The accelerator of open science

The impact of the Finnish Open Science and Research Initiative (ATT)

Lauri Tuomi

2016

CONTENT

![profitmakers]

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Abstract

The aim of this evaluation is to analyse the impact of the Open Science and Research Initiative (ATT Initiative) both nationally and internationally. In addition, the evaluation seeks to offer recommendations for the last operational year of the ATT Initiative, and for the years ahead. Dr. Lauri Tuomi, CEO, Profitmakers Ltd, served as an external evaluator and the process was executed during the period from June to November 2016. The target groups of the evaluation were the research organisations and their staff members, research funders, the national stakeholders, representatives of the innovation ecosystem and international organisations (UNESCO, OECD, European Commission, Nordforsk and Nordic Council of Ministries).

The Open Science and Research Roadmap 2014 – 2017 was utilised as a frame for the evaluation. The impact was evaluated on three levels, namely the interest, policy and operational levels. All in all, the ATT Initiative has been a dynamic, multi-actor and multi-level facilitator of the transformation towards open science. As a whole, the initiative has had a strong impact on the 'interest' level. The ATT Initiative has been able to raise interest in open science among its target groups. However, some variation was found on this level; for instance, its impact in the innovation ecosystem has been weak thus far.

On the second level, the impact has been medium strong. The ATT Initiative has affected the strategies or policies of the target group, but there was great variation among the target groups. For example, in the research organisations the strength of the impact varied according to the level of maturity in open science. On the operational level, the impact has been weak. However, there are many activities that focus on the operational level of the target groups (i.e. services for researchers). Thus, the impact is expected to increase during the final period of the ATT Initiative.

Finally, the target groups generated a set of ideas for the ATT Initiative's operations in its final year, 2017. The ideas cover the following themes: (1) active participation in international forums, (2) collection of best practices, (3) special attention towards open innovation and (4) specific actions in order to activate the researchers and staff members.

All the participants in the evaluation process highlighted the importance of the continuation of the ATT Initiative in some form. The current collaborative and practical approach has been praised. Finland is seen as a forerunner in open science and thus the conceptualisation of the ATT Initiative has been expressed as a wish by international organisations. There is a need to carry out national-level transformations both in Europe and globally. This may provide an opportunity for Finland to establish itself as a forerunner in open science.

Avoimen tieteen ja tutkimuksen (ATT) hankkeen vaikuttavuus

Tiivistelmä

Tämän selvityksen tavoitteena oli tunnistaa opetus- ja kulttuuriministeriön asettaman poikkitieteellisen ATT hankkeen vaikuttavuus kansallisesti ja kansainvälisesti. Koska hanke jatkuu vielä vuoden 2017 loppuun, tavoitteena oli tunnistaa kehitysideoita sekä viimeiselle vuodelle että yleisemmin avoimen tieteen ja tutkimuksen edistämiseksi tulevaisuudessa. Hankkeen ulkoisena arvioitsijana toimi KTT Lauri Tuomi, CEO, Profitmakers Oy. Arviointityö tehtiin kesäkuun ja marraskuun 2016 välisenä aikana. Arvioinnin kohderyhmiksi valittiin tutkimusorganisaatiot ja näiden henkilöstö, tutkimusrahoittajat, hankkeen kansalliset sidosryhmät, innovaatio ekosysteemi sekä kansainväliset organisaatiot (UNESCO, OECD, Euroopan komissio, NordForsk ja Pohjoismaiden ministerineuvosto).

Avoimen tieteen ja tutkimuksen tiekartta 2014-2017 toimi arvioinnin viitekehyksenä. Yhteenvetona voidaan todeta, että ATT-hanke on kohderyhmien mukaan ollut dynaaminen, monitasoinen ja monitoimijalähtöinen avoimen tieteen ja tutkimuksen muutoksen vauhdittaja. Vaikuttavuutta tarkasteltiin kiinnostuksen herättämisen, strategioiden kehittymisen sekä arkikäytäntöjen näkökulmista. Kokonaisuudessaan ATT-hanke on ollut kohderyhmissään vahva vaikuttaja kiinnostuksen herättäjänä. Tällä tasolla tunnistettiin jonkin verran kohderyhmien välistä vaihtelua. Esimerkiksi innovaatioekosysteemin kohderyhmässä vaikuttavuus on vielä vähäistä.

ATT-hankkeen vaikutus kohderyhmien strategioiden kehittymiseen on ollut keskivahvaa. Tästä näkökulmasta tarkastellen vaihtelua kohderyhmien välillä on jonkin verran. Esimerkiksi yliopistojen, ammattikorkeakoulujen, tutkimuslaitosten ja yliopistollisten keskussairaaloiden kohdalla vaikuttavuuteen näytti vaikuttavan organisaation asemoituminen Avoimen tieteen ja tutkimuksen kypsyystasolla. Mitä kypsemmällä tasolla organisaatio oli sitä vahvempaa oli hankkeen vaikutus strategioiden kehittymiseen. ATT-hankkeen vaikutukset kohderyhmien arkikäytäntöihin näyttää vielä vähäiseltä. Hanke on tuottanut ja tuo vielä loppuaikanaan runsaasti juuri henkilöstölle suunnattuja palveluita, ja siten vaikuttavuuden voi odottaa vahvistuvan tulevaisuudessa.

Kohderyhmät tuottivat runsaasti ideoita hankkeen jatkokehittämiseen. Keskeiset teemat olivat: (1) aktiivinen osallistuminen kansainvälisillä foorumeilla, (2) hyvien käytäntöjen kokoaminen, (3) erityishuomio avoimeen innovaatioon ja (4) erityishuomio henkilöstön aktivointiin.

Kaikki kohderyhmät korostivat jatkuvuuden merkitystä. Erityisesti kiitettiin nykyistä kokonaisvaltaista, osallistavaa ja käytäntölähtöistä otetta hanketyössä. Suomea pidetään avoimen tieteen ja tutkimuksen edelläkävijänä. Kansainväliset kohderyhmät ovat esittäneet ATT-hankkeen konseptointia ja vientiä Eurooppaan sekä globaalisti maakohtaisten muutosprosessien toteuttamiseksi.

Effekten av projektet Öppen vetenskap och forskning (ATT)

Sammanfattning

Syftet med denna utredning var att analysera den nationella och internationella effekten av det tvärvetenskapliga projektet ATT som undervisnings- och kulturministeriet har inlett. Eftersom projektet fortsätter till slutet av år 2017, var målet att ge rekommendationer för det sista året samt mer allmänt om utvecklingen av öppen vetenskap och forskning i framtiden. ED Lauri Tuomi från CEO, Profitmakers Ab verkade som utomstående utvärderare av projektet. Utvärderingsarbetet genomfördes under perioden juni–november 2016. Målgrupper i utvärderingen var forskningsorganisationer och deras personal, finansiärer av forskningen, nationella intressegrupper, representanter för det innovativa ekosystemet samt internationella organisationer (UNESCO, OECD, Europeiska kommissionen, NordForsk och Nordiska ministerrådet).

Den vägledande planen för öppen vetenskap och forskning 2014–2017 fungerade som referensram för utvärderingen. Sammanfattningsvis kan konstateras att projektet ATT har enligt målgrupperna varit dynamiskt och det har stimulerat utvecklingen inom öppen vetenskap och forskning på flera nivåer och utifrån olika aktörer. Effekten granskades ur olika synvinklar: intresse, strategier och daglig praxis. I sin helhet har projektet ATT varit en stark intresseväckare i målgrupperna. På den här nivån fanns en del variation mellan målgrupperna. Till exempel i målgruppen för innovationsekosystemet var effekten ännu liten.

Effekten på utvecklingen av målgruppernas strategier har varit medelstarkt. Ur denna synvinkel finns en viss variation mellan målgrupperna. Till exempel när det gäller universitet, yrkeshögskolor, forskningsinstitut och universitetssjukhus ser effekten ut att påverkas av organisationens position inom öppen vetenskap och forskning. Ju mer utvecklad organisationen är, desto större inverkan har projektet på utvecklingen av strategierna. Effekterna på daglig praxis verkar ännu vara små. Projektet har fört med sig många nya tjänster som riktar sig till personalen och många fler är på gång under den sista perioden. Därmed kan även effekten väntas öka i framtiden.

Målgrupperna hade många idéer för vidareutveckling av projektet. Centrala teman var: (1) aktivt deltagande på internationella forum, (2) sammanställning av god praxis, (3) särskild uppmärksamhet för öppna innovationer och (4) särskild uppmärksamhet för aktivering av personal.

Alla målgrupper betonade betydelsen av kontinuitet. Speciellt uppskattades det övergripande, aktiverande och praktiska tillvägagångssättet. Finland betraktas som föregångare inom öppen vetenskap och forskning. De internationella målgrupperna har föreslagit konceptering av projektet ATT samt export av det till Europa och över hela världen för att förverkliga nationella förändringar.

Preface

How to analyse the impact of Finnish open science and research Initiative

Openness is a key scientific principle. Openness creates new opportunities for participation by researchers, decision makers and the general public. The benefits extend to all branches of society. Openness makes science more reliable, efficient, and responsive to societal challenges.

Interdisciplinary research has more potential than ever before because digitalisation is changing the way how research is carried out. The same happens in traditional research fields. Openness accelerates this process. Open science also has potential to enable economic growth and innovation through reuse of scientific information.

In 2014, the Ministry of Education and Culture of Finland released the Open Science and Research Roadmap 2014–2017, which sets the policy framework for national efforts in the field. This report analyses success in achieving targets, and the progress and impact of individual measures.

The analysis tackles different levels, from the level of international policies to the 'grassroots' level. Has the initiative managed to change the culture towards openness, and what actions should we take to gain benefits from this and to ease the transition towards openness?

The report tackles several key questions related to open science and research. How are researchers harnessing the benefits of open science and research? What are the societal benefits? What are the challenges? How should we support the way forward? Can we learn something from this approach to managing system-level changes?

The suggestions of this report form an important viewpoint for defining future action in open science and research. Finally, we would like to express our sincere gratitude to the numerous persons who have participated in the interviews, answered the questionnaires and the web brainstorming. Without your efforts, the evaluation process would not have been possible.

Juha Haataja, Eeva Kaunismaa, Sami Niinimäki and Pirjo-Leena Forsström

1. The goals, methods and process

The aim of the evaluation is to analyse the impact of the Open Science and Research Initiative (ATT Initiative) both nationally and internationally. In addition, the evaluation seeks to offer recommendations for the last operational year of the ATT Initiative and the years ahead. Dr. Lauri Tuomi, CEO, Profitmakers Ltd, served as an external evaluator and the process was executed during the period from June to November 2016

The Roadmap 2014 – 2017[1] (Ministry of Education and Culture 2014) formed the framework for the evaluation. Especially the responsibilities of different target groups described in the roadmap will be applied. In addition, the possible impact of the overall megatrend of open science will be taken into account and thus the focus is on the direct impact of the ATT Initiative. The overall framework for the evaluation is described in Figure 1.
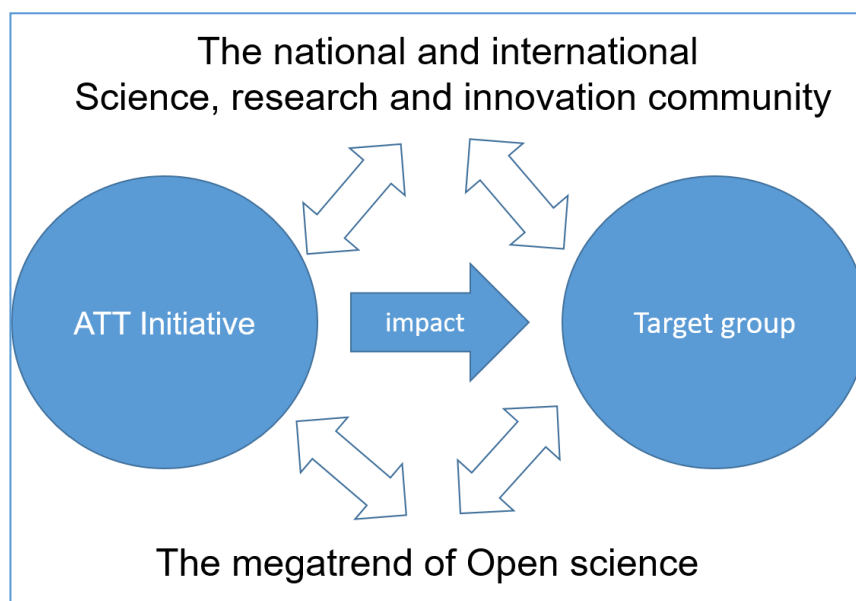

Figure 1. The framework for the evaluation

Individual and group interviews (thematic), questionnaires and web brainstorming will be used as methods (Table 1). In addition, all the documentation (with some limitations due to confidentiality) of the ATT

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[1] http://www.minedu.fi/OPM/Julkaisut/2014/Avoimen_tieteen_ja_tutkimuksen_tiekartta_2014_2017.html?lang=en

Initiative was provided electronically to the evaluator through the 'eduuni' service. All the interviews were either recorded or manually transcribed, and the content analysis was then executed. The data of the web brainstorming was analysed by using the analysis system of Fountain Park Ltd (explained in more detail in Chapter 3).

Table 1. The targets and methods

The targets	The method
Researchers and staff members	Web brainstorming / Crowdsourcing
Research organisations	Interviews
Research funders	Interviews
National stakeholders	Email questionnaire
Innovation ecosystem	Interviews
International organisations	Interviews
ATT projects	Group interview, documentation
Operational groups of the ATT Initiative	Group interview, documentation
Contracts	Interviews, documentation

The thematic interviews followed the same structure:

1) Background of the interviewee
2) Discussion on the impact (three levels)
3) Responsibilities for the target group (the roadmap)
4) Ideas for the ATT Initiative for the year 2017
5) Ideas for the future

The impact was analysed by using a three-level structure. The levels are presented in Table 2.

Table 2. The levels of impact

Level of the impact	Description
Intangible impact/Interest	The ATT Initiative has raised interest in open science in the target group
Tangible impact/Policy	The ATT Initiative has affected the strategies/policies of the target group

Tangible impact/Operations	The ATT Initiative has affected the operations of the target group

The evaluation process follows the guidelines provided by the European Union Commission (Commission Guidelines for Evaluation) and American Evaluation Association (AEA). The main principles applied are the following:

- ✓ Systemic inquiry of data (accuracy and credibility)
- ✓ Competence of the evaluator (education, ability, skills, experience)
- ✓ Integrity (well-defined process, documentation, procedures)
- ✓ Respect for people (confidentiality, understanding the contextual elements of the evaluation)
- ✓ Responsibilities for the society (diversity of general and public interests and values are taken into account)

The terms used in this report on Open science and research follow the definitions of Open Science and Research Handbook[2]. The main terms used in the report:

Open science (OS) means the promotion of an open operating model in scientific research. The key objective is to publish research results, along with the data and methods used, so they can be examined and used by any interested party. Open science includes practices such as promoting open access publishing, open access publishing itself, harnessing open-source software and open standards, and the public documentation of research processes with 'memoing'.

Open data refers to unprocessed information accumulated by research organisations, researchers, public administration, companies or private persons that is made freely accessible to third parties for use without charge.

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[2] http://openscience.fi/handbook

2. The researchers and staff members

Crowdsourcing was utilised in order to elicit the participation of the researchers and staff members of universities, universities of applied sciences, research institutes and societies of science. The aim was to understand the current status of open science at the 'grassroots' level and thus get a view on the impact of the ATT Initiative.

Crowdsourcing also provided a forum for providing information about the ATT Initiative. The crowdsourcing process was executed with a virtual brainstorming service provided by Fountain Park Ltd [3]. In total, 365 respondents participated in the virtual brainstorming, representing universities (49%), universities of applied sciences (24%), research institutes (18%), university hospitals (2%) and other organisations (6%).

All the disciplines of science were represented among the respondents (Table 3). Moreover, 20% of the respondents did not identify themselves as belonging to any of the disciplines (e.g. if their tasks consisted of e.g. services in the institute).

Table 3. The disciplines

Natural sciences / RDI / education	22.5
Not relevant (e.g. services)	20.2
Social sciences / RDI / education	16.5
Engineering and technology sciences / RDI / education	14.2
Medical and health sciences / RDI / education	11.6
Humanities sciences / RDI / education	8.6
Other sciences / RDI / education	4.1
Agriculture and forestry sciences / RDI / education	2.2

The tasks of the respondents are presented in

Table 4. In all, 47% of the respondents work in researcher positions (senior, junior or research/RDI services), and 21.4% in middle or top management

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[3] http://www.fountainpark.fi/en/services/what-is-a-virtual-brainstorm/

positions. The rest of the respondents represent a wide range of tasks of their institutes (e.g. education and library).

Table 4. The tasks

Task	%
Researcher / RDI, senior position (doctoral degree)	18.0
Research / RDI services	15.7
Team / middle management	13.5
Researcher / RDI, junior position	13.5
Other tasks	8.6
Top management	7.9
Pedagogic / curricula planning	5.6
Information services/library	5.2
Quality / processes / planning	4.1
ICT services	3.7
Communication/marketing	1.5
Commercial services	1.1
Student services	0.7
International services	0.7

Virtual brainstorming as a process

The respondents were asked first to articulate their viewpoints on *how open science could benefit the respondent in his/her tasks*. In all, 158 different topics were generated. In the second phase, the respondents were asked to prioritise the topics. In this part, the virtual brainstorming tool served as a virtual 'dartboard' (Figure 2). The 'dartboard' enables the brainstorming software to transform qualitative information to quantitative data. Thus, both the importance (i.e. the measure of how close the selected topic is to the centre of the virtual 'dartboard') and the disagreement (i.e. the deviation between the responses) can be calculated on each of the topics.
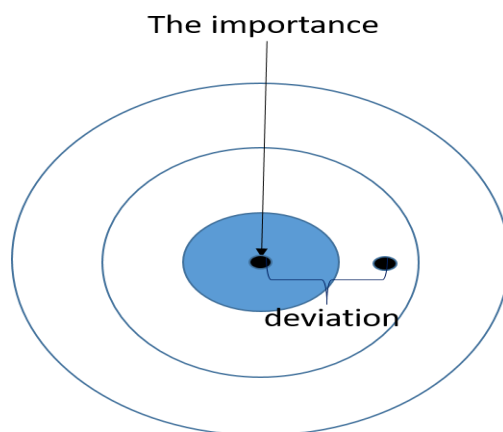
Figure 2. The 'dartboard' tool

Open data – the most discussed topic

The most discussed topics – i.e. the topics that were found on the textual content of the brainstorming[4] – are: data, collaboration, innovations, funding, publications and infrastructure. The most discussed topics are set on the scales of importance (high-low) and disagreement (high-low) in Figure 3. '**The data'** is the most discussed topic and it was seen as an important issue benefiting the staff members in their tasks.

The comments by the respondents concerned topics such as the sharing and reuse of data, access to valid data and metadata. '**Collaboration'** was the second most discussed topic, generating high disagreement but only a modest level of importance. Regarding collaboration, the responses covered topics such as 'open science provides new possibilities for collaboration'. The discussion around the innovations (e.g. open innovation) and funding (e.g. funding as a source for open research) divided the respondents on their views on how beneficial these issues are for them.

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[4] The qualitative data of the most discussed topics can be found on: http://urn.fi/urn:nbn:fi:csc-kata20161115145530790471

Figure 3. The most discussed topics

The most beneficial topics – close to the daily practices of staff members

By locating all the topics on a grid by using the scales of importance and disagreement (Table 5), a complete picture can be formed on how open science could benefit the staff members. The upper left corner of the grid covers the topics that were seen to be the most important and on which the disagreement was low. All in all, these topics consist of issues that are **close to the daily practices** of a staff member.

The most important topic is *access to open publications*. The second most important topic is *sharing and reuse of data*. The *ethics and verification of results* is the third most important issue. *Infrastructures, international collaboration and access to valid data* are ranked from the 4th to the 6th on the scale. *Easy and free access to most recent research* is the 7th most important issue. Regarding the 8th issue, the respondents state that open science enables them to *focus on the specialities* because the results achieved by

others are in use. Finally, the 10th issue is *funding, which* is seen as an enabler of open science.

Table 5. The importance and disagreement on the topics

Most important	
High relevance, low disagreement	**High relevance, high disagreement**
1. Access to open publications	1. Quality
2. Sharing and re-use of data	2. Quality of research improves
3. Ethics and verification of results	3. Surprising findings motivates to continue
4. Infrastructures	4. Cost-effective use of resources
5. International collaboration	5. Better quality of data
6. Access to valid data	6. Sharing results allows bettor focusing
7. Easy and free access	7. Open innovation
8. Don't have to do everything by ourselves	8. How to guarantee quality?
9. possibilities for collaboration	
10. Funding	
Low relevance, low disagreement	**Low relevance, high disagreement**
1. Incentives	1. No access management everywhere
2. Open, shared data and software motivates the earlier work	2. Until now open science intiatives have not benefited me
3. Competence development	3. Opening up research results is the way to go - with limits
4. Hands on facilities for data mining and reserch cooperation	4. Open data of cities (transport, activity, use of energy)
5. Collaboration possible in small research areas	5. Open innovation sounds good, but who owns it?
6. Co-creation with businesses	6. Open use of public scientific environments to companies
7. Parallel publishing is at the moment the best way	7. Interdisciplinary continuing training programmes
	8. Open source code makes e.g. optimization methods applicable
	9. testing in the way to larger understanding.
	10. How to use augmented reality as added value

RELEVANCE (MEAN) ↑ — DISAGREEMENT (STDDEV) →

Topics regarding the quality of the research are considered to be important, but similarly there is high disagreement among the respondents. In the upper right corner, the quality of the research is seen from three different perspectives. First, openness is seen leading to quality by hindering fraud. Secondly, the quality of the research is ensured if the data can be evaluated by other researchers. Third, the ethical aspect of open data is linked to quality, too. Other highly relevant topics involving high disagreement deal with findings, resources, sharing of the results and open innovation.

The topics that were ranked low in terms of importance and which involved high disagreement are located in the bottom right corner of the grid. These topics are more specific in their nature. Examples of specific topics include the arguments that openness decreases managerial work and that open science initiatives have not benefited the respondent thus far. Also, the respondents are divided on the third topic in this corner: *opening up research results is the way to go – with limits*. On this topic, the respondents state that their feelings are positive towards open science but that there are unanswered questions concerning issues such as incentives, publishers' cost, contracts,

commercialisation, etc. The rest of the topics in this corner are: open data of cities, IPRs, companies and open science, open source code, testing and experimentations and augmented reality.

The bottom left corner contains topics that have not been seen benefiting the tasks of the respondent in the context of open science. The topics in this corner include a number of specific examples such as data mining, hindrances to parallel publishing, small research areas and software. Moreover, incentives, competence development and co-creation with businesses were ranked low.

Open publishing is the most utilised form of open science

In the final section of the virtual brainstorming, the staff members were asked what forms of open science they had utilised so far (Figure 4). Almost all of the respondents (98%) had already used open publishing/manuals or blogs. Open data was utilised by 63% of the respondents. Open code was utilised by 45% and a data management tool by 43% of the respondents. Open peer review was utilised by 28% of the respondents.
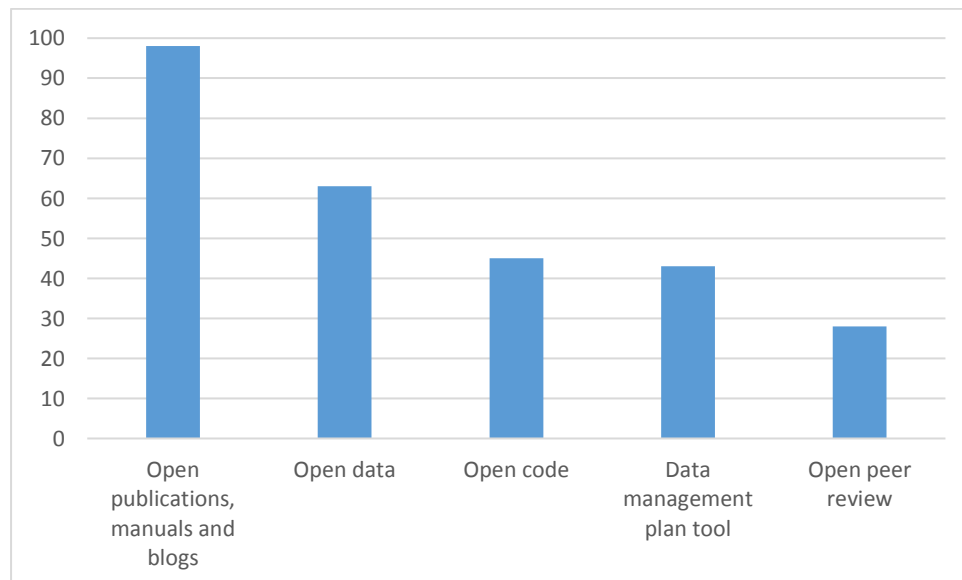

Figure 4. The utilised forms of open science

Finally, the staff members were asked if they were familiar with the website of the ATT Initiative (www.openscience.fi or www.avointiede.fi). Most of them

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were familiar with the website (69%). However, it is important to note that 31% of the respondents did not know these websites before the brainstorming.

All in all, the list of the most important issues benefiting the staff members in their tasks can be used as a 'checklist' for the facilitation of open science in higher education and research institutes. Interestingly, there were some topics that were ranked low but are traditionally seen as means of ensuring the implementation of open science at the grassroots level, such as competence development, incentives and funding. A possible interpretation for this may be the fact that, if open science tools and services are not used to support daily work, the competence development, incentives, etc. will not benefit the transformation towards a new working culture.

The results of the virtual brainstorming cannot be generalised as such but they indicate that open science is a topic that the staff members are ready to discuss. There are many questions still to be answered. However, the transformation has started. Open publications are utilised by almost all respondents. Clearly, the next 'wave' of transformation focuses on open data – which was the most discussed topic. All in all, it can be determined that the ATT Initiative has had a partial impact at the grassroots level. The websites of the ATT Initiative are familiar to 69% of the respondents. However, there is still much to do as 31% of the respondents were not familiar with the websites before the virtual brainstorming.

The key findings:

- ✓ The practical issues that support the tasks directly benefit most the transformation towards OS
- ✓ Open data is the most discussed topic and the next 'wave' in the transformation towards OS

3. Higher education, research institutes and university hospitals

The roadmap of the ATT Initiative consists of a wide range of responsibilities targeted at research organisations. The topics cover strategic and policy development, services for researchers, competence development, promotion of interoperability, encouragement of the use of common service infrastructures, improvement of the replicability of research and overall promotion of openness.

In all, 14 thematic interviews were conducted among universities, universities of applied sciences, research institutes and university hospitals in order to evaluate the impact of the ATT Initiative. The interviewed research organisations cover all the levels of the maturity assessment. The results of the assessment of 2015 and 2016 were bases for the selection of the organisations. The ATT Initiative conducted the maturity assessment, which provides information on the open operational culture of the organisations. There are five levels of maturity. In this evaluation, levels 1 and 2 are later called 'the lower levels' and levels 3 to 5 are called 'the higher levels' of maturity.

In order to have a wider perspective on the situation in the research field, the representatives of Unifi (Universities Finland) and Arene (The Rectors' Conference of Universities of Applied Sciences) were interviewed. Also, a representative of the National Library of Finland was interviewed in regard to background information on OS in the field. Moreover, the representatives of the R&D&I directors' network of universities of applied sciences were interviewed, as the entire sector initiated OS efforts later than academic universities.

Open science in research organisations today – libraries' role is changing and close collaboration with business promotes (or hinders) openness

The representatives from Unifi (Universities of Finland) and Arene (Rectors' Conference of Finnish Universities of Applied Sciences) highlighted that openness is included in their strategies and present in their daily practices. Due to the autonomy of individual higher education institutes, both Arena and

Unifi operate by discussing current topics and forming unanimous decisions and statements on these opinions. Also, both organisations stated that they are willing to participate – not just follow – the operations of the ATT initiative.

All in all, the concepts of open science and open innovation seem to be well suited to the field of **universities of applied sciences**. Close collaboration with businesses (incl. SMEs) and a user-driven approach in research, development and innovation call for the widening of the approach of the ATT Initiative more towards the business sector. Currently, it seems that almost all universities of applied sciences have started operations on open science. According to the interview with the representative of Arene, the first assessment of maturity has been an eye-opening process and a change driver.

According to the interview with the representative of Unifi, in the field of **academic universities**, the ATT Initiative has operated directly with individual universities and not that much with Unifi. Thus, in Unifi's forums the Initiative has not been on the agenda even though open science as a phenomenon has been included on the agenda. All in all, it seems that academic universities have been ahead of universities of applied sciences in implementing open science into their strategies and practices.

The interviewees of **the research institutes and university hospitals** highlight that openness is one of their values due to the fact that they mainly operate with public funding. In most cases, all the basic services (e.g. the guidelines for parallel publishing) have been developed, and openness is included in the strategy. The specific tasks of the research institutes may either hinder or accelerate their efforts to achieve openness. In one of the institutes, there were challenges in obtaining public data for reasons such as juridical interpretations or the practices and guidelines of other public organisations operating under different ministries. University hospitals had encountered the same problem. Greater interaction with different ministries is expected in order to promote open science in practice.

Another issue that may be seen as a barrier to open science is close **collaboration with businesses**. This may lead to the closing of research data and results. In some cases, close collaboration with businesses has led

to a situation in which open science is not promoted almost at all in the organisation. Interestingly, in another case, close collaboration with a business has led to greater openness. In this case, a research-intensive company gave part of their research data to the research institute in order to create a common large dataset (targeting big data). The reason for this was the expectation that the large dataset would lead to better results and new innovations than could be achieved with separate data collection in different organisations.

All in all, it seems that the libraries' role is changing and strengthening due to open science. The **National Library of Finland** coordinates the training offerings of the ATT Initiative and a number of their personnel are involved in the operations of the ATT Initiative. The National Library of Finland's role is important in terms of, for instance, providing expertise on metadata and an open publication archive platform and promoting open access by means such as negotiating with the publishers. Thus, it seems that libraries are becoming a more equal partner with researchers, providing the knowledge, tools and services on open science. The representative of the National Library of Finland highlights that open science provides huge possibilities for the future if, for instance, citizens and businesses utilising open data and also libraries are willing to create this kind of world together with other organisations.

The ATT Initiative fights for the top managements' attention

From all the interviews, it became evident that the ATT Initiative fights for the attention of the rectors with the many grand challenges that higher education faces today (e.g. structural changes and financial savings). Thus, the more strategic open science is valued in the institute, the stronger the impact. If the institute's strategy does not embrace open science and the ATT Initiative, resourcing is not taken into account either – due to which policies, guidelines, services, etc. are not being developed and/or implemented.

Also, it may be the case that the top management has not been interested in learning more about open science. In those cases, it may be that the top management decides not to allocate resources to open science due to their own (often erroneous) interpretations of the ATT Initiative. In some institutes with lower levels of maturity, it became evident that top management may be

committed – but not fully - to open science. Then decisions are made only because they are considered to be compulsory according to the signals from the Ministry of Education and Culture. In these cases, the implementation of open science is only partly executed. In these institutes, it seems that the top management and the persons responsible for OS live in two different 'realities'.

Not only the commitment but also the involvement of top management

From the interviews, it became evident that the transfer towards OS needs not only (1) a decision to include OS in the strategy but also (2) a strategic positioning of OS in terms of how important it is compared to the actual challenges in the higher education sector. If these two steps are taken, then the top management is not only **committed** to OS but also **personally involved** in ensuring the transformation. As one of the managers said: *"My role is strategic. We have made a decision to be a forerunner. Thus, OS is a part of my normal work and my role is to make the change."* Most of the interviewees highlighted that the ATT Initiative has provided guidelines, tools and services to make the transformation possible. Without the ATT Initiative it would have been much harder and more expensive to create the tools and services and develop the competence of staff members.

Institutes with lower levels of maturity – the impact varies

There seem to be different reasons why some institutes have lower levels of maturity. There are still institutes that have not interacted with the ATT Initiative or have ignored the information and thus their top management is not familiar with the roadmap, for instance.

Moreover, at top management level, the **lack of knowledge** of open science and the ATT Initiative may lead to **misunderstandings** about the concept. For example, one of the interviewees said that their research data has *always* been available to the research team and that their students have access to all the main publications in the field. In this case, openness is seen traditionally only from the university's point of view – not from the society's.

Key persons with open science experience recruited from other organisations seem to have an important role in starting the transformation.

They bring knowledge of open science and the services of the ATT Initiative to their new workplace. At two of the interviewed institutes, these key persons have been the drivers of change and they have served as advisors for the top management, too. In addition, the training organised by the ATT Initiative has been one of the tools used to widen the pool of competent 'change agents'.

Interestingly, at one of the interviewed institutes, the forthcoming impact evaluation interview was a driver for starting the first steps towards open science.

All in all, it seems that the libraries have a vital role in starting the discussion on OS and its implementation in the institutes with a lower maturity ranking. The representatives of the libraries seem to be well-informed about the ATT Initiative. However, the libraries understand they cannot carry out a cultural transformation on their own, and thus many of them have made initiatives for the top management to start the transformation, such as by drafting the policy lines of OS.

The institutes on the upper levels of maturity – strong impact and future-orientation

Future-orientation, top-management involvement, openness in the value base, clear strategies, outward-looking way to operate and systemic implementation of open science are the main differences between the institutes with higher and lower levels of maturity.

According to the interviewees, open science and openness are factors that holistically affect **the future of higher education**. "*Universities used to have a role in analysing and collecting data. What is their role in the future? Think about a world where all the data is available and you have access to all publications. The target groups will be something totally new. So much happens in this surface [i.e. university-society],*" says one university director.

A systemic way to implement the responsibilities stated in the roadmap of the ATT Initiative is prominent in the institutes with higher maturity rankings. At one of the interviewed institutes, the strategy was implemented by, first, producing specific open science policies and then developing their own version of the roadmap. The preparation of the roadmap was assigned to a

team of experts and then the final decision was made by the top management.

The outward-looking way to operate has been one of the factors that has shed light on the societal need to utilise open science in the institute. All of the interviewees were actively involved in the operations of the ATT Initiative. Moreover, most of them were actively participating in international working groups of open science, too. **This 'open' way to operate** provided the institutes with the newest knowledge on the progress in open science both nationally and internationally.

Internally, these institutes engaged in different operations for the development of open science. Research/RDI services, libraries and ICT services were the key actors. The interviewees pointed out that there is a need to involve teachers and curricula developers in the implementation of open science. Moreover, the interviewees point out that all the students (and more specifically doctoral students) should be provided with the latest knowledge of open science.

The conclusions on the impact in research organisations

The impact of the ATT Initiative has been strong (Figure 5) on the institutes with higher levels of maturity. More precisely, a strong impact can be found on (1) raising the interest towards open science (i.e. the intangible/interest level), (2) affecting the strategies and policies of the institute (i.e. the tangible/policy level) and (3) affecting the procedures and guidelines of the institute (i.e. the tangible/operational level).

Figure 5. The impact on institutes with high ranking on maturity

However, at institutes with lower levels of maturity, the picture of the impact is much more **complex** (Figure 6). In some cases, it can be detected that the impact is almost zero. The management of the institute may have ignored both the ATT Initiative and the overall discussion on open science by arguing that there are 'much more important things to do'. There may be many reasons for this: financial or structural renewal of the institute, misinterpretations or lack of knowledge of open science, etc. However, as noted before, at these institutes the change may have been started, for instance, by the library or ICT services, which operate closer to the researchers and students. Thus, in Figure 6 the impact is described, providing an overall picture of the situation. The figure shows that most of the institutes have started open science efforts, while some are sceptical about the need for change and instead focus on other issues than open science.

Figure 6. The impact on institutes with low ranking on maturity

Positively, in many cases even though the institute is at a lower level of maturity, the institute **may have woken** to the need to start the process of transformation. Then, fast progress is possible if the change is processed together with institutes with higher maturity rankings. The interviewees raised many examples of how they are able to learn from the experiences of others, and also that, for instance, they are developing new services together with their colleagues. Also, collaboration with the ATT Initiative was mentioned as a tool to enhance and accelerate change.

Ideas for the future

The interviewees provided a huge number of ideas for the future. The ideas can be categorised into four themes: (1) the evidence of the benefit, (2) the role of higher education, research institutes and university hospitals, (3) the ATT Initiative's way to operate and (4) content themes of open science.

The ideas generated on creating evidence of the benefit of open science:
- Best practice cases are needed from different disciplines
- Ecosystem cases

- The critical debate and research on open science as such
- Measures of impact

Ideas generated on the role of research institutes in the future:
- Discussion on the future of universities and open science
- Open science linked to e.g. the quality systems of organisations
- Will open science be included in the result-based funding structure?
- University hospitals recognised as research organisations (currently not funded by bodies such as TEKES)
- How to involve the personnel in OS
- The specific competencies of libraries need development (e.g. bibliometrics, altmetrics and information design)
- The students' involvement in OS – curricula design

The ideas generated on open science:
- Business models
- Ownership and IPRs
- Funding modes for open access publishing
- Qualitative data as open data
- Validation of data and its reuse
- Ethics and open science

Ideas generated for the ATT Initiative's possible way to work:
- ATT Initiative as an accelerator – impulses for the society
- In 2017, a strong focus on selected topics
- Participation of a wide range of stakeholders
- Communication and interaction
- Participation on international forums – especially EU
- Discussion forums
- Removal of the barriers in the society on open science

The key findings:
- ✓ **The impact varies according to the maturity level of open science**
- ✓ **The commitment and involvement of top managers needed for the transformation**

4. Research funders

Three organisations representing the main research funders were selected for the interview: The Academy of Finland, Finnish Funding Agency for Innovation TEKES and COFF Council of Finnish Foundations.

The Academy of Finland's[5] mission is to fund high-quality scientific research, provide expertise in science and science policy, and strengthen the position of science and research. It is an agency within the administrative branch of the Finnish Ministry of Education, Science and Culture. The funding for research amounts to EUR 428 million in 2016. Each year, the Academy contributes to funding the work of about 2,700 people (FTEs) at universities and research institutes in Finland.

Finnish Funding Agency for Innovation[6] **Tekes** promotes a broad-based view on innovation: besides funding technological breakthroughs. Tekes emphasises the significance of service-related, design, business, and social innovations. Tekes works with the top innovative companies and research units in Finland. Every year, Tekes finances some 1,500 business research and development projects, and almost 600 public research projects at universities, research institutes and universities of applied sciences.

The Council of Finnish Foundations COFF[7] is an association for Finnish grant providers, the only benefit and support organisation for foundations in Finland. There are 172 foundations as members. The significance of charitable foundations in Finnish society is notable: in 2014, the Council members supported Finnish art, science and culture with more than EUR 415 million. The total wealth of the members is over EUR 7 billion and the members represent more than 80% of the wealth of Finnish foundations. (COFF 2016)

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[5] http://www.aka.fi

[6] http://www.tekes.fi/en

[7] http://www.saatiopalvelu.fi/en.html

The roadmap and research funders' responsibilities

The Open Science and Research Roadmap 2014-2017 contains five categories of responsibilities for the research funders (Table 6). Next, the funders' activities on OS are discussed and the potential impact of ATT Initiative analysed.

Table 6. The research funders' responsibilities

Research funders' responsibilities	Monitoring
Research funding decisions should require: - the rapid and widest possible publication of research results - good availability and comprehensibility of results - clear contracts on copyrights and proprietary rights for research results - the open licensing of results (the Open Science and Research Initiative ATT recommends a CC4.0 BY licence) - the planning of data management and prediction of further use (including the documentation and description of materials, the standards used in production and distribution, data collection design, services used, and links to other materials) - a working method that safeguards the long-term preservation of research results, as well as the use of any associated services - an open use policy for funded research infrastructures.	Funding guidelines available in the information network
Research funders should support: - open publication (publications, materials, methods); that is, the costs of open publication should be accepted as project expenses and thus supported financially - the preparation of materials for publication (including anonymisation and documentation) - researchers' efforts towards openness, through, for example, awards for researchers - open cooperation and making research results generally comprehensible - the building of a common service infrastructure.	Descriptions of funding formats
Research funders should state: - their recommendations concerning open access publication alternatives - how openness will be rewarded in career development - how the funder would like copyrights and proprietary rights to be managed - what quality criteria they stipulate for research - the methods and indicators to be used in evaluations.	Funding terms and conditions
Research funders should reward: - clear contracts, open licensing, policies that support openness and their associated plans.	Funding terms and conditions
Research funders should promote: - the establishment of an open accreditation model - expertise in openness and good data management - peer reviews of data and methods alongside peer reviews of publications, in both national and international frameworks - the assessment of openness and the most transparent measurement possible - the creation and maintenance of the expertise required to harness the opportunities afforded by openness - the clarification of financing instruments that support openness.	Participation in efforts to promote openness

Open science in the research funders' agenda

All the interviewed funding organisations have actively included open science in their agenda. Both the Academy of Finland and TEKES have been actively participating in the working groups and other operations of the ATT Initiative. Thus, the representatives were able to find links between the ATT Initiative and their operations.

Openness is included in the strategies of these organisations, but the impact is not fully caused by the ATT Initiative, as there has been a long tradition of supporting the openness of research in both of the organisations. Open science has been on COFF's agenda as well. However, the impact of the ATT Initiative has been weak so far. COFF actively follows OS discussions in the research field and guides their foundations to suggest that researchers will follow the instructions of their home universities. The foundations act independently and thus COFF has not required its members to have specific procedures on OS.

The impact of the ATT Initiative is strongly visible on the operational level of both the Academy of Finland and TEKES. Both organisations have actively used the ATT Initiative – its tools, working groups and expertise – in creating their guidelines for researchers. As a good practice, there is *'an internal ATT working group'* at TEKES, which aims at promoting OS inside the organisation. TEKES has also created their '*internal roadmap'* for the transformation. A positive finding was also the collaboration between the Academy of Finland and TEKES during the process when TEKES produced its guidelines for the applicants.

TEKES has made the decision to recommend the opening of research data in research projects. Openness is a requirement for publications. These decisions are justified by the fact that TEKES operates closely with companies and thus cannot require the openness of data. Also, the Academy of Finland requires openness – in both publications and data – and, for instance, requires a data management plan to be annexed in applications. All in all, at both TEKES and the Academy of Finland, most of the responsibilities stated in the roadmap have been discussed and procedures have been decided. Hence, the ATT Initiative proves to have a strong impact on these organisations.

In sum, all the funders have taken steps towards OS. However, the impact of the ATT Initiative varies according to the funder's operating context and the organisation's current role and connections to the ATT Initiative. Thus, the impact of the ATT Initiative is strong at the intangible/interest level as well as the tangible/operational level. Interestingly, at the strategy level the impact is not that strong due to the fact that at the Academy of Finland and

TEKES, openness has been an overall strategic theme even before the ATT Initiative. At COFF, however, openness is not that strongly present, and that is justified by the independence of their foundation members, which have their own freedom to make independent strategic decisions. All in all, the impact at the funding organisations is described in Figure 7.
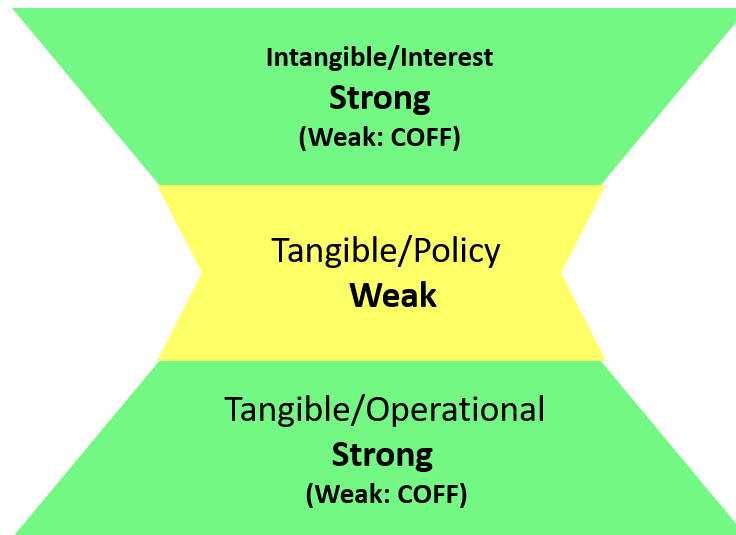

Figure 7. The impact of research funders

Ideas for the future operations

Finally, the future of the ATT Initiative was discussed and the representatives were asked to express their ideas on how OS could be promoted in the future. COFF would like to get concrete and specific operational recommendations which then could be discussed among their foundation network. Thus, more interaction between COFF and the ATT Initiative is needed.

Moreover, according to the interviewees, openness as such is self-evident but it should continuously be raised as a topic for discussion. According to the Academy of Finland, OS should be introduced as a topic of education already in primary and secondary education; the ability to understand and read metadata is one of the skills that will be needed in the future.

Open science is seen as a grand transformation in the society and the competencies need to be developed. The representatives of TEKES highlighted the need to widen the perspective towards businesses and it should be taken into account how companies would be involved in the

activities of OS. Also, another idea was to create measures which would encourage researchers towards usability and partnerships with businesses.

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The key findings:

- ✓ The funders have a key role in creating an impact at the operational level in society – both in the research and business sectors
- ✓ There is a strong link between the intensity of interaction between the ATT Initiative and funding organisation and the impact
- ✓ The funding organisations focus on recommending the OS focus – in some cases, if possible, the decisions regarding requirements (e.g. open access / data / methods) would enhance the impact

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5. The national stakeholders

The following national stakeholder projects/programmes or networks were invited to provide their views on the impact of the ATT Initiative:

- **Open Knowledge Finland ry** (OKFFI) is a registered not-for-profit association and part of the wider international Open Knowledge network. (http://fi.okfn.org/about/)
- **KDK, National Digital Library**

  The National Digital Library (NDL) is a project of the Ministry of Education and Culture which aims to ensure that electronic materials of Finnish culture and science are managed to a high standard of quality, easy to access and securely preserved well into the future. (http://www.kdk.fi/en)
- **KOTUMO is** a multi-annual development process to deepen collaboration between institutions of higher education and research institutes.
- **TUHA** is a broad network focusing on research support and administration. All the experts on these fields are able to join the network from universities, universities of applied sciences, research institutes and other stakeholder organisations.
- **FinELib consortium** promotes the use and availability of e-materials with various development projects. The National Library of Finland is responsible for the activities of FinELib. (https://www.kansalliskirjasto.fi/en/services/licensing-services/finelib)
- **Open Data Programme 2013-2015** aimed at accelerating and coordinating the opening of the public sector data resources. The Open Data Programme was based on extensive cooperation between ministries, government agencies and institutions, local government, research institutes and developer communities. The programme was coordinated by the Ministry of Finance. (https://www.avoindata.fi/en)
- **The Council for Finnish University Libraries** is an assembly coordinating and developing cooperation within the network of Finnish university libraries. (http://yliopistokirjastot.fi/en/)

An email questionnaire was sent to all seven stakeholders and answers were received from five of them. The representatives of the stakeholders were asked to answer the following questions:

- Has the ATT Initiative affected the organisation/network/project:
  - by raising interest towards open science?
  - by affecting the policy/strategic level decisions?
  - by affecting guidelines, procedures, etc. produced by the stakeholder?

- o Has the stakeholder acted according to the responsibilities stated in the roadmap?
- o Ideas for the development of the ATT Initiative during the final year 2017
- o Ideas for the development of OS as a whole after 2017

Close collaboration has created mutual impact

The close collaboration and interaction between the stakeholders and the ATT Initiative has been the basis for mutual impact. Many representatives of stakeholders have been invited to participate in the operations of the ATT Initiative. Evidently, that has been the tool for supporting both the stakeholders' operations and the operations of the ATT Initiative. For example, a strong impact can be found on the Open Data Programme coordinated by the Ministry of Finance during the years 2013 – 2015. The impact can be found in the concrete OS lines produced by the Open Data Programme. Moreover, all stakeholders highlight that the ATT Initiative has strengthened the discussion culture on OS in their focus groups.

At the policy level, the ATT Initiative has affected the production of the guidelines for the public sector by the Open Data Programme and the guidelines for researchers by the Council of Finnish University Libraries. Also, according to FinELib, the ATT Initiative has fastened the determining of the data collection. OFK states that its 'footprint' can been found on the guidelines, publications and tools of the ATT Initiative. All in all, the impact of the ATT Initiative has been strong at each level of impact (intangible/interest, tangible/policy and tangible/operations) (Figure 8).

Figure 8. The impact on the national stakeholders

Ideas for the year 2017

The stakeholders suggest that the following topics should be taken into account during the final year of the ATT Initiative:

- The services developed should be established in the daily practices of the researchers
- The OS knowledge of the researchers and especially doctoral candidates and their supervisors should be developed
- The actors of open democracy (scientific associations, independent research societies, citizens) should also be taken into account in the roadmap
- The data on publishers' costs should be collected and reported continuously.

Two organisations working for the KDK project – the National Board of Antiquities and the National Archive – mention that closer collaboration and exchange of information with the ATT Initiative would lead to positive outcomes on OS in society.

Ideas for the future – wider presence of open science in the society

The stakeholders highlight the importance of the continuous strengthening of the policies and guidelines of OS as part of the national data policy. The promotion of OS is a long-term and collaborative activity. Also, the financial and societal impact of OS should be evaluated, and that raises the need to develop the evaluation methods, procedures and data collection.

Moreover, the stakeholders raise an important question: How can the research data be better used in decision making, at companies and in the everyday life of citizens? Technologically, it is important to create tools that make the researchers' work easier. For example, automated metadata creation and tools that read handwritten texts are mentioned.

Finally, the stakeholders underline the importance of competence development at all of the levels: researchers, administration, businesses and citizens. Also, they emphasise that in a networked society everyone is a producer, distributor and user of data. Regardless of this, critical thinking and reading skills are needed. All in all, the stakeholders point out that we should already start discussing "beyond open access", i.e. the vision of where open science could ideally lead in the future.

> **The key findings:**
>
> - ✓ Close collaboration and interaction has led to mutual impact and strong impact at all the levels (interest, policy and operational)
> - ✓ Stakeholders are interested in continuing and deepening the collaboration with the ATT Initiative
> - ✓ The roadmap could be updated: clearer roles for stakeholders could strengthen the impact in the future

6. Innovation ecosystem

One of the four main goals of the ATT Initiative is to increase the societal impact of research. In the roadmap it is stated that "*the societal impact of research may mean the birth of new innovations and their commercialisation … Circulating and popularising research data outside academic scientific circles plays an important role in increasing its societal impact.*"

In this respect, the roadmap lists responsibilities to trade and commerce as follows:

- Understanding the benefits of openness and developing associated expertise in the strategic and practical implementation of openness
- Harnessing the materials and methods now available under open licences and encouraging the strategic availability of companies' own materials

In order to evaluate the impact on the innovation ecosystem, the representatives of the Federation of the Finnish Enterprises (Mika Tuuliainen and Veli-Matti Lamppu) and Confederation of Finnish Industries (Riikka Heikinheimo) were interviewed. In addition, the ATT project 'Enhancing openness in the user-driven innovation ecosystem on universities' (Seliina Päällysaho) as well as the adviser of innovation systems Bror Salmelin from the European Commission, Directorate General for Communications, Network, Content and Technology were interviewed.

Next, the impact is discussed in more detail concerning SMEs and industries from the European perspective. Finally, the actions taken by the ATT Initiative will be analysed and the conclusions on the impact made.

Open science democratises research and enables SMEs to join

An interesting phenomenon among SMEs is that today the number of highly educated entrepreneurs is rising. As a result, SMEs are more ready and willing to utilise forms of open science. Thus, it can be said that in the future data will be the fuel for ensuring growth. Open science can also be said to democratise the possibilities of SMEs to use data in their business. However,

SMEs need open science competencies in order to be able to renew their business and innovation processes.

The representatives from the Federation of Finnish Enterprises highlight that the trend is towards small, agile and flexible organisations. Thus, universities and research institutes could also learn from SMEs how to operate in the fast-changing environment. Their wish is that the research infrastructures would be opened to enable SMEs to join. Also, in regard to new innovations, phenomenon-based open research is needed. Finally, best-practice cases are needed in order to assure SMEs about the importance of open science and its possibilities for entrepreneurs.

So far, the impact of the ATT Initiative has been minor in regard to the SME sector, and thus specific actions and close collaboration are proposed as tools to enhance its impact in the future.

Industries face digitalisation – dialogue as a tool to understand company-specific needs

The representative of the Confederation of Finnish Industries told that today digitalisation is strongly on their agenda due to the fact that it affects all industries, not only the technology sector. Open science as an approach can be seen to be closely connected to the megatrend of digitalisation.

For industries, the quality and effectiveness of research is important. One of the concerns is the current situation of public funding for open innovation, which has faced tremendous cuts. The representative of the Confederation of Finnish Industries asks, "How can we compete in Europe or globally if competitive resources are not available for the creation of knowledge-based innovations?"

Finally, it is good to bear in mind that the needs vary according to the different industries. There is no single need at industry or company level. Thus, closer dialogue between research and industries is desired in the development of the ATT Initiative and promotion of open science. Also, pilots and experimentation

are needed in order for industries to be forerunners in the digitalised world. Similarly, as was the case with SMEs, the impact of the ATT Initiative has been minor on the industries represented by the Confederation of Industries in Finland.

New competencies enable the shift towards open innovation

The discussion with Bror Salmelin from the European Union Commission raised specific issues to be taken into account by the ATT Initiative in the future. From the perspective of open innovation, Bror Salmelin states that the structure of the ATT Initiative is good: three of the four pillars target academia and one of them focuses on societal impact. Without a solid base of open science, the possibilities for societal impact and open innovation would be minimal. According to him the competencies are crucial. New kinds of competencies are needed in the change towards open innovation. More specifically, the new roles in the field of openness are (1) *the Bridger,* who builds bridges between the science disciplines and other ecosystem players, (2) *the Curator,* who ensures that all the issues regarding the scientific disciplines are taken into account, and (3) *the Architect,* who builds the ecosystems. These competencies are needed both in academia and in business, and thus open science and the new competencies should be included in the curricula of higher education.

Open innovation is closely linked to open science. The main premise should be that we do not close knowledge and activities unless this is specifically necessary. However, open does not mean that everything needs to be free and accessible. Thus, the right knowledge of what is meant by open science and innovation is crucial.

Another point of view is that in regard to open innovation the relationship with basic academic research will be changed. There needs to be experimentation close to basic research and willingness to integrate different disciplines. In this sense the research infrastructures and innovation environments (e.g. living labs) form new possibilities for collaboration and interaction. Different disciplines will encounter in new ways. This change is tremendous. Thus, it is important to start experimentation and piloting.

The ATT Initiative has already taken some innovation ecosystem-related actions

'Enhancing openness in the user-driven innovation ecosystem on universities' – an ATT project coordinated by SEAMK UAS – has been launched. It is taking the first steps towards an innovation ecosystem, especially with a focus on SMEs. First, the project made a survey with the aim of understanding the knowledge needs of SMEs. Second, the project has collected information on the research infrastructures of universities of applied sciences. This information will be used among UASes in service development. A positive finding was that a number of SMEs are already involved in the activities of infrastructures. Third, parallel publishing has sought to ensure that SMEs have access to the publications produced in UASes. Finally, open data and access to data is currently under process and the needs of SMEs will be taken into account.

Currently the ATT Initiative has a minor impact on the innovation ecosystem

To conclude, so far the ATT Initiative has focused its operations on creating a solid base for open science in research organisations. Thus, its impact has been weak in the innovation ecosystem. However, the first steps have been taken by the ATT project "Enhancing openness in the user-driven innovation ecosystem on universities". Thus, it is recommended that during its final year the ATT Initiative should target its focus more on the societal impact and draft a specific action plan to ensure dialogue and collaboration with the actors in the innovation ecosystem.

The key findings:

- ✓ The impact on the innovation ecosystem is weak – the first actions have been taken
- ✓ Open science would democratise the research and enable SMEs to participate
- ✓ The megatrend of digitalisation and open science as part of it could provide opportunities for Finnish industries to enhance their global competitiveness
- ✓ Specific actions of the ATT Initiative together with actors in the innovation ecosystem are recommended
- ✓ New competencies needed in both academia and industry

7.International organisations

In order to analyse the impact at the international level, representatives of **OECD, UNESCO, the European Commission** and **NordForsk** were interviewed. The representative of the **Nordic Council of Ministers** provided a written answer to the thematic questions. The aim was to hold discussions with the representatives of the organisations about their personal views regarding the impact. Thus, the aim was not to collect official statements on the impact of the organisations.

The thematic interview was divided into four themes. First, the intangible impact was discussed to determine issues such as whether the ATT Initiative has raised interest in the organisation. Second, the possible tangible impact on politics and/or strategies of the organisations was discussed. Third, the tangible impact at the operational level was discussed. Finally, ideas for the future of the ATT Initiative and the role of Finland in the international open science context were discussed.

Strong impact at the intangible/interest level

The Finnish approach has raised interest and it has been discussed in the working groups of all the organisations, and thus the intangible impact of the ATT Initiative has been strong. Especially, the holistic approach of the Finnish Initiative was praised by all the organisations. Finland has been seen as a leading country in open science at both the European and global levels. Several other countries were mentioned as being active in OS, i.e. the Netherlands, United Kingdom and the USA. However, it was stated that Finland could be at the vanguard, as the ATT Initiative could be the model for other countries aiming at strengthening the role of open science.

Medium strong impact at the policy level

Even though the ATT Initiative has had a strong effect on raising interest towards the Finnish approach, at the tangible/policy level the direct impact is not that evident. The organisations found it difficult to name exact policy procedures or documents affected by the ATT Initiative. However, the *holistic approach* of the ATT Initiative has been taken into account in different policies

developed by the organisations. For example, in OECD the Finnish approach has helped to frame better the concept of open science. Also, it was mentioned that the Finnish representatives in EU working groups have been forming the policies and that involvement in different processes has been a 'tool' to bring the 'Finnish touch' to the policy documents. Also, an example was mentioned by the representative of Nordforsk: their board has discussed that it should embrace a more ambitious (referring to Finland) approach on open science in its operations in the future.

Some impact at the operational level

At the operational level, some impact was found. For example, OS is taken into account in the practices and guidelines of NordForsk. Also, in the publication 'Making Open Science Reality'[8] (OECD, 2015) some evidence for the Finnish impact can be found according to the OECD's representative. The reason for the weak impact at this level may lie in the fact that the representatives of the organisations were not very well informed about the latest status of the ATT Initiative. Therefore, they wished for continual interaction and information flow between the ATT Initiative and the organisations. This would allow the organisations to keep themselves informed on the latest developments made by the Initiative and also learn from the best practices.

To sum up the discussions with the international organisations, the strength of the impact is described in Figure 9. At the intangible/interest level, the impact is strong. At the tangible/policy level, the impact is medium strong, and at the tangible/operational level some impact was found.

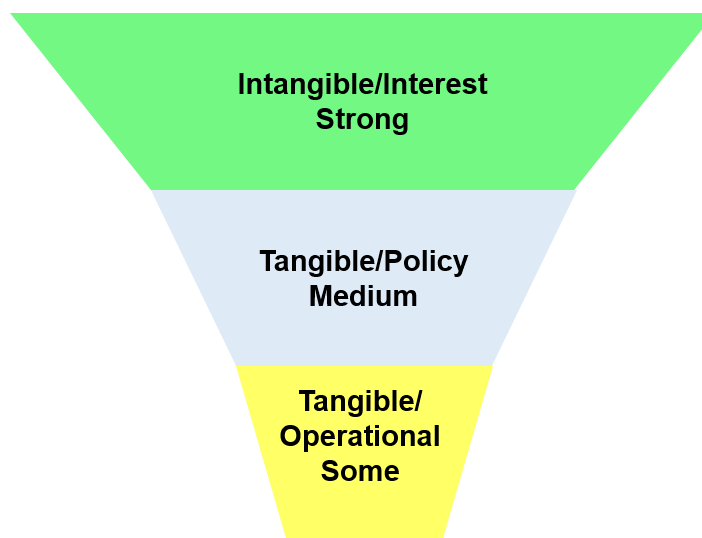[8] https://www.fct.pt/dsi/docs/Making_Open_Science_a_Reality.pdf

Figure 9. The impact on international context

Ideas for strengthening Finland's role in the future

The next question for the representatives of the organisations was: *'How can Finland strengthen its open science and research approach in the future?'* All the representatives highlighted the importance of the ATT Initiative. According to them, OS policy development is an important and timely topic globally. Thus, there is a huge need for support at different levels – especially in policy making and operationalising the transformation process at the national level. Especially on that account, the Finnish approach could provide support for that development. Specifically, the representative of OECD emphasised that more should be learned about the business models and the role of business sectors utilising OS. Moreover, the representatives of the European Commission stated that the incentives for the researchers comprise one of the most important topics – without incentives, the transformation towards openness is not possible. In spite of these, the technological solutions supporting OS are of importance (e.g. Cloud). In addition, the representatives suggested that Finland could be the land for experimentation and piloting the new forms of OS and that it could share its experiences with other countries.

Ideas for strengthening Finland's role – the procedures

The final question was: *'Are there any discrepancies in the procedures between different countries – Is there something in which Finland could take a*

role in strengthening the European/global-level policy, procedures or practices?' During the discussions, it became evident that internationally there are strong expectations towards Finland. There are numerous topics on which it was said that Finland could take a leading role. First, an important question is how OS could be measured. In particular, the representative from UNESCO said that integrated measures could provide a new way to support policy making in their member states (e.g. the positive correlation between innovativeness and openness). Second, topics such as incentives, sustainability and skills were mentioned as being critical in implementing open science. In addition, there is a need to widen the knowledge on research infrastructures, especially in the business sector. Finally, it was hoped that a website would be launched to collect the best (and worst) practices on open science. As Finland has been the forerunner in developing the holistic approach, all the experiences would help other countries in their transformation.

Ideas for the global dissemination of the ATT Initiative

All in all, according to international organisations, open science should be treated as a new 'modus operandi' or 'paradigm' for how to do research. Therefore, the Finnish way to aim at holistic transformations was praised. Thus, there is a strong wish that Finland would conceptualise the ATT Initiative and form a model that could be implemented elsewhere in the world. This concept could be also commercialised and sold to other OECD or UNESCO countries, for example. Finally, continuous communication with the organisations, the encouragement to make 'noise' on the experiences and achievements, and active involvement in different forums are needed in order to maintain the forerunner status.

The key findings:

- ✓ Finland is seen as a forerunner in open science by all the international stakeholders
- ✓ Open science is not just an instrumental change of the way research is done – it is a new 'modus operandi' and challenges societies all over the world to embrace transformation
- ✓ Internationally, Finland could conceptualise (and even sell) the ATT Initiative and support the transformation in other countries – the respondents stated that they would like to collaborate with all the international stakeholders

8. The operational groups of the ATT Initiative

The following operational groups of the ATT Initiative were invited to participate in a thematic group discussion:

- ✓ **Management of ownership and IPRs**

  The working group supports the other operations of the ATT Initiative by providing juridical expertise on IPRs, e.g. on data management planning, metadata, services created by the ATT Initiative, etc.
- ✓ **Common procedures on open publishing**

  The aim of the group is to support the goals of the ATT Initiative on open publishing. Also, the group acts as a link between the ATT projects focusing on parallel publishing.
- ✓ **Services**

  The group acts as a forum for open science and research service providers. The aim is to clarify the role of the services in the research process.
- ✓ **Metadata and IPR management**

  The group aims at developing a recommendation for clear and easy-to-produce metadata regarding the rights to use and the possible restrictions.

The following themes were discussed with the chairpersons of the working groups:

- o The current situation of the working group
- o Have the working groups raised interest towards open science and research in their target groups?
- o Have the working groups affected the national strategies or policies on open science?
- o The operations of the working groups and the operational effect at the operational level?
- o Ideas for the development of the ATT Initiative
- o How should the activities of working groups be developed in order to create impact?

The flexible way to operate as a source for practical solutions

During the discussion on the current situation of the working groups it became evident that they operate in the *'deep core'* of open science. The working groups work on the most critical issues (ownership and IPR, metadata, open publishing and services) that form the solid base for open science in research organisations.

Thus, it may be said that the groups have a *'meta-level' role* in the ATT Initiative. This specific role means that despite their own agenda, the working groups support other working groups and operations of the ATT Initiative (e.g. on juridical issues). Also, many of the working groups have been involved in the holistic operations of the ATT Initiative – e.g. writing the roadmap and the handbook. An example of the specific tasks is the role of the service group in annually evaluating the services developed by the ATT Initiative.

All in all, flexible working methods, wide participation by experts and open organisation structure (the persons interested in the topic may become members of the working group) have provided a solid flow of practical solutions. A positive aspect is that most of the chairpersons are also working on a daily basis on topics they develop in the working group. Thus, a practical touch and an understanding of real-life challenges have been ensured.

Another positive observation was that there is a direct linkage between the chairperson of the IRP group and the Ministry of Education and Culture. This link ensures the connection to the preparation of the law and guidelines in the ministry as well as a connection to the European Union.

A continuously moving target poses a challenge

Dynamism has its positive aspects, but may also turn out to be a challenge or a risk. Some of the working groups had not been notified about the roadmap even though their operations are crucial for the ATT Initiative. Also, as one of the chairpersons states: "All the time we try to shoot a moving target." Thus, the role of the chairperson is crucial in keeping the focus on the right track, finding the right resources and allocating time for the tasks.

Another possible challenge raised by the chairpersons is the autonomy of researchers. Especially in regard to service development, the world is changing and the needs of the end-users become more and more differentiated. Similarly, due to the autonomy of higher education, institutes need to decide their policies on ownership and IPRs. The ATT Initiative can only support organisations and draft guidelines on juridical issues promoting open science.

The impact

The working groups of the ATT Initiative are important – even vital - instruments to ensure that the 'grand' challenges hindering the transformation towards openness are solved. The working groups have been strategic in the sense that they have participated in the development of materials such as the roadmap and handbook that form the basis for the ATT Initiative. Moreover, the working groups operate continuously. Thus, they can be seen to have a very strong effect on supporting the whole impact of the ATT Initiative. These groups operate mainly on the first three pillars of the ATT Initiative: (1) reinforcing the intrinsic nature of science and research, (2) strengthening openness-related expertise and (3) ensuring a stable foundation for the research process.

The working groups' role in regard to intangible impact (raising interest towards open science) can be seen to be strong with respect to their specific issues and on specific forums of the ATT Initiative, and through the products (guidelines, policies, etc.) for the wider audience of the ATT Initiative. In this sense, the impact at tangible levels (i.e. policy and operational levels) can also be focused on the specific target groups of the working groups.

Ideas for the future

The chairpersons of the working groups expressed the following ideas for the future. First, the IT architecture could apply the mash-up principle in which the services are developed as small cells – not as layers. Second, the reusability of data should be a focus. Third, user-centric design and user experience should be focuses. Fourth, a holistic approach should be highlighted. Fifth, activity both internationally and in the Nordic countries should be addressed.

The key findings:

- ✓ the working groups have been vital instruments in handling the grand issues of open science
- ✓ a flexible way to work has enabled effective results
- ✓ the working groups have been the supportive forces for the total impact of the ATT Initiative

9. The ATT projects

The Ministry of Education and Culture has funded several projects (annex 2) which aim at enhancing the drivers towards open science. These ATT projects are followed and supported by the ATT Initiative. The project managers were invited to participate in a thematic group discussion. In addition, after the discussion the project managers were asked fill out a form on which they were asked to provide deeper information on the impact of the ATT Initiative.

The thematic group discussion covered the following topics:

- ✓ The current situation of the project
- ✓ Has the project raised the interest towards open science in the focus groups?
- ✓ Has the project affected strategies/policies at the organisational/national level?
- ✓ Can any impact be found at the operational level (e.g. on guidelines, action plans, daily routines of the focus groups)?
- ✓ Ideas for the further development of the ATT Initiative.

All the projects are in an active operational stage

Currently all the projects are in an active operational stage. Most of the projects have been operating since 2015 and some started their operations in 2016 (e.g. FIRE project). Of course, the various situations of the projects need to be taken into account in analysing their possibilities to create and enhance the impact of the ATT Initiative. However, in regard to the potential to create an impact, the situation is highly positive. All the projects are actively following their action plans, the focus groups have been activated for the operations, and the specific cases and pilots have provided information for adjusting the procedures. The most positive aspect is that several projects have been able to involve the end-users and that it has been possible to collect detailed information on how open science works in the daily lives of researchers, for instance. In these kinds of experimental projects, the role of project managers

is highly important in keeping all the activities running and the focus clear in the minds of all the actors.

Strong impact at the intangible/interest level

All the project managers who participated in the group discussion highlighted that there has been an impact on raising interest towards open science among the focus groups of the projects. The strength of the projects creating impact is their practical and experimental focus. The projects have been able to take the end-users into account and this participative approach has been the secret behind several success stories in different projects. The projects have been able to establish best practice operations by means such as creating tools together with end-users and by activating researchers on specific forums. All in all, the projects have been effective tools to accelerate the impact at the intangible/interest level on the specific focus groups of the projects.

Medium level impact at the tangible/policy level

The strength of the impact on policy-level decision making has varied among the projects. Even though the main focus of the projects has been to create practical and tested results, many of the projects have been able to affect policy-level decision making in their focus groups. For example, the UAS ATT project has been interacting closely with the Rectors' Conference of Finnish Universities of Applied Sciences (ARENE), which is preparing the lines of strategy for open science. Also, the Kotilava project has affected the action plans of the participating journals. The NopSA project has affected the policy decisions and lines on open science and more specifically also the incentives for the researchers.

Strong impact at the tangible/operational level

As mentioned earlier, the relevance of the ATT projects lies in their strong practical orientation. These are pioneering projects in their fields, aiming at solutions that have not been seen in Finnish research before. All the projects have yielded practical results and almost all the results have been already piloted in practice and with end-users. The forerunner role of the projects has

raised some challenges with respect to issues such as the usability of the applications, compatibility of the data applications, business models hindering openness, etc. Thus, from this perspective, too, the projects have been able to generate knowledge regarding open science in real life.

Therefore, experimentation and piloting in particular have been the enablers for a deeper understanding of open science. Also, quite many of the project managers have other roles in the ATT Initiative (e.g. membership in operational or strategy group) and this linkage has proven to be important, as the experiences gained in the project have contributed to the wider discussions on open science. Moreover, measures have been developed in quite many of the projects. This has provided the project managers with instruments to follow the progress of the project.

Funding as an accelerator

According to the project managers, almost all of the topics would have been developed without the specific funding allocated to their organisation. However, the project structure and the focused funding have enabled systematic operations and resource allocation. In spite of this, the project managers have been thankful for networking with other projects and ATT working groups. Networking has been seen as an excellent way to exchange knowledge and experiences, and thereby gain better results than would have been possible when working alone.

Also, the flexibility of the funding was praised: the possibility to hire coding competencies, for instance, has been of importance in creating specific applications. In the university of applied sciences sector, project funding has been seen to be extremely important in facilitating the transformation of the whole sector. The amount of funding is considered well balanced when compared with the operations of the project and the financial resources.

All in all, the ATT projects have proven to be one of the success stories of the ATT Initiative. They have focused on practical problems of open science and aim at finding practical and tested solutions. Currently the topics and consortiums vary from a single topic in a single organisation to national-level

operations. Thus, it may be appropriate to ask whether the projects cover the most critical topics, how the dissemination of the results and transformation to other fields are taken into account (especially in projects focusing on a single university) and do the projects include overlapping activities (e.g. on developing interfaces or applications). Despite this slight criticism, the projects have been excellent instruments in terms of impact: the impact has been strong at both the intangible/interest and tangible/operational levels and medium strong at the tangible/policy level (Figure 10)

Intangible/Interest
Strong

Tangible/Policy
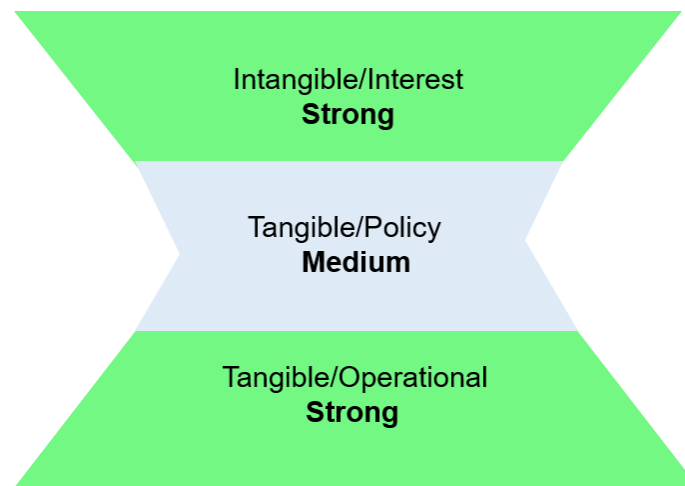**Medium**

Tangible/Operational
Strong

Figure 10. The impact of the ATT projects

The key findings:

- ✓ The experimental nature + piloting in practice + end-user focus => usability of the results -> strong impact
- ✓ The projects have created concrete measures for the follow-up of progress
- ✓ Networking and the linkages to the ATT Initiative – project managers' role as key to success

10. Conclusions

The aim of this evaluation was to analyse the impact of the Open Science and Research Initiative (ATT Initiative) both nationally and internationally. In addition, the evaluation sought to offer recommendations for the last operational year of the ATT Initiative and the years ahead. Dr Lauri Tuomi, CEO, Profitmakers Ltd acted as external evaluator and the process was executed during the period from June to November 2016. The target groups of the evaluation were the research organisations and their staff members, research funders, the national stakeholders, representatives of the innovation ecosystem and international organisations (UNESCO, OECD, European Commission, Nordforsk and Nordic Council of Ministries).

The evaluation was carried out during the period from June to November 2016. The utilised methods included both individual and group interviews, questionnaires and virtual brainstorming. The roadmap[9] set the frame for the evaluation, i.e. the responsibilities of various target groups and the real-life actions were analysed. In addition, all documentation (with some exceptions due to confidentiality) of the ATT Initiative was available for the analysis.

ATT Initiative has been an accelerator of open science

The evaluation process was comprehensive, starting from the international policy-level perspective and ending at the grassroots level of researchers' daily work. The impact was evaluated on three levels: interest, policy and operational levels. The three-level approach proved to be beneficial due to the fact that the ATT Initiative is a holistic programme targeting a national transformation towards open science. Thus, the ATT Initiative has operations that target all of the levels of impact.

All in all, the ATT Initiative has definitely been an accelerator of open science in Finland and in the international context, too. The ATT Initiative has been a dynamic, multi-actor and multi-level facilitator of the transformation towards

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[9] http://www.minedu.fi/OPM/Julkaisut/2014/Avoimen_tieteen_ja_tutkimuksen_tiekartta_2014_2017.html?lang=en

open science. It has been able to address a huge number of issues, such as digitalised services for the research field, creating reference architecture for open science, providing practical guidelines and support for researchers, creating models and tools for open access, long-term preservation, metadata, etc. In addition, the ATT Initiative has provided comparative information for funding and research organisations on their position with respect to open science. These are just a few of the topics that we could mention. None of this would have been possible without a collaborative approach to operations.

The impact is found at all three levels: interest, policy and operations

On the first level of impact, the ATT Initiative has raised interest towards open science among its target groups. The impact is strong (Figure 11). However, due to the large number of target groups, there is still much to do. For example, about one third of the staff members of research organisations say that they were not familiar with the websites of the Initiative. Similarly, among the research organisations that ranked on lower levels of the maturity assessment, the impact of the ATT Initiative is low. Special attention must be paid to both foundations that provide research funding and the business sector, too.

On the second level, the ATT Initiative has affected the strategies or policies of the target groups. At this level the impact has been medium strong. Also, at this level variation among the target groups has been high. In the research organisations, the strength varied according to the level of maturity in open science. Thus, the higher the maturity, the stronger the impact on the strategies. Among the research organisations with a lower maturity ranking, the situation was the other way around: the ATT Initiative had not affected the strategies of the organisation. Positively, a medium strong impact was found among international organisations.

A wide range of the ATT Initiative's activities target the grassroots level. However, at this operational level, the impact is still 'weak' or 'started'. Currently, many operations concerning practical tools, services and guidance are still in process, and thus the expectation is that the impact will be stronger in the future. However, on a positive note, the impact is strong in some target

groups. For example, the funders already apply their new guidelines, which include the requirements on open science for the researchers.

Also, among national stakeholders, the impact is strong as each of the stakeholders is applying the procedures on open science in their operations.
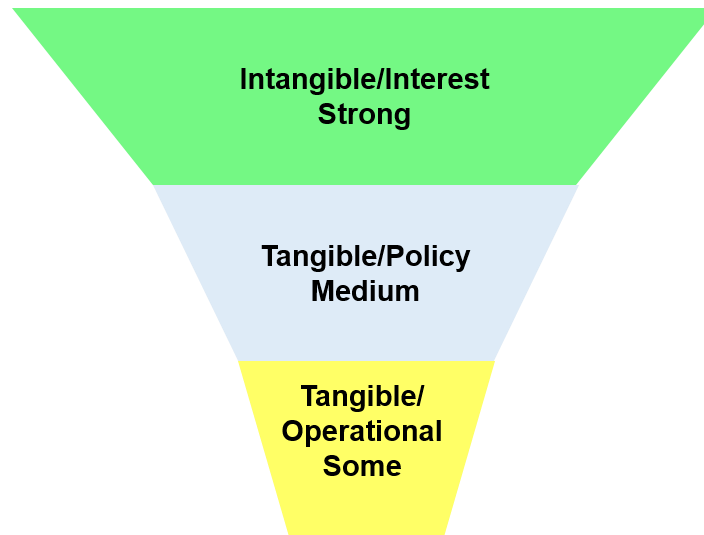

Figure 11. The impact of the ATT Initiative

The ATT Initiative and ideas for 2017

The target groups generated many ideas for the ATT Initiative's operations in 2017, its final year. First, active participation in international forums and the possible conceptualisation of the ATT Initiative would support the transformation of other countries towards open science (the concept could also be sold to other countries). Second, the best practices and cases from different disciplines are needed to convince the sceptics, to help the organisations in their processes and to inspire new actors. Third, the tools in the development process should be tested, finalised and implemented. Fourth, special attention must be paid to open innovation and the innovation ecosystem, including SMEs. Fifth, specific actions are needed in order to activate the researchers and staff members.

Ideas for the future

All the participants in the evaluation process highlight the importance of the continuation of the transformation towards open science. In addition, an overwhelming topic during the interviews was the 'future university' and how

open science changes the way research is done and how the whole sector needs to embrace openness. Also, there is a need to look at open science from the perspective of wider audiences: for instance, how are the students involved in it and what kinds of open science competencies will they need in the future? Moreover, some interviewees state that open science should be taught already in schools and kindergartens, not only in higher education. As so many grand questions still remain unanswered, there is a need to continue ATT in some form. Especially, the importance of the role of the operator is highlighted. If the transformation would be left to the individual organisations, the interviewees consider that this would pose a risk that the pace of change will slow down.

All in all, the ATT Initiative has been able to accelerate the transformation towards a society in which open science and research lead to surprising discoveries and creative insights, making Finland a leading country for openness in science and research by 2017. In this global situation, where trends such as closing the borders are gaining momentum, it is even more important to achieve the vision of openness. Thus, it is hoped that this report will be utilised as one of the tools for change.

Annex 1
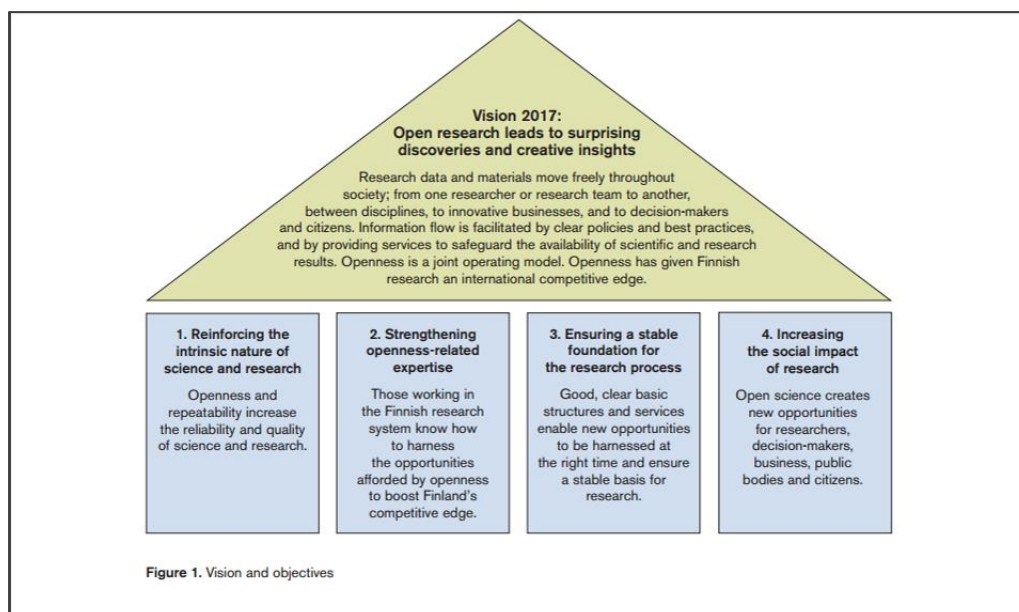
The thematic interview – International stakeholders

Name:

Organisation:

Date:

Background information:

http://openscience.fi/documents/14273/0/Open+Science+and+Research+Roadmap+2014-2017/e8eb7704-8ea7-48bb-92e6-c6c954d4a2f2

The vision and the objectives of the Finnish initiative:

Vision 2017:
Open research leads to surprising discoveries and creative insights

Research data and materials move freely throughout society; from one researcher or research team to another, between disciplines, to innovative businesses, and to decision-makers and citizens. Information flow is facilitated by clear policies and best practices, and by providing services to safeguard the availability of scientific and research results. Openness is a joint operating model. Openness has given Finnish research an international competitive edge.

1. Reinforcing the intrinsic nature of science and research

Openness and repeatability increase the reliability and quality of science and research.

2. Strengthening openness-related expertise

Those working in the Finnish research system know how to harness the opportunities afforded by openness to boost Finland's competitive edge.

3. Ensuring a stable foundation for the research process

Good, clear basic structures and services enable new opportunities to be harnessed at the right time and ensure a stable basis for research.

4. Increasing the social impact of research

Open science creates new opportunities for researchers, decision-makers, business, public bodies and citizens.

Figure 1. Vision and objectives

Thematic interview

What is your role in Open science and research?

Intangible impact: In your opinion, has the Finnish approach/initiative raised interest in your organisation?

Tangible - Policy level: Has there been impact on the policy level (decisions, documents: strategies, white papers etc.)

Tangible - Operational level: Is there concrete and tangible impact on operational level
(guidelines, tools, processes, working papers, decision making, tools, practices)

In your opinion, how Finland could strengthen the Open science and research in the future?

Are there any discrepancies in the procedures between different countries – is there something on which Finland could take role in strengthening the European level policy, procedures or practices.

Annex 2.

- ✓ **IRKE** coordinated by University of Helsinki. The project creates stakeholder-driven development of interfaces for climate science.
- ✓ **Suomi-monitori** (Finland-monitor) –project coordinated by University of Tampere. The project aims at creating an easy-to-use interface for the research data and results regarding the societal research.
- ✓ **NopSA**-project coordinated by Hanken School of Economics. The project aims at developing and implementing the fast ways for the researchers to open science.
- ✓ **FIRE**-project coordinated by University of Helsinki. The projects creates a databank containing seismological data and which is openly accessible.
- ✓ **LODSci**-project coordinated by Aalto University. The project aim at developing a Linked Open Data Science Service for publishing and using scientific Linked Open Data in research.
- ✓ **Suomi Rinnakkaistallentamisen mallimaaksi** (Finland as model country of parallel publishing) –project coordinated by University of Eastern Finland and University of Jyväskylä. The project aims at developing a process and service model for parallel publishing.
- ✓ **Avoimen tieteen yhteiskunnallisen vaikuttavuuden mittarit** (Measuring the societal impact of open science) - project coordinated by University of Turku. This research project will develop methods to investigate the societal impact of Finnish research, and investigate the current state of research in Finland using altmetric research methods and data.
- ✓ **Avoimuuden lisääminen korkeakoulujen käyttäjälähtöisessä innovaatioekosysteemissä** – project coordinated by Seinäjoki University of Applied Sciences (Later 'UAS ATT'). "Enhancing openness in the user-driven innovation ecosystem of universities" is a joint project of 25 Finnish Universities of Applied Sciences (UAS). The objective is to support the openness of research, development and innovation (RDI) work and to enable the more effective dissemination of research results.
- ✓ **Kotilava** –project coordinated by The Federation of Finnish Learned Societies and The National Library of Finland. The project aims at supporting Finnish scholarly journals in their transition to immediate Open Access.
- ✓ **TAJUA**-project coordinated by the National Library. The project aims at increasing the open and sustainable access of Finnish research.