potential prejudices), the randomness in the answers and the absence of predetermined statistical trait (bias). In short, we tested if there were patterns when interrelating given answer codes and ranks. As such, the null hypothesis was supposed to be accepted.

The alternative hypothesis (H1) is the opposite of the null hypothesis. Put plainly, we wanted to investigate: the existence of bias. As explained above (and detailed in the code), our P value was above the chosen significance level ($P > 0.05$ to accept the Null hypothesis) so we accepted the null hypothesis for all instances i.e., accept that our sample gives reasonable evidence to reject the alternative hypothesis. Hence the existence of bias or interinfluences. As a reminder, the choice of significance level at which you reject or accept H0 is arbitrary. Conventionally the 5% (less than 1 in 20 chance of being wrong), 1% and 0.1% ($P < 0.05$, 0.01 and 0.001) levels have been used.

Table 9 P-value analysis general population

Round	Rank 1 answers vs Rank 2 answers	Rank 2 answers vs Rank 3 answers	Rank 3 answers vs Rank 4 answers	Rank 4 answers vs Rank 5 answers	Rank 5 answers vs Rank 6 answers
P Value	0.4391880196459126	0.5204801485704	0.17352262550757058	0.33313859608780555	0.4792925236077593

The term alpha significance level introduced in our hypothesis definition refers to a pre-chosen probability. This probability of type I error (that is the false rejection of the null hypothesis) appears to be rather non-existent as all our different runs confirm the acceptance. We indeed do have instances at the very extreme prism of the analysis, which is defined as very improbable “black swans” (Taleb, 2007). In other words, the probability of the appearance of a bias in the answers is very unlikely. At the same time, the probability that we accept a bias when there is none (Type II error) is also rather limited (power of a test, that is one minus the probability of type II error: beta) as all test iterations, whatever the sample taken, led to the same conclusions of absence of bias.

II.1.2 The knowledge environment viewed by European civil society.

Feedback on this first questioning brings a certain number of unanticipated results that should be commented on. First, while the knowledge society is defined above all, for most respondents, as having a strong link with innovation (767 occurrences), it is not this notion that is addressed at first sight. In fact, the participants mention first (and massively, as it is the answer most often cited by them in their first round of replies: 386 replies) the fact that the knowledge society is limited to industrial research. It was indeed this series of results that made us raise the question of biases that could taint the answers, biases that statistical analysis, as we have seen, has ruled out. However, this initial vision quickly fades during the following iterations in favour of a readjustment of the balance between academic and non-industrial research on the one hand, and research beneficiaries on the other (Table 10 below). The latter take fourth place in the overall responses (579 occurrences), even though after 386 "votes". The reference to industrial research no longer receives any votes in the following iterations.

Table 10 The knowledge environment viewed by European civil society.

Answers-types	Global	Round1	Round2	Round3	Round4	Round5	Round6
Lobbyists	196	63	10	14	24	31	54
Industrial research alone	386	386	0	0	0	0	0
End-users of research and innovation outputs & results	579	76	78	171	136	119	0
Education (higher education & vocational training)	608	56	162	239	152	0	0
Research at the university (academic research)	739	186	358	195	0	0	0
Innovation in general	767	534	236	0	0	0	0

It can therefore be said that, if instinctively the knowledge economy is understood as being rather in the business ecosystem, this is moving quite rapidly towards a vision that is less business-centred and more in a logic of general interest, highlighting the importance of the academic rationale, but also the fundamental importance to be given to the beneficiaries of knowledge (and not only in a logic of financial or economic value creation).

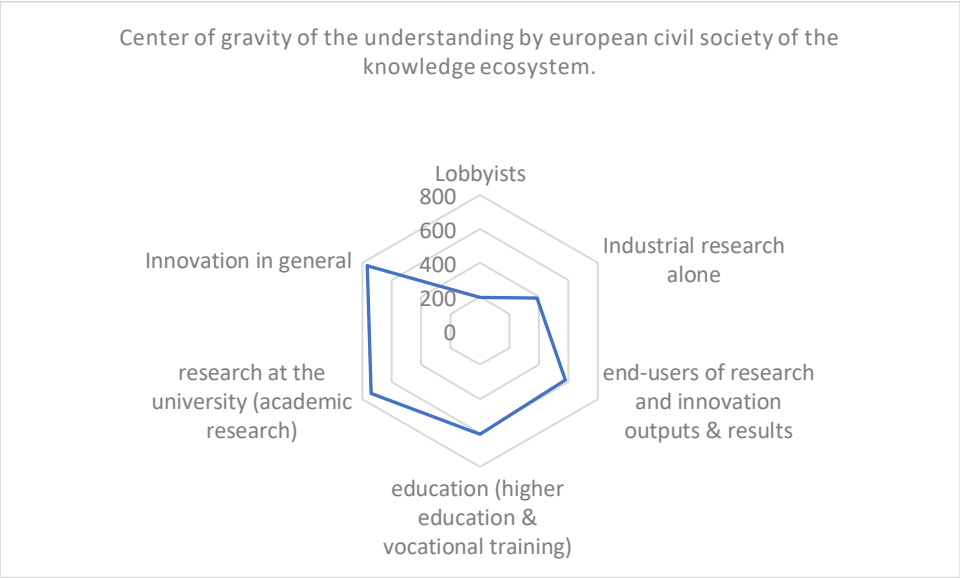


Figure 5 Center of gravity of the understanding by european civil society of the knowledge ecosystem.

The message sent here seems to indicate that the societal expectation towards the knowledge society is rather of general interest. Knowledge would be a common good that creates meaning rather than economic value (Möller & Svahn, 2006).

It is also interesting to note that the COVID crisis has reinforced this vision with a nuance of importance: the existence of a genuine tension between on the one hand, an idea of knowledge distorted by the business ecosystem and on the other, free knowledge carried by individuals (more than organisations) with proven scientific visions and recognition.

Synthesis section II.1

Stakeholders see the knowledge-based society as primarily the result of innovative approaches, regardless of the field, most promoted by the academic world, the sphere of education and the beneficiaries of this knowledge, with non-preponderant industrial research component and participation. Does this mean that industrial players are not perceived as innovative, or that they have little involvement in the strategic orientations underpinned by the rationale of knowledge creation? This remains to be verified. Influencers are not perceived as part of the innovation and knowledge ecosystem.

II.2 - The question of trust: knowledge economy and knowledge ecosystem, a fundamental distinction.

Literature abounds regarding the trust that civil society can have in science, or rather scientists (Brewer & Ley, 2013). However, more than with regard to an individual, it is the issue of institutions that question. In fact, the "scientist" as a person has more or less had the same level of approval over the last 30 years: around 2/3 of respondents in all surveys, from the old Eurombarometer 55.2 of 2001 to the more recent approaches available in Switzerland (Science Barometer Switzerland 2019), Germany (Science Barometer – A Representative Survey of German Citizens on Science and Research, 2017), Ireland (Science in Ireland, 2015) and a large number of European countries overall. While the institutions that carry the scientists are not in this configuration as our analyses show.

Anyhow, this confusion between the individual and his or her field in which research perseveres is in line with the question already raised long ago of the personification of the scientific approach (Campbell, 1975) which has been guiding the industry's rhetoric, including the management of its crises, particularly in terms of responsible research, for more than half a century. As noted in the DEFORM project, it is the individual alone (and not his or her environment) that often suffers from sanctions related to real or supposed breaches, without the intrinsic causes of such breaches being considered. This in no way excuses unwelcome, if not fraudulent, practices, but it may explain them and thus make it possible to prevent them by amending how they are approached or by putting in place processes to anticipate them. (Ashmawy, 2018).

It is in this lack of questioning of institutions that rely on individuals to avoid having to evolve (Zemba, Young & Morris, 2006) that we find the deep roots of the dichotomy. This is observed between the literature that insists on the continuity of trust in the scientist (the person) and his field (science), without addressing how domains and people fit into society, particularly through research organisations and dedicated ecosystems. It is at this precise level that the breakdown of trust is taking place – and has been for at least two decades (Millstone & Van Zwanenberg, 2000).

This proxy logic has given rise to paradoxical situations, as we witnessed during the recent Covid19 crisis where institutions were looked upon with mistrust, while full-fledged members of these institutions were selectively listened to with deference. The French case of Professor Raoult is emblematic in this respect. The latter is well established in the hospital ecosystem (he is PUPH at La Timone in Marseilles), yet he has not suffered from the population's growing lack of confidence in the institution of which he is a pillar (Ramli, 2019).

By focusing on the individual rather than the institution, even though failures often stem directly from its governance problems, the latter has sown the seeds of mistrust, particularly because permanence is no longer a concept accepted by stakeholders who are being called upon every day to comply with "changes" imposed in ever-increasing numbers (Clarke, 2015). In other words, by claiming to be immutable (or unchallengeable), institutions have sown the seeds of a lack of confidence in them (Araiza, 1997), which allows actors dependent on these organizations to position themselves in strong opposition to them, which only serves to increase doubts. Thus, this situation is symptomatic of a growing conflict between individual knowledge actors (scientists) who wish to be fully integrated into the knowledge ecosystem, without the filter of institutions, and the latter, which are determined to preserve their preponderance (figure 6 below).

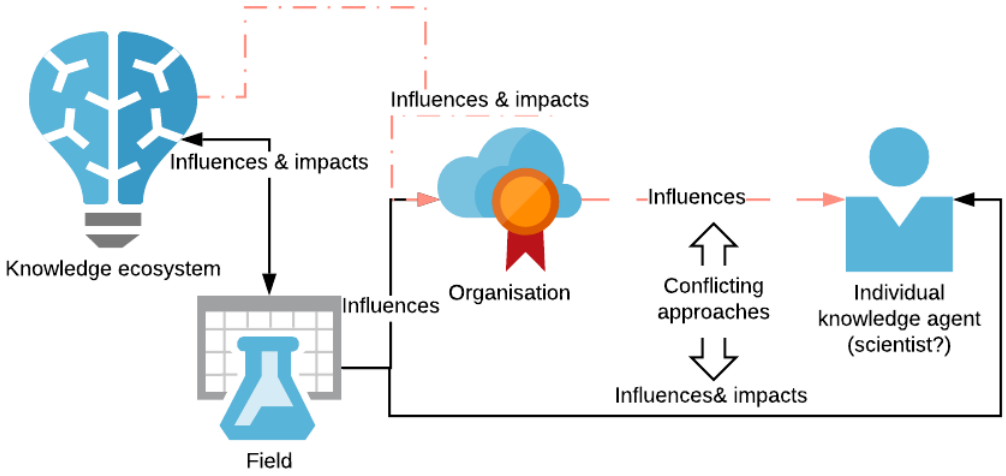


Figure 6 : Conflicting approaches in the knowledge ecosystem

Moreover, it is increasingly integrating into an ecosystem – more than just belonging to an institution – that in a way allows an actor, even a scientist, to be impactful or not (Posner, McKenzie & Ricketts, 2016).

This institutional practice of individualisation/personalisation of the lack of trust has had the adverse effect of giving primacy to the individual over the ecosystem (if the latter faces the blame alone, why would it not benefit alone from the successes?), making it difficult to identify the components of the lack of trust, and therefore the targets of the actions to be taken to restore this trust (Puusa & Tolvanen, 2006). Even if it already seems interesting for the institutions to think about getting out of the personification of trust to get out of the personification of lack of trust, it is necessary to identify, in the process of building trust and lack of trust, what the responsibility of the ecosystem and the actors is.

We have therefore formulated three questions about trust in the knowledge economy and its actors in general and by typology. It is no longer science that is being questioned but the different stakeholders that make it up. This is a strong societal trend in the age of citizen science that tends to propose involving citizens in the process of knowledge creation to increase confidence in its outputs.

These three questions are:

1. Does trust in the field of science imply trust in the different players concerned with the subject matter?
2. What component of the ecosystem receives the most positive feedback from citizens? Hence, which level of trust is placed in the various players making up the knowledge economy?
3. Which component of the ecosystem is more responsible for the lack of trust? Thus Identifying the perimeter of the lack of trust

II.2.1 - Does trust in the field of science imply trust in the different players concerned with the subject matter?

We have seen that it is not the scientific ecosystem that is being questioned by the current situation. Thus, it is proven that there is a global adhesion, a generalised confidence in "science" when it is not represented by an operator. It is moreover probably on the basis of this conceptual trust that citizens can appropriate – whether rightly or wrongly – scientific controversies in order to feed their own

doubts (Nguyen & Catalan, 2020) and express them publicly through social networks (Waszak, Kasprzycka-Waszak & Kubanek, 2018) by inventing their own "scientific demonstrations", which may be oriented if not fallacious, but which are always capable of being accepted by gullible people because of the alleged authority and knowledge of the bearers of this type of message (Scheufele & Krause, 2019): how many "doctors" promote alternative cures for lethal diseases without clinical evidence, how many, despite repeated studies indicating the opposite, continue to say that vaccination (if it can have its faults) is the cause of pathologies such as autism? (Hopf, Krief, Mehta & Matlin, 2019).

But this is not our point. If science as such is not questioned by the citizen (so little questioned that politicians tend to hide behind it when an unexpected crisis occurs (esley & Velasco, 2020), one can very legitimately wonder whether it is not the actors of the scientific world who are at the origin of the often violent rejection of its conclusions by some (Camargo, & Grant, 2015). The debate is not new in itself, but if the literature abounds in theoretical readings and solutions, it is likely that the lack of an empirical approach to solving these questions is at the root of the doubt that persists not with regard to science, but to the various operators of science.

We have therefore questioned the level of confidence that European citizens have in the said operators. To do this, again with the help of the scipy packages, we have carried out a certain number of analyses relating to the answers of our participants to the survey.

As a reminder, our approach consists of confirming the general confidence granted to the scientific field and its actors without distinction (the ecosystem of knowledge: Q2 & Q3), and, on the other hand, in giving a "score" to a level of confidence towards the different actors identified in the previous questions (Q4).

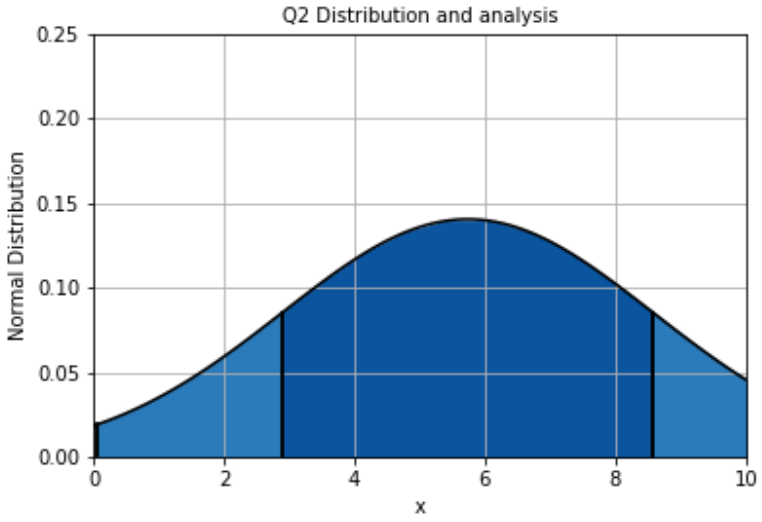
We considered each return separately and then carried out parametric comparisons using state of the art statistical data processing tools: filtering methodologies (Uni-variate analysis of variables: sorting, distribution, histograms, Bi and Multi-dimensional variate analysis of variables: sorting correlations, correlations, the test of the flat and cross sorting, as well as factor analysis).

To facilitate the reading of what will follow, a quick reminder of what can be expected from the latter tests carried out is given below. Flat sorting is the most basic method. It simply consists of obtaining a statistical measure question by question (the answer given by country to each question). It provides information on the criteria that are the most important to respondents. Statistics are measured simply by dividing the number of responses per criterion by the total number of responses. Cross-sorting is the integration of an additional variable to the flat sort to obtain statistics specific to each segment of the sample population. The additional factors we've to consider here is the country of origin of the respondents to report potential discrepancies between MS and/or Partner Countries. As detailed below, all the available methods for data analysis were used in compliance with different data types:

- ✓ Principal Component Analysis (PCA): A table of quantitative data of n individuals with p variables, PCA allows for the representation of similarities between rows and links between columns.
- ✓ Correspondence Factor Analysis (CFA): Contingency table representing the crossing of two qualitative variables on a sample of size n.
- ✓ Multiple Correspondence Analysis (MCA): Allows a CFA with p qualitative variables to be performed using a complete disjunctive table.
- ✓ Discriminant factor analysis (DFA): Allows to describe the links between the variable to be explained and the explanatory variables and to partition all individuals into disjunctive classes.

✓ ANOVA, that is analysis of variance was also implemented.

Figure 7 Distribution analysis Q2



This quick methodological parenthesis on the different statistical techniques used being completed, the most significant results concerning question 2 (Trust in the Knowledge Ecosystem/Industry) are as follows:

There are a limited number of countries in which the maximum score (10) was given (25%). Thus, in France, Germany, Greece, Portugal and the UK, confidence towards the Knowledge Ecosystem (KE) in general is higher as compared to other Members and/or Partner countries. The set mean is 5,73, median is 6 and the standard deviation is 2.844196. The standard deviation is a measure of how spread out numbers are. Most scores are between 3.2 and 8.8. The set is not widely scattered which implies that, despite certain disparities, there is one sort of consensus in Europe on the issue of "conceptual trust in KE".

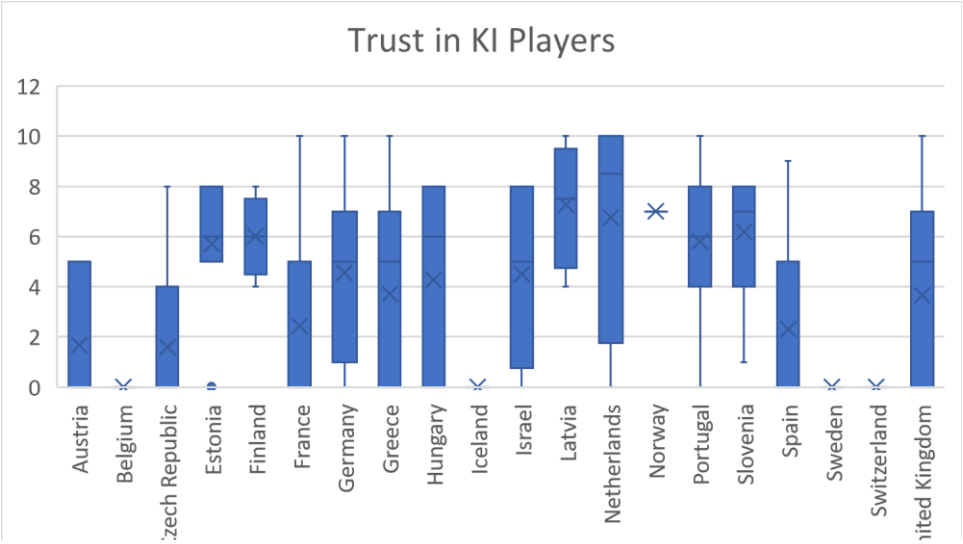


Figure 8 Trust in KI Players

In this context, and if players are trusted as a whole, how can the apparent contradiction between these figures and the sense of lack of trust that has long been echoed by the main actors in the field (Benneworth, 2009) be explained? Could it be that it is not the scientific stakeholders that are at stake, but some component of them? If so, which one? This is the hypothesis that's is going to be explored through the analysis of the third question in our survey. Nonetheless, this sense of an ecosystem on which citizens rely is somewhat confirmed by chart analysis showing a *negatively skewed* set (Figure 7). The left tail is longer; the mass of the distribution is concentrated on the right of the figure and leans towards higher scores (above 6). The distribution is thus left-*skewed (*despite the fact that the curve itself appears to be skewed or leaning to the right). Furthermore, the mean (5,73) being slightly lower the median (6), we have limited, though exiting, outliers

in the low end, which implies that negative readings of the concept of trust in KE are more marginal (and analytically mostly identified in Switzerland, France, the UK and Germany) than the reverse.

In this respect, there is a certain schizophrenia in these countries, as the people with the most and least confidence in the ecosystem reside there (Figure 8). This observation, added to the fact that scores above 8 are scarce in the set, tends to indicate that this statement of confidence does not, for citizens, in any way mean a blank cheque for the scientific ecosystem. It would be interesting to analyse the volatility of the concerned population in order to try to forecast a potential turnaround in the situation, but since this is a predictive analysis, it is outside the scope of the current investigation.

Concerning question 3, the most significant results are as follows:

The matter appears to be more disputed. Indeed, 39% of the participants did not express an opinion about trust in given social entities/institutions (compared to only 12% when the question was asked in a less detailed manner). This reluctance to answer when the issues increase in granularity has been observed for a long time (Tourangeau, Rips & Rasinski, 2000) and potentially reflects two sociological trends: the feeling that the respondent does not have sufficient knowledge of the field to make a commitment (but in this case, these rates should be found on a majority of questions, which is not the case) or the wish not to stigmatise this or that component of society (Lamont & Mizrachi, (Eds.), 2013). In this case, it seems that we are in the latter instance. In any event, the chart & statistical analysis shows that this questioning is more problematic for participants at the European level: candles are less homogeneous (see Figure 9), and analytically, the variance measuring sample spread values is much higher than that expressed in the previous query (11.417289 vs. 8.0839839). There is clearly less consensus on this topic than on the previous one. Median is higher – and in larger proportion than in question 2 – than the mean (Median = 5 Mean = 3.690331), which indicates again that the outliers are in the high end of the distribution, in spite of the important amount of non-respondents which skew the distribution to the right.

Figure 9 Trust in Knowledge Ecosystem

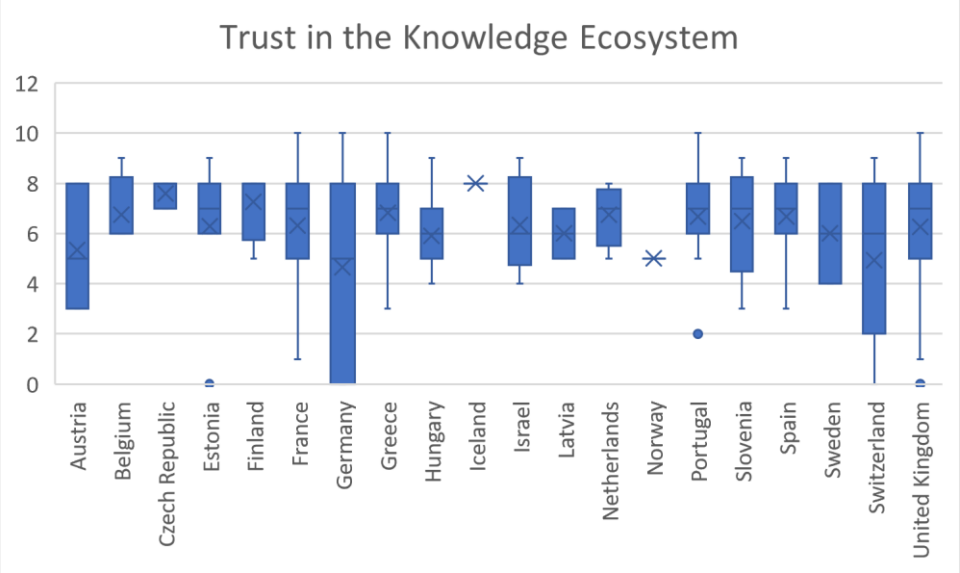
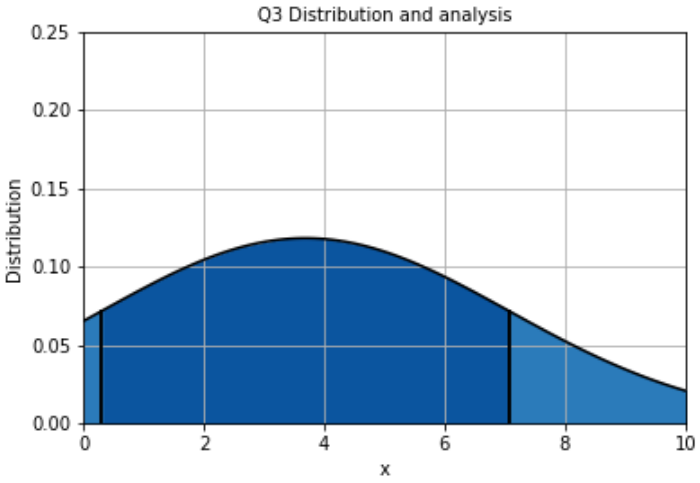


Figure 10 Q3 Distribution and analysis



This right skew is an oddity linked to the fact that the lower bounds are extremely low relative to the rest of the data. In other words, the propensity of survey participants to avoid answering is emblematic of a situation, which was explained above.

In fine, we compared the potential interactions between the two questions. Broadly speaking, we asked ourselves whether the hypothesis of inference from one question to the other could be verified, i.e., whether the answer on trust in research influenced the answer on research stakeholders. It appears that this is not the case, as the null hypothesis about a subject was rejected and confirmed by the ANOVA analysis (Figure 10). The null hypothesis can be thought of as a *nullifiable* hypothesis. That means one can nullify it or reject it. What happens if the null hypothesis is rejected? It gets replaced with the "alternate hypothesis", which is a postulate about what might be true about a given situation. In our context of interrelation, the null hypothesis can be worded as follows: "does trust in the ecosystem automatically implies trust in operators of this ecosystem". Logically, if this were the case, there should be a statistical correlation between the answers to the 2 questions. However, this correlation does not exist (Figure 11). We can therefore say, in all objectivity, that ***it is not because a population has conceptual confidence in the knowledge ecosystem that it will have the same confidence in the actors of the said ecosystem.***

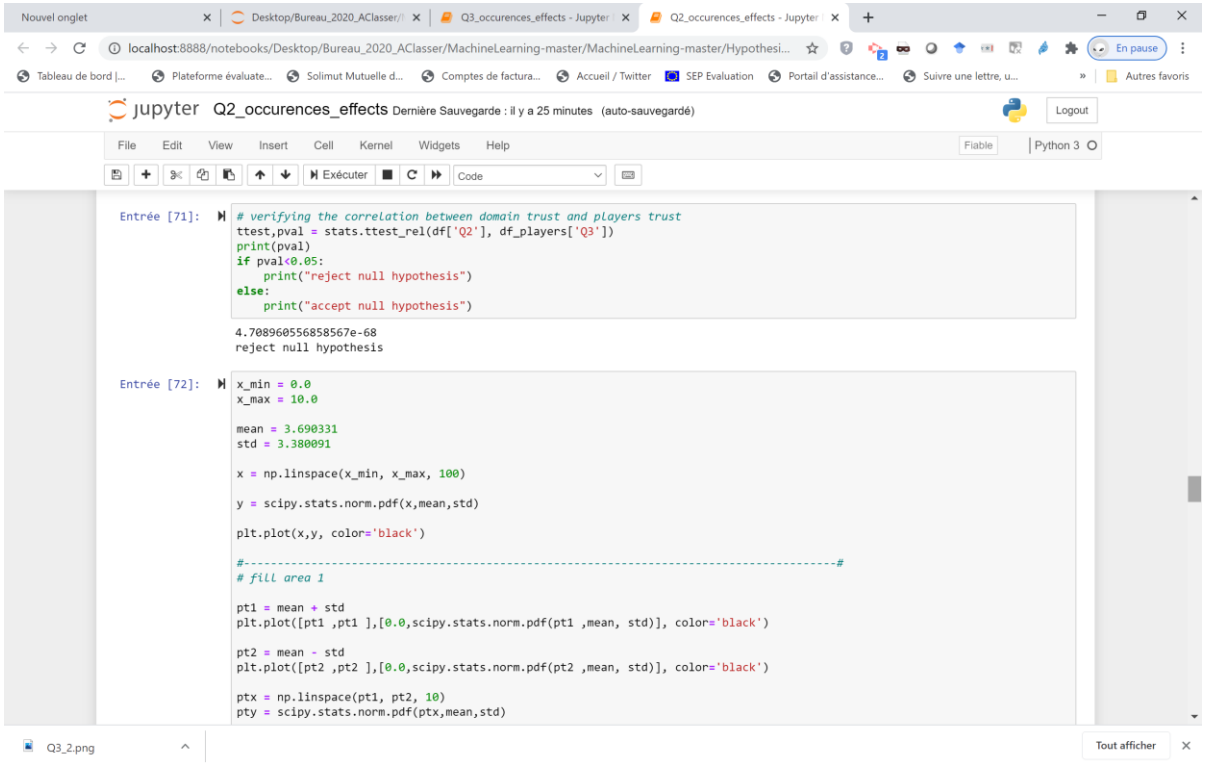


Figure 11 Occurrences' effects Q2 Python Code extract

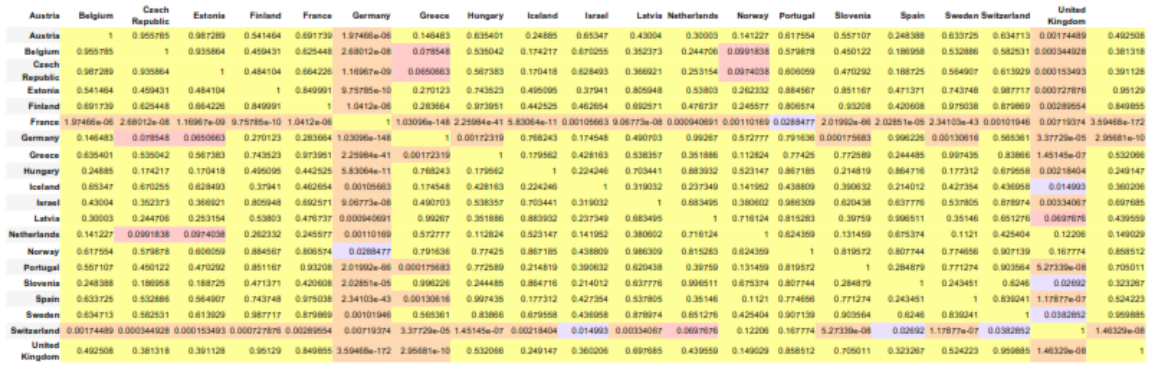
The reasons for this disenchantment have been abundantly analysed, but the novelty lies in the fact that it is clear that the problem of confidence in the ecosystem of knowledge is not a question limited to individuals (contrary to the theory of "rotten apples") but rather to the operators of the latter (Bonanno, 2015). It would therefore be the operators of knowledge who would have to undergo metamorphosis, and not the researchers backed by these operators: without denying for all that that there are indeed cases of fraudsters but that these remain merely low signal incidents, even if the financial impact is far from negligible. In this context, would it make sense to move from witch-hunting to governance and organizational failures hunting as it is becoming increasingly clear – as demonstrated by the "Diesel gate" – that ***it is institutional deviations that lead to personal deviations and not the other way round***.

II.2.2 - What component of the ecosystem receives the most positive & negative feedback from citizens? Hence, which level of trust is placed in the various players making up the knowledge economy?

The lack of confidence in the research operators being empirically established, it is now necessary to try to identify which operators are concerned. As mentioned above, we have identified 6 components of stakeholders in the research process. These six components are significant of what is today understood as research actors in the broadest sense. This was confirmed in the first question of this study. These 6 groups have been ranked in an attempt to answer this question.

Pairwise comparisons show that we may strongly reject the null hypothesis ($p < 0.01$) only for the pair of countries in light orange and conclude that only a limited number of countries differ in their views of the level of trust that can be directed towards industrial research. However, the graduation of the colors indicates that these proportions are not all of

the same intensity. Light yellow thus indicates a very strong presumption against the null hypothesis, while pale red indicates a weak presumption against the null hypothesis. The orange indicates, as mentioned above, the absence of presumption against the null hypothesis (Figure 12 below).



	Austria	Belgium	Czech Republic	Estonia	Finland	France	Germany	Greece	Hungary	Iceland	Israel	Latvia	Netherlands	Norway	Portugal	Slovenia	Spain	Sweden	Switzerland	United Kingdom	
Austria	1	0.955785	0.987289	0.541464	0.691739	1.97468e-06	0.146483	0.635401	0.24885	0.65347	0.43004	0.30003	0.141227	0.617554	0.557107	0.248388	0.633725	0.634713	0.00174489	0.492508	
Belgium	0.955785	1	0.935864	0.459431	0.625448	2.68012e-08	0.078548	0.535042	0.174217	0.670255	0.352373	0.244706	0.0991838	0.579878	0.450122	0.186958	0.532886	0.582531	0.000344928	0.381318	
Czech Republic	0.987289	0.935864	1	0.484104	0.664226	1.16967e-09	0.0650663	0.567383	0.170418	0.628493	0.366921	0.253154	0.0974038	0.606059	0.470292	0.188725	0.564907	0.613929	0.000153493	0.391128	
Estonia	0.541464	0.459431	0.484104	1	0.849991	9.75785e-10	0.270123	0.743523	0.495095	0.37941	0.805948	0.53803	0.262332	0.884567	0.851167	0.471371	0.743748	0.987717	0.000727876	0.95129	
Finland	0.691739	0.625448	0.664226	0.849991	1	1.0412e-06	0.283664	0.973951	0.442525	0.462654	0.692571	0.476737	0.245577	0.806574	0.93208	0.420608	0.975038	0.879869	0.00289554	0.849855	
France	1.97468e-06	2.68012e-08	1.16967e-09	9.75785e-10	1.0412e-06	1	1.03096e-148	2.25984e-41	5.83064e-11	0.00105663	9.06773e-08	0.000940691	0.00110169	0.0288477	2.01992e-66	2.02851e-05	2.34103e-43	0.00101946	0.00719374	3.59468e-172	
Germany	0.146483	0.078548	0.0650663	0.270123	0.283664	1.03096e-148	1	0.00172319	0.768243	0.174548	0.490703	0.99267	0.572777	0.791636	0.000175683	0.996226	0.00130616	0.985361	3.37729e-05	2.95681e-10	
Greece	0.635401	0.535042	0.567383	0.743523	0.973951	2.25984e-41	0.00172319	1	0.179562	0.428163	0.538357	0.351886	0.112824	0.77425	0.772589	0.244485	0.997435	0.83866	1.45145e-07	0.532066	
Hungary	0.24885	0.174217	0.170418	0.495095	0.442525	5.83064e-11	0.768243	0.179562	1	0.224246	0.703441	0.883932	0.523147	0.867185	0.214819	0.864716	0.177312	0.679558	0.00218404	0.249147	
Iceland	0.65347	0.670255	0.628493	0.37941	0.462654	0.00105663	0.174548	0.428163	0.224246	1	0.319032	0.237349	0.141952	0.438809	0.390632	0.214012	0.427354	0.436958	0.014993	0.360206	
Israel	0.43004	0.352373	0.366921	0.805948	0.692571	9.06773e-08	0.490703	0.538357	0.703441	0.319032	1	0.683495	0.380602	0.986309	0.620438	0.637776	0.537805	0.878974	0.00334067	0.697685	
Latvia	0.30003	0.244706	0.253154	0.53803	0.476737	0.000940691	0.99267	0.351886	0.883932	0.237349	0.683495	1	0.716124	0.815283	0.39759	0.996511	0.35146	0.651276	0.0697676	0.439559	
Netherlands	0.141227	0.0991838	0.0974038	0.262332	0.245577	0.00110169	0.572777	0.112824	0.523147	0.141952	0.380602	0.716124	1	0.624359	0.131459	0.675374	0.1121	0.425404	0.12206	0.149029	
Norway	0.617554	0.579878	0.606059	0.884567	0.806574	0.0288477	0.791636	0.77425	0.867185	0.438809	0.986309	0.815283	0.624359	1	0.819572	0.807744	0.774656	0.907139	0.167774	0.858512	
Portugal	0.557107	0.450122	0.470292	0.851167	0.93208	2.01992e-66	0.000175683	0.772589	0.214819	0.390632	0.620438	0.39759	0.131459	0.819572	1	0.284879	0.771274	0.903564	5.27339e-08	0.705011	
Slovenia	0.248388	0.186958	0.188725	0.471371	0.420608	2.02851e-05	0.996226	0.244485	0.864716	0.214012	0.637776	0.996511	0.675374	0.807744	0.284879	1	0.243451	0.6246	0.02692	0.323267	
Spain	0.633725	0.532886	0.564907	0.743748	0.975038	2.34103e-43	0.00130616	0.997435	0.177312	0.427354	0.537805	0.35146	0.1121	0.774656	0.771274	0.243451	1	0.839241	1.17877e-07	0.524223	
Sweden	0.634713	0.582531	0.613929	0.987717	0.879869	0.00101946	0.565361	0.83866	0.679558	0.436958	0.878974	0.651276	0.425404	0.907139	0.903564	0.6246	0.839241	1	0.0382852	0.959885	
Switzerland	0.00174489	0.000344928	0.000153493	0.000727876	0.00289554	0.00719374	3.37729e-05	1.45145e-07	0.00218404	0.014993	0.00334067	0.0697676	0.12206	0.167774	5.27339e-08	0.02692	1.17877e-07	0.0382852	1	1.46329e-08	
United Kingdom	0.492508	0.381318	0.391128	0.95129	0.849855	3.59468e-172	2.95681e-10	0.532066	0.249147	0.360206	0.697685	0.439559	0.149029	0.858512	0.705011	0.323267	0.524223	0.959885	1.46329e-08	1	

Figure 12 absence of presumption against the null hypothesis

It is, therefore, safe to say that there is a relative consensus at the European level on the following findings. Furthermore, the statistics also show a high rate of non-response, which would support the idea that there is a certain difficulty for participants to take a stand when it comes to pointing the finger at this or that stakeholder as being more or less responsible for a situation.

This non-response rate could be problematic because it could lead to a bias in the readability of the results, so we have weighted the results to reduce the latter risk.

As we do not have precise information on the participants outside their country of origin (this information was not collected in order to avoid a risk of reverse engineering, a major non-compliance with the GDPR). We consider that, precisely in view of this volume of non-response, which only manifests itself in this question, there could be a risk of systematism of certain answers.

To avoid that our samples do not accurately reflect the general population, we have chosen, rather than accept a poor match between the sample and the population, to use weights to bring the two more closely into line. This is known as “non-response weighting”.

The reweighting methods consist of dealing with non-response by modifying the survey weighting of respondents, to fill in the absence of certain answers. Each individual k is then assigned an answer probability ck, and if this is known for all individuals, then unbiased estimators are available using the respondents' responses weighted by survey weights divided by the probabilities of answer. In the case of estimating a total Y and a simple random sample design of a n individuals among N, we obtain the following unbiased estimator:

Equation 2 reweighting estimator

$$\hat{Y} = \sum_{k \in R} \frac{Y_k}{\pi_k \times c_k} = \sum_{k \in R} \frac{Y_k}{\frac{n}{N} \times c_k} = \sum_{k \in R} w_k Y_k$$

where R is the set of survey respondents, π_k is the probability of inclusion of the individual k in the sample (equal here to n/N) and w_k is the modified weight of respondent k. However, we assumed that the distribution in the responding population was the same as in the non-responding population. Of course, this is debatable from a methodological point of view, but the lack of precise information (see above regarding regulatory constraints on data processing) leads us to this hypothesis. It is therefore the intensity, not the distribution, of this population that the analysis has impacted.

Table 11 Weighted population Q4

Score_ level	Ranking_ Trust_industrial_research	Ranking_Trust_ innovation_in_ general	Ranking_ Tust_academic_ research	Ranking_Trust_ higher_education_ vocational_training	Ranking_Trust_end_ users_of_research_innovation_outputs_results	Ranking_ Trust_ lobbyists_ influencers
1	6,32%	3,99%	4,10%	4,43%	3,99%	29,42%
2	12,77%	7,21%	4,22%	4,99%	11,42%	26,41%
3	39,73%	37,90%	22,19%	29,54%	42,07%	27,53%
4	31,30%	37,67%	41,96%	41,62%	32,30%	11,87%
5	9,88%	13,23%	27,53%	19,42%	10,21%	4,78%

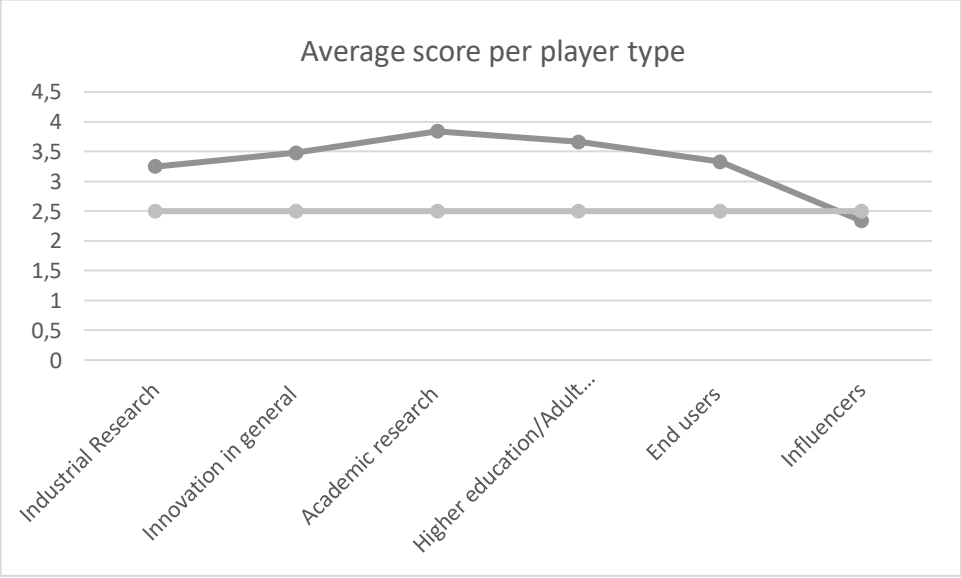
Having said that, an analysis of the results allows several conclusions to be drawn. Above all, however, it should be remembered that there are two biases often raised by the literature when issues of trust in the knowledge economy are discussed: the existence of a more developed (real or supposed) trust of civil society concerning academics financed by public actors at the service of the general interest (the academic biais => over or under confidence in the academics), and the corollary of an increased mistrust of this same civil society with regard to research that would be financed by private actors for the benefit of these same interests (the industrial research bias => over or under confidence in the private sector). It is thus necessary to question the answers received in order to try to verify whether these trends are true and, when several answers are proposed, whether or not a systematic response constituting a bias is established, i.e. the existence or not of systematic responses without distinction on the part of survey participants, which would correspond to a non-opinion, and would therefore justify dismissing the said respondent.

To do this, we again conducted a set of hypothesis testing. Using python, we proceeded to set up several well documented statistical tests (Huang, Curran, Keeney, Poposki & DeShon, 2012): p value, ztest, ttest, anova and chi-square which all concluded to the absence of bias in the scoring (the calculation details and python notebooks are annexed to the present document).

We found no statistical significance indicating systematisation in the answer (existence of a pattern per stakeholders' group, hence a bias). It, therefore, appears possible to say that the facts presented below are established without any apparent bias.

Generally speaking, there ***are no actors who score astronomically, either positively or negatively, except for influencers***, but we will come back to this. Thus, 5 of the six groups analysed are in an overall average score range from 3 to 4. The level of confidence is thus rather above the mean score, except for the influencers, who only scored 2.34, and therefore happens to be the only group that does not collect the average (Figure 13). The belief in pseudo-science that is being spread on social networks is therefore far from unanimous, or at least it does not deceive anyone in the random sample studied. Knowledge is not a fashion product.

Figure 13 Average score per player type



In the first place, academic research is the one that, at the margin, collects the most trust markers (27.53% of 5 and 41.96% of 4). This is confirmed by an average score of 3.84. It can be said that the "feeling" of lack of confidence that one can read here and there in relation to research carried out in the academic world is not at first sight confirmed (Vazire, 2017).

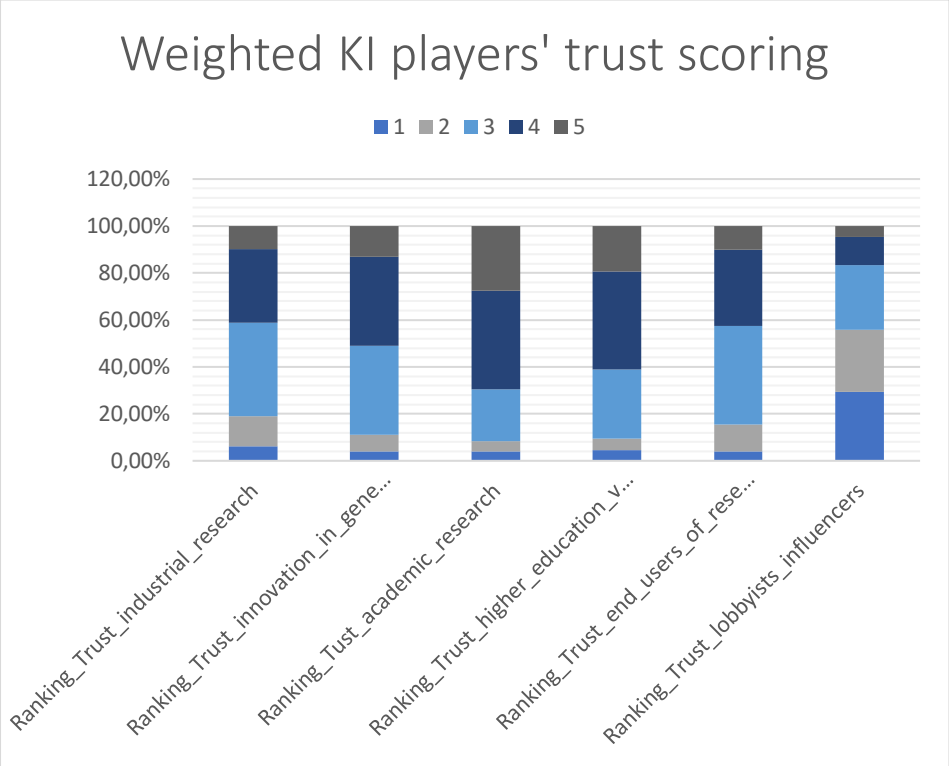


Figure 14 Weighted KI players' trust scoring

Even if there is (as shown by the answers that we will consider below) a relative ambivalence of respondents in this respect, they express both their confidence in academic research, but also consider it to be relatively responsible for the problems of trust raised by the nowledge economy (see Q5): in wanting to hunt witches so much, could academic researchers raise doubts? Conversely, industrial research receives a relatively good confidence score (3.25).

Furthermore, and though it is in the penultimate place of the panel, it is nevertheless viewed with relative benevolence. This is rather a surprise in view of the literature, which often raises the biases of practitioners driven by the market sector, even if they are academic (Lucier, 2019), although the recent crises have clearly demonstrated the existence of biases, particularly in the context of economic research (Giacalone & Wargo, 2009).

Another surprise lies in the confidence placed in the users of research results, which is more important than the scientific literature in the field suggests once again. Indeed, the latter tends to carry a message that is opposed to the massive deployment of citizen science, particularly because of the problems of misconduct that it could underlie (Rasmussen, 2019). However, the results suggest an expectation, and above all a real confidence of the respondents in the participatory logic, which could prove to be an asset for the large-scale deployment of data collection or the implementation of operational tests-beds.

However, this vision of trust must be balanced by a closer look at the actors considered as "responsible" for the confidence challenges raised in the context of the knowledge economy. This was done through Question 5: Who do you think is responsible for the lack of trust towards the knowledge industry? This question allowed for multiple responses to capture a global view of the understanding of responsibility for the lack of trust in the knowledge ecosystem as carried by the survey participants. Before analyzing the responses received, it was necessary to test their robustness, notably by verifying their potential for inter-influences both from the point of view of the responses provided as single values and as paired values. Our hypothesis (H0) is that there is no inter-influence between the variables. In other words, it is not because respondents consider x as responsible that they will fail to consider y also as responsible. Provides a wide vision of responsibility.

The first two rounds validate this assumption by default. This is the case for the following rounds, but to a lesser extent, the figures come closer to a rejection of H0, only to

deviate strongly from it afterwards (see figure). Nevertheless, the validity of the figures after round 2 raises questions of accuracy due to the large number of non-responses. In round 8, only 23 respondents out of 1479 remain. As indicated in our methodology, we only retain those responses that ensure statistical relevance to the analysis. As a result, we have discarded those rounds where non-response no longer seemed to be of any significance, other than as an expression of difficulty in considering the question in depth. In this case, the non-responses are statistically significant because they indicate that beyond one persona (Round 1), 42% of the population has difficulty attributing responsibility for a lack of confidence in the knowledge ecosystem to other groups. From Round 2 onwards, for many, but without this being a majority approach, the vision of responsibility in relation to the knowledge ecosystem stops at a first position without going further in the analysis. We can therefore say that the participants identify precisely the first actors they consider responsible but have more difficulty in improving the granularity of their approach.

In this context, the appearance of quasi-interinfluences at the level of rounds 3,4,5 (p-value close to the rejection of H0) is probably due to the fact that the remaining respondents take into consideration their previous answers as a basis for their responses, while the large differences reported in rounds 6 to 8 are probably due to the low volume of responses observed (Figure 15).

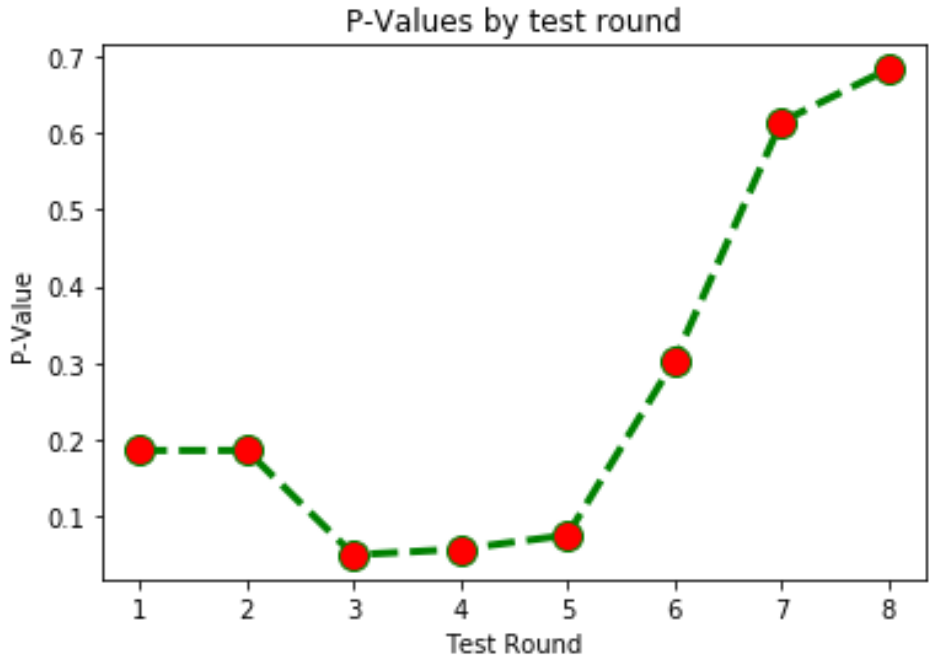


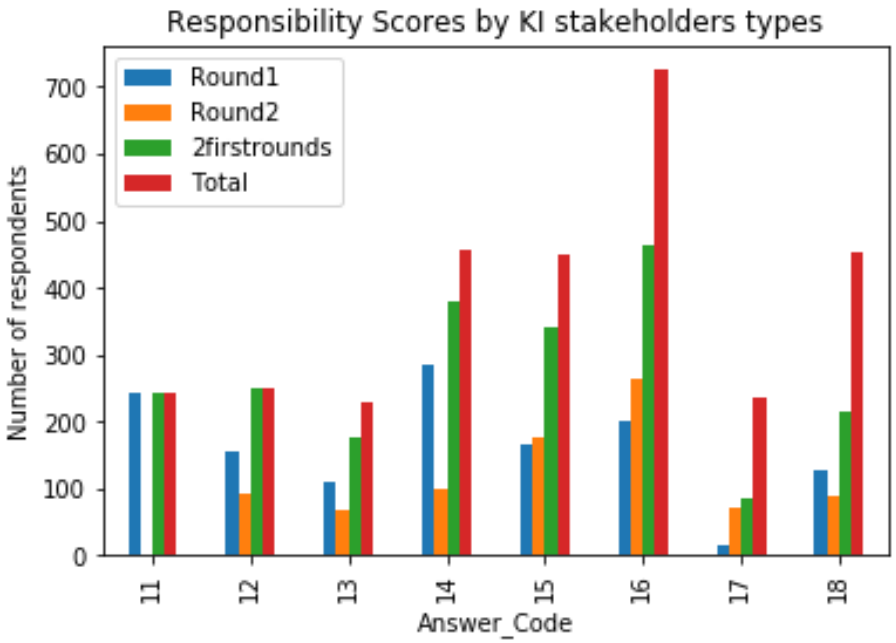
Figure 15 P-values per tests rounds Q5

These analytical prerequisites having been established, a certain number of elements from the answers to question 5 are used to weight the statements reported in question 4. In this respect, it is interesting to note that the participants consider ***researchers*** (243 responses) and ***Public research & innovation policy-makers including as ministries, research organisations*** (283 responses) to be primarily responsible for the lack of confidence in the knowledge ecosystem, even though they trust them quite a lot. There is therefore a distance between trust and responsibility. It is also possible that the feeling of lack of trust in the knowledge ecosystem that has been publicised in recent years (Gawande, 2016) comes more from the fact that the general public considers these actors to be responsible for the lack of trust, without not trusting them.

In their perpetual quest for trust (even though it has been achieved – see Q4), researchers and public actors seem to obtain the opposite effect: they bear the responsibility for the doubt that sets in: “Where there is smoke, there is fire”, as the proverb says. And this is indeed what the respondents underline in their answers.

There is therefore a high probability that this confusion of understanding is the reason for the deep hiatus that has presided over many developments in scientific institutions, particularly academic institutions, in recent years: the systematic search for individual responsibility alone in issues related to scientific best practices, as if, by virtue of a communication purely focused on the discovery of "fraudsters", positive developments had been overlooked.

Figure 16 Responsibility scores per stakeholders



In this respect, and as has already been documented, notably in the analysis carried out as a preliminary step to the present work (Deliverable 6.1), researchers and academics would benefit from proposing a more balanced vision of their activities, publicising or making visible both good practices and problems. However, the methodologies to enable this have never been explored. For this reason, participants were asked to address these issues in the final questions of the current survey, but we will come back to this point later.

That notwithstanding, the person-centred approach tends to fade in the second round in favour of a more institutional view of accountability that tends to make organisations accountable.

Thus, after the second round, it is the private financiers (464 cumulative responses) who are rather pointed to as being responsible for the lack of trust in the knowledge ecosystem. We will not repeat here what has been repeatedly documented (Beaudry & Allaoui, 2012 or Carrick-Hagenbarth & Epstein, 2012) on the causal relationships of private funding on research results.

However, it is essential to avoid any systematism, as there are different types of private funding and not all of them seek to influence the output of the projects they support: foundations are private bodies at the service of the general interest, which invest 6.8 billion euros a year in research (Rey-García & Álvarez-González, 2015) and are careful not to influence the outcomes of the projects they support. It would therefore be useful to analyse the granularity of R&I funders in order to avoid the automatism of the opposition between public and private funding

and, above all, to improve the understanding of the notion of private funding among the general public. An approach having at the heart of its analysis – as the Buteccrrii project tends to promote – more reading by the general interest than by the nature of the financing would constitute an enriching vision for the knowledge ecosystem.

It is only at the very end of the spectrum that the responsibility of the private sector stands out as solely responsible for the doubts about the knowledge economy. This is a clear indication that this is not the view that prevails in public opinion (Figure 16).

Synthesis – section II.2

The main conclusions that can be drawn regarding trust in the knowledge ecosystem and the responsibility of stakeholders for a possible lack of trust can be summarized as follows:

1 - It is not because a population has conceptual confidence in the knowledge ecosystem that it will have the same confidence in the actors of the said ecosystem**.**

2 - No knowledge ecosystem stakeholders score either positively or negatively, except for influencers. As such, no actors are trusted or distrusted except influencers who are clearly not trusted.

3 - It is academic research that, at the margin, collects the most trust markers, but adversely, is also considered to be relatively responsible for the problems of trust raised by the knowledge economy. Could it be that in seeking to systematically highlight problematic practices, without positive communication to counterbalance this focus, the academic world has generated the lack of trust that it claims to suffer from?

4 - Industrial research receives a relatively good confidence score.

5 - Respondents give a good confidence score to the end-users of the knowledge economy's outputs (patients, etc.), which pleads for the deployment of citizen science as a future important part of this ecosystem.

6 - *Researchers* (243 responses) and *Public research & innovation policy-makers including as ministries, research organisations* (283 responses) are seen to be primarily responsible for the lack of confidence in the knowledge ecosystem,

7 - After the second round, it is the private financiers (464 cumulative responses) who are rather pointed to as being responsible for the lack of trust in the knowledge ecosystem.

8 - However, after two questioning rounds, 42% of the population has difficulty attributing responsibility for a lack of confidence in the knowledge ecosystem, which indicates a problem in understanding the granularity of its components. There is, therefore, an urgent need to introduce nuances, notably by avoiding overly Manichean oppositions (public vs. private sectors for example).

II.3 - The remediation process: what are the potential methodologies and tools for rebuilding trust and confidence in the KI ecosystem?

Having identified the components relating to the issue of trust in the knowledge ecosystem and the responsibilities for any shortcomings in this respect, it is necessary to determine what could improve the situation.

II.3.1 – Needs to rebuilt trust: topics and format

The first element that emerges is a ***significant expectation of transparency*** in the development of policies relating to the knowledge ecosystem and a ***request for objective tools*** to assess and make these degrees of transparency visible, in particular through a rating system. The public's approach is, therefore, not focused on governance issues (which have been the main element in the answers to questions relating to trust in recent years) but rather on transparency (720 cumulative answers between Rounds 1 & 2, with 100% of the answers given in Round 1) and objective tools to assess this transparency (710 cumulative answers). The other approaches are far behind in terms of public adherence (Table 12).

Table 12 Needs to enhance trust

Responses	Responses R1	Responses R2	Cumulated R1 & 2
More transparency in the processes of establishing public research and innovation policies,	721	0	721
More transparency in companies' research programmes (publication in annual reports, list and publication of patents in progress, etc.),	87	89	176
Tools for rating transparency in research & innovation,	262	448	710
More transparency in the use of research & innovation results,	157	70	227
Evaluation and scoring tools to establish the care given to the potential uses of research & innovation,	62	37	99

This expectation regarding the transparency of public policies (who decides on the directions of investments in the ecosystem? for whom and for what? who benefits from them? There are so many questions over which the participants consider they have no control), seems to be the direct consequence of doubts as to the fact that these policies are arbitrated not for the greater good but for a restricted circle of people who are hearable from governments (Bernhagen, 2013).

Moreover, this is all the more sensitive in that it echoes the perception mentioned above that the responsibility for the lack of confidence in the ecosystem of knowledge is linked to the creators and bearers of public policies in the field. There is a repeated expectation on the part

of civil society to see the policy makers offer increased transparency of their actions in the field of R&I, which necessarily involves increased readability. An option that has clearly not been explored to date in the context of, for example, the COVID-19 crisis (Spalluto et al., 2020).

Furthermore, in developing our deliverables for this project, we assumed that in order to improve the bond of trust between the public and the knowledge sector, the expectation of the former would focus on the evaluation and monitoring of R&I related funding practices. In particular, we considered that the monitoring of economic flows was the founding element of rebuilding of confidence in this area. However, this needed to be verified by a longitudinal study that we conducted in the present framework and which did not entirely confirm our reading. Thus, the preparation of a tool to strengthen confidence in the knowledge economy must first and foremost be developed by giving greater visibility to :

1 - tracking down and reducing the misuse of research results (671 cumulative responses)

2 - the societal demand presiding over R&I activities, i.e., the social legitimacy of the research carried out. The research must therefore be clearly in the general interest and not carried out for the benefit of specific social bodies (604 cumulative responses).

3 - the origin of the raw data used (sourcing: 545 cumulative responses).

These answers concretise a strong demand to make transparent not only the R&I design processes (legitimacy & data) but also the use made of the results. The value of the data is thus enshrined, as is the expectation of citizens for greater involvement in processes relating to the knowledge economy. From being a blissful and passive user, the citizen asks to become an actor in R&I advances and therefore wishes to understand before adopting (Bucchi, 2008). Storytelling seems to have lived through because it is largely insufficient to build trust; in its place, educational marketing of innovation and public policies in this area remains to be built.

However, financial issues must not be totally disregarded. In fact, while they may ultimately come last in the concerns of citizens in terms of cumulative responses, they are the first ones mentioned in the cycle of replies. And by far (406 answers) in round 1. As a result, transparency on the financing of operations should not be ruled out (McManus, Holtzman, Lazarus, Anderberg & Jahansoozi, 2006).

Nevertheless, this low level of interest may reflect the fact that such transparency already exists to a large extent in practice. Thus, it is known that to hope to publish, it is necessary to make public the origin of the funds that have presided over R&I activities (Fontanarosa, Flanagin & DeAngelis, 2005).

In the same vein, it is surprising to note that the interest shown by the institutional actors of research and innovation in scientific controversies or in the expiatory questioning of some of their actors, their obsession to flush them out on the grounds that washing one's dirty laundry in public in this way would be a motor of confidence, is not at all favoured by the citizens. Not only does the subject come second last in terms of volume of cumulative responses, but it quickly disappears from the radar by not being mentioned at all from round 3 onwards. The focus on controversy would therefore be rather counterproductive. Indeed, if one should not be blissfully angelic and stop tracking down fraud and misconduct, perhaps a more effective but less systematically inquisitive treatment would be beneficial. The rate of identification and sanctioning of malpractices remains excessively low as demonstrated by the DEFORM project (at a cost of several hundred million Euros) even though allegations are made public without going through contradictory processes, sometimes ruining career opportunities for the targeted people without them having the opportunity to defend themselves.

Where are the ethics and good practice in these institutionalised witch hunts (Theall & Franklin, 2001)? Perhaps, in this area, a codification of practices, including the requirement for

an adversarial process before any publicising would help to improve confidence in the knowledge economy?

In addition to ideas on content, the participants also clarified their requirements in terms of the format that the "tools of trust" should take in the context of the knowledge economy. Once again, the answers proved to be different from those expected and therefore called for a recasting of the approach initially envisaged. Indeed, we had foreseen in our deliverables to provide "A financial document assessing the impact on the accounts/finances of a player in the knowledge-based economy of problems related to research and innovation". However, the proposed format (a financial document) only came third (out of 5) when asking the question of what element would be pertinent to better trust in the KI, and under which format. Likewise, out of 1479 respondents, only 229 thought that the document-based approach was of interest and could indeed better things. (15,4%) whereas, in contrast, the technical analysis approach (recommendation + indicator) was considered pertinent by 859 respondents (58%). A vision that is much more in line with the logic of current citizen involvement. Thus, the document-based angle, whether it contained a measure of impact or not, was not favored by the majority of respondents, but rather recommendation processes to outline critical paths to be followed to engage in a trustful knowledge process. In short, stakeholders thus expressed a need for transparency on the actual implementation process of building an ethical environment (ecosystem) for research and innovation, rather than on the financial impacts of poorly designed processes. Moreover, they considered that economic modelling should be established ex post and not ex ante, in contrast to what we had hypothesized. In short, stakeholders are saying, "show me the process & the documentary sources you have used are trusted/corresponding to your needs, so that I can get an idea of how much trust I can give to your R&I process".

This approach is original in the sense that it submits to collaborative analysis constructs that are supposed to be the basis for building trust, a way of doing things that have already proven its effectiveness, especially in the field of innovation financing (Walthoff-Borm, Vanacker & Collewaert, 2018).

Indeed, in their response to question 8, the respondents stated that they would like to see the creation of confidence indicators and a recommendation tool to validate the appropriateness of the methodologies used or the design implemented in line with good research practice (Table 13). Of note: We consider the two approaches together because indicators can only be derived from (live) data collection processes. The existence of separate questions arises from our desire to have a better granularity in the understanding of information collection methodologies.

Table 13 The ideal format that the confidence tool should take

An indicator with precise and transparent criteria,	567
A recommendation/rating system with precise and transparent criteria,	292

In this context, ProRes has produced recommendations concerning the establishment of good practices in the field of R&I (the Accord). An interesting indicator could be, for example, a % of adoption of the process in question.

Similarly, ProRes has concatenated all the emblematic documents of good practice in R&I design. A recommendation tool would make it possible to propose a critical path for the use of this information, and help the actors of the knowledge economy to choose the good

practices adapted to their profile or their needs. Within this framework, these options will therefore be discussed in the third stage of our work.

In conclusion, to build sustainable confidence in the knowledge economy, stakeholders call for the development of a tool to make the process of designing R&I projects legible & visible, notably through illustrative workflows or indicators showing:

- ✓ the origin and nature of the information used to build the knowledge creation process (predominance of data)
- ✓ the legitimacy of the exercise (for whom? why?)
- ✓ the use that will be made of the results of the knowledge created.

In other words, a major overhaul of current methodologies.

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II.3.2 -The pathway to trust: usage and efficiency of a tool

In this last phase, we will question the scope of applicability of the tools and indicators envisaged as well as the adherence of the respondents to them. The perimeter of applicability will be considered both vertically (to whom the tool should be applied) and horizontally (for which operation it should be applied). This is a state-of-the-art approach (Yan, Lin, Zheng, Zhang & Feng, 2017) that will give us important information about the design expected by the stakeholders. Finally, we will measure public support for the project.

The first question concerns the scope of application of such a tool. One might think that it would find its audience more if it were addressed only to organisations active in the field of research and innovation. This is indeed the vision that comes – at first glance – immediately to the minds of the survey participants. In Round 1, it is this response that was the most important with 734 replies. But in a second phase; it is eventually to all the actors of the knowledge ecosystem that the participants finally wish to

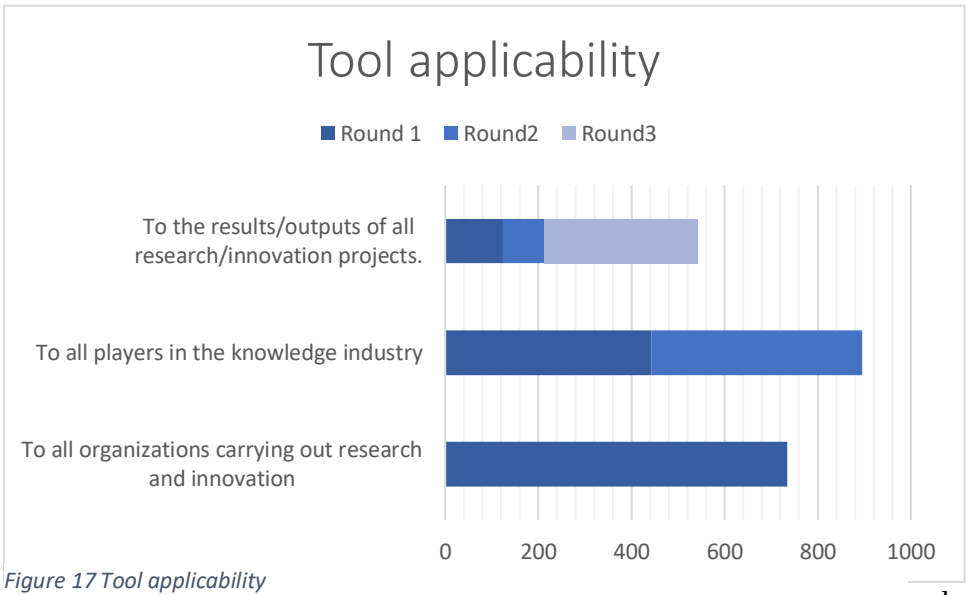


Figure 17 Tool applicability

see the tool applied. Thus, overall, this second vision prevails with 895 cumulative responses (Figure 17).

It is therefore clear that there is a desire to see the tool become part of a certain universality, in line with what people understand today of the knowledge society. In this respect, the survey does not contradict recent sociological tendencies towards the aforementioned ecosystem (Allegra et al., 2017).

However, what about the use of these mechanisms that stakeholders are calling for? Indeed, it is interesting to have instruments, but there must be support for them, i.e., the ecosystem must be ready to make use of them either globally or for specific actions. In this context, the answers to question 10 (Table 14 below) are preponderant.

They give us a clear indication, that the stakeholders, in a quintuple helix logic, view the tools to be developed more as being able to give funders visibility on the risks relating to the R&I project's ecosystem, than on the project risks as such, which, according to them, are already well identified: the planned frameworks should not be an evidence gathering system nor an actuarial system.

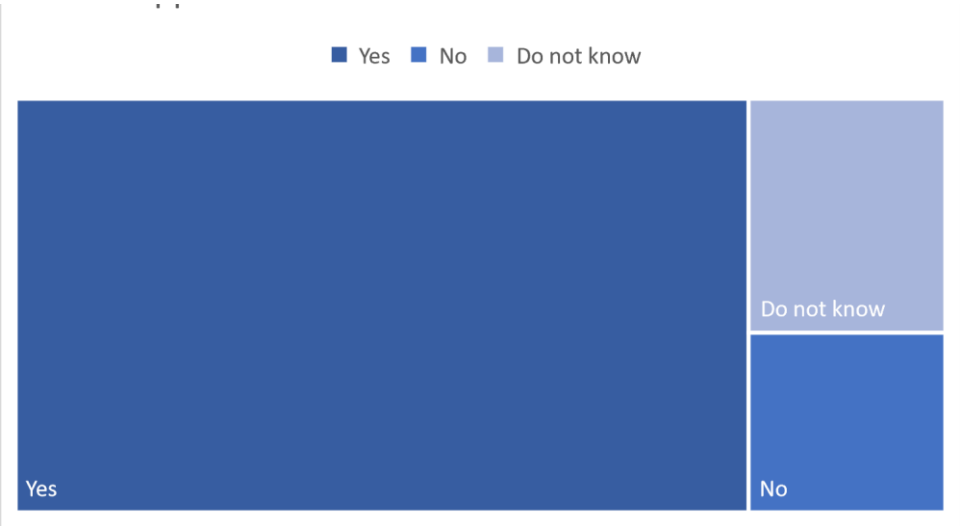
Table 14 Question 10

Q 10: For you, this type of tool would be effective if (multiple answers possible):	Numerical value
It was used in the evaluation of projects,	639
It was used in project funding decisions: institutional decisions at the policy or corporate strategy levels for example,	414
It was used in the financial analysis of companies,	149
It was serving in judicial processes,	43
It was used in the evaluation of insurance premiums.	55

Stakeholders, thus, support the idea that compliance with a certain number of procedures, suggested by a recommendation tool and validated by adherence indicators, could be integrated into the appraisal processes of R&I proposals to promote operational objectivity or with respect to their strategic positioning. Finally, this reading is very much in line with what is said above in terms of appetite for the inclusion of R&I proposals from a perspective of societal legitimacy.

Thus, it appears that stakeholders prefer objective processes that have already proved their worth in other contexts (Wong, Liu & Chiang, 2015) to the discourses promoting improved governance, or to the various comitologies that organisations are fond of. In this specific context, confidence in the knowledge economy could be strengthened as demonstrated by the very broad consensus expressed in the answers to the final question asked in the study on the usefulness of the proposed processes (79% support: Figure 18).

Figure 18 Support to recommender and related indicator(s)



Synthesis – Section II.3

There is a significant expectation for transparency in the development of policies relating to the knowledge ecosystem and, a request for objective tools to assess and make these degrees of transparency visible.

As such, the public's approach seems not to be focused on discourses claiming to better governance in the knowledge economy that are considered insincere. Stakeholders request a tool to strengthen confidence in the knowledge economy by giving greater visibility to (1) tracking down and reducing the misuse of research results, (2) the social legitimacy of the research/innovation carried out (3) the data sourcing.

Citizen asks to become actors in R&I advances and therefore wishes to understand them before adopting them: Storytelling is largely insufficient to build trust and pedagogical marketing of innovation and public policies in this area needs to be built (in line with what Christine Lagarde said in her monetary policy strategy review introduction address 30/09/2020).

The "tool of trust" format should be preferably recommenders and indicators, not document based. There is a request for interactivity and participatory trust building.

Stakeholders' considered that the economic modelling should be established ex post and not ex ante. In short, they are saying, "show me the process & the documentary sources you have used are trusted/corresponding to your needs, so that I can get an idea of how much trust I can give to your R&I process and consequently what are the potential costs of the risks you are taking".

Stakeholders desire to see the tool become part of a certain universality, in line with what people understand today of the knowledge society

Stakeholders support the idea that suggested recommendation tool and indicators, could be integrated into the appraisal processes of R&I proposals to promote operational objectivity or with respect to their strategic positioning.

There is a consensus between the participants on the usefulness of the proposed processes.

III. Conclusion

Analysis of the mechanisms of trust within the knowledge ecosystem has shown a number of strong expectations on the part of civil society, particularly in terms of transparency. More than documentary constructions (analytical reports in different forms, ad-hoc comitology and governance efforts) which have shown their limits, the demands today are centered on the possibility of proposing objective indicators and tools to measure the relevance of critical paths serving as an operational foundation for increased trust. It is proposals relating to these tools that will ultimately be deployed within the framework of our final deliverable.

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I . Context and methodology

87.61% | 1479 | 20000

596 | 550 | 550

This over-representation in relation to the population of France and Germany has been weighted so that the results from each member country have the same relative weight as their population.

I.1 Raw data collection and preparation: data splitting.

Our sample size - the number of complete responses received for our survey, that is the portion of our target population whose opinions on remediation tools to enhance trust in the knowledge society – is of 1479.

The minimal requested sample is of 1359 individuals which is covered by the sample detailed above.

II Results

II.1 Defining the understanding of the knowledge economy by stakeholders and the civil society.

II.1.1 The knowledge environment viewed by European civil society

Answers-types	Global	Round1	Round2	Round3	Round4	Round5	Round6
Lobbyists	196	63	10	14	24	31	54
Industrial Research Alone	386	386	0	0	0	0	0
End-users Of Research And Innovation Outputs & Results	579	76	78	171	136	119	0
Education (Higher Education & Vocational Training)	608	56	162	239	152	0	0
Research At The University (Academic Research)	739	186	358	195	0	0	0
Innovation In General	767	534	236	0	0	0	0

Table 1 The knowledge environment viewed by European civil society.

Synthesis section II.1

Stakeholders see the knowledge-based society as the result of innovative approaches, regardless of the field, most promoted by the :
1 - academic world,
2 - the sphere of education
3 - the beneficiaries of this knowledge,
with a non-preponderant industrial research component and participation.

Does this mean that industrial players are not perceived as innovative, or that they have little involvement in the strategic orientations underpinned by the rationale of knowledge creation?

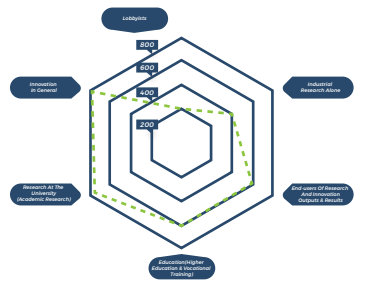


Figure 1 : Center of gravity of the understanding by european civil society of the knowledge ecosystem.

II.2 - The question of trust: knowledge economy and knowledge ecosystem, a fundamental distinction.

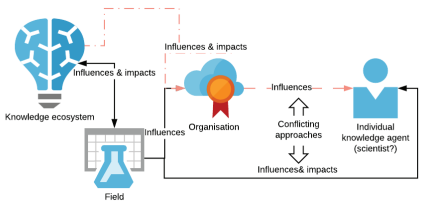


Figure 2 : Conflicting approaches in the knowledge ecosystem

II.2.1 - Does trust in the field of science imply trust in the different players concerned with the subject matter?

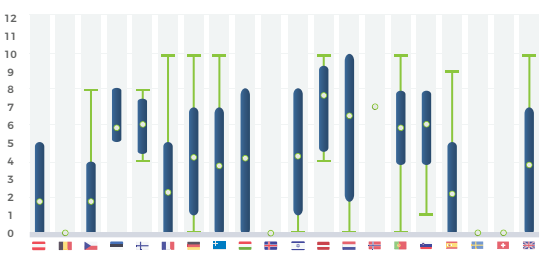


Figure 3 Trust in KI Players

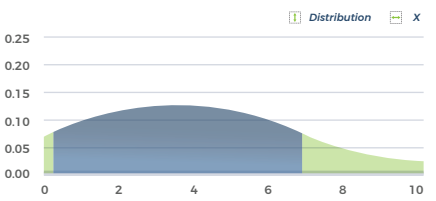


Figure 4 Distribution Analysis Q3

II.2.2 - What component of the ecosystem receives the most positive & negative feedback from citizens?Hence, which level of trust is placed in the various players making up the knowledge economy?

Figure 5 Average score per player type

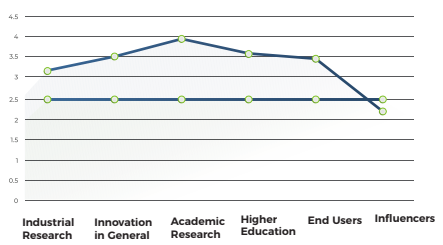
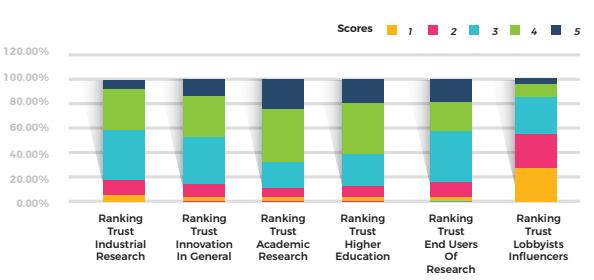


Figure 6 Weighted KI players' trust scoring



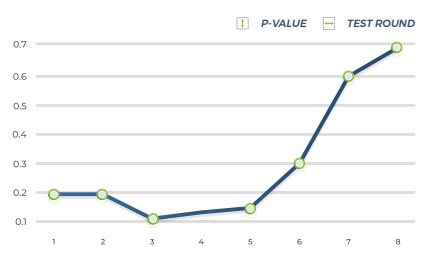


Figure 7 P-values per tests rounds Q5

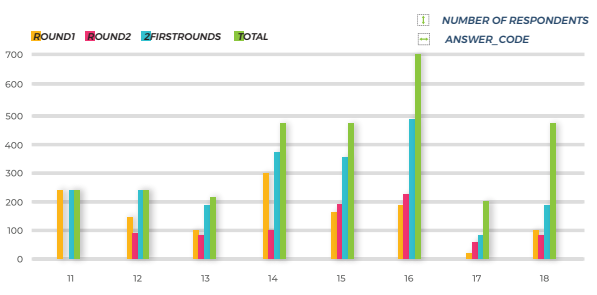


Figure 8 Responsibility scores

Synthesis – section II.2 : **Trust in the knowledge ecosystem & the responsibility of stakeholders for a possible lack of trust**

1 - It is not because a population has conceptual confidence in the knowledge ecosystem that it will have the same confidence in the actors of the said ecosystem.
2 - no knowledge ecosystem stakeholders score either positively or negatively, except for influencers. As such, no actors are trusted or distrusted except influencers who are clearly not trusted.
3 – It is academic research that, at the margin, collects the most trust markers but – adversely – is also consider it to be relatively responsible for the problems of trust raised by the knowledge economy. Could it be that in seeking to systematically highlight problematic practices, without positive communication to counterbalance this focus, the academic world has generated the lack of trust that it claims to suffer from?
4 - Industrial research receives a relatively good confidence score.
5 – Respondents give a good confidence score to the end-users of the knowledge economy's outputs (patients, etc…), which pleads for the deployment of citizen science as a future important part of this ecosystem.
6 - Researchers (243 responses) and Public research & innovation policy-makers including as ministries, research organisations (283 responses) are seen to be primarily responsible for the lack of confidence in the knowledge ecosystem,
7 - After the second round, it is the private financiers (464 cumulative responses) who are rather pointed to as being responsible for the lack of trust in the knowledge ecosystem.
8 – However, after two questioning rounds, 42% of the population has difficulty attributing responsibility for a lack of confidence in the knowledge ecosystem, which indicates a problem in understanding the granularity of its components. There is therefore an urgent need to introduce nuances, notably by avoiding overly Manichean oppositions (public vs. private sectors for example).

II.3 - The remediation process: what are the potential methodologies and tools for rebuilding trust and confidence in the KI ecosystem?

II.3.1 – Needs to rebuilt trust: topics and format

Responses	Response R1	Responses R2	Cumulated R1 & 2
More transparency in the processes of establishing public research and innovation policies,	721	0	721
More transparency in companies' research programmes (publication in annual reports, list and publication of patents in progress, etc.),	87	89	176
Tools for rating transparency in research & innovation,	262	448	710
More transparency in the use of research & innovation results,	157	70	227
Evaluation and scoring tools to establish the care given to the potential uses of research & innovation,	62	37	99

Table 2 Needs to enhance trust

An indicator with precise and transparent criteria,	567
A recommendation/rating system with precise and transparent criteria,	292

Table 3 The ideal format that the confidence tool should take

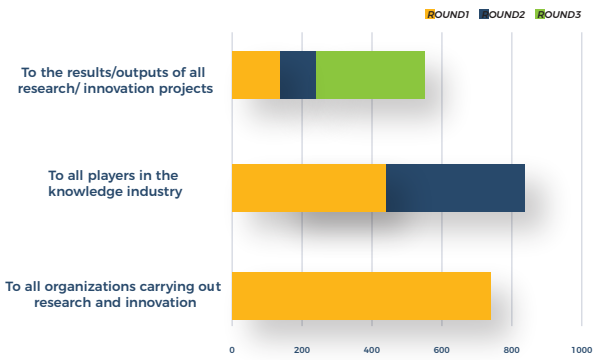


Figure 9 Tool applicability

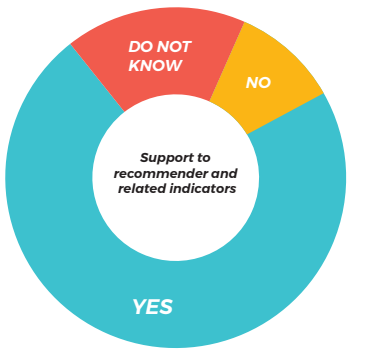


Figure 10 Support to recommender and related indicators

Q 10 : For you this type of tool would be effective if (multiple answers possible):	Numerical value
It was used in the evaluation of projects,	721
It was used in project funding decisions: institutional decisions at the policy or corporate strategy levels for example,	414
It was used in the financial analysis of companies,	149
It was serving in judicial processes,	43
It was used in the evaluation of insurance premiums.	55

Synthesis – Section II.3

There is a significant expectation for transparency in the development of policies relating to the knowledge ecosystem and, a request for objective tools to assess and make these degrees of transparency visible.

The public's approach seems not to be focused on discourses claiming to better governance in the knowledge economy that are considered insincere.
Stakeholders request a tool to strengthen confidence in the knowledge economy by giving greater visibility to
(1) tracking down and reducing the misuse of research results,
(2) the social legitimacy of the research/innovation carried out
(3) the data sourcing.

Citizen asks to become actors in R&I advances and therefore wishes to understand them before adopting them.
Storytelling is largely insufficient to build trust and pedagogical marketing of innovation and public policies in this area needs to be built.
The "tool of trust" format should be preferably recommenders and indicators, not document based. There is a request for interactivity and participatory trust building.
Stakeholders' considered that the economic modelling should be established ex post and not ex ante. I
Stakeholders desire to see the tool become part of a certain universality, in line with what people understand today of the knowledge society
Stakeholders support the idea that suggested recommendation tool and indicators, could be integrated into the appraisal processes of R&I proposals to promote operational objectivity or with respect to their strategic positioning.
T**here is a consensus between the participants on the usefulness of the proposed processes.**

III Conclusion

Analysis of the mechanisms of trust within the knowledge ecosystem has shown a number of strong expectations on the part of civil society, particularly in terms of transparency. More than documentary constructions (analytical reports in different forms, ad-hoc comitology and governance efforts) which have shown their limits, the demands today are centered on the possibility of proposing objective indicators and tools to measure the relevance of critical paths serving as an operational foundation for increased trust. It is proposals relating to these tools that will ultimately be deployed within the framework of our final deliverable.

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