ANALYSIS OF THE ATTITUDE WITHIN ACADEMIC AND RESEARCH COMMUNITIES TOWARDS OPEN SCIENCE – A QUANTITATIVE SURVEY

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Abstract

Ideas of Open Science have gained popularity and become ever more accepted as a model for conducting research in the 21st century. Its acceptance at all stages of the research process and scholarly communication gets ever stronger in international institutions, OECD and European Commission, in particular. There are many initiatives constituting awareness on those processes, and good practices of implementing the ideas of Open Science are promoted. In Poland, we could observe several actions in the course of implementation, ranging from a set-up of national ICT platforms for scientific and technical information, that are expected to constitute a core of the national knowledge infrastructure, up to appropriate underlying legislation changes. Apart from ever more numerous activities contributing to the development of specific technical solutions, analyses are lacking in Poland that would show and provide diagnosis of the acceptance for those changes. The same lack is the case for the overall distribution of Open Science models in research work. It is our aim to present initial results of a quantitative survey addressing the social context of Open Science. A study undertaken was focused on the attitude and awareness level among the Polish academic and research communities on broadly viewed general idea of Open Science, open access to research publications, research data and problems of Science 2.0.

Background of the survey

Digital revolution has contributed to fundamental changes in the way research is conducted and its results are distributed. The emergence of Open Science paradigms has reflected the very essence of those processes. The main characteristics of Open Science include maximally wide provision of the public free access to knowledge (to publications, research data, educational material) and possibly wide openness and transparency at all stages of the research and communication process. It also refers to building new e-infrastructure and usage of networked tools supporting those researchers who want to adopt open science ideas in their research practice.

Open Science have become central as driving concepts for running and organizing processes of scientific research in the 21st century. The popularity and growing acceptance of the openness at all phases of research process and scholarly communication is supported equally by the most significant international organizations, including European Commission, OECD, World Bank and UNESCO, as by leading research

institutions and organisations, among those National Science Fundation (US), Research Center of UK, Deutsche Forschungsgemeinschaft, Wellcome Trust, Howard Hughes Medical Institute, on the administrative side and practically all world-leading universities, Max Planck Gesellschaft, on the academic side (Niezgódka et al., 2012). Ever more initiatives get founded worldwide that aim at building awareness of those developments, ever more numerous become individual references of the Open Science implementations in practice.

The recent recommendation position statement of the European Commission of July 17, 2012 sets a new landscape for future presentation of research results and their sharing (EC, 2012). Member countries of EU have been requested there to define an agenda of the related implementation process.

Poland has only recently entered the path towards wide-range implementation of Open Science concepts (Niezgódka et al., op cit.: 10). The launch of the virtual library of science e-infrastructure, open to the entire academic community (equally research staff and students), has been initiated around 1996, a couple of years later accompanied by an expansion of the Digital Library community movement.

A groundbreaking change refers to the SyNaT project whose main objective has been to develop and launch a unified networked IT platform for hosting and communication within entire national resource of academic and research data, publications and knowledge documentation. The system has been designed and developed so as cover needs of the entire academic community on national level. As intended, the system will contribute to new quality in a wide range of research and academic education developments in Poland. As an underlying model, the schemes of Open Science are exploited.

It is a clear sign on the represented attitude that the Polish Ministry for Science and Higher Education has announced the priority of introducing the open access to published research results based on public funding. The action will comply with the Communication and Recommendation released by the European Commission on July 17, 2012.

Only during the last decade the understanding of research results as common goods gained wide acceptance. Thus, regardless all enthusiasm declared by a large part of the academic community, comprehensive studies on foundations, chances and risks accompanying the practical implementation of Open Science are needed. Still an insufficient level of public discussion in Poland about Open Science and the lack of surveys dedicated to its main problems have motivated us to do a survey on the readiness to accept and support open models in Polish academic community.The same refers to the knowledge on the general implementation of Open Science models in research work.

In order to examine those issues, we conducted a survey aimed to measure what Polish scientists think about Open Science. A study undertaken at the National Information Processing Institute (OPI PIB) was focused on:

- Diagnosis of the attitude and awareness level among the Polish academic and research communities on broadly viewed open access to research publications, research data and, more generally, problems of Science 2.0.

- Analysis of the implementation range and level of the open science paradigms and tools to research, including among others open notebook science, open peer review, legal tools and scientific networking.

Analytic data resulting from that research were considered as enabling a diagnosis of the potential barriers, bottlenecks and sources of fear within the community.

Methods

The questionnaire was sent to over 24K scientists in Poland, holding at least PhD degree and registered in the "Polish Science" database, operated by the OPI PIB for the Ministry of Science and Higher Education.

A study based on distributing an e-questionnaire was launched in 2013 (from May to June) using the LimeSurvey platformI[1]. 1300 respondents were logged in to the e-questionnaire, 849 completed it, additional 456 dropped it out (after starting).

The survey covered four thematic groups of questions: Open Science - generalities, Open Access, Open Data, Science 2.0. (in total 37 questions).

In addition, supplementary questions were asked on: age, sex, discipline, participation in international projects, academic title/degree, experience as research team leader, type of the institution of affiliation.

Respondent profile

Majority of the respondents were male (70%). Average age of participants was 46. PhD holders were the largest group of examined respondents (67%). Accordingly, 18% DSc, 12% professors participated.

Most of the respondents were representatives of Engineering and technology (24%). Accordingly, 22% were representatives of Arts and Humanities, 20% Natural Science and 19% Exact Sciences. The smallest group were representatives of Medical Science (10%).

Overwhelming majority of the respondents indicated the University as the main place of employment (81%). Accordingly 10% indicated Research Institute and 6% Polish Academy of Science.

48% of examined respondents were leaders of the research projects while 6% were leaders of the research programs . Only 5% were leaders of the institutions. 36% of the respondents were not leaders of any research projects.

53% of exanimated respondents already participated in international research projects, 47% did not.

[1] https://www.limesurvey.org/

1. GENERAL ATTITUDE WITHIN THE COMMUNITY

Open science – generalities

The idea of Open Science assumes more transparency at all stages of research, less anonymity of evaluations (again ranging from project proposals through final results of research), higher inclusiveness of academic community, finally treating knowledge as common (public) good (Peters, 2011). These concepts are legitimized at all institutional levels and fit into a broader context of democratized knowledge accessibility and research progress considered to be high strategic priorities of national and international policies (David, 2007).

In our survey, most interviewed scientists met the concept of Open Science before (70%)(Figure 1). But the level of knowledge is different among them. Only 14% know exactly what does Open Science mean and the largest group includes those who, despite of facing the idea of Open Science know little or nothing about it (20%). There are still many people who have never met the Open Science idea before (26%).

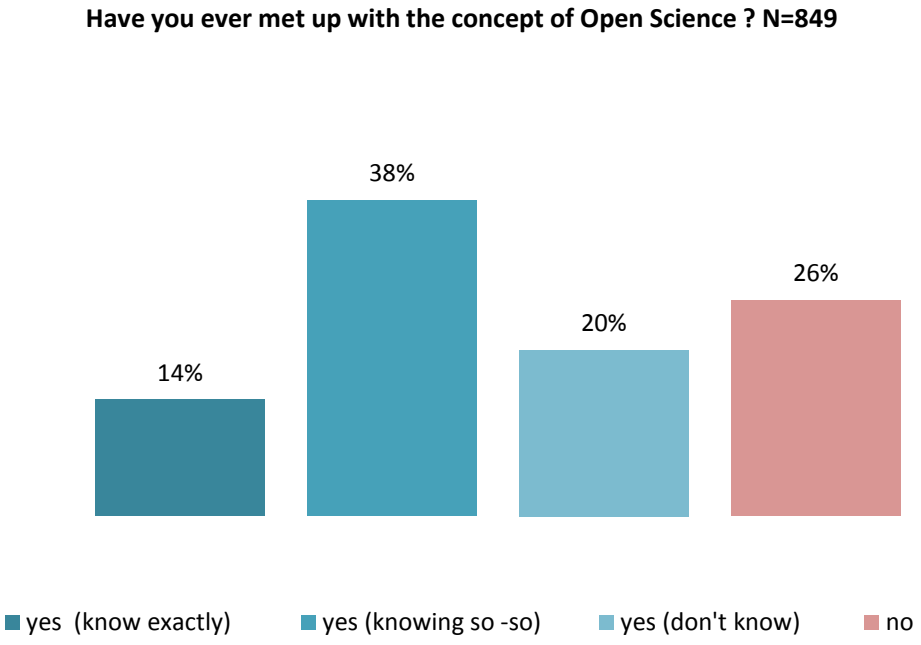

Figure 1. Knowledge about Open Science

In this connection, as the term Open Science is quite well known among Polish scientists, a natural question follows of whether Open Science is recognized a good tendency or rather bad ? (Figure 2). It turns out that the development/spreading of Open Science concept is viewed as a positive phenomenon and scientists almost unanimously indicated that it may bring a lot of good consequences for their respective research field (81%). And only few (9%) perceived it as a sort of threat or danger.

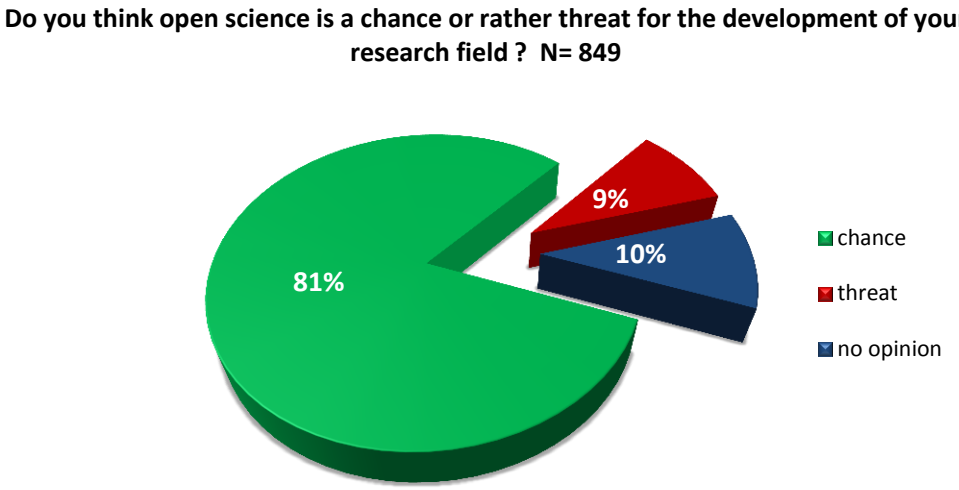

Figure 2. Positive or negative impact of Open Science on Research Field

Positive attitude toward Open Science general concepts should be treated as a starting point and background for farther characteristics of the openness in science. Open Science certainly is not just an abstract notion and its ideas are implemented in rather concrete way. The positive perception of openness values is not so surprising, as the latter validates real attitude of the scientists participating in the survey.

Open Access

Strong promotion of free access to research literature also in Poland is still quite limited but year by year gains more popularity. It makes the Open Access aspects best recognizable and crucial dimension of the Open Science idea. It was clearly visible in the survey results. The vast majority of the respondents are acquainted with Open Access ideas while only few have never met the concept.

What is the level of support for the concept of Open Access? To what extent is the related attitude positive?

It is remarkable that the respondents very strongly sympathize with general principle that research outputs published as articles in scholarly journal should be accessible openly and without any restrictions – 85% declared such opinion. So strong positive attitude does not appear wherever we have asked about other Open Science dimensions (Open Data, Science 2.0).

As shown in Figure 3 many respondents share rather positive than negative opinions about Open Access. Scientists indicate that free access to research literature contributes to raising international visibility of the Polish science and, what is crucial, Open Access provides wide information on research – such a recognition prevents from repeating research already done. On the other hand, scientists also recognize drawbacks such as higher fraction of poor quality publications due to lack of peer-review verification.

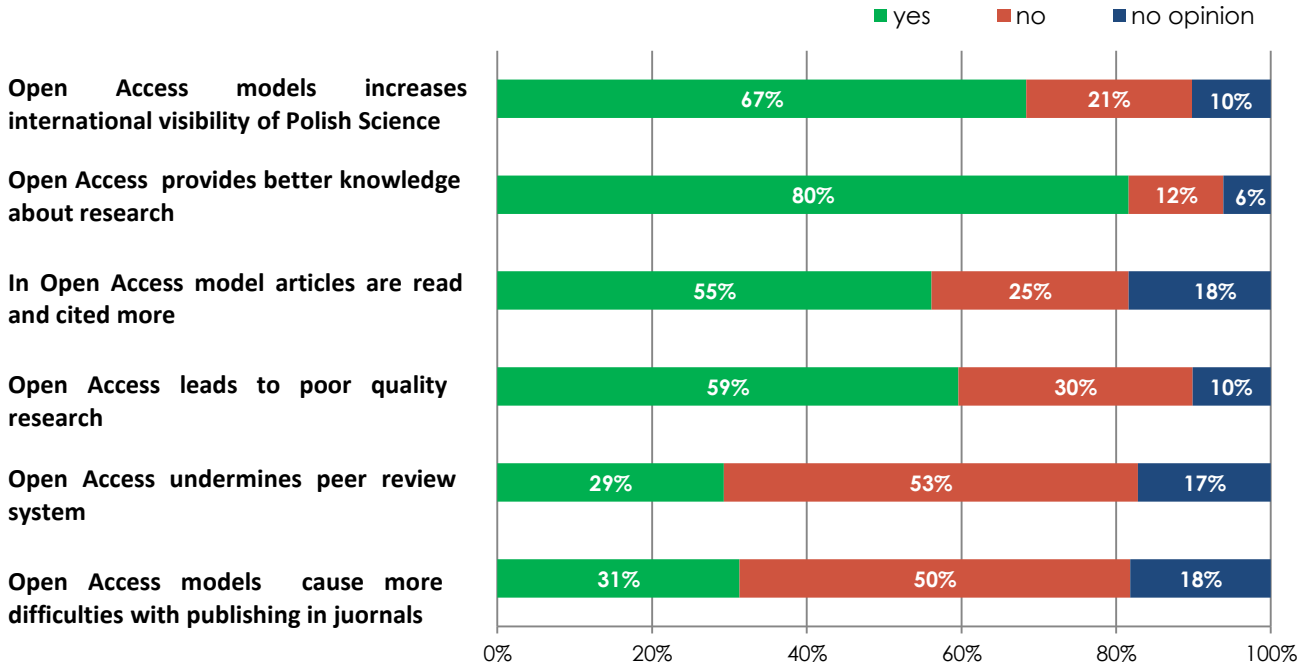

Figure 3. Opinions about advantages/disadvantages of Open Access

An important observation is shared that Open Access may be considered as a process more beneficial for the development of the entire system of knowledge rather than it is the case viewed from an individual scientist perspective and the associated research career. Also we have observed relatively large group of scientists who have not expressed opinion about basic issues of the Open Access (either positive or negative). Those results show that some Open Access concepts and notions are still not quite clear and known among Polish science community - the latter refers not only to open legal basis models of publishing (such as Creative Commons) but also to digital tools providing access to knowledge – repositories. Many scientists (30%) still do not know if the university they are affiliated with provides any repository where they could store publications.

Apart from natural barriers restraining from fully adoption of Open Access models in Poland such as insufficiently developed economic and legal science system, or low awareness among the scientific community, we also noted, as already mentioned, very positive reactions. On the other hand, when we asked the question - do you think scientists in Poland are ready for open access models ? (see figure 4) in most cases the answer was negative: 70% of respondents declared such statement. This can prove that scientists represents positive thinking toward Open Access adoption but in the same time think that others scientist are not ready.

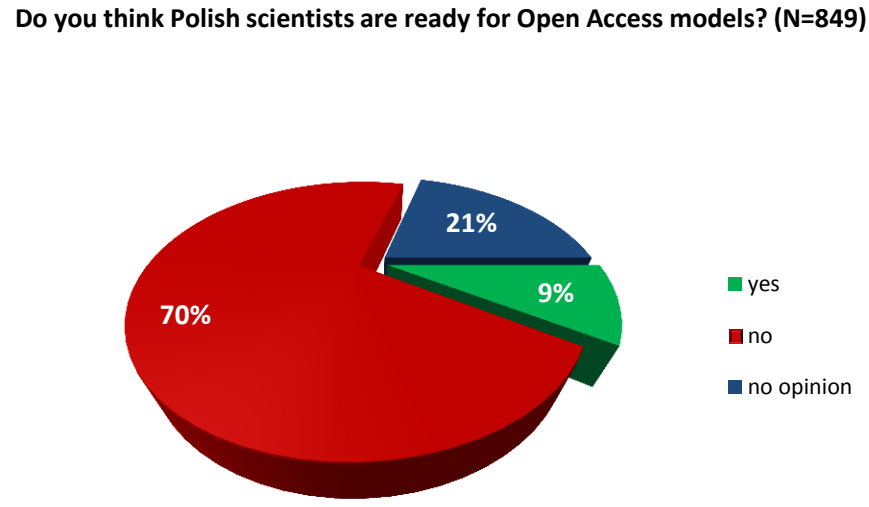

Figure 4. Readiness for Open Access.

However when we take a better look on the aspect of active participating in Open Access model (publishing) we can find that it is deeply above those positive declarations and not so directly linked. 46% of respondents published their scientific outputs in Open Access models (34% in the gold Open Access model, and 12% in the green one).

As such a situation shows, the individuals can be strongly convinced that sharing research results is in general interest of knowledge progress, still they refrain from undertaking any own supporting action. A sort of fear often prevents from any individual implementation of such a model.

The attitude towards Open Access models is in general positive. Scientists are convinced that it could enrich Polish science, thus it should be developed and maintained. The positive opinions about advantages of Open Access models mostly refers to science as whole, less to individual perspectives and scientific careers. There are still many respondents who have never actively met any Open Access models. Among many indicated barriers limiting the development of Open Access models in Poland one of the most important refers to the lacking readiness on the community level to adopt Open Access models. It is quite remarkable that there are many respondents among scientists whose knowledge about Open Access is rather limited.

Open Data

Another central dimension of Open Science, becoming more and more articulated refers to the access to research data. Even though the problem of Open Data is less established in science system, during last years a large amount of new projects addressing this issue were launched. Those initiatives show an increasing need for changes in those matters (Hofmokl et al. , 2009). In Poland, similarly to Open Access questions, discussions about Open Data problems have been just arising among some actors of the

science system scene. It is only the context of the EU Horizon 2020 program that the whole range of problems related to the access to research data have been articulated like never before.

A limited level of discussion and similar to this lack of any supporting action from the Polish government side may create impression that those issues would not be positively recognized among Polish scientific community. Natural fear seems to be more typical than a wide acceptance.

Those are quite common opinions, still the outputs of our research show that the situation is rather different.

The concept of open access to research data is known to more than half of respondents – 67% of them declare to be acquainted with this concept. 89 % of the respondents claim that sharing research data in research practice may positively contribute to a progress in their discipline. Such a high level of support complies with the main arguments addressed by advocates of Open Science, that giving and sharing research data would give extra boost to the process of scientific progress.

Problems of open access to research data are increasingly recognized as of key importance by public agencies supporting research. Those institutions in many cases not only require open access to research publications funded but also impose obligations for prospective grant beneficiaries on granting access to produced research data (NSF). In Poland national funding agencies such as NCN and NCBiR do not require any specific data management plan yet.

Results of the survey show that those political changes in science, even though they have not yet directly affect Polish scientists, still raise positive reactions among them. Most scientists claim that providing access to data after a research project is completed should become a rule and obligation rather than just only any individual act of goodwill. 76% of the responding scientists gave positive answer to the question on an obligation of sharing data from publicly funded research.

Many authors consider the introduction of any model of open access to research data to represent a longer – term process. In that process, an introduction/maintenance of effective and acceptable standards that would ensure a dissemination of specific data, ranges of data, and specify rules for data storage, plays a very important role (RSCP, 2012)**.** This process is by no means easy and in many fields of research raises still a lot of controversies.

Our survey shows that many scientists express serious concern about this process. Scientists fear that data could be misused and misinterpreted by others. Almost half of them share such an opinion (Figure 5).

It should be mentioned that a fear against providing open access to data is compensated by strong positive tendency to consider the lack of access to data as the main source of problems in research practice. 71% of the examined scientists indicated that without access to data the inquiry is less effective while 63% declared that it causes serious slack in research process (Figure 5).

In both cases, equally for positive and negative opinions, we could observe that some 25% of the examined researchers do not have any specific opinion about those issues. The latter may suggest that there is still quite large group of scientists who possibly know little about it.

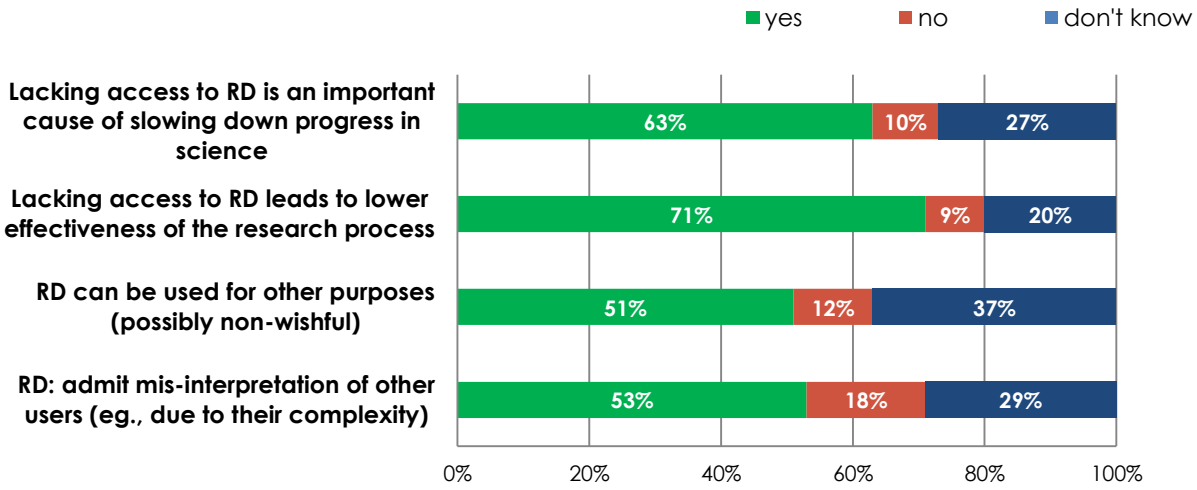

Figure 5. Opinions about Advantages / Disadvantages of Open Data

We also asked scientists about reasons for not sharing research data. The main indicated reason was the lack of appropriate locations to store data (21%) and missing established standards to do so (20%).

Another question refers to the type and range of research data scientists are ready to share. In this connection, 42% of the examined group indicated raw data and outputs of some analytics (scripts, codes), 57% declared readiness to share a detailed documentation of research experiments. 72% support sharing computer software data.

Science 2.0

It has been recently observed that Internet evolves towards higher interactivity, collaboration between web services and stronger position of users who become active producers of the content. The latter trend contributes to setting up new tools, such as wiki, blogs and social services which allow users to share information and create new projects (O'reilly, 2007). Also the changes in science practice go further in this direction.

The way scientists could work with each other on global scale by communicating information and spreading ideas is possible like never before. New science of the 21st century, commonly referred to as Science 2.0, directly refers to the use of the digital technology and e-infrastructures.

In our survey we addressed only few questions dedicated to those matters.

The survey results show that even though Science 2.0 is not yet popular – hardly 40% of respondents have heard about this idea, with expectations raised. In particular, most of the respondents who have heard about social science portals think those portals can be useful as tools for science development (76%). They also declared strong will to join such platforms once appeared and gather scientists from the appropriate research field - (77%) indicated such expectation (Figure 6). When asked about any reason of not utilizing such platforms, the most popular answer of the scientists was “I have no time to do it”.

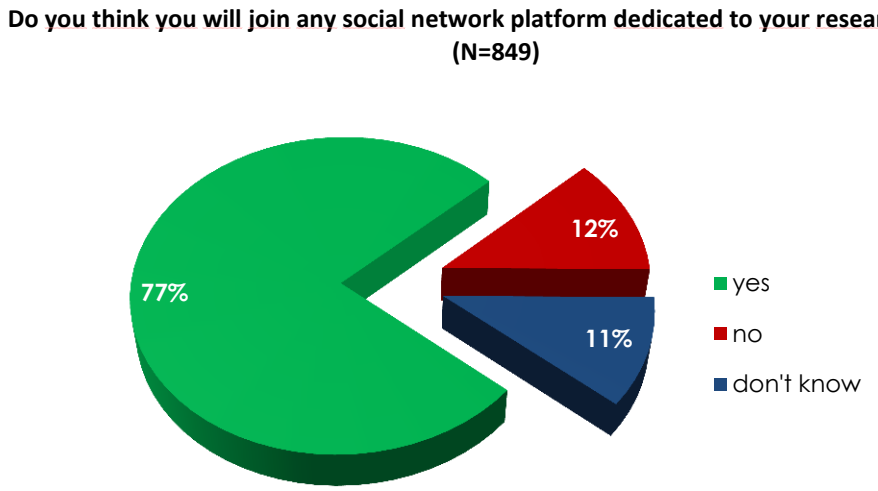

Figure 6. Readiness to participate in Science 2.0 platforms

Like in previous cases (Open Access, Open Data), the survey showed that the level of participation is still very limited. Scientists hardly ever used blogs, wiki and social science portals dedicated to scientific community. Apart from the lack of time, probably the most obvious reason is that any appropriate incentives promoting such a behavior are missing in the science system.

Many authors and advocates of Open Science claim that motivations for scientists to support open knowledge distribution are rather limited because the traditional academic evaluation rules do not promote such a behavior. In this connection, a main dilemma reduces to the question on how to change the culture and system of awards in academia, thus how to ensure that openness becomes equally advantageous to the entire academic system as also to its individual members (Nielsen, 2008).

Summarizing conclusions

Respondents claim positive to Open Models (primarily to the Open Access, eventually to Science 2.0) and they confirm a positive impact of the Open Science onto the entire scientific research in Poland, primarily referring to their own research discipline. Such a positive attitude does not imply the researchers would publish in Open Access models. Still active participation in open models (publishing, sharing research data) remains below a European average level.

Vast majority of the respondents identify a range of barriers that can cause additional bottlenecks for such a process. The respondents claim that the idea of Open Science transformation is insufficiently supported by national funding agencies, in addition the research community itself is not yet prepared to that transformation.

2. ANALYSIS OF THE ATTITUDE: LINEAR REGRESSION MODELS

The overall community attitude, presented above, gives only basic information on what scientists think about Open Science. In order to disclose more interesting relations between variables there was a need to carry out more advanced statistical tests. Our main goal was to find out how the attitude towards Open Science depends on independent variables like sex, discipline, participating in international projects, etc.

The general presumptions we made for the statistical analysis claimed that the general attitude toward Open Science could be discussed in three aspects: cognitive (knowledge about Open Science), behavioral (publishing in Open Science), affective (emotions and feelings about Open Science models). This tripartite conception of attitude was taken from popular and classical distinction used in psychology and social psychology: the attitude toward some object/subject addresses these three main aspects (Marody, 1976)

In this survey we asked a number of questions about Open Science which could be treated as referring to specific dependent variables. To reduce the number of those variables, we applied a standard factor analysis, first aiming to reduce the number of variables and secondly to detect an underlying structure of the relationships between them. The factor analysis was applied to the variables that cover cognitive, behavioral and affective aspects of the attitude toward Open Science. As a result, we have identified three dominating factors:

- Knowledge (about OS),
- Behavior (publishing in Open Access),
- Opinions (positive opinions towards Open Access).

Those three dominating factors were used as new dependent variables. We assumed that they would depend on some predictors (independent variables), including age, sex, discipline, track record in international projects, academic title/degree, experience as research team leader, type of the institution represented, and would also mutually interfere with each other.

To test this presumption we used linear regression models – general statistical method to verify influence one variable on other. We generated three regressions models.

Model I: Positive opinions about Open Access

In the first model we tested how the variable "Positive opinions about open science" would depend on selected predictors. As shown in Table 1, three predictors proved to be statistically significant: *Discipline:* ***Arts and Humanities****, Gender:* ***Female****, and Type of institution:* ***Research Institutes***. The first two ones showed positive influence (Beta > 0) while the third one negative (Beta< 0). The *discipline: Arts and humanities* showed as the most significant and the most dominant/strong influence predictor. In the model, three predictors explained some 5% variance of the dependent variable.

Table 1. Influence of selected predictors on the dependent variable (Positive opinions about Open Science)

Predictors	B	Beta	Sig.
Gender: female	**0,139**	**0,063**	**0,067**
Discipline: Arts and Humanities	**0,464**	**0,194**	**0,000**
Discipline: Medical Science	0,86	0,027	0,487
Discipline: Natural Science	-0,061	-0,024	0,545
Discipline: Exact Science	-0,057	-0,023	0,573
Type of institution: Polish Academy of Sciences	**-0,264**	**0,064**	**0,064**
Type of institution: Research Institutes	0,126	0,038	0,270
Dependent variable: Positive opinions about Open Access			

Model II: Knowledge about Open Science

In the second model, we tested how the dependent variable "Knowledge about Open Science" would depend on selected predictors. As shown in Table 2, four predictors proved statistically significant: *Gender:* ***Female****, Type of institution:* ***Research institutes****, Type of institutions:* ***Polish Academy of Sciences***. The first three showed negative influence (Beta <0) while the fourth one positive (Beta> 0). *Participating in Internationals Research Projects* appeared to be the most significant and the most dominant/strong influence predictor in this model. The weakest significance and weakest influence were observed for *Type of institution:* ***Polish Academy of Sciences***. In this model four predictors explained about 3,5% variance of the dependent variable.

Table 2. Influence of selected predictors on the dependent variable (knowledge about Open Science)

PREDICTORS	B	Beta	Sig.
Gender: female	**- 0,234**	**- 0,104**	**0,009**
Type of institution: Polish Academy of Sciences	**- 0,331**	**- 0,080**	**0,044**
Type of institution: Research Institutes	**- 0,336**	**- 0,099**	**0,013**
Participating in Internationals Research Projects	**0,236**	**0,116**	**0,004**
DEPENDENT VARIABLE: Knowledge about Open Science			

Model III: Publishing in open models

In the third model, we tested how *Publishing in open models* would a) depend on selected predictors and b) interfere with *Knowledge about Open Science* and *Opinions about Open Access*

a) As shown in Table 3, five predictors: ***Participating in international project***, *Discipline* - ***Exact science***, ***Leaders of research project***, *Discipline* - ***Natural science*** and ***Age*** were observed to be statistically significant. The first four of them showed positive influence (Beta > 0) while the fifth one negative (Beta< 0). The most significant and the most dominant/strong influence predictors in this model were: *Discipline*- ***Exact science*** and ***Participating in Internationals Research Projects***. The weakest significance and influence predictor was *Discipline: Natural science*. In the model, five predictors explained about 6,2% variance of the dependent variable.

Table 3. Influence of selected predictors on the dependent variable (publishing in open models)

PREDICTORS	B	BETA	SIG.
Age	**-0,009**	**- 0,106**	**0,013**
PhD holders	0,130	0,060	**0,180**
Professors	0,227	0,076	**0,081**
Discipline: Arts and Humanities	0,105	0,044	**0,275**
Discipline: Medical Science	-0,092	-0,029	**0,444**
Discipline: Natural Science	**0,184**	**0,074**	**0,063**
Discipline: Exact Science	**0,376**	**0,148**	**0,000**
Leaders of Institutes	0,116	0,026	**0,493**
Leaders of Research Programs	0,120	0,029	**0,414**
Leaders of Research Projects	**0,174**	**0,087**	**0,024**
Participating in international projects	**0,290**	**0,146**	**0,000**
DEPENDENT VARIABLE: Publishing in open models			

b) In Table 4, it is shown how *Knowledge about Open Science* and *Positive opinions about Open Access* interfere with publishing in open models. Those two factors (predictors) are statistically significant and both positively and strongly influence the dependent variable *Publishing in open models*. In the model, *Knowledge about Open Science* have greater positive impact than *Opinions about Open Access*.

Table 4. Influence of two dominating factors on the dependent variable (publishing in open models)

PREDICTORS	B	Beta	Sig.
OS_Knowledge	**0,280**	**0,283**	**0,000**
OS_Positive opinions about Open Access	**0,103**	**0,104**	**0,007**
DEPENDENT VARIABLE: Publishing in open models			

Summary of the conclusions following from linear regression models

Representatives of arts and humanities are more positive towards Open Access than others. Such a support declared by the representatives of arts and humanities is somewhat surprising as, usually, Open Science models have been in the first instant associated with life and exact sciences. On the other hand, the results of linear regression models showed that representatives of exact sciences are those who tend to publish more within Open Access models. Such a result is not surprising as in exact sciences, due to their specificity and the very nature of research process there, open models are more acknowledged and more commonly used. The time to result is typically shorter there, hence fast knowledge sharing and addressing abroad audiences are fostered.

The analysis applied showed that international research track records are strongly correlated with publishing in Open Access models and lead to better knowledge on Open Science. The participation of Polish researchers in international projects should get projected into higher knowledge and awareness of Open Science. In the most developed countries, implementation of Open Access policy principles is visibly more advanced. In several countries, Open Access rules have become not only commonly accepted but also mandatory for the results of publicly funded research.

As follows from gathered data, knowledge about Open Science and positive opinions toward Open Access have shown a positive impact on the frequency of publishing in open models. That knowledge has a greater positive impact than opinions.

According to the research results, higher age leads to lower number of Open Access publications.

The use of solutions attributed to Open Science often requires a better knowledge of the Internet environment. Elder generations of scientists are generally less familiar with new technologies and often show higher skepticism in that connection. They are not quite convinced of the relevance of new technology-based research methods, the latter in particular applying to open models.

The Internet environment is in general better known to younger-generation scientists. They utilize Internet tools without reservation and are creative in transferring those tools to other fields of research. The latter effect may affect a better adaptivity to the environment of open models.

Female scientists show lower awareness of Open Science models as well as staff members of research and R&D institutes (compared to university members) and Polish Academy of Sciences. Female scientists are more positive towards Open Access whereas researchers from institutes of the Polish Academy of Sciences are more conservative.

General concluding remarks

Open Science adoption is so far limited in Poland, still Polish scientists consider open models to be an important driving factor for the progress, equally in science as whole and in its individual disciplines. A general impact onto the entire research system is viewed more articulated from the advantages for individual carriers.

Strong open publishing promotion, the related systemic solutions and advantages for individuals contribute to the exposure of Open Access as the main aspect of Open Science. Other key aspects, including open data and Science 2.0, have still somewhat limited visibility.

Polish research community is split in their attitude towards various dimensions of openness. Knowledge of Open Science, positive attitude towards open publishing as well as that of publishing in open models are driven by factors whose majority is of international nature, however some local features referring to a specific national research model can be observed, too.

This report summarizes preliminary observations based on the conducted survey. More comprehensive analysis would still require some supplementary research, in particular of qualitative nature.

References:

David, P. (2007). *The historical origins of 'open science' An Essay on Patronage, Reputation and Common Agency Contracting in the Scientific Revolution*. Oxford Stanford University & the University of Oxford. Avaible from: http://www-siepr.stanford.edu/workp/swp06008.pdf

Hofmokl, J., Tarkowski, A., Bednarek-Michalska, B., Siewicz, K., & Szprot, J. (2009). *Przewodnik po otwartej nauce*. Avaible from: http://otwartanauka.pl/wp-content/uploads/2010/01/przewodnik-po-otwartej-nauce.pdf.

Marody, M. (1976). *Sens empiryczny a sens teoretyczny pojęcia postawy. Analiza metodologiczna zasad doboru wskaźników w badaniach nad postawami*. PWN, Warszaw Avaible from: http://otworzksiazke.pl/images/ksiazki/sens_teoretyczny_a_sens_empiryczny_pojecia_postawy/sens_teoretyczny_a_sens_empiryczny_pojecia_postawy.pdf

Nielsen, M. (2008). *The Future of Science*. Avaible from: http://michaelnielsen.org/blog/the-future-of-science-2.

Niezgódka, M., Czerniawska, D., Leszczyński, K., Szprot, J., Fenrich, W., Bartecki, P., & Siewicz, K. (2011). *Wdrożenie i promocja otwartego dostępu do treści naukowych i edukacyjnych. Praktyki światowe a specyfika polska. Przewidywane koszty, narzędzia, zalety i wady*. Avaible from: http://www.pte.pl/pliki/pdf/OA_ICM_Wdrozenie_i_promocja_otwartego_dostepu_do_tresci_naukowych.pdf

O'reilly, T. (2007). *What is Web 2.0: Design patterns and business models for the next generation of software. Communications & strategies*, (65). Avaible from: http://mpra.ub.unimuenchen.de/4578/1/MPRA_paper_4578.pdf

Peters, M. (2010). The Idea of Openness, In The Encyclopedia of Educational Philosophy and Theory, M. Peters, T. Besley, (eds.). Avaible from: http://eepat.net/doku.php?id=the_idea_of_openness

Royal Society Science Policy Centre (2012). *Science as an open enterprise*. Avaible from*:* http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/sape/2012-06-20-SAOE.pdf

European Commission Recommendation of 17.7.2012 on access to and preservation of scientific information, Avaible from: http://ec.europa.eu/research/sciencesociety/document_library/pdf_06/recommendation-access-and-preservation-scientific-information_en.pdf