

VALUATION OF ALTMETRICS
IN
RESEARCH FUNDING

Grischa Fraumann

University of Tampere
Faculty of Management

Master's Degree Programme in
Research and Innovation
in Higher Education (MARIHE)

M. Sc. (Admin.) Thesis

Supervisors:
Prof. Seppo Hölttä, University of Tampere, &
Dr. Kim Holmberg, University of Turku

June 2017

Abstract

University of Tampere	Faculty of Management
Author:	Grischa Fraumann
Title of the thesis:	Valuation of altmetrics in research funding
M. Sc. (Admin.) Thesis:	VIII, 115 pages, 20 tables, 5 figures, 6 appendices
Date:	June 2017
Keywords:	altmetrics, alternative metrics, societal impact, research impact, research funding, strategic research funding, valuation, higher education system

This master's thesis is about the potential valuation of altmetrics or alternative metrics in research funding, which is apparent in current high-level policy debates in higher education. Altmetrics measure the outputs of scholarly research online. Valuation is defined not in the monetary sense of the word, but as giving worth to something as a social construct. Based on the Sociology of Valuation and Evaluation, the author intends to map the potential usage and valuation of altmetrics in research funding. A mixed method research design was chosen for this study. Firstly, a review of policy papers from supranational organisations, national governments, and organisations in higher education was carried out. Secondly, qualitative interviews (n=6) with research policy makers and members of a research funding organisation in Finland were conducted. Thirdly, the quantitative phase consisted of four online surveys (n=290) with researchers at a university and reviewers in Finland and on an international level. Finally, these data sets were analysed together (N=296). The findings suggest that altmetrics is mostly unknown and of low importance among the study participants, and only a small amount of altmetrics users could be identified. It is a prominent research policy topic these days, and considered as on the rise in debates on higher education. And, despite the unawareness and little valuation of altmetrics, some respondents use altmetrics in some way or the other, and are highly-aware of the concept of altmetrics. Altmetrics might be more important in future in the reporting phase compared to the research funding application phase. Considering the current high-level policy debates, it is recommended to stakeholders in the higher education system to become familiar with altmetrics, as they might play a larger role in future. Policy makers need to communicate more clearly on the challenges of research impact assessments, and altmetrics.

Content

Acknowledgement.....	VII
1 Introduction	1
2 Impact in Higher Education Systems	8
2.1 Research Impact.....	8
2.2 Research Policies	16
2.3 Strategic Research Funding	18
3 Altmetrics – Alternative Metrics	22
3.1 Altmetrics and its Origins in Open Science.....	25
3.2 Altmetrics Data Providers.....	26
3.3 Challenges concerning Altmetrics	28
3.4 Ethical Issues concerning Altmetrics.....	30
3.5 Usage of Altmetrics and Altmetrics in Research Funding	31
3.6 Major Altmetrics Research Projects	32
3.7 Usage of Altmetrics in Finland.....	35
4 Theoretical Framework.....	36
4.1 Context.....	36
4.2 Valuation Studies	39
5 Research Methods and Data	41
5.1 Methodology.....	41
5.2 Research Methods.....	43
5.3 Research Data Management	49
5.3.1 Data Documentation, Quality, Backup and Access.	50
5.3.2 Ethics and Data Storage.	50
5.4 Research Data Collection.....	51
5.4.1 Policy Documents.	52

5.4.2	Qualitative Interviews.....	53
5.4.3	Online Surveys.....	54
6	Results.....	59
6.1	Policy Documents.....	59
6.2	Qualitative Interviews.....	60
6.3	Online Surveys.....	62
6.3.1	Researchers registered at PlumX Altmetrics Dashboard.....	62
6.3.2	Reviewers at the Strategic Research Council.....	69
7	Discussion of the Results.....	75
8	Conclusions.....	79
9	References.....	82
10	Appendices.....	95
10.1	Acronyms.....	95
10.2	Introduction to the questionnaires.....	97
10.3	Example of a PHP code for filter questions within the questionnaires.....	98
10.4	Questionnaires of all 4 surveys.....	99
10.5	Topic guide for interviews.....	108
10.6	Extended description of PlumX Metrics.....	109

Figures

Figure 1. Article with the currently 2nd highest Altmetric Attention Score in June 2017 titled “United States Health Care Reform: Progress to Date and Next Steps by Barack Obama” (data compiled by Altmetric.com; as of 6 November 2016)..... 28

Figure 2. Analytical framework for the master's thesis..... 39

Figure 3. Research funding process at the Strategic Research Council (source: Academy of Finland, 2017) 44

Figure 4. Formula to calculate RR6 as defined by the AAPOR 57

Figure 5. Daily survey response rate as of 3 June 2017 (dark blue: completed interviews; light blue: partially completed interviews) (source: SoSci Survey, 2017). 57

Tables

Table 1. An overview of strategic research funding in EU Member States	20
Table 2. SWOT analysis of altmetrics	32
Table 3. Sources of altmetrics data providers	35
Table 4. External pressures on research funding.....	37
Table 5. Examples of PlumX Metrics	47
Table 6. Schedule for preparation of the study and the master's thesis	48
Table 7. Interviewees and survey respondents	52
Table 8. Qualitative document analysis	52
Table 9. Codings of the interviews.....	61
Table 10. Researchers: Usage of PlumX dashboard	63
Table 11. Researchers: Usage of altmetrics	65
Table 12. Researchers: Would you distinguish between different altmetrics sources to demonstrate research impact?	67
Table 13. Researchers: Demographics	67
Table 14. Reviewers: Awareness and usage of altmetrics	70
Table 15. Reviewers: Demographics	72
Table 16. PlumX Usage Metrics	109
Table 17. PlumX Capture Metrics.....	111
Table 18. PlumX Mention metrics	112
Table 19. PlumX Social Media Metrics	113
Table 20. PlumX Citation Metrics	113

Acknowledgement

First of all, I would like to thank my supervisors, Prof. Seppo Hölttä and Dr. Kim Holmberg for their support, guidance and help, that was essential for my learning process. I appreciate a lot what I have learnt from their expertise, that helped me to finish this thesis. I would also like to thank them that I was able to pursue a topic that I was personally interested in, and for their support on this journey, and or how they would call it: “Let’s do it!”.

I am very grateful for the Erasmus Mundus scholarship that presented the possibility to meet people from all over the world, to study and work for the first time in my life in Austria, Finland, the Netherlands, and China, which was a life changing experience to me, and broadened my horizon. I am also grateful for a travel grant by the Volkswagenstiftung for the University Governance Conference 2016 in Hannover, a travel grant for the Altmetrics Conference and Workshop 2016 in Bucharest by the Wellcome Trust, SpringerNature, Elsevier, PLOS, Frontiers, Altmetric, Crossers, SAGE, and Plum Analytics, and a scholarship for the Digital Future Conference 2016 in Berlin by Deutsche Telekom AG. These grants helped me to shape my research topic further.

I would like to thank the MARIHE staff and lecturers at all partner universities, especially Prof. Attila Pausits for the programme coordination, Assistant Prof. Vuokko Kohtamäki for her comments on the initial research proposal, Maria Ranta, Astrid Kurzmann and Florian Reisky for helping to settle down in Austria and Finland, Assistant Prof. Yuzhuo Cai for his guidance in the research methods classes and thesis seminars, Dr. Charles Mathies for useful information on altmetrics in Finland. Also, Eveliina Permi, Dr. Yohannes Mehari, and Assistant Prof. Jussi Kivistö for the administrative support at the end of the thesis. Also, I would like to thank my MARIHE classmates, especially Işıl for her feedback on the thesis.

I would like to thank my colleagues at CWTS, especially Dr. Zohreh Zahedi, Dr. Rodrigo Costas, and Dr. Ingeborg Meijer for their support in Leiden. I would like to thank Prof. Rogério Mugnaini and Prof. Philipp Sandner for feedback on the draft of the thesis, and Elisabeth Vogler for sharing her literature list on altmetrics. I would like to thank Prof. Rosa Pagola Petrirena who inspired me to become more interested in research in 2009.

Also, I would like to thank all persons, that provided me with opportunities to work in higher education in Finland, namely Dr. Lauri Tuomi, Dr. Pirjo-Leena Forsström from CSC, my colleagues from the Finnish Ministry of Education and Culture, especially Eeva Kaunismaa,

Erja Heikkinen, Sami Niinimäki and Juha Haataja, Dr. Perttu Heino from TAMK, Antti Heikkilä, and my colleagues Dr. Jörg Langwaldt and Tuukka Pöyry from Tampere University of Technology.

Most importantly, I would like to thank all interviewees and survey respondents of my study, that kindly invested their time to share their views on the topic, which made this thesis possible in the first place.

And finally, I would like to thank all persons that helped and supported me along the way to reach the publication of my thesis. Without all of you this work would not have been possible, and I hope that I did not miss anybody here. I would thank Stefan for his support in crucial times. Also, I would like to appreciate especially those, who always supported me, that is my family, namely my mother. *Danke für Deine Unterstützung in allem, was ich erreichen wollte.* I would like to thank Motolani, *o se gan* for your support all along the way. *Mo nife re.*

1 Introduction

At any rate, altmetrics, or alternative metrics, are gaining momentum (Holmberg, 2016) in today's higher education, and have reached the highest levels in European policy debates. In May 2017, the University of Helsinki for instance shared their experiences in using altmetrics during a country visit as part of the Open Science Mutual Learning Exercise (MLE) by the Horizon 2020 Policy Support Facility. Mutual Learning Exercises are carried out under the Joint Research Centre Research and Innovation Observatory (RIO), and are aimed at providing best practice examples from European Union (EU) Member States, and Associated Countries. That is, this initiative is aimed at highest policy levels, and stakeholders within those countries. Participating countries are spread all over Europe, namely Armenia, Austria, Belgium, Bulgaria, Croatia, France, Latvia, Lithuania, Moldova, Portugal, Slovenia, Spain, Sweden, and Switzerland. The initiative will last from January 2017 until December 2017, and will answer questions about the usage of altmetrics within EU Member States, in particular within research funding organisations (RFOs) (European Commission, 2017c). Further evidence can be found in EU High-Level Expert Groups that advise the European Commission among others on Science, Research and Innovation. From 2016 until 2017, altmetrics has been playing a role in several of these high-level advisory bodies. For instance, in May 2017, the EU High-Level Expert Group RISE (Research, Innovation and Science Policy Experts) presented a report on the future of EU Research Policy, and recommended among other things to replace the Journal Impact Factor with altmetrics, as a better indicator (European Commission, 2017b), as the Journal Impact Factor is widely criticized by various scholars around the world (Mugnaini, 2016). This master's thesis will explore this usage of altmetrics with a focus on research funding considering debates on research policy, and research impact.

Concerning altmetrics, everything started with a tweet in 2010. When Jason Priem, then a doctoral student at the University of North Carolina at Chapel Hill (USA) tweeted the term altmetrics (Howard, 2013), he started a concept in academia that exhibited a fast development during the last years. In particular in 2016 and 2017, altmetrics gained more attention through several policy initiatives. The European Commissioner for Research, Science and Innovation Carlos Moedas highlighted in his speech titled "What new models and tools for measuring science and innovation impact?" on 20 September 2016 at the OECD (Organisation for Economic Co-operation and Development) Blue Sky Forum in Ghent (Belgium), the importance of a tran-

sition from citation-based metrics to altmetrics (Moedas, 2016). This describes one among several policy speeches that occurred in 2016 and 2017, and they all relate to the fact, that alternative metrics are gaining momentum in higher education. Altmetrics measure the mentions of scholarly outputs online, such as in online social networks, blogs, news sites, and Wikipedia. Compared to traditional counting of citations this approach provides many advantages, such as fast tracking of impact, among others. The EU Open Science Monitor “provides statistics for altmetrics events in EU Member States, which are counted by the mention of publications in Twitter and news” (Parks, Lichten, Lepetit, & Jones, 2017). This would be one potential source to find out more about the number of articles that are tracked by altmetrics data providers. Nevertheless, the following numbers were taken from press releases of the altmetrics data providers Altmetric.com¹ and Plum Analytics. Altmetric.com, one of the largest altmetrics data providers, curates “over 10 million research outputs” in the Altmetric Explorer (as of 6 June 2017) (Altmetric.com, 2017a). The explorer is a similar system as the PlumX altmetrics dashboard. A PlumX dashboard is an online system that is used to visualize the impact of the university’s researchers in altmetrics sources and bibliometric databases. Plum Analytics covers 52,6 million research outputs (as of 7 June 2017) (Plum Analytics, 2017a). Further, citation counts from Elsevier’s Scopus database and Clarivate Analytics’ Web of Science are also included into the data, respectively. There are more and more studies published each year on altmetrics, and it is already called a stabilized research field (Gauch & Blümel, 2016). For instance, Erdt, Nagarajan, Sin, & Theng (2016) estimated the number of journal articles on altmetrics in 2011 to be around eight, and for the year 2015 until September 2015 to be around 65. Gauch & Blümel (2016) estimated the number of articles on altmetrics for the year 2016 until September 2016 to be around 125. Even if both team of authors employed different methods for data collection, their common conclusion is that articles on altmetrics exhibit a fast growth. Furthermore, major international organisations such as the OECD support studies on altmetrics (OECD, 2016). At the same time, many challenges are related to altmetrics as such.

The European Commission’s Expert Group on Altmetrics formulated in June 2016 in a call for evidence certain challenges that have to be solved concerning altmetrics (see also chapter 3 Altmetrics – Alternative Metrics). One of the areas that need to be studied consists of the usage of altmetrics in certain areas of the society. The present study focuses on the usage of

¹ In this study, Altmetric is used to refer to the company Altmetric.com and altmetrics in general to all alternative metrics. In some instances, this altmetrics data provider is named as Altmetric.com to distinguish it more clearly from altmetrics.

altmetrics among researchers and research funding reviewers, a research funding organisation, and policy makers, in the context of this study, the University of Helsinki, the Finnish Ministry of Education and Culture, and the Academy of Finland. The study aims to contribute to current discussions on the usage of altmetrics in research funding. This topic will be approached by the means of semi-structured interviews (n=6), that is interviews with staff members of the Ministry of Education and Culture and board and staff members of the Academy of Finland. Further, four online surveys (n=290) were carried out, targeted at reviewers for societal impact and scientific excellence at the Academy of Finland, and highly-ranked researchers and regular users at the University of Helsinki's PlumX dashboard.

Altmetrics is closely related to another phenomenon, that is open science. Altmetrics might provide evidence for the advantages of open access publications and open access to research data, as the usage of research outputs can be measured as such. This kind of measurement is one school of thought of the open science movement (S. Niinimäki, personal communication, 19/09/2016; Fecher & Friesike, 2014). Starting as early as 1964 in Helsinki (Finland) (WMA (The World Medical Association), 1964), and following the increased public attention on open access since the Open Access Declarations in Budapest (Hungary), Berlin (Germany) and Amsterdam (the Netherlands) (Government of the Netherlands, 2016; Max Planck Gesellschaft, 2003; Open Access Directory, 2017; Open Society Institute, 2002), in 2002, 2003 and 2016 respectively, this study looks at the outputs of open science and research at certain universities tracked by PlumX as one specific altmetrics tool. PlumX was firstly available as a free tool, and was acquired by EBSCO in 2014, and from the former by the publishing house Elsevier in February 2017. Altmetrics tools are implemented in several universities, journal and publisher websites, and large information systems such as SciELO, the largest open access repository in Latin America, South Africa, and Spain (Packer, Cop, Luccisano, Ramalho, & Spinak, 2014). The latter in turn uses Altmetric.com as a provider, and the publications and their altmetrics counts are also available on ScienceOpen, a large open science platform. Altmetrics is currently, thus, one of the most disruptive innovations in scholarly communications, and its impact is studied profoundly.

To elaborate further on altmetrics, a few current initiatives are presented. As aforementioned, the European Commission's Directorate-General for Research and Innovation nominated in beginning of 2016 an "Expert Group on Altmetrics" which published a final report in the beginning of 2017, in spring 2016 the European Commission announced the so-called Eu-

European Science Cloud that will be probably be implemented in 2018, the US National Information Standards Organization (NISO) carried out an initiative about common standards in altmetrics, the European Research Council (ERC) published a study on the impact of ERC funded projects taking into account altmetrics, and the Finnish government promotes the topic of Open Science and Research in a major national initiative spanning from 2014 until 2017. These are only a few examples that show the relevance of the topic of this study. The interpretation of altmetrics in the Finnish higher education sector is also a crucial development nowadays (Open Science and Research Initiative (ATT), 2015). As aforementioned, this thesis explores the valuation of altmetrics in an original case study through the lenses of three levels of the Finnish higher education system, namely the Finnish Ministry of Education and Culture (staff members), the Academy of Finland (staff and board members) as the largest research funding organisation for basic research in Finland and the University of Helsinki (researchers of this organisation) as the largest Finnish university. By doing so, it is aimed to grasp the current valuation of altmetrics in research funding in Finland from all relevant levels, as these three organisations play an important role in the Finnish higher education system, and on international level. The interviewees were chosen based on the function that they perform in the research funding landscape. The role of the ministries' employees might not have been clear to someone outside the organisation, but the roles of the other interviewees were carefully selected based on the rationale for the study.

Altmetrics is also closely related to other, current debates in higher education concerning accountability of higher education institutions, evaluation and performance, but also on communication on social media by researchers (Adie & Roe, 2013; Alhoori & Furuta, 2014; Bar-Ilan et al., 2012; Leibniz Gemeinschaft, n.d.; Mounce, 2013; van Noorden, 2014), and finally the impact or value that is created by scholarly research (Auranen, 2006; Bornmann, 2012, 2014; Bornmann & Marx, 2014; Kohtamäki, 2011; Meijer, 2012; Wallace & Ràfols, 2015). In this regard, one can observe an intense on-going debate about research impact in several countries, and on international level, that manifests itself in several conferences, policy debates, and initiatives. One may call especially the term 'impact' a buzzword, because of its frequent appearance in research projects, policy documents, public debates, and so on.

Impact assessments play a large role in the funding sector, and it relates to return on investment on funded projects. This is not only apparent in higher education, but in many parts of societies, for example at non-governmental organisations (NGOs) such as the Bosch Foundation, that also call for impact measurements (Bosch Foundation, 2016). Similarly, funding

that focuses on impact is also largely criticized, because it might among others hinder scientific excellence, and is an obsession with quantifiable little pieces of science. For instance, the German Rectors' Conference urged in November 2016 in a statement to focus mainly on scientific excellence, and include impact only as an additional path after the project has finished (HRK German Rectors' Conference, 2016). This is related to the notion to promote also more strongly basic research, that does not necessarily lead to economic outcomes, but contributes to the advancement of knowledge. This criticism might again be country-specific to a certain extent.

Furthermore, the term 'impact' seems to appear frequently in discussions in today's higher education. Research impact, for instance on the society or economy, is on the agenda in several initiatives around the world. One way to approach this topic is through specific funding instruments that target scientific excellence and research impact at the same time. How the latter is measured in the end, is the topic of this thesis. Some scholars argue that this could be carefully facilitated through altmetrics, so the thesis focuses on the potential valuation of this metric in research funding. This is done by interviewing and surveying stakeholders. Concerning research impact, several policy initiatives around the world formulate the demonstration of it. The most recent and prominent announcements might be the fact, that in the public stakeholder consultation as part of the interim evaluation of Horizon 2020, it is mentioned that the "[t]he European Commission's goal is to maximize the socio-economic impact of the EU support to research and innovation". That is, adequate measurements are called upon by many stakeholders, and the interaction between science and society is also included in the scoping papers for the Horizon 2020 work programme 2018-2020, *Science with and for Society*. Similarly, impact as such is a prominent topic in the overarching strategy document for the Horizon 2020 Work Programme 2018-2020, and is formulated since its establishment in 2014 as an integral part of Horizon 2020, the EU Framework Programme for Research and Innovation (European Commission, 2017a). Despite the many challenges and shortcomings of alternative metrics, some stakeholders argue that these tools could partly answer in future the question of the return on investment in research, as mentions outside the scientific community can be considered, suggesting evidence for an impact on the society. This is of importance in research funding, and some stakeholders such as research funding organisations were among the first to support altmetrics, because it underlines their strategies of demonstrating impact of funded research. One example includes the British Wellcome Trust (Thelwall, Kousha, Dinsmore, & Dolby, 2016). Therefore, this study's main focus is on research funding, and the related demonstration of impact through altmetrics.

In contrast to previous studies, this study focuses on the potential valuation of altmetrics within a funding instrument of one research funding organisation, the Strategic Research Council at the Academy of Finland, and within one university, the University of Helsinki. A funding instrument is supposed to support a specific aim of the funder, and a funding programme is usually a theme that runs for a certain period of time under this instrument. For instance, the Finnish government decided to introduce strategic research funding as a funding instrument to solve grand challenges, and the instrument provides themes for three to four years, such as from 2016 to 2019 with a focus on ‘Urbanising Society’, ‘Skilled Employees – Successful Labour Market’, ‘Security in a Networked World’, and ‘Health, Welfare and Lifestyles’ (Academy of Finland, 2017b). Considering for what altmetrics initially were conceived, research funding in Finland is examined further, and a unique sample of stakeholders was identified. It is essential for the study of higher education systems, to be aware to what extent data sources might be considered for future use. The study aims to target a wide audience in the higher education sector, as such information is useful for researchers, policy makers, university managers, and funding advisors. The theoretical base is provided by Valuation Studies, which is seen as an emerging field, that created dedicated journals and it is part of the research agendas in recent years, for instance as part of a research unit at the German Centre for Higher Education Research and Science Studies (DZHW, 2017). The assumption is that altmetrics counts might be considered to a certain extent in research funding applications and reporting of funded research, because they are gaining momentum in higher education today, and certain organisational altmetrics platforms are already in use. Press releases and marketing materials by altmetrics data providers mention the usage of altmetrics in researchers’ CVs, but how widely spread this usage is within different higher education systems, universities, research funding organisations and by policy makers remains mainly unclear.

The majority of studies on altmetrics have mainly focused on the technical assessment of altmetrics in terms of its comparison to citations, data quality, identification of users, the technical potential of the usage of altmetrics in research funding, etc. Very few studies have explored in a survey design the usage of altmetrics within the scientific community, and at universities, but this kind of research design is becoming more apparent recently (Erdt et al., 2016; Gauch & Blümel, 2016). The latter were mostly authored by librarians, research managers, public relations or altmetrics data providers, but also by some researchers (Madjarevic & Davies, 2015). What remains to be explored further, is an external view of a particular altmetrics tool at a university, and the opinion of policy makers, and reviewers as well as staff and board

members of a funding instrument of a research funding organisation. This master's thesis addresses this research gap with a unique sample from the Finnish higher education system.

The purpose of this study is to explore the potential valuation of altmetrics within research funding. Based on this introduction, the following research question were formulated for this study:

1. To what extent are values attached to altmetrics in research funding in Finland?

As subquestions, the following will be explored:

- 1.1 To what extent are altmetrics currently used and valued by reviewers, board and staff members in the Strategic Research Council at the Academy of Finland?

- 1.2 To what extent are altmetrics currently used and valued by researchers that are registered at the University of Helsinki's PlumX altmetrics dashboard?

The study follows an exploratory sequential mixed methods design (Creswell, 2014). First, two pilot interviews on a strategic level within a university and a university of applied sciences in Finland were carried out and policy documents were studied to explore the topic. Second, interviews (n=6) with higher education policy makers, and board members and staff members were carried out at the Ministry of Education and Culture and the Academy of Finland, respectively. Third, the qualitative phase was followed by four quantitative surveys addressing research funding reviewers at the Academy of Finland (n=80), and researchers at the University of Helsinki (n=210). By choosing such a sequence, the research field can be first explored, and it is possible to enhance the survey design, as common themes can be extracted from the interviews, and can be considered while designing the survey instruments. The research design is also used to generalize the findings to a certain extent.

The introduction gave an overview over the topic that is to study. Chapter 2 will describe impact in higher education systems, that is the background of research impact, how it is translated into research policies, and how funding instruments are designed with the aim of achieving impact.

2 Impact in Higher Education Systems

2.1 Research Impact

To be precise, research impact is connected to other public debates, such as demands and expectations of internal and external stakeholders from universities, and therefore, cooperation with the environment (Hölttä, 1999), and the concepts of the entrepreneurial university.² Also, even to a wider extent the notion about the third mission, additionally to the teaching and research mission of universities (Mugabi, 2014). One may also see these concepts as a linkage of education, research, and serving society, and more importantly, the theoretical and practical usage of research (Mugabi, 2014). So, it is postulated as the opposite of the so-called ivory tower, an academia that is to a certain extent isolated, and mostly only interacts regarding research within these boundaries (Hoffmann, 2015; Hölttä, 2000; Hölttä & Cai, 2013). One has to distinguish between academic or scholarly impact and societal impact. One definition among many is the following, which was developed for the ‘Metrics Tide’ report in the UK:

Academic or scholarly impact is a recorded or otherwise auditable occasion of influence from academic research on another researcher, university organisation or academic author. Academic impacts are most objectively demonstrated by citation indicators in those fields that publish in international journals (Wilsdon et al., 2015).

In contrast, societal impact is described as beyond the scientific community:

As for academic or scholarly impact, though where the effect or influence reaches beyond scholarly research, e.g. on education, society, culture or the economy.

*Research has a societal impact when auditable or recorded influence is achieved upon non-academic organisation(s) or actor(s) in a sector outside the university sector itself – for instance, by being used by one or more business corporations, government bodies, civil society organisations, media or specialist/professional media organisations or in public debate. As is the case with academic impacts, **societal impacts need to be demonstrated** [bold font by the author] rather than assumed. Evidence of external impacts can take the form of references to, citations of or discussion of a person, their work or research results (Wilsdon et al., 2015).*

² Parts of the text on research impact are based on a short study assignment by the author submitted to the course “Systems in Transition II” at the University of Tampere in April 2015,

As previously mentioned, there are many definitions of the term impact, and these also depend on national, organisational or disciplinary standards. The Academy of Finland defines it in a pragmatic way as “Applying the research results outside the research community causes societal effects (Academy of Finland, n.d.)” Research impact is also one of the key themes in the publication “Reformative Finland 2015–2020” by Finland’s Research and Innovation Council, the highest policy-making body with regards to innovation, that sets the direction on Science, Technology and Innovation for the whole country. The Council is made up of several high-level representatives from the Finnish government, academia and private sector. (Government Communications Department, n.d.).

To illustrate, more examples around the world are mentioned concerning research impact. From 2016 until 2024, the Oslo Institute for Research on the Impact of Science (OSIRIS), which is funded by the Research Council of Norway, and located at the University of Oslo (Norway), brings together partners from the INGENIO research institute (Valencia, Spain) and the Manchester Institute for Innovation Research (UK) to explore the ways research has an impact on the society (“OSIRIS - Oslo Institute for Research on the Impact of Science,” 2017). In 2015, the international network Assessment & Evaluation of the Societal Impact of Science (AESIS) was launched, an association for practitioners and scholars engaged in this field, mainly operating in the Netherlands (Assessment & Evaluation of the Societal Impact of Science (AESIS), 2015). Universities in the United Kingdom are required to publish their research impact case studies which makes up 20% of the total research funding, the Finnish University Act 2009 included research impact (as part of the concept of third mission). Reports are published that assess the impact of social sciences and humanities research on society, and conferences such as “Research Impact: Evidencing the REF (Research Excellence Framework) Programme” are carried out. Within the REF 2014 the research quality of UK universities is measured (which included almost 7.000 impact case studies provided by universities) (Aarrevaara & Pekkola, 2012; Cressey & Gibney, 2014; Hölttä & Cai, 2013; REF (Research Excellence Framework), n.d.; Tinkler, 2008; Ylijoki, 2012).

Another example shows that the societal impact that was created by the Centre of Excellence Programmes of the Academy of Finland was evaluated (*ex-post*) apart from the evaluation of scientific excellence, and was required to be demonstrated in applications for the 2016 call (Academy of Finland, n.d., 2017a; Hölttä & Cai, 2013). The Irish Research Council introduced a funding scheme that focuses on impact, and the UN Sustainable Development Goals, titled CAROLINE (Irish Research Council, 2017). Additionally, not only in Europe, but also

developments in the United States of America (USA) can be observed. To illustrate, the University of Chicago and the University of California, Berkeley, raise extensive impact campaigns (University of California Berkeley, 2015; University of Chicago, 2015). And finally, the National Science Foundation conducts a programme on broader impacts of science (National Science Foundation, 2016). Research impact is discussed in international meetings of policy makers, for instance during the meetings of the Small Advanced Economies, in which Finland is one member country (Science Foundation Ireland - SFI, 2016). Other member countries include Denmark, Ireland, Israel, New Zealand, Singapore, and Switzerland (Small Advanced Economies Initiative, 2016). Furthermore, many research centres and higher education institutions inform stakeholders in press releases, how their research creates a certain impact, for instance on policy. To illustrate, such press releases are issued by the International Institute for Applied System Analysis (IIASA) based in Vienna (Austria) (International Institute for Applied System Analysis (IIASA), 2017).

Further, research impact and the measurement thereof is a highly criticized concept, especially in the humanities and social sciences. In particular, because it is believed to be against the fundamental principles of science, that is “inequality, random chance, anomalies, the right to make mistakes, unpredictability and a high significance of extreme events (Bornmann, 2017).” Inequality refers to the fact that a vast majority of academic papers, and even scholars never or only rarely get cited. Random chance and unpredictability are about science being a sort of gamble, where no one is able to predict the outcomes of research which eventually lead to innovations. Anomalies refers to the observation that citation analyses on an aggregate level, such as countries or higher education institutions, might be distorted by a few anomal citation counts, such as one highly-cited paper that pushes the whole institution to a higher rank. The right to make mistakes is more or less self-explanatory. Extreme events are about the nature of science, which is characterized by scientific revolutions, for instance an academic paper that pushed the limits of its field and may change long-established paradigms (Bornmann, 2017). Nevertheless, some other disciplines such as STEM (Science, Technology, Engineering and Mathematics) might benefit from a stronger focus on research impact, because they might have advantages through processes such as technology transfer. For example, to date, the citation in a patent is apart from the mention in clinical guidelines the only fully established form of measuring impact of research outside the scientific community. That is, these are traditionally strong in STEM, medicine and related fields. Whereas, impact of research on other parts of the society does mostly not rely on an established measurement, and is oftentimes based on narrative case

studies (Bornmann, 2017). Furthermore, universities of technology were in its origins closely-related to the profession of engineers, which reflects also in the influence of external stakeholders on the organisational governance. Examples in Finland include Helsinki University of Technology (HUT) (Hölttä, 2000; Hölttä & Malkki, 2000), which merged in 2010 with the Helsinki School of Economics and the University of Art and Design Helsinki to form Aalto University (OECD, 2017), or Tampere University of Technology with close relations to the local industry. The critics rely in particular on the fact, that research is seen as an economic outcome, and should be measured as a kind of performance. These scholars argue that such measurements are against academic freedom, and do not consider the many shortcomings as such. It is therefore part of the audit society and academic capitalism, and is against the principles that universities were accustomed to since their establishments until the 1980s–1990s. The exact years of change differ according to the country, higher education system, etc. Furthermore, some scholars argue that universities are under pressure because of these developments (Popp Berman & Paradeise, 2016). The author of this thesis acknowledges this criticism, and stresses that the measurements have to be studied in depth. This is for instance carried out in one academic discipline, the Sociology of Valuation and Evaluation.

For the sake of clarity, the focus on research impact assessment is seen as a worldwide trend with different degrees, affecting all continents and countries, and pushed by several organisations and associations, for example in order to set global standards (Bornmann & Marx, 2014; Thelwall & Kousha, 2015). To set the context, research impact is sometimes also used as a synonym for citation level, as it occurs in rankings that are counting the research output of higher education institutions (HEIs), for example The Higher Education Evaluation and Accreditation Council of Taiwan, and a part of the CWTS Leiden Ranking (Aaltojarvi, Arminen, Auranen, & Pasanen, 2008; Altbach & Salmi, 2011; Hazelkorn, 2008). For a long time, research impact has been limited to or expressed by publication production and citation impact only as an indicator of scholarly esteem in the communication or exchange with fellow scholars (personal communication, I. Meijer, 15/07/2015). Altbach calls assessing scholars' productivity, impact or prestige “a cottage industry in higher education” (Altbach, 2006), which highlights the degree of influence on the higher education system. That is, an intensive measurement of individuals, HEIs, and even higher education systems is carried out nowadays (Altbach, 2006; Hicks, Diana, Wouters, Waltmann, de Rijcke, & Ràfols, 2015).

Bibliometrics were developed in the 1950s in the USA (Altbach, 2006), and Altbach describes it as follows:

The basic idea of bibliometrics is to examine the impact of scientific and scholarly work, not to measure quality. The somewhat questionable assumption is that if an article is widely cited, it has an impact and also is of high quality. Quantity of publications is not the main criterion. A researcher may have one widely cited article and be considered influential, while another scholar with many uncited works is seen as less prestigious (Altbach, 2006).

Despite Altbach's criticism about the focus on quantity and its misleading connection to quality, further concerns that are raised in public debates about bibliometrics highlight that citation analysis focus mostly on English-speaking publications, and therefore, the majority is primarily based in the USA (and/or UK) due to its dominance in higher education (Altbach, 2006; Auranen, 2006). According to Altbach (2006), citations are useful to track which themes raise interest and how research is communicated within the scientific community (Altbach, 2006). Meanwhile, it promotes mainstream research, maybe set apart from topics of the researcher's home country (Altbach, 2006). Finally, it is seen as unfair for social sciences and humanities compared to hard sciences (Altbach, 2006). Nevertheless, in advanced bibliometrics the issues about quality are considered, and (partial) solutions are developed, such as the invention of bibliometric indicators for specific disciplines, for instance for the social and human sciences (Hug, Ochsner, & Daniel, 2013). To tackle these issues, also other novel methods were introduced, such as altmetrics, which measure the mentions of scholarly publications in social media and further online sources, such as news websites.

Firstly, it is argued that the demand for demonstrating research impact will increase in the future worldwide. Diana Hicks, one of the authors of The Leiden Manifesto for research metrics, which defined principles and best practices for (metrics-based) research assessment in 2015 (Hicks et al., 2015), puts it this way: "Every government wants to know the societal impact of its research." (as cited by Van Noorden, 2015), but so far there are no fully reliable measurements to fit this need. But will such a measurement ever be achieved?

Additionally, there is also some evidence that younger researchers strive more than elderly researchers for impact (Matthews, 2016). There are also differences among countries. For instance, in Germany, to date there is not a single university that shares its altmetrics data to a similar extent as in other countries such as Finland, even if national and discipline-specific publication databases have started to implement altmetrics and research is being carried out on the topic, such as at the Leibniz Information Centre for Economics and the GESIS – Leibniz

Institute for the Social Sciences. Through several studies it was also proved, that metrics are valued differently around the world, taking into account cultural differences (Penny, 2016).

To broaden the context of research impact, the German Federal Ministry of Education and Research funds a whole research line at several organisations all over Germany, which investigates the performance assessment in the higher education sector (German Federal Ministry of Education and Research (BMBF), 2015), and in April 2017 another funding call on quantitative science studies was announced, which includes altmetrics as well (German Federal Ministry of Education and Research (BMBF), 2017). By being aware of these public debates, universities, research funding organisations and governmental agencies are starting to consider carefully the use of advanced methods in research impact assessment (van Noorden, 2015). To illustrate, there are several institutions that use the institutional platform by Altmetric.com, among them one can also find a research funding organisation, namely the British Wellcome Trust (Thelwall et al., 2016; Wellcome Trust, 2014). According to a press release by Altmetric on 6 June 2017, European universities such as Ghent University (Belgium), Eidgenössische Technische Hochschule (ETH) Zürich (Switzerland), and École Polytechnique Fédérale de Lausanne (EPFL) (Switzerland) are among its customers (Altmetric.com, 2017a). According to Altmetric.com, some researchers include their Altmetric Attention Score into their CVs that is attached to funding proposals (Chimes, 2014). However, it is not clear, how widely spread this usage in the higher education sector is, as the publications only mention a few selected examples, but no (institutional) user statistics of Altmetric.com. There is a strong need to study this usage in research funding applications. Meanwhile, the Wellcome Trust regards it as a possibility to measure impact of its funded research, and, much more importantly, according to the Wellcome Trust (2014) the HEFCE (Higher Education Funding Council for England) carried out a review, whether “altmetrics might contribute to the next Research Excellence Framework, likely to take place in 2020”. However, the HEFCE arrived at the conclusion that “metrics cannot replace peer review in the next REF”. There are five impact case studies, which mention altmetrics as an evidence for impact, even if it is a very small amount compared to the total numbers of impact case studies in the REF 2014 (REF (Research Excellence Framework), 2014). In a similar vein, in the beginning of 2016, the European Commission called for experts that have competences in altmetrics to contribute to the development of evaluation methodologies of funded research projects in Horizon 2020 (European Commission, 2016).

Taking these recent developments into account, it is essential, to assure un-manipulated altmetrics data (in the most probable way), when it comes to funding decisions, as Haustein et

al. (2014) postulate. At the same time, it has to be stated, that this development cannot be foreseen, whereas this thesis shall provide a deeper analysis of the potential valuation of altmetrics. The potential manipulation of altmetrics refers also to Campbell's Law which states: "The more any quantitative social indicator is used for social decision-making, the more subject it will be to corruption pressures and the more apt it will be to distort and corrupt the social processes it is intended to monitor (Sugimoto, 2015)." This is for example the case, when universities are subject to novel evaluation regimes, and try to adjust their organisation based on the evaluation criteria. Another example is the publish or perish phenomenon, which might create in some cases various publications of a lower quality, or even false findings for the only reason to meet the targets set on research output per individual researcher, research group or university. Examples of this falsehood are summarized on dedicated blogs, such as Retraction Watch (Retraction Watch, 2017), and a large biannual international conference on research integrity tackle these problems as well (WCRI, 2017).

Therefore, it is essential, that scholars and university managers have a profound knowledge with respect to research impact assessment, so that they can adapt their working routines (e.g. for preparing research funding proposals). Given the fact that third-party funding is a substantial income for universities worldwide with different percentages, success in funding leads (ideally) to success for the whole organisation to reach its goals. Above all, if a HEI seeks excellence in research, or strength in regional development, it is essential to consider impact issues. As it can be seen in the most common worldwide higher education (HE) rankings, particularly the HEIs that perform outstanding in international research rankings are also aware of their research impact on the society and align it to their strategic goals, as it was mentioned before for the University of Chicago and the University of California, Berkeley. One has to say, that the framing of impact is most probably also based on the requirements of the country's higher education policies. Subsequently, as tax payers and stakeholders can demand accountability from HEIs and research funding organisations, one may argue, that they can also demand that the scholarly research has an influence on the society itself, as it is mainly generated through the leverage of public funds.

Furthermore, it is understandable, that advanced methods of research impact assessment were developed, as the demand to have an exact measurement increased (National Information Standards Organization (NISO), 2016; Sarli, Dubinsky, & Holmes, 2010; STAR METRICS, 2017; van Noorden, 2014). Still, it is important, that not everything is measured without deeper

reflection, because this may as well decrease the uphold academic freedom which is an important part of scholarly research, and sparkles creativity. One might question at the same time, what happens to all the data that is gathered to measure research impact, and how can ethical standards be assured? This is an on-going debate in research on big data, which poses challenges for the whole society (Cambridge Big Data, 2017).

In a similar vein as research impact, open access is postulated in today's higher education. This can be seen in several national and international initiatives and the advocacy of scholars and organisations. Such initiatives can be found in the work of the United Nations Educational, Scientific and Cultural Organization (UNESCO) (UNESCO, n.d.) and for instance on national level in Finland, where the Open Science and Research Initiative (ATT) is carried out from 2014 until 2017. As a matter of fact for the importance of this topic in Finland one might recall the following: "Finland seeks to become a leader in OSR [open science and research], applying its principles to accelerate Finnish scientific research and boost its impact (Open Science and Research Initiative (ATT), 2014)." Part of this movement is open access (OA) publishing, which is defined as follows:

In its simplest form, open access publishing (articles, reports, monographs) means uploading a research publication to a data network and granting rights to read, copy, print and link to entire scientific publications. Open access publishing means free dissemination of scientific information. A scientific publication is openly available when both the scientific community and the general public have unrestricted access via the Internet without charge. In simple terms, Golden OA (the Gold Road) means open journals, while Green OA (the Green Road) means self-archiving (Open Science and Research Initiative (ATT), 2014).

On top of that, impact measurement is also an important countermeasure against the distrust of universities and research in many parts of the society nowadays. This is acknowledged by several politicians. To illustrate, in a recent speech the President of Estonia among others made reference to that (Schildt, 2017). Impact is here referred to in a broader sense, also related to knowledge and technology transfer, but it goes into the same line, and is apparent in many policy discussions these days. Societal impact of research is also promoted by international university consortia, such as by the European Consortium of Innovative Universities (ECIU) (European Consortium of Innovative Universities (ECIU), 2017). As in the case of Finland, the latest example includes a study on the societal and economic impact of Finnish

universities, that was contracted by Universities Finland (UNIFI) and published in June 2017, with the aim to provide evidence for the various impacts that are created by universities in Finland (BiGGAR Economics, 2017). To sum up this section, it can be noted that “[g]overnments and funding organizations are increasingly asking scholars to demonstrate societal impact and relevance, in addition to scientific excellence (Sugimoto, Work, Larivière, & Haustein, 2016).”

To achieve impact and relevance is related to strategic research funding. This type of funding has the aim to mainly solve grand challenges of societies, for instance the grand challenges that a country faces. What defines ‘grand’ is also disputed, and is a fashionable term that is primarily used in policy (Ulnicane, 2016). For that reason, strategic research funding instruments are implemented in a number of countries, and are also closely tied to national evidence-based or knowledge-based policy making (OECD, 2015). In Finland, the Prime Minister’s Office contracts studies to provide evidence for policy-making to support the Strategic Government Programme (Halme, Saarnivaara, & Mitchell, 2016). This section relies more on policy papers than academic papers, as these sources are more common when it comes to strategic research funding. The Academy of Finland’s Strategic Research Council (SRC) was taken as a case to study such a funding instrument. The SRC is part of the Academy of Finland, and started in 2014 (Halme et al., 2016; Halme, Saarnivaara, & Mitchell, 2017; Saarnivaara, 2015), and is based on national research funding reforms from 2012–2013, and an evaluation of the Academy of Finland in 2013, which recommended to expand its role into strategic research funding (Könnölä, 2014; OECD, 2015). In June 2017, the funding rounds from 2015 and 2016 have been completed, and the one for 2017 is still ongoing. The aim of the SRC is to contribute to social policies in order to solve grand challenges of the Finnish society, and 55 million euros per year have been made available for that purpose (Halme et al., 2016; Könnölä, 2014; OECD, 2015). Therefore, it plays an important role in research funding in Finland. Compared to the other Research Councils at the Academy of Finland, two out of nine SRC board members also come from the industry. Apart from the SRC, the Centers of Excellence that are funded by the Academy of Finland, are also required to elaborate on the potential impact already in the application phase 2016, as it was mentioned before.

2.2 Research Policies

As the focus of this section is set on research impact and related funding schemes as well as higher education policies, national strategies for science, technology and innovation and

national action plans for the European Research Area were considered. These national action plans have certain aims in common. They were proposed through a dialogue between the European Commission and the Member States, considering national characteristics of research and innovation systems. Further, most of them were developed in 2016, and follow a similar process. As a particular feature of the European Research Area, every Member State should keep up its individual characteristics, which should show the strength of collaboration between several national systems. But it has to be noted, that these policy documents are also shared and discussed among the Member States, which could lead to the adoption of best practices from other Member States. The focus was set on whether research impact appeared in the national action plans, and if altmetrics was mentioned as a tool to measure this impact. As evidence-based policies are one part of the process to build a European Research Area, altmetrics might provide a tool to provide evidence. In two national ERA action plans, altmetrics were mentioned, namely in the Belgian Wallonia Brussels Federation and Norway (Federal Government of Belgium, 2016; Norwegian Ministry of Education and Research, 2016).

As aforementioned, altmetrics are a highly-debated topic in higher education and research policy nowadays. For instance, the European Commission plays an important role regarding the higher education policies of the EU Member States, and contracts studies on altmetrics, for example, as part of the European Science Cloud and through the EU Expert Group on Altmetrics. The usage of altmetrics data in certain institutions was also addressed by the EU Expert Group on Altmetrics (European Commission, 2016; European Research Council, 2016; Wilsdon, 2016). Similarly, it also refers to one section of a 2016 call for tenders by the European Research Council (ERC) to monitor the open access compliance of ERC funded projects (European Research Council Executive Agency ERCEA, 2016). The assumption by the author is, that the developments in Norway and Belgium will also have influences on other EU Member States. Through the open method of coordination by the European Commission, such initiatives are set to spread in all Member States to a different degree and considering national and local characteristics of the higher education systems. The fact that these two Member States mention the implementation of altmetrics, will most probably sooner or later also have an influence on other countries. This is also quite predictable, as some national initiatives carry out studies or introduce altmetrics on national publication databases. As defined in the theory of transnational policy transfer and circulation of policy models, these new initiatives will also influence further policies, letting them circulate across national borders. In future studies, it

would be interesting to gather opinions from other national governments, research funding organisations, and users of altmetrics in the EU. These circulations are especially studied in public policy (International Public Policy Association - IPPA, 2016). By considering the developments of altmetrics in 2016–2017 and over the previous years, one can draw the conclusion that altmetrics are gaining a considerable momentum in research policies. A few years ago, this could not have been predicted as such, and may come as a surprise to some stakeholders in higher education. The country level was taken as a basis in this study, because strategic research is supposed to solve grand challenges that societies face, and might have an impact on the national or even international level.

2.3 Strategic Research Funding

This section describes strategic research funding in general and in particular in Sweden, as a historically closely-related country to Finland (Hölttä, 2000). Nevertheless, examples from other countries are also mentioned. Research councils in general were initially, in particular after World War II, controlled by researchers on a collegiate basis, and focused on peer review that evaluated research based on scientific merit (Benner & Sandström, 2000). Referring to the Triple Helix model, different actors have gained influence on universities, that changed the evaluation and performance of universities. That is, these are the industry and the government, or referring to the Quadruple Helix, also other societal actors. It was also referred to by other scholars such as Burton Clark as knowledge triangle (Hölttä, 1998). These forces have an influence on the collegiate control of research, and is embedded in the knowledge-based economy. That, again, is connected to entrepreneurialism and serves as a bridge between the academia and the market (Benner & Sandström, 2000). Research funding organisations play an important role in setting norms for the system, that either focus on scientific excellence, societal impact, or both (Benner & Sandström, 2000). Funding in general is also an important instrument for policy-makers to steer higher education (Hölttä & Malkki, 2000). How research is evaluated has in turn an influence on the academic system, and in particular on the orientation and expectations of applicants. As in the case of Sweden, strategic research gained importance in the late 1990s with related research funding (Benner & Sandström, 2000). Strategic Research Funding in Sweden mainly entails the Strategic Research Foundation that was established in 1993 (Benner & Sandström, 2000). The most recent development is seen in five strategic programmes intended to address societal challenges, that were started by the Swedish government in 2016 (Lindholm, Jacob, & Sprutacz, 2017). Hellström and Jacob (2005) also include MIS-TRA (the Swedish Foundation for Strategic Environmental Research), the Swedish Foundation

for Strategic Research, the Knowledge Foundation (established in 1994), and Vinnova (Sweden's Innovation Agency) into this set of research funding bodies. The Swedish strategic research bodies as such also foster a discourse on the need for societal relevance of the academic system (Hellström & Jacob, 2005). In Sweden, there is a distinction between basic and strategic research funding, whereas the latter is focused on sectoral relevance, such as industrial growth, and is influenced by policy-makers and industry representatives. This research policy focus is also apparent in other EU Member States and OECD countries (Hellström & Jacob, 2005). Hellström and Jacob (2005) trace back the beginning of the impact of science to concepts as early as established by Joseph Schumpeter in 1939, on how the outside world might benefit from science, that were later further developed to establish the present-day discourse on impact, which they call a 'Schumpeterian managerial paradigm'. That is, it rather focuses on a market-driven approach than a knowledge and invention-driven one. Especially since the end of the 1990s, the notion that Europe is lagging behind the USA and Japan in terms of innovation was frequently used in policy debates. Together with the demographic shift of modern societies, and the fear that this will require more economic growth, this informs the research policy of governments around the world. In turn, together with the paradigm of national innovation systems, Hellström and Jacob (2005) define this phenomenon as "corporatist collusion of state and firm interests to subsume an increasing portion of scientific production" (Hellström & Jacob, 2005). Scholars are nowadays more likely to highlight the relevance of their research to policy makers and industry, which is oftentimes a pledge for research funding (Hölttä & Malkki, 2000). This requirement to prove impact is also criticized within the academe. Similarly, some practices from the academic system are also to be adopted in the industry, while the latter has a bigger influence on the academic system. The concept of university-industry collaborations is then fostered through targeted funding instruments, and to make them become a reality, such as it is the case in strategic research funding. (Hellström & Jacob, 2005). Oftentimes, the users of the societally-relevant research is then the industry, which contributes to the development of a merged economic and higher education or science policy (Hellström & Jacob, 2005; Hölttä & Malkki, 2000). In Finland, a similar development could be observed as external stakeholders such as those from the industry gained influence on universities through higher education reforms in the 1980s–1990s, whereas the influence had been always quite high in some parts as mentioned before (Hölttä, 1998, 2000). The aforementioned merger of economic and science policy also manifests itself in the OECD Innovation Policy Review on Finland in 2017, which assessed the national system based on criteria that are relevant for higher education and the

industry simultaneously, and the review was contracted by the Ministry of Education and Culture and the Ministry of Economic Affairs and Employment (OECD, 2017). Obviously, this relation is apparent in other OECD countries as well.

For this study, a review by the author gives an overview of strategic research funding instruments in some other EU Member States, that can be used as a comparison to Finland. This list is by no means intended to be complete, and the instruments also differ to a certain extent, but it gives an overview on international counterparts. The information was taken from the websites of the national research councils, and these organisations were identified through the Joint Research Centre Research and Innovation Observatory (RIO), an initiative by the European Commission that provides a database on the characteristics of the EU Member States' national research and innovation systems.³ Only organisations that provide information in English about a similar funding instrument to the SRC were included.

Table 1. *An overview of strategic research funding in EU Member States*

Research funding organisation and country	Research funding instrument addressing grand challenges that societies face	Description
Irish Research Council	CAROLINE ⁴	Postdoc fellowship to address the United Nations (UN) Sustainable Development Goals
Higher Education Funding Council for England	Social Innovation Fund ⁵	Addressing social issues through knowledge exchange
Research Foundation Flanders (FWO), Belgium	SBO (Strategic Basic Research) projects ⁶	Innovative research which creates prospects for economic or societal applications

³ <https://rio.jrc.ec.europa.eu/en/country-analysis/>

⁴ <http://www.research.ie/funding/caroline>

⁵ <http://www.hefce.ac.uk/funding/sifund/>

⁶ <http://www.fwo.be/en/fellowships-funding/research-projects/sbo-projects/>

French National Research Agency	Major Societal Challenges	Major Societal Challenges addressed in the Agency's Work Programme 2017
Luxembourg National Research Fund (FNR)	CORE ⁷	“In the eyes of the FNR, high quality research [in CORE] capacities form the essential pool of knowledge and expertise from which social, environmental and economic impact emanate [bold font by the author].”
Research Councils UK	Global Challenges Research Fund ⁸	“The Global Challenges Research Fund (GCRF) is a £1.5 billion fund announced by the UK Government to support cutting-edge research that addresses the challenges faced by developing countries.”
Swiss National Science Foundation	National Research Programmes (NRPs) ⁹	“NRPs embrace research projects that contribute to solving the key problems of today.”

⁷ <https://www.fnr.lu/funding-instruments/core/>

⁸ <http://www.rcuk.ac.uk/funding/gcrf/>

⁹ <http://www.snf.ch/en/funding/programmes/national-research-programmes-nrp/Pages/default.aspx#Details>

Danish Council for Strategic Research ¹⁰	-	-
Swedish Foundation for Strategic Research ¹¹	-	(see explanation in section on Sweden above, pp 18–19)

Chapter 2 described impact in higher education systems, that is the concept of research impact, how it is translated into policies and research funding instruments. To conclude, impact is a widely used concept in several higher education systems, and related research policies and funding instruments are in place with the aim to achieve more impact. In turn, impact is also a highly criticized concept, as it might be against the basic principles of science, and favour some academic disciplines and certain organisational types of higher education institutions, such as STEM and universities of technologies. Chapter 3 will explore the concept of altmetrics, and what role altmetrics play in the debate on impact in higher education systems.

3 Altmetrics – Alternative Metrics

Research impact is closely related to the concept of altmetrics, as among others stated in the OECD Science, Technology and Innovation Outlook 2016: “[...] altmetrics [...] are likely to be increasingly used alongside more traditional bibliometrics to assess research impacts (OECD, 2016).” Altmetrics track down and count the mentions of scholarly outputs in social media, news sites, policy sites, and social bookmarking sites, and aggregate the number of mentions. This allows an observation of how many times research has been viewed, discussed, followed, shared, adapted, and downloaded. By following this line of thought, one might relate these mentions to a kind of impact in the wider public or the society outside of the scientific community, because everybody with an internet connection would be able to engage with scholarly outputs online, even if this is obviously only the case for a fraction of the overall number of users. Nevertheless, it is important to note that these mentions do not correlate with quality of a scholarly output, they mostly visualize a community of attention. Altmetrics is an

¹⁰ <http://ufm.dk/en/research-and-innovation/councils-and-commissions/former-councils-and-commissions/the-danish-council-for-strategic-research/for-applicants/about-funding-for-research-activities>

¹¹ <http://stratresearch.se/en>

innovation with potential for further development (Bornmann, 2014; CWTS, 2017; Holmberg, 2016; Liu & Adie, 2013; Piwowar, 2013; Priem, Taraborelli, Groth, & Neylon, 2010; Nicolás Robinson-García, Torres-Salinas, Zahedi, & Costas, 2014; Thelwall, Haustein, Larivière, Sugimoto, & Bornmann, 2013). Even though the possibility of introducing a method for web mentions had already been discussed before by several scholars (Aaltojarvi et al., 2008). According to Robinson-García et al. (2014) it is also seen as a research field, and is receiving attention by various scholars, that produce their own research corpus. Even though it is still considered as an emerging research field, there are certain new established research groups that focus among others on altmetrics, such as the working group “Society Using Research” of Centre for Science and Technology Studies (CWTS) at Leiden University (the Netherlands), “Research Evaluation and Scientific Communication” at University of Granada (Spain), the Canada Research Chair on the Transformations of Scholarly Communication at University of Montreal (Canada), the Scholarly Communications Lab at Simon Fraser University and University of Ottawa (Canada), or the above mentioned research unit on valuation of altmetrics at DZHW in Berlin (Germany). One definition of altmetrics is as follows:

Altmetrics are non-traditional metrics that cover not just citation counts but also downloads, social media shares and other measures of impact of research outputs. The term is variously used to mean ‘alternative metrics’ or ‘article level metrics’, and it encompasses webometrics, or cybermetrics, which measure the features and relationships of online items, such as websites and log files. The rise of new social media has created an additional stream of work under the label altmetrics. These are indicators derived from social websites, such as Twitter, Academia.edu, Mendeley, and ResearchGate with data that can be gathered automatically by computer programs (Wilsdon et al., 2015).

Altmetrics is thus also regarded as part of the study of the internet, which can be described as the discipline of Cybermetrics, Webometrics, Web Science, or Internet Science (Network of Excellence in InterNet Science (EINS), n.d.; Statistical Cybermetrics Research Group, 2017; ZBW, 2017). It attracts large attention among scholars, and related research is carried out at various institutes, for example: Statistical Cybermetrics Research Group at University of Wolverhampton (UK), Australian National Centre for the Public Awareness of Science, Canberra, German National Library of Economics at Kiel University, Leibniz Research Alliance Science 2.0, Kiel, Alexander von Humboldt Institute for Internet and Society, Berlin (Germany), Oxford Internet Institute, University of Oxford (UK), Berkman Center for Internet & Society at Harvard University (USA), Helsinki Centre for Digital Humanities (HELDIG;

Finland), and Nordic Centre for Internet and Society at the Norwegian Business School (Oslo). In May 2017, another research centre was added to the list, the German Internet Institute in Berlin, which is to research the whole outcomes of digitalization on the society and economy. Ultimately, nowadays it is also considered to use online social networks (OSNs) as ranking data focusing on graduate outcomes, such as it is already carried out by LinkedIn, in certain areas (Choudaha, 2015). Assessing new technologies is also part of science and technology studies. This discipline has been in existence since the 1960s and was developed as an attempt to understand the relations between science, technology and society. The scholars in this research area are engaged, among others, in carrying out (critical) technology assessment (Cutcliffe, 2000). The interdependency between the internet and the science community and to a larger extent the whole society, and the following transition process is also postulated in a consultation document by RAND (Research and Development) Corporation that was contracted by the European Commission (European Commission, 2014). To put in a simple image, one might narrow it down to a sentence that summarizes the importance of the web in daily life:

The importance of the web itself as a communication medium and as a host to an increasingly wide array of documents, from journal articles to holiday brochures, needs no introduction (Statistical Cybermetrics Research Group, 2017).

Furthermore, it is also connected to the fact that universities share their knowledge production online, which can be observed for instance at the National Autonomous University of Mexico, Mexico City (Aaltojarvi et al., 2008; UNAM, 2017). Not quite surprisingly, universities also rely more and more on the reputation that is gathered on the institution online, and launching press releases such as “Cambridge tops the UK league in on-line impact” (University of Cambridge, 2016). At the same time, there are rankings that exclusively retrieve their data about universities online such as Webometrics Ranking of World Universities (Ranking Web of Universities, 2017). From this perspective, also the European Commission funded the development of a large ranking, known as U-Multirank which is exclusively available online (U-Multirank, n.d.). There are also conferences that only focus on the internet in academia, such as the Science 2.0 Conference in Hamburg (Germany), or the 2nd international conference on Internet Science “Societies, Governance and Innovation” in Brussels (Belgium) (Network of Excellence in InterNet Science (EINS), n.d.). Additionally, there is even the European Network of Excellence in Internet Science (EINS), which was funded under FP7, the European Commission's Seventh Framework Programme (Information and Communication Technologies).

The importance of the internet is connected to the fact, that online sharing presents the possibility for universities and researchers to contact –and maybe much more importantly interact with– a wider audience than ever before. Therefore, this kind of impact, or in this case, the impact of research, could be measured. Here altmetrics could play a role. As such, it is a possible method of measuring the impact of research by gathering quantitative data of scholarly outputs in the web, crawled from blogs, media websites, social media networks, etc. This data is compiled automatically by private companies (e.g. Altmetric.com), as such when compared to traditional measurements it could have a time advantage, as citations usually require more time to occur. As a result, older publications might be only marginally included in this measurement. Apart from social media, news sites, social bookmarking tools, etc., policy documents have become an important source for tracing the societal impact of scholarly outputs. That is, if scholarly outputs are cited in policy papers. Altmetric.com harvests for example policy paper from the UK and US, but might be neglecting other languages than English (Gauch & Blümel, 2016).

Obviously, data from online sources and in particular social media, such as from Twitter is not only limited to identifying links to scholarly outputs (Haustein et al., 2014). Further usages apart from research impact and altmetrics include the study of political elections such as the prediction of voters' attitudes (Tumasjan, Sprenger, Sandner, & Welpe, 2010), or the business value of the posted Tweets such as in information on stock markets (Sprenger, Tumasjan, Sandner, & Welpe, 2014). This list is not intended to be exhaustive, and there are many other perspectives on how to collect and analyse data from social media.

3.1 Altmetrics and its Origins in Open Science

Altmetrics is often cited as being a part of open science, which also entails other areas of the scientific process, such as open peer review. The latter is implemented by several organisations, and is also postulated to be used in Horizon 2020 (Research Research Limited, 2016). It also entails open research, which basically means to share the whole research process with others (McKiernan et al., 2016). For example, it is possible to publish already the research idea in dedicated journals, such as in RIO (Research Ideas and Outcomes). By doing so, a researcher is able to claim authorship for a certain research idea, so that such proposals can also be cited by other researchers. How altmetrics and open science are connected is also shown through the

fact how large open science platforms, such as the European Commission's OpenAire¹² and ScienceOpen (owned by a private company)¹³ promote altmetrics, and implement it on their platform.

As mentioned above, the European Commission introduced a bold initiative that will include partly altmetrics and will affect all EU Member States: The European Science Cloud. The cloud relies on national research infrastructures to make research data and publications freely available, and is to be launched in 2018. Researchers merits are supposed to be displayed there, among others through altmetrics. Similar initiatives are also started through the Commission's OpenAIRE 2020 publication platform.

The PlumX dashboard can also be attributed to open data, as researchers and their merits are made open by the universities themselves. Without this open data, the present study would not be possible. But open access is much more than that. It is also seen as inclusion, to give everyone the possibility to gain knowledge from various sources without any restrictions. This might have a huge impact on society. Several studies are carried out to quantify the potential impact, for example by Tennant et al. (2016). The tracking of open science sources, that is open research data and open access publications is a common theme in several recent studies (Mounce, 2013). This tracking is also provided by data providers, such as the Canadian company 1science¹⁴.

3.2 Altmetrics Data Providers

Most relevant altmetrics data providers are the following: Altmetric.com, PLOS ALM, Plum Analytics and Impactstory (Gauch & Blümel, 2016). PLOS ALM or article-level metrics were developed by the Public Library of Science for its journals, and Impactstory lets researchers showcase their impact in an online profile. These are also called altmetrics aggregators as suggested by Erdt, Nagarajan, Sin, & Theng (2016). Plum Analytics is compared to Altmetric.com a secondary data providers, as its data is collected from secondary sources (Gauch & Blümel, 2016). In February 2017, Elsevier acquired Plum Analytics from EBSCO (Carpenter, 2017). The fact, that such large corporations show interest in altmetrics also says something about the value of altmetrics, and which stakeholders might be interested in the generated data.

¹² <https://www.openaire.eu/>

¹³ <https://www.scienceopen.com/>

¹⁴ <http://www.1science.com/>

This study focuses only on the scholarly outputs, that are tracked by PlumX. This might indicate certain limitations, but it also shows a clear focus. The University of Helsinki's PlumX dashboard was chosen, because the University was the first to offer such a system in Finland. That is why, it is possible to ask users about their perceptions of altmetrics, as it has been in use since November–December 2015.

As it was stated in a marketing material by Plum Analytics in February 2016, several benefits of their altmetrics dashboards are claimed; interaction with research users; possibility to build up new collaborations; identify publication outlets and research funding (Chant, 2016). The business model of EBSCO concerning PlumX can be seen as platform ownership, one of the most essential developments in the industry in recent years, and also highly-connected to the digitalization of higher education. The content is mostly free, but the licence and maintenance are charged by the company to the (institutional) customer. The business model can therefore be attributed to the so-called platform economy (Kenney & Zysman, 2016). Altmetric.com offers for example free badges for the websites of individual researchers, which lets them showcase the attention surrounding their scholarly work. Related to that, platform science is becoming a topic of debate. To date, service providers are mostly separated, such as Altmetric.com, ResearchGate or further platforms. This brings platform science to attention, which would mean a full integration to track all metrics from all systems on one single system. Obviously, this is only a theoretical construct so far, and the challenges and unintended effects need to be assessed as well, for example if such a system would be a 'walled garden' like Facebook, or if it would rely on open standards, and how privacy, security and confidentiality issues are tackled (OECD, 2016).

Figure 1 presents an example of an altmetrics detail page of the most mentioned publication in 2016 as tracked by Altmetric.com. One can see the different altmetrics sources, geographical coverage, and the aggregated Altmetrics Attention Score inside the shape of a colourful donut, the colours representing each source for which data has been aggregated. The screenshot that the author has taken shows the number of times the article has been shared on Facebook, but other headers include news, blogs, policy documents, Twitter, and Google Plus. These headers can be adapted to the content and context of the article. The articles can also be sorted by demographics of the users for whom some demographics have been detected. The calculation of the score might not be visible in the first place, as mentions in social media are differently weighted. In February 2017, Altmetric.com added citation counts from Clarivate Analytics'

Web of Science (acquired from Thomson Reuters in 2016) to their article detail pages. PlumX displays citation counts from the Elsevier Scopus database.

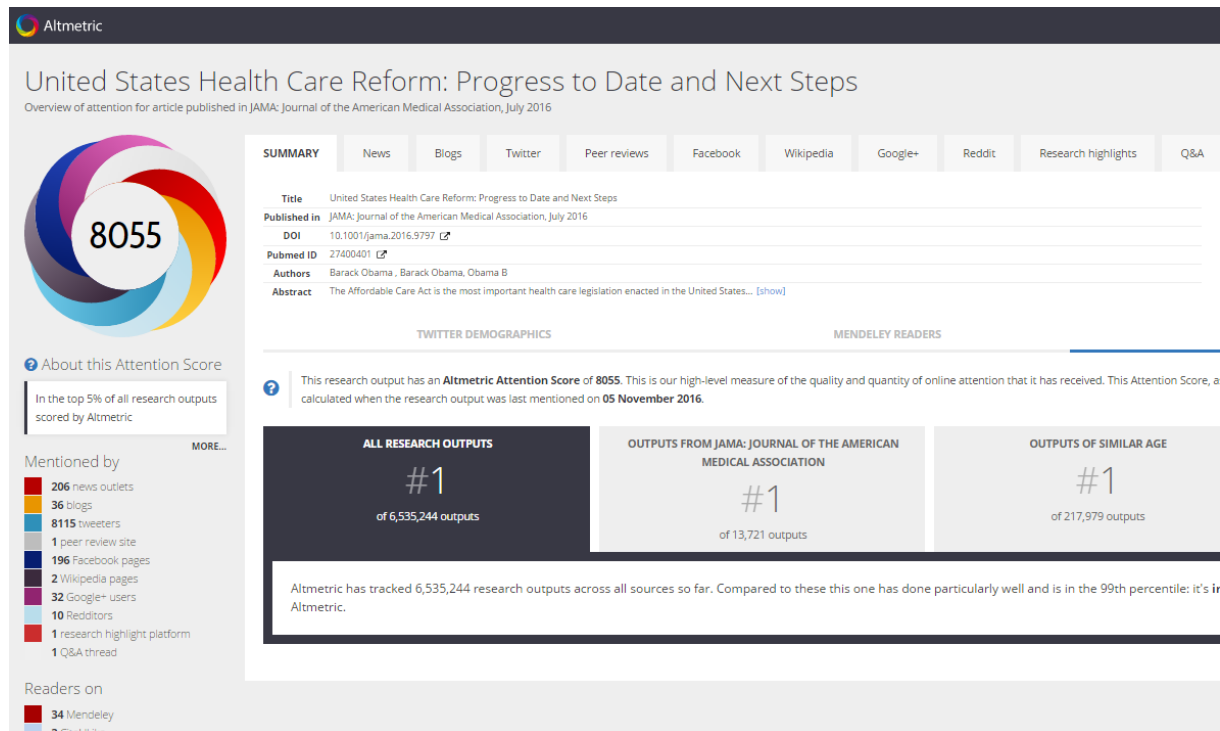


Figure 1. Article with the currently 2nd highest Altmetric Attention Score in June 2017 titled “United States Health Care Reform: Progress to Date and Next Steps by Barack Obama” (data compiled by Altmetric.com; as of 6 November 2016)

3.3 Challenges concerning Altmetrics

As mentioned before, altmetrics also highlight communities of attention (Costas, n.d.), addressing questions like who mentions the publications of a university, a research institute, or a particular scholar? Which are the common interests of these users? By doing so, an author might get new insights about the users that are interested in his or her research outputs. Therefore, new networks can be established, or benchmarking with similar institutions might be carried out. Nevertheless, it has to be considered that this kind of attention does not necessarily indicate a positive attention. High altmetrics scores based on many tweets, for instance, can also mean that a paper of relatively low quality or one that contains a dramatic failure is tweeted, which makes it an object of humour for many Twitter users (Costas, n.d.). Examples from Altmetric.com show articles, where it was forgotten to remove insulting comments about the work of other scholars and retracted articles, where the first author had suggested a peer reviewer and then carried out this peer review by himself with a fake e-mail account that he had sent to the publisher (Altmetric.com, 2016; Retraction Watch, n.d.). These examples show once again that

it is essential to know what is behind altmetrics counts and not just to see it as ranking to appraise scholars and their work. Another issue that needs to be discussed is the effect that influential users play within networks, as these can increase the speed of sharing news of other users. News sharing network also play a particular role in this regard (Fraumann, Zahedi, & Costas, 2015; National Academies of Sciences, 2017).

By extension, the reliability or maturity of altmetrics has been questioned by scholars and researchers in this field, and knowledge of the concept is still quite low, but rapidly growing. For example, the level of attention the publication gathers on the internet does not correlate with the quality of a scientific publication (Madjarevic & Davies, 2015) and certain criticisms have been raised about it (Boon & Foon, 2014). Hence, altmetrics data should always be backed up by a qualitative analysis as Haustein et al. (2016) and Holmberg (2014) suggest, for instance to identify automated tweets from bots, etc. Questions have also been raised about the fact that altmetrics data is mostly offered by commercial companies such as Altmetric.com and Plum Analytics (Costas, Zahedi, & Wouters, 2014; Zahedi, Costas, & Wouters, 2014), which is also an issue with traditional bibliometrics and proprietary citation databases such as Scopus or Web of Science (J. Haapamäki, personal communication, 03/10/2016). Whereas in other academic disciplines, many stakeholders argue that university-business relations shall be fostered more, the research on altmetrics depends primarily on these companies. Similarly, they support the largest annual meetings on an international level, the Altmetrics Conference and Workshop, and take part in these events in discussions with researchers, librarians and publishers.

Several studies on altmetrics also compared altmetrics data providers, and differences of their coverage (Jobmann et al., 2014; Zahedi, Fenner, & Costas, 2014). This is also connected to the call for altmetrics standards, which is pushed forward by many stakeholders (National Information Standards Organization (NISO), 2016). Generally speaking, if one considers the various rankings that are published these days, information literacy might be one of the most important skills that need to be developed within the higher education sector. That is, one needs to understand the context and background of rankings, their value, and most importantly, how scores are calculated and how the data collection takes place.

An initiative by NISO (the US American Information Standard Organisation) in 2016 concluded after a process with several stakeholders certain standards on altmetrics. Altmetrics data providers were also part of this initiative. A highly-debated topic in the Altmetrics Conference and Workshop in September 2016 in Bucharest (Romania) focused on the differences

in the perception of metrics around the world. Another focus was set on the locality of sources, because some organisations see the need for including more local sources that reflect more their regional engagement compared to English-speaking sources. The next Altmetrics Conference and Workshop is set to take place in September 2017, and will also include a track on altmetrics in research evaluation.

Concerning the relation to the academic career model, altmetrics might transform the reward system to a certain extent. For an early career researcher, it usually takes quite a long time until a manuscript makes it into a high-impact journal, and in the current academic reward system those are needed to advance one's career substantially. Similarly, forms of online mention are in the reach of early career researchers. It is much more common that a certain research output gets shared, downloaded or receives comments than to achieve citation counts, or even publication in high-impact journal. This might increase the motivation to aim for an academic career, and give young researchers a stronger voice. At the same time, senior researchers do not have a disadvantage if they are not active on online social networks and so forth, as altmetrics counts can also be noted without such a presence.

3.4 Ethical Issues concerning Altmetrics

Ethical questions concerning altmetrics are based on the fact, that all data is tracked, no matter if an online user is aware of it or not. This is to some extent platform-dependent, as for instance a Twitter user might expect to be mentioned somewhere else, but most Facebook users are probably not aware that the activity of their public profiles and anonymous data about other activities is accessible by external providers to such a large extent. Further, most Mendeley users might not be aware that their usage data is analysed, and included as an altmetrics data source. As the Association of Internet Researchers notes in its ethical guidelines on the tensions between public and private in the digital age: "People may operate in public spaces but maintain strong perceptions or expectations of privacy. Or, they may acknowledge that the substance of their communication is public, but that the specific context in which it appears implies restrictions on how that information is -- or ought to be -- used by other parties (Markham & Buchanan, 2012)." That is why, many conflicts may arise from the inclusion of such private data into altmetrics. On the one hand, individual users are not really visible in large aggregated data sets of altmetrics, while on the other hand, some users might give their consent about the data collection, and some might not. This depends on individual assumptions, and on cultural habits, for instance, to what extent public online interaction and privacy restrictions are valued.

This dilemma is called ‘perceived privacy’, which is a common challenge that can be observed with many internet technologies. A recent study by Williams, Burnap, & Sloan (2017) explores the ethical issues of using Twitter data by employing a large survey of Twitter users. The respondents were asked, to what extent they would agree that their Twitter data might be used for publications, such as in research studies. It was found, that most users would not feel comfortable with it, even if using Twitter data does not violate the company’s rules. Given this fact, the authors suggest guidelines to ask for informed consent, even if so-called ‘public’ social media, in this case Twitter, are concerned.

3.5 Usage of Altmetrics and Altmetrics in Research Funding

Several universities actively promote the usage of altmetrics, to name only a few these include the University of Cambridge, the University of Manchester, Duke University and Aalto University (Madjarevic & Davies, 2015; University of Cambridge, 2016). Furthermore, altmetrics are implemented on several online platforms, university library repositories, information systems, and journal websites. Several studies are carried out nowadays, that focus on a particular system, and its altmetrics data. To illustrate, SciELO (Scientific Library Online) is one of the largest information systems worldwide, concentrating on open access publications. SciELO implemented Altmetric.com scores for its journals and journal articles. These are studied by several authors, because it is also possible to gauge developments in several countries, as SciELO started in Brazil, but has own versions in many Latin-American countries, and also in South Africa and Spain (Alperin, 2015; Alperin, Fischman, & Cetto, 2015; Araújo, Murakami, Leduc de Lara, & Fausto, 2015; Fraumann, Costas, Mugnaini, Packer, & Zahedi, 2016; Spano et al., 2014; Spinak, n.d.).

What is more, some international funders already connect altmetrics data with their data about awarded grants to show the impact of their funded research, such as Autism Speaks, the largest international funder for research on autism based in the US. The question is therefore, what kind of values are attached by research funding organisations, and what kind of values researchers themselves attach to altmetrics counts and rankings. These values are particularly important in the funding sector, because it might influence funding decisions that are done by the board and committee members. The rankings by altmetrics data providers show a simplified output of altmetrics data, as the counts are aggregated. Concerning the promotion of research impact, altmetrics might be a measurement that could in the future (partly) answer to questions about return on investment by funders that is not based on reports such as impact case studies

by the funded researchers themselves. This concerns also the digital transformation of the higher education sector, as the data is only gathered online.

3.6 Major Altmetrics Research Projects

The first EU funded project on altmetrics and related concepts was ACUMEN, funded under FP7 (Gauch & Blümel, 2016), but web metrics were firstly suggested as early as 1995 (Gauch & Blümel, 2016). In a currently funded Horizon 2020 project that focuses on Open Science and Research titled OpenUp, a preliminary SWOT analysis for the whole concept of altmetrics was carried out (see Table 2), which led to the following results.

Table 2. *SWOT analysis of altmetrics*

Strengths	Timeliness of some metrics
	Complementary information filters
	Catalyst function towards downstream impacts
	Responsiveness through open concept
	Balanced signalling of importance and impact
	Promotion of unique IDs
Weaknesses	Data Integrity & Quality
	Confusion through Composite Indicators
	Conceptual and terminological confusion
	Gaming
	Lack of research into Altmetrics on data, software and video content
Opportunities	New theoretical perspectives on impact

	New ways of understanding the dynamics of science
	Potential for new cultures of appreciation
	Increased speed up knowledge turnover
	New ways of engaging and improving as a researcher
	Motivations for improving data access and quality
Threats	Algorithmization of reception and knowledge flows
	Strong dependence of Altmetrics on Digital Object Identifiers

Note. Adapted from Gauch & Blümel 2016.

The analysis provides a solid overview of aspects that are related to altmetrics. It has to be noted that it is only a preliminary analysis, but the OpenUp project provides an extensive coverage on the topic of altmetrics. One might add to ‘Threats’ ethical issues on using altmetrics data, which requires attention as it was described in section 3.4. Further, under ‘Strengths’ responsiveness through open concept might also mislead to a certain extent, as the data is only gathered by commercial data providers.

Most studies on altmetrics focus on validating and scrutinizing the technical concept (Gauch & Blümel, 2016), and therefore study mainly on the following topics: “1) the coverage of articles with mentions in social media platforms, 2) the validity of data sources, 3) scrutinization studies that compare Altmetrics with traditional measures of scholarly performance and influence (citations)”. Recent studies focus in particular also on an understanding of the users and stakeholders of altmetrics (Gauch & Blümel, 2016), an approach that was also chosen for this study. Gauch & Blümel also argue that “Altmetrics scholarship has reached a certain stage of stabilization” (Gauch & Blümel, 2016), as it was mentioned earlier. Understanding motivations of social media users is an important research topic. The inclusion of altmetrics sources in research funding decision is seen as a critical point to date (Erdt et al., 2016). Still, it is

important to find out, how far stakeholders consider altmetrics as an evidence for impact. The publications by Gauch & Blümel (2016), Erdt et al. (2016) and Sugimoto et al. (2016), in the form of literature reviews are the most recent ones on altmetrics. The advantage of these studies is the fact, that they handle a vast amount of literature, that would be otherwise out of reach of this thesis. Table 3 provides an overview of sources that are used by altmetrics data providers.

Table 3. *Sources of altmetrics data providers*

Categories	Data sources
Social bookmarking	CiteULike, Mendeley, Delicious
Video, photo and slide sharing	YouTube, Vimeo, Slideshar, Flickr, Daily Motion
Blogging	Nature blogs, PLOS blogs, Scientific American blogs, Research Blogging, Nature
Microblogging	Twitter, Sina Weibo, Tumblr
Recommendation and review systems	F1000, F1000Prime, Reddit, Publons, Amazon reviews, Goodreads
Q&A	Stack exchange, other
Online digital libraries and repositories	PMC, Europe PMC, Biomed Central, PubMed, Scopus, Web of Science, Crossref, Figshare, arXiv, WorldCat, institutional repositories, RePec, EBSCO, SSRN, Eprints, dSpace, USPTO Patents, Lexis, CRIS
Dataset repositories	Dryad, Datacite, ADS
Source code repositories	Github, Sourceforge, Bitbucket
Online publishers	PLOS, Open Edition, Copernicus
Search engines, blog aggregators	Science seeker
Other	ORCID, Google code, Google patents, WIPO, bit.ly, COUNTER

Note. List of data sources as of November 2016 (adapted from Gauch & Blümel 2016).

3.7 Usage of Altmetrics in Finland

Even if the developments on altmetrics are happening on an international level, some specifics for the situation in Finland need to be described briefly. In Finland, altmetrics are implemented at several higher education institutions. Implementation in this case, means that the organisations are using a system to display the altmetrics counts of their researchers. These

are in turn mainly offered by altmetrics data providers, such as Plum Analytics and Altmetric.com. Examples include University of Helsinki, and Tampere University of Technology, that are using PlumX altmetrics dashboards, and the University of Tampere and Aalto University that are using Altmetric.com. The University of Helsinki was the first to introduce an altmetrics dashboard in November–December 2015. The systems are mainly hosted by the university libraries. The organisations are not further described here, as only the usage of altmetrics is of importance for this study. Furthermore, the Ministry of Education and Culture funds studies on altmetrics through its Open Science and Research Initiative, and related research is carried out at several universities, such as the University of Turku, University of Helsinki and Aalto University.

Chapter 3 described the concept of altmetrics and its origins in open science, the most prominent altmetrics data providers, and challenges concerning altmetrics. Further, ethical issues concerning altmetrics were explored. The chapter ended with a brief summary of the usage of altmetrics and altmetrics in research funding, major altmetrics research projects, and the usage of altmetrics in Finland. To sum up, altmetrics is a highly-debated topic in today's higher education, and the usage is growing. Still, challenges such as the validity of altmetrics sources, and ethical issues need to be examined further. Chapter 4 is dedicated to the theoretical framework of this study. It will describe its context, and define the Sociology of Valuation and Evaluation.

4 Theoretical Framework

4.1 Context

The data collection and analysis is based on the research strategy, which relates to the analytical framework that were developed for this study. Due to the relatively recent focus of social sciences on altmetrics, not many theoretical frameworks can be found in the literature. An example is the one proposed by Haustein et al. (2015), which tries to frame the different acts that might happen with a research object online, and its interrelation with users or agents. The authors refer to citation theories, and adapt them to altmetrics.

To pick one example, the so-called Matthew effect might have the strongest foundation to explain acts in social media. That is, an already prominent user or platform attracts more and more users and engagement as the time proceeds. The Matthew effect is defined as follows, which can be also related to social media.

The Matthew effect describes the phenomenon that in societies, the rich tend to get richer and the potent even more powerful. It is closely related to the concept of preferential attachment in network science, where the more connected nodes are destined to acquire many more links in the future than the auxiliary nodes. Cumulative advantage and success-breeds-success also both describe the fact that advantage tends to beget further advantage (Perc, 2014).

Recalling the main research question that was introduced in chapter 1, namely to what extent are altmetrics currently used and valued in research funding in Finland, this framework guides the analysis. Even though the study of altmetrics in social sciences is a relatively novel field, certain theories have been applied for that matter (see also section 5.1. Methodology). For instance, the attempt of theoretically framing acts in social media by Haustein, Bowman, & Costas (2015) or Impression Management, a theory developed by Erving Goffman, and for instance applied by Bar-Ilan, Bowman, Haustein, Milojević, & Peters (2015) for the study of altmetrics or online presence of scholars in general. These theories fall short for this inquiry, as the focus is not on altmetrics as a stand-alone phenomenon, but its wider embeddedness in higher education, and ultimately research funding. From this, Valuation Studies has been depicted as adequate (see section 4.2 Valuation Studies). It assumes that the different stakeholder groups have an influence on the valuation of altmetrics in research funding. That is, the valuation of altmetrics is influenced through these groups, and this process leads to the valuation in research funding. These groups represent some stakeholders that are involved in the process of planning, advising, executing, reviewing and continuously improving the research funding process at the Academy of Finland. Another influence comes from external pressures. Table 4 addresses some examples of them, even if it is not supposed to be a complete picture.

Table 4. *External pressures on research funding*

Phenomena	Stakeholders
Adoption of altmetrics dashboards (including altmetrics rankings)	Higher education institutions, research funding organisations, university hospitals, university libraries, business schools, etc.
Promotion of altmetrics (marketing, press releases, free altmetrics data licences, open data sharing, etc.)	Altmetrics data providers, researchers (in particular in the open science movement)

Research studies and conferences on altmetrics	Researchers, librarians, publishers, academic associations, etc.
Promotion of altmetrics indicators	Governments that oversee National/Regional Research and Innovation Systems in the European Research Area, such as the Norwegian Government and the Government of the Belgian Wallonia Brussels Federation
Nomination of the EU High Level Expert Group on Altmetrics; mention of altmetrics in further EU High Level Expert Groups	The European Commission's Directorate-General for Research and Innovation
Calls for tenders on research impact assessment through altmetrics	for example, by the European Research Council
The promotion of evidence-based policy making, research impact	European Commission, national governments, further interest groups

Based on table 4, figure 2 visualises the scope of analysis as the framework to be used in this study. It was also developed for this study. It visualises the phenomena that were described in table 4, and relates to section 4.2 on Valuation Studies. The lowest level shows the different stakeholders that are surveyed on the valuation of altmetrics, and displayed in open circles, as they also occupy various roles in the system. Their valuation is seen as a social construct and a categorization of the value of altmetrics. The process arrow in the middle directs towards the valuation of altmetrics in research funding. This process is marked by external influences that ultimately lead to the value that is established. To sum up, the theoretical framework focuses on stakeholders and their value judgement, which leads together with external influences to the valuation of altmetrics in research funding.

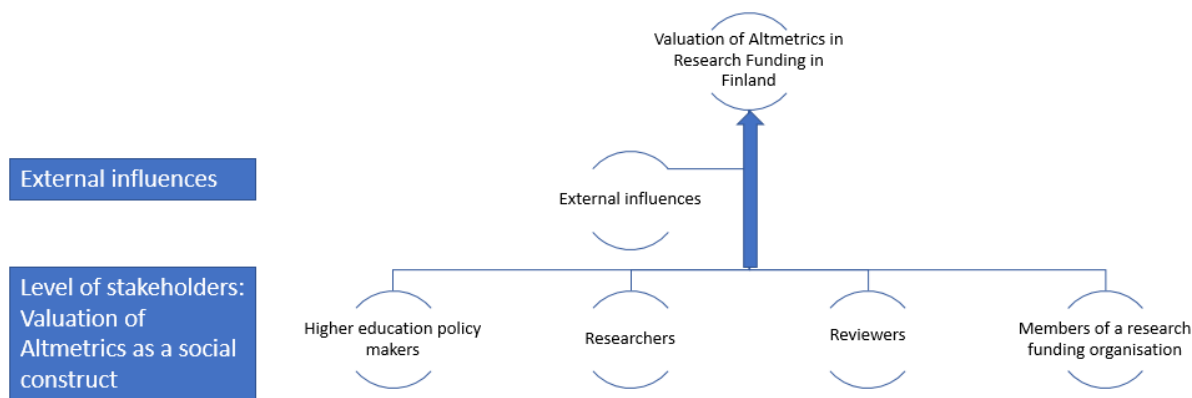


Figure 2. Analytical framework for the master's thesis

4.2 Valuation Studies

Valuation is all around us in everyday practices, online and offline, at work and leisure activity such as sports. It is about giving worth to something, that is a value judgement (Cefai, Zimmermann, Nicolae, & Endreß, 2015) which is then assessed by evaluations. From this, the following describes the theory that was identified as suitable framework for the master's thesis, namely Valuation Studies. Valuation Studies are becoming more prominent in the academic discourse, and gained momentum in recent years. Scholars relate this discipline to the Sociology of Valuation and Evaluation (personal communication, M. Lim, 30/09/2016). In this thesis, the term valuation is used. Sociology of Valuation and Evaluation can be seen as a subdiscipline, or as a focus of perspective. It has been studied by sociologists since the 1960s–1970s (Cefai et al., 2015), and was put more prominently on the map in 2013, following an initiative by certain scholars, to found an academic open access journal. This discipline explores the ways people assign worth to objects, and how this valuation as a process is carried out (Gauch & Blümel, 2016). A brief definition is also provided by the Journal of Valuation Studies, which states that valuation “denotes any social practice where the value or values of something is established, assessed, negotiated, provoked, maintained, constructed and/or contested” (Journal of Valuation Studies, 2016).

To further elaborate on this definition, the following paragraph summarizes a review by Michèle Lamont (2012) on the Sociology of Valuation and Evaluation, and connects it to altmetrics, which were not part of her argument, but fit to in the same line, and were mentioned among others by Gauch & Blümel (2016). Evaluation is a common practice in all kinds of

domains in higher education, such as teaching and learning, research, or national higher education systems (Lamont, 2012). These sorting processes define matrices of worth, that is “how value is produced, diffused, assessed, and institutionalized (Lamont, 2012).” Valuation and evaluation are distinguished as follows, but they are also at the same time intertwined: “valuation practices (giving worth or value) and evaluative practices (assessing how an entity attains a certain type of worth) (Lamont, 2012).” This study focuses on valuation, that is giving worth or value towards altmetrics in research funding. That is, the value that is established in practices and experiences, and as a cultural and social process, and does not mean the study of the value inside the minds of participants. In this case, the value judgement on altmetrics could also be seen as an innovation, as the impact gathered online is considered as being of worth since 1995 with the advent of web measurements (Cefaï et al., 2015; Gauch & Blümel, 2016). Valuation is made up of categorization, in this case to which group an object belongs to, and legitimization, in this case how the object gains value, and how this value is recognized. This notion goes back to the French sociologist Pierre Bourdieu, and his studies on social capital (Lamont, 2012), distinction and cultural production (Cefaï et al., 2015). Central to valuation is also a heterarchy, that is how evaluation criteria are defined and supported by different actors (Lamont, 2012). That is, the study is not focused on monetary value, but on the symbolic capital (Lamont, 2012). Peer review is a prominent example of the application of valuation practices. Peer review is naturally a human judgement, and should be ideally based on meritocratic criteria (Lamont, 2012), such as academic achievements within a certain field. In the case of peer review, it is important to distinguish between rating and ranking. A rating compares an item to a certain set of defined indicators, and a ranking compares the items against each other, creating for instance a league table (Lamont, 2012).

For this study, that is, what role altmetrics might play in research funding, the notion of valuation is the most appropriate theoretical base. In terms of altmetrics, a pluralistic evaluative culture prevails, as it is a relatively novel field, and no concrete hierarchies are established yet (Lamont, 2012). Evaluative practices are also based on conventions, that is in this case what has been evaluated in the past also defines the evaluative practice in the present day and future (Lamont, 2012). The usage of certain instruments in public evaluations also produces standards of legitimacy and accountability (Lamont, 2012). In our case for example to make the computation of altmetrics understandable and to validate the sources. Whether customary rules of evaluation are followed, depends also on the view that the reviewer has about evaluations and their self-concept as an evaluator (Lamont, 2012). Studies also try to find out how comparables

are selected and who selects them (Lamont, 2012). In research funding, the scarcity of resources make this a prominent question (Lamont, 2012). The classification in which the items are being sorted is still highly disputed in altmetrics (Lamont, 2012). The easily accessible information, in this case altmetrics, also shapes evaluative practices, as even laymen can take part in it. This impact needs to be studied as well (Lamont, 2012). Finally, valuation in this context refers to the fact, that altmetrics are gaining momentum in research funding, and its value remains to be explored. To the best of our knowledge, valuation has not been yet used extensively to study the perception of altmetrics of a certain sample of a university and a research funding instrument in Finland. Nevertheless, it is a useful theory, as it is used in all kinds of valuation processes within societies, and can be of particular interest for the study of altmetrics. The connection between valuation studies can be established, as through the counting of altmetrics and the usage of thereof, a certain value might be established. Studying valuation is certainly not limited to sociology, and the scope itself is seen as interdisciplinary (Cefai et al., 2015). That is why, it is a fitting focus of perspective for higher education research on altmetrics.

Chapter 4 described the context of the theoretical framework, and the Sociology of Evaluation and Valuation or Valuation Studies. Most importantly, Valuation is defined not in its monetary sense of the word, but as a social construct for giving worth. From this, chapter 5 will describe the research methods and data to be used in the study. It will summarize the methodology and research methods, research data management and research data collection.

5 Research Methods and Data

5.1 Methodology

The methodology of this study relies on the following approach. A mixed methods research approach was utilised in this study (Creswell, 2014), and a study of policy papers, qualitative interviews and online surveys were conducted. The interviews tend to be more qualitative, and include more closed-ended responses by the participants. The online surveys through questionnaires tend to be more quantitative. The paradigm or worldview that was chosen for this study is pragmatism. Pragmatism is not limited to one system of philosophy and reality, and it “pragmatism opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis (Creswell, 2014).” It allows to follow a research approach based on mixed-methods. For this study, it is important to tap into various stakeholder groups that share an interest in altmetrics and research impact.

Therefore, the aim is to collect data from various sources, to combine or triangulate them, and to be able to draw overall conclusions from them (Creswell, 2014). The rationale is to optimize the data collection, and minimize certain weaknesses that occur when only one data collection method is employed. The design is based on exploratory sequential mixed methods, as the inquiry starts with qualitative interviews that shall lead, firstly, to optimize the data collection through a quantitative approach, and secondly, to choose a more practical way of reaching out to interviewees, due to the geographic location of the international reviewers. The transcripts from the interviews were analysed, and combined with the data analysis gathered from the online surveys. The interviews were carried out to gather a detailed view from participants, and to prepare the surveys with a larger sample to be able to generalize the findings. As the surveys are focused on stakeholders that might change during the course of the funding instrument, and that might have different expectations of altmetrics, the study might be limited. Still, such a funding process has to assure a certain degree of standardization, which is why the findings could be also useful for other funding processes.

To go back to the conceptualization of this study, the main aim is to investigate how altmetrics rankings might influence research funding decisions, and what this means for organisations and individuals involved in this digital change process, in particular in research funding. This research contributes to current debates about the uses and values of altmetrics data in research funding decisions and reporting of funded research. The study of valuation concerning bibliometric tools is quite prominent in higher education research. Following this school of thought, the aim of the empirical part is to approach the value of altmetrics in the Finnish research funding sector. It has to be noted, that the study is not aimed at assessing the funding instrument and its valuation as such. In turn, the study tries to answer if altmetrics is seen by the study participants as a valuable tool for measuring the promoted research impact, and how widely spread altmetrics are in this regard. Strategic Research Funding presents the possibility to study this valuation, as the aim is to achieve besides scientific excellence also a certain wider impact coming from the funded research projects. The thesis is not supposed to be a study on the Academy of Finland and the University of Helsinki, or on individual researchers and reviewers, but on a specific funding instrument and the valuation of altmetrics as an organisational online tool that might be related in this regard. That is why, the study does not evaluate or judge these two organisations, further individuals and their activities or performances, but rather looks at the potential role of altmetrics. The study also does not try to find out if it is a good or bad decision to use an organisational altmetrics dashboard. The study is also not aimed

at the monetary valuation of altmetrics, rather focusing on the perceived value by stakeholders involved in research funding. In this case, stakeholders are board members and reviewers of the Academy of Finland, policy makers, and researchers (with a dual role as research funding applicants and reviewers) themselves.

5.2 Research Methods

Firstly, many research funding organisations such as the Academy of Finland, require including a plan for broader impact in the research plan submitted by applicants. To this end, the Academy of Finland as the most important research funder for basic research in the Finnish higher education sector will be included in the sample for this master's thesis. The data collection will focus in particular on the Strategic Research Council (SRC) at the Academy of Finland, as this is a funding instrument where prospective consortia need to describe societal impact in letters of intent, and which is targeted at government priority areas. It is aimed at providing empirical evidence for policy makers, and is therefore highly-regarded in research funding in Finland, and “[t]he SRC funds high-quality research that has great societal impact” (Academy of Finland, 2016). Figure 3 visualizes the research funding process of the SRC. An open consultation is employed, to involve citizens in defining themes for the SRC. Further steps include a theme proposal by the SRC to the government, which decides upon this proposal. In turn, the programme decisions are made within the SRC, which then publishes a call, and decides on the submitted letters of intents by the consortia. The funding decision are made by considering a judgement by experts, namely Finnish and international reviewers.



Figure 3. *Research funding process at the Strategic Research Council (source: Academy of Finland, 2017)*

The SRC was also studied recently in a Horizon 2020 research project concerning societal interaction (as part of the Project “PE2020 Public Engagement Innovations for Horizon 2020”) (Timo Aarrevaara & Pulkkinen, 2016), but this master’s thesis will focus on a different aspect, namely the potential value of altmetrics in SRC project applications and reporting apart from a mere focus on societal engagement. The difference concerns also the fact, that the H2020 project was devoted to the researchers and how the projects were developed, whereas the aims of this master’s thesis are to find out how the funding applications might have been assessed, and if altmetrics could play a role in the assessment of application for upcoming SRC calls. It is unclear how the SRC will be continued in future, as this kind of funding instrument is naturally also developed further, but it was also named as ambitious, for example during the Finland OECD Review on Innovation Policy (OECD, 2017). Nevertheless, the SRC provides a well-fitting case to study the valuation of altmetrics in research funding. That said, the online surveys will target the reviewers from the last two SRC calls (the panels responsible for societal impact and scientific excellence), and board members, as well as staff members from the Academy. The staff and board members were chosen, because they administer and oversee the research funding instrument, and play a central role in its further development. In turn, the reviewers as study participants were chosen, as “[p]eer review is a central part of the scholarly communication system, as it functions as a quality control and gatekeeping mechanism (Sugimoto et al., 2016).”

Secondly, selected staff members from the Ministry of Education and Culture will be interviewed. It has to be noted that the Ministry has no particular influence on the funding decisions and/or related processes, and that the Finnish government only sets the priority areas for the SRC. Still, the findings can inform the study further.

Thirdly, to approach the usage and valuation of altmetrics at universities, PlumX dashboards of higher education institutions (HEIs) are studied. The study focus is set on the University of Helsinki, due to the relatively early introduction of the PlumX dashboard, and the connection between the SRC and the PlumX dashboard is the fact, that the displayed altmetrics data is promoted as being an evidence for societal impact. The aim is to find out how the altmetrics data has been interpreted and valued so far. The author aims to find out, how the rankings of the researchers are used by the researchers themselves, for example, if some of them include the output in funding applications, or reporting, and how the rankings are valued by stakeholders. It has to be noted, that funding applications for important grants in higher education undergo a long and manifold process, that involves several stakeholders. For example, the writers of the application include the principal investigator as such, peers in the own organisation and partner organisations, grant writing services at the own organisation or through private consultancy companies, scientific committees of the own organisation, and so on. The whole production of a research funding application is therefore in some stages a black box, and cannot be traced back completely, which is obviously also not required. The whole process can only be approached to a certain extent. The market share of private consultancy companies in EU proposal writing in Finland is estimated to be around 10%, but no concrete data is available. That is, of all EU funding proposals 10% might be prepared in collaboration with private companies (J. Langwaldt, personal communication, 08/06/2017).

External users that browse the user interface of the PlumX dashboards, usually only see a certain part of displayed data, and this might also create an image for external users of the ‘societal impact’ or merit of individual researchers. The master’s thesis does not address the underlying altmetrics data, but tries to investigate how the displayed data is valued by the registered researchers themselves. Researchers register at the dashboards voluntarily, especially during the test phase of the system. It is essential to find out the interpretation of data, as most of them will probably not check the underlying sources, data and the context. The assumption by the author is that most users will not undergo the effort of checking the underlying data that is used to compute the scores, because the data validation is time-consuming, and requires additional knowledge on altmetrics, or at least on social media platforms. Furthermore, studies on

other rankings in higher education such as the Times Higher Education Ranking also showed that most external users are not aware how the scores are calculated.

As aforementioned, the survey instruments are based on the qualitative interviews that were conducted in the first phase of this study. The interviews were audio recorded, and these files were transcribed and coded. The codes were sorted into groups, and ranked according to their number of appearances. The most prominent topics that were considered as useful for this study were then added to the questionnaires, that is to create new items or improve existing ones. Apart from the interviews, further sources were used to compile the questionnaire (personal communication, S. Niinimäki, 19/09/2016; Aung, Aw, Sin, & Theng, 2016; Chigwada, 2016; EUA, 2016; European Research Council, 2016; Stančiauskas & Banelytė, 2017; ZBW, n.d.). The development of instruments is quite a recent one in the field of valuation studies, and there are only limited studies available to establish the value of altmetrics. That is why, it is not possible to take items from a standard questionnaire with established items, as it is the case in several other academic disciplines. This provides the opportunity to develop a novel instrument based on the qualitative research phase for this particular case study. The surveys are piloted to some extent in the qualitative phase, because this phase will be the basis for the surveys, as common themes are identified based on the interviewees' responses. Further, the surveys were pre-tested with eight international reviewers, and experts in altmetrics and research funding, that are not related to the studied organisations, but could be also part of the same target group. The surveys were sent out on 26 May 2017 with a deadline of seven days. After the first deadline, three reminders were sent after a few days, that gave the respondents in total 15 days to reply until 3 June 2017. The e-mail with the invitation were only sent out to reviewers and researchers, that were taken from a publicly available lists and databases. Every e-mail contains a personalized link. That is why, most likely only the contacted respondents will fill out the survey, and the responses can be organized with the online survey software.

The data collection from the PlumX dashboard took place in May 2017, whereas the author downloaded the profiles of the most prominent researchers at the University of Helsinki (n=39). In total, there are 239 registered users at the University of Helsinki as of 19 May 2017, but not all of them could be surveyed because of missing e-mail addresses, etc. The most prominent researchers were defined as automatically visible in the organisational rankings computed by PlumX. If a user clicks on the ranking button on the start page, they are redirected to a new browser window on which 20 highly-ranked researchers for each PlumX Metric (see Table 5 for a brief description of the metrics) are shown in graphs and/or tables. Some researchers, but

not all of them appear at the same time on rankings for several metrics. To the best of our knowledge, there are only three HEIs worldwide that offer this additional feature, namely Saint Mary's College of California, China Europe International Business School, and University of Helsinki. These HEIs share their altmetrics data on PlumX openly. The other organisations only display the results grouped by departments, etc. In further studies, the sample could be expanded to include all three HEIs that display altmetrics researchers' rankings, and compare them with those that do not have these rankings. For this master's thesis, the scope was narrowed down to provide an adequate focus, and to simplify the data collection. The researchers' rankings could be downloaded in 2016 only as PDF, but in May 2017 it was also possible to download all data in EXCEL, which speeds up the whole analysis process. The rankings include the indicators 'Usage', 'Captures', 'Mentions', 'Social Media', and 'Citations', so called PlumX Metrics. Table 5 describes the PlumX Metrics and sources briefly (for an extended description see section 10.6 in the appendices):

Table 5. *Examples of PlumX Metrics*

Metric	Examples
Usage	Clicks, downloads, views, library holdings, video plays
Captures	Bookmarks, code forks, favourites, readers, watchers
Mentions	Blog posts, comments, reviews, Wikipedia links
Social media	+1s (e.g. Google), likes, shares, tweets
Citations	Citation indexes, patent citations, clinical citations

Note. Adapted from Plum Analytics, 2017b.

In 2016, PlumX linked its altmetrics data with citation counts from the Clarivate Analytics' Web of Science. The aggregated indicators show a league table and a graph of the registered researchers. These rankings will not be displayed as such in this master's thesis. PlumX dashboards are used by various customers around the world, ranging from several continents, and organisational types.

To set the focus on the Finnish higher education system, the university sample consists only of researchers from the University of Helsinki. The users of the dashboard (n=210), of which a valid e-mail address could be found, were contacted via online surveys by the middle of May 2017. The surveys are aimed at their own perception of altmetrics rankings, and the usage of altmetrics, for example in research funding applications. It has to be noted that the University of Helsinki's Research Service Unit considers the altmetrics data only as supplementary to bibliometrics (Nykyri & Vainikka, 2016). The data from PlumX sites, only concerns open data from one university (from a system of an external data provider) and the survey are only intended for non-commercial use, which should justify the data usage.

Another group of respondents is made up of reviewers for the Academy of Finland's Strategic Research Council (SRC) in 2015 and 2016, which are the only two calls that have been completed so far until June 2017. This group was surveyed to find out, how altmetrics counts are interpreted by the research funding organisation and its reviewers, and if they are considered in research funding decisions.

Research impact depends highly on the regulations that are set out in higher education policies. 60% of university funding in Finland is provided by the Ministry of Education and Culture, and universities are steered through this authority. The basic budget accounted to an even higher proportion by the end of the 1990s (Hölttä, 1998). That is why, a third group is made up of ministry representatives. The data collection and analysis process is presented in table 6.

Table 6. *Schedule for preparation of the study and the master's thesis*

Steps	Related Samples
Identification of research problem	-
Literature review, identification of study participants, monitoring of current developments in altmetrics and research funding	-
2 pilot interviews with senior staff members at higher education institutions in Finland	
Research data management plan	
In depth interviews and interview analysis	Sample 1:

	Staff members of the Ministry of Education and Culture, & Members of the Academy of Finland
Download of list of registered researchers from the University of Helsinki	Sample 2: Highly-ranked researchers at the University of Helsinki, & other researchers at the University of Helsinki
4 online surveys	Sample 2: Highly-ranked researchers at the University of Helsinki (1), & other researchers at the University of Helsinki (1) Sample 3: Reviewers that assessed impact/societal relevance (1) and the ones that assessed scientific excellence (1) of the Academy of Finland
Survey data analysis	
Summary report and conclusions	
Publication	

5.3 Research Data Management

This section presents the research data management plan that was developed for the master's thesis. The plan was first created as a separate document for the research proposal, and finally integrated into the main text. Research data management forms the basis for the whole study and should guide the research process. A data management plan provides the ground for a research project, and evolves over time during the research process, whenever the study advances. Such a plan became even more important due to digitalisation, as it describes how the data is collected, analysed, secured, archived, and stored for future use. Most major research funding organisations around the world require such a plan (mostly with different specifics) in addition to research proposals to be submitted for review (for an overview of case studies around the world see LEARN, 2017). It is also used to guide an external reader on the whole

data process, so that the study can be repeated, the metadata can be used to interoperate different databases, and an external user can judge if the data would be useful. The research data management plan for this master's thesis was developed according to the guidelines of the Finnish DMP Tuuli project¹⁵.

5.3.1 Data Documentation, Quality, Backup and Access.

The interviews were recorded as an MP3 file with an external dictaphone, and afterwards transcribed with MAXQDA, a research data software that can be used for qualitative, quantitative and mixed methods analysis. The responses from the online surveys were downloaded from SoSci in a SPSS data file, the data was cleansed (e.g. deleting unnecessary columns, defining missing values, ordering interview cases, etc.), and analysed in SPSS.

The metadata for the collected dataset will provide standardized and structured information explaining the purpose, origin, time references, geographic location, creator, access conditions and terms of use of a potential data usage. Processed data files are reviewed by a supervisory staff member before the final analysis. The online survey data is backed up to a password protected secure server maintained by SoSci. The audio files of the interview are saved on a personal computer, and an external hard-drive. During data analysis, the data was only accessible by the author of the master's thesis. Data is only presented in a summarized form in the master's thesis. Finally, the data from the online surveys and the qualitative interview was included in a summarized form in the master's thesis, but not as a separate file. The data from the interviews might be traced back to the official capacity of the interviewees themselves, which will be avoided by only publishing the data in a summarized form.

5.3.2 Ethics and Data Storage.

Information collected can be released in summarized form without privacy restrictions because in a summarized form it does not constitute private or sensitive information about identified human subjects, and the respondents are anonymized through identifiers. Informed consent for full public release of the data was obtained from the survey respondents and interviewees. That is why, it is highly unlikely that a response without given consent and vulnerable respondents will be included in the data set. It is not expected that the research outcome will cause any social or professional harm. The benefits for the research community, policy makers,

¹⁵ https://www.dmptuuli.fi/about_us

research funders and other stakeholders might be a certain contribution to the knowledge on altmetrics in research funding. The data about the survey participants was obtained through public lists, which is explained to the survey respondents. It is not expected that consent must be asked for from any of these three organisations apart from the consent of the participants themselves.

According to the Ethics Review Committee of the Tampere Region, an IRB (Institutional Review Board) approval is not needed for a master's thesis. However, the research ethics for this study adhere to recommendations developed by AOIR, the Association of Internet Researchers (Markham & Buchanan, 2012). Firstly, the output of this academic association was chosen, as the study concerns the internet technology altmetrics, and secondly, a large part of the data is collected through online surveys. All these topics are also addressed in these guidelines. It states the following principles for a research project: “the fundamental rights of human dignity, autonomy, protection, safety, maximization of benefits and minimization of harms, or, in the most recent accepted phrasing, respect for persons, justice, and beneficence.” The guiding questions of this document were considered while preparing the study. Some of the reviewers and researchers might not expect a questionnaire targeting at their opinion on altmetrics in research funding. The guiding principles were also compared against the “responsible conduct of research and procedures for handling allegations of misconduct in Finland” (RCR guidelines) by the Finnish Advisory Board on Research Integrity (TENK). Intellectual Property Rights (IPR) are not applicable for this study. As the study does not bear commercial interests, and includes no large mailings to registered researchers, the use of this public information by the PlumX altmetrics dashboard is eligible. Researchers and other stakeholders will be able to contact the author of the master's thesis for further information on the data. The full data set will not be shared to avoid identification of the participants. A summary of the data will be included in the publication.

5.4 Research Data Collection

The overall sample size (N=296) is distinguished from completed and partially completed interviews (n=122), consisting of the following study participants as interviewees and survey respondents (see Table 7).

Table 7. *Interviewees and survey respondents*

Organisations	Interviewee(s)	Survey respondents (completed and partially-completed interviews)
Ministry of Education and Culture	1	
Academy of Finland	5	36
University of Helsinki		80
Subtotal	6	116
Total		122

5.4.1 Policy Documents.

As aforementioned, one prestep was to analyse several policy documents and related documents as basis for the qualitative interviews. That is, national ERA (European Research Area) action plans, that described impact measurements and altmetrics in national Research and Innovation Systems in EU Member States and Associated Countries were analysed. These documents also led to further national R&I strategies. Another pillar was focused on strategy documents by the Academy of Finland, Finnish government policy papers, strategy plans of higher education institutions, the preliminary H2020 Working Programmes 2018–2020. The rationale was to compare the Finnish document types with its counterparts on a European level to find out more about the promotion of research impact, and the usage of altmetrics. The following table lists the documents and summarizes the purpose for the analysis. The objective is not to present a complete list of policy documents, but to enrich the qualitative part with additional carefully picked sources. The selection criteria were broadly defined as documents that are also relevant on a European level.

Table 8. *Qualitative document analysis*

Document type	Aim for analysis
National ERA (European Research Area) action plans	Usage of altmetrics as indicators in EU Member States and Associated Countries
RIO country reports	See above

OECD Science, Technology and Innovation Outlooks	See above
OECD Reviews of Innovation Policy: Finland 2017	Usage of altmetrics as indicators in Finland
Strategy documents by the Academy of Finland	Usage of altmetrics/promotion of research impact by Research Funding Organisations
Finnish government policy papers	Promotion of altmetrics in the Finnish higher education system.
Strategy plans of Finnish higher education institutions	Promotion of research impact within HEIs
Preliminary H2020 Working Programmes 2018-2020 (<i>final version to be adopted in October 2017</i>)	Promotion of research impact in H2020
REF 2014 impact case studies	Usage of altmetrics to demonstrate impact in case studies

These policy documents were used as a basis for the interviews, and to develop the quantitative phase of this mixed methods study.

5.4.2 Qualitative Interviews.

The interviews were carried out in a setting as natural as possible, that is in the workplace of the interviewees. Each interview lasted for about 20 minutes. The interviews follow guiding questions, but are semi-structured. This inductive design is used to develop the main themes that can later be used deductively as instruments in the online surveys. By doing so, the study participants' views are included. And, it is also an emergent design to be able to adjust the research process later, based on the findings that were gathered during this early phase of the research project (Creswell, 2014).

The qualitative interviews gathered the meaning that research funders and policy makers attach to altmetrics. This helped to prepare the most prominent themes for online surveys with reviewers that contribute to funding decisions. It might have happened that interviewees had spoken to each other before the actual interview took place, because they are all colleagues in

the same or closely-related organisation. This could have influenced the outcomes of the interviews, but it is expected that the results are still a useful basis for the survey questionnaires. This also means that some parts of the survey questionnaire have changed after these expert interviews had been coded. For example, altmetrics in research reporting was added as an item to the questionnaire. The transcripts of the expert interviews were shared with the interviewees. The interview phase was started with two informal pilot interviews on a strategic level at Finnish higher education institutions, before the semi-structured interviews were planned. The qualitative interviews are seen as “unstructured and generally open-ended questions that are few in number and intended to elicit views and opinions from the participants (Creswell, 2014)”. This part then leads to the online surveys.

5.4.3 Online Surveys.

There are two samples for the online surveys. The sample of the researchers from the University of Helsinki is surveyed to find out about their altmetrics usage in research funding applications, and elsewhere. Another sample is made up of reviewers of the Strategic Research Council at the Academy of Finland.

The same questionnaire was addressed in two surveys to two subsamples. The survey asked the respondents a set of questions concerning the usage and valuation of altmetrics, which was also the connection between the two samples (see section 10.4 in the appendices for the questionnaires). First, researchers that are highly-ranked on the University of Helsinki’s PlumX altmetrics dashboard, and therefore, are also immediately visible if a user clicks on the ranking button. Second, researchers that are registered at the dashboard, but are not visible at all in the main ranking, that is those among the highly-ranked researchers (n=39) in the indicators that were defined by PlumX.

The survey questions are grouped into several categories, which also informed the data analysis. Some questions were used in both questionnaires, directed at researchers and reviewers. The validity of the questionnaire was improved by completing three face-to-face meetings, and sending the questionnaire in a pre-test phase to eight respondents from the same target group, namely researchers at universities, and research funding specialists in Finland, Germany, the Netherlands, Malta and Brazil. International pre-testers were chosen, as the study targets several international respondents. The validity was further improved by choosing some similar items from the Horizon 2020 funded OpenUp project, which targeted a large sample of researchers in Europe on open access related topics, including altmetrics (Stančiauskas &

Banelytè, 2017). Further, the validity, reliability, and quality of the survey questions was improved by checking two sample questions with the Survey Quality Predictor online tool, that was developed by the Research and Expertise Centre for Survey Methodology (RECSM) at the Universitat Pompeu Fabra, Barcelona (Spain) (Saris & Gallhofer, 2014). The automatically generated recommendations were then used to improve the remaining questions. For example, the number of words in the questions were decreased, sentences were not split into two parts, where possible, some question words were changed, and more answer options were created.

There was a relatively low survey response rate in the beginning, which could have been caused by several factors. The survey was sent out at a late hour of Friday, and another weekday would have been a better choice. Further, the survey was active from the end of May until beginning of June, and this time of the year is traditionally a holiday season in many countries. Naturally, there were also less responses on the weekends. Further, no monetary incentives were offered for participating in the survey. There was a considerable amount of wrong e-mail addresses and the addresses of some respondents could not be found. The questionnaires that were not completed might have been respondents that are unaware and/or not interested in altmetrics. This might be concluded based on the final comment by some respondents. Nevertheless, the respondents that clicked on the survey link in the e-mail, were also most likely to start the survey in the browser. That is why, for the first e-mail reminder after seven days and for some failed e-mail addresses after three days, the wording was edited to make the survey more appealing to respondents, and to encourage them to click on the URL. For example, it was highlighted in the e-mail more clearly that the survey respondent was specifically selected, and that the study is part of an Erasmus Mundus Master Degree of partner universities in Europe and Asia. This strategy was chosen, after consulting again the literature on response rates, and incentives (Pedersen & Nielsen, 2016).

Some respondents were excluded from the researchers' survey, for example those that do not work at the University of Helsinki, as the PlumX dashboard displayed also researchers from some local affiliated organisations. Many respondents are registered at PlumX without using the dashboard or even knowing about their registration. The author expected, that more respondents would be aware of their registration. Some improvements for further surveys could be identified. The focus was set on respondents that were expected to know about altmetrics, and to be able to gather expert views to some extent. For those respondents that are unaware of altmetrics further surveys could explain the term 'altmetrics' shortly, and highlight how it is debated in research funding. The question about other altmetrics data providers could include

more further options to select from. Further, it could be asked, what other sources apart from altmetrics does the respondent use to demonstrate societal impact in research funding application and/or research reporting. Additionally, a distinction between different altmetrics sources could be highlighted more clearly.

The first reminder after six days generated a relatively large amount of responses. The surveys were sent out on different weekdays and hours to reach different kind of respondents. The surveys might have also minor implications for the usage of this specific PlumX dashboard, as it reminded some respondents, or even made them aware for the first time that they are registered at the dashboard. That was an unintended effect of the surveys, as it was expected that most researchers are aware of their registration. Obviously, this does not influence the outcomes of this study, or generate negative effects.

The response rate was calculated according to the American Association for Public Opinion Research (AAPOR). All nonrespondents were eligible, because they were contacted based on their function within the University of Helsinki, and the Academy of Finland. Only those respondents were excluded, where the correct e-mail address could not be found, and those that replied that they were not interested or in their opinion should not be included in this study. Undelivered e-mail messages are according to AAPOR part of unknown eligibility. Correct e-mail addresses that generated no response are also nonrespondents, that is eligible sample persons. Some cases might have been filtered or land in the SPAM folder without getting an error message, because the survey was sent through a serial mail targeting a large sample of a particular domain, @helsinki.fi. Some e-mails could have been only seen by someone who is not the right addressee anymore, because the account changed. Further invisible, technical errors might also have occurred (AAPOR, 2016).

Completed interviews are defined for this study as those, where the last page in the survey questionnaire was reached, even if some questions were not answered, which occurred only rarely. Partial interviews were defined as those, where the survey respondent clicked “next” on the first page to start the interview, but did not complete the questionnaire. That means, that contacted potential respondents (n=290) included refusal and break off (R), non-contact (NC), and other (O) (n=174). 116 responded to the questionnaire. 102 out of 116 completed the questionnaire (I), and 14 out of 116 partially completed the questionnaire (P). This study uses as response rate (RR) RR6 as defined by the AAPOR (AAPOR, 2016; Phillips, A. W., Friedman, & Durning, 2017). Therefore, response rate RR6 (see figure 4) is 40%. There is

a vast amount of studies on response rates, and the findings differ to a large extent, given the fact that different disciplines, topics, interview modes, etc. have to be considered. To illustrate, Mollenhorst, Völker & Flap (2008) consider a response rate of 40% to be quite common in survey research on sociological topics in the Netherlands. Whereas a meta-analysis of surveys in organisational research found an average response rate of 52,7% among 490 examined studies from 2000 to 2005 (Baruch & Holtom, 2008). Nevertheless, the formula to calculate the response rate by the AAPOR can be seen as a gold standard in survey research, but it cannot be said with full confidence that the response rate of 40% for this study is adequate.

$$RR6 = \frac{(I + P)}{(I + P) + (R + NC + O)}$$

Figure 4. Formula to calculate RR6 as defined by the AAPOR

Figure 5 visualizes the daily response rates, that developed during the time, when the survey was active.

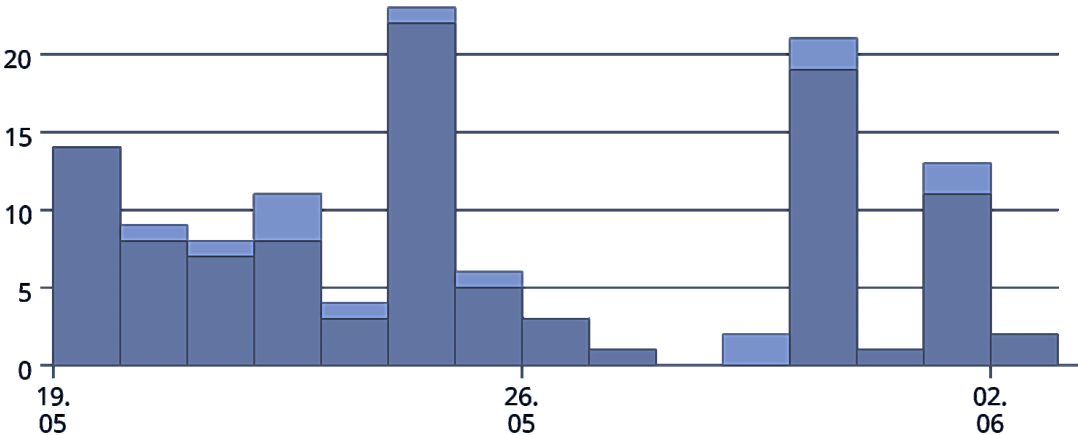


Figure 5. Daily survey response rate as of 3 June 2017 (dark blue: completed interviews; light blue: partially completed interviews) (source: SoSci Survey, 2017).

As for the sample of the reviewers, a survey design was employed to be able to reach out to a larger number of respondents (n=80), and to those research funding reviewers that live outside of Finland, mainly from other EU Member States, that is in the following countries: Austria, Belgium, Denmark, Germany, Ireland, Norway, Poland, Sweden, Switzerland, the Netherlands, UK, US. Still, most reviewers are from Finland. As the number of reviewers from

certain countries is very low, the country was not asked for in the surveys to avoid identification of the respondent. The online surveys provide a more practical approach than to only conduct interviews with the respondents. Further, all respondents within one group fill out the same questionnaire. This makes it more valid to compare the findings among the respondents, and the survey software presents the possibility for a solid analysis. Finally, it is a cost-efficient model. The nature of the surveys is cross-sectional, that is the data is collected at one point in time (Creswell, 2014).

The survey is addressed to specifically named persons (AAPOR, 2016), but their anonymity will be kept. The sample size (n=290) represents also the whole population so far, as the population consists of all reviewers for the Strategic Research Council, and all registered researchers at the University of Helsinki's PlumX dashboard. The reviewers were sampled according to the role that they had in the funding procedure, that is, if they had assessed scientific excellence or societal impact. That is why, the population was stratified in such a way, that the reviewers for scientific excellence and the reviewers for societal impact make up each one group, and the researchers with a prominent position regarding altmetrics and citation counts, and those with a regular position make up each one group. In total, there are four surveys based on these groupings. That is, a single-stage sampling procedure is employed, as the list with the names of the organisation are available, and was not harvested. However, the surveys were only analysed according to two samples, that is the one of researchers and reviewers. Based on a considerable difference of the response rates among the subsamples, the common analysis of the whole sample has been more fruitful.

The first question for the reviewers was a filter question. That is why, 15 respondents of the sample of reviewers that are not at all aware of the term 'altmetrics' were filtered out, and forwarded to the pages with questions about demographics. The aim was to include only respondents that are aware of the term 'altmetrics', so that it is not necessary to first introduce it. As it was a filter question without the possibility to change the previous given response, some respondents might have clicked too fast on the filter question, which might bias the results to a minor extent. Nevertheless, it was only criticized by one respondent.

Chapter 5 described what methodology and research methods were employed for this study. It described how the research data is managed, and what research data has been collected.

By doing so, the main data collection, that is policy documents, qualitative interviews and quantitative surveys, was summarized. This leads to chapter 6, that will describe how the collected policy documents, interviews, and surveys will be analysed based on the theoretical framework.

6 Results

6.1 Policy Documents

To recall the introduction given in chapter 2, policy documents showed that research impact is naturally a part of the agenda of higher education systems, higher education institutions, and frequently mentioned in policy debates and discussions on indicators in research evaluations and research funding. In turn, the usage of altmetrics seems to gain momentum. First examples could be observed in Norway, and the Belgian Wallonia Brussels Federation, whereas it is not exactly specified how they are used within these higher education systems. Further, the national ERA roadmaps are alike to a letter of intent, and the agenda do not have to be fully implemented. Usually, they are drafted within the ministry that is also responsible for national research policies, and various stakeholder groups are able to give input to formulate the roadmap. The documents analysed from the Academy of Finland concentrated on how impact is described as such. Altmetrics were not found in these documents, but the usage of social media by researchers is promoted by the Academy of Finland. The policy document that was studied by the University of Helsinki is effectively the current strategy, which emphasized in particular the term ‘impact’, that is the theme ‘A high level and high-impact research’.¹⁶ In particular, at higher education institutions altmetrics are in use to demonstrate impact of the university’s research. This is more seen as a showcase of the impact that was generated, but has probably no influence on research funding or related matters. Even if data providers such as Plum Analytics also offer an additional feature that combines PlumX Metrics with a grants database. On top of that, altmetrics was mentioned in the OECD Science, Technology and Innovation Outlook 2016 and some REF 2014 Impact case studies, but not in the OECD Innovation Policy Review on Finland or RIO country reports. These analyses of the policy documents informed the analysis of the qualitative and quantitative phase. These will be discussed in the following sections.

¹⁶ <http://strategia.helsinki.fi/en/#themes>

6.2 Qualitative Interviews

An interesting finding from one of the pilot interviews suggests, that organisational types have to be distinguished concerning altmetrics. Universities of applied sciences in Finland, for example see their mission as, to educate students in RDI projects ideally in close collaboration with industry networks, and these skilled graduates later create their own impact in the economy. Research impact is therefore seen in a different sphere compared to universities, which focus in particular on research, mainly measured through the output of scientific publications.

In the beginning, 13 potential interviewees from the target population were contacted, and six respondents agreed to be interviewed. The interviewees were first selected because of their functions within the organisations. One of the interviewees was suggested by another interviewee. The semi-structured interviews were carried out from March until May 2017.

Findings include the assumption, that altmetrics might be more useful for reporting on funded research, but not so much for deciding on funding. Based on the findings from the interviews, the expectations about the role of altmetrics in research funding had to be lowered down. Obviously, a research funding organisation does not just pick any new trend without a solid base of studies. The validity of altmetrics data sources was questioned by the interviewees, as was the role of more prominent social media users, and the influence this might have on the computation of altmetrics counts. This can be attributed to the Matthew effect that was introduced in the beginning, and refers in this case to a social process, where a prominent user is able to accumulate more and more social capital (Perc, 2014). It can be also extended to networks that gain a certain advantage based on their previous achieved position, such as media networks (Fraumann et al., 2015; National Academies of Sciences, 2017). Still, media presence of applicants as such is an emerging issue within the funding instruments. This relates not solely to altmetrics, but the fact that it is appreciated if a scholar also appears in the media, if this does not diminish their primary task, that is to achieve scientific merits. Related to that, an example was mentioned during a pilot interview, but not during the actual interview phase. That is Meltwater's media service¹⁷ for universities, which automatically compiles a list of all media mentions where the university name appeared on the internet. For example, when the name of the university is mentioned in a newspaper, or magazine on the internet. This service is used by

¹⁷ <https://www.meltwater.com/?ucs>

Finnish universities, maybe more intensively than altmetrics. Finally, one interviewee mentioned the problems that could arise from the term ‘alternative metrics’, as ‘alternative’ might relate the concept to a very prominent debate these days, such as alternative facts or fake news in social media. Naming this kind of metrics ‘alternative’ has also been debated by many other scholars in the field, and current debates are still ongoing.

Table 9 shows the codes that were created based on the transcripts of the interviews. Some of them, but not all, were used to refine the survey questions, create new items, etc. As one can observe from the table, the codings ‘altmetrics as impact assessment tool’ was mentioned most frequently, followed by ‘evaluation through peer review’, ‘validity of altmetrics sources’ and ‘citation counts as an approved method’. These were taken into consideration while comparing the codings against the background of the survey items.

Table 9. *Codings of the interviews*

Code Nr.	Code label	Nr. of codings in all inter-views	% of the codings in all interviews
1.	Altmetrics as impact assessment tool	12	8,63
2.	Evaluation through peer review	9	6,47
3.	Validity of altmetrics sources	9	6,47
4.	Citation count as an approved method	9	6,47
5.	Limitations of citation counts	7	5,04
6.	Limitations of altmetrics	7	5,04
7.	Impact within the scientific community	6	4,32
8.	Awareness but no usage of altmetrics	6	4,32
9.	Bibliometric data not part of the Academy’s research evaluations	5	3,60
10.	Different valuation of citation indices in academic disciplines	4	2,88
11.	Distinction between citation counts and altmetrics	4	2,88
12.	Role of impact in HE policy	3	2,16
13.	Advantage of prominent persons in social media	3	2,16
14.	Competences of applicants	3	2,16
15.	Citation counts as indicator for visibility	3	2,16
16.	Organisational view on research evaluations	3	2,16
17.	Altmetrics as a current topic in higher education	2	1,44
18.	Variety of altmetrics sources	2	1,44
19.	Altmetrics as part of a dialogue, not in assessments	2	1,44
20.	Researchers' social media self-promotion	2	1,44
21.	External oversight of universities	2	1,44

22.	Complex activities/roles of universities	2	1,44
23.	Altmetrics an additional perspective to citation counts	2	1,44
24.	Unaware of altmetrics dashboards	2	1,44
25.	Search for valid impact indicators	2	1,44
26.	Unit/level of assessment	2	1,44
27.	Different valuation of altmetrics in academic disciplines	2	1,44
28.	Personal view on research evaluations	2	1,44
29.	Wider societal impact	2	1,44
30.	Publish or perish	1	0,72
31.	Use of citation counts by reviewers	1	0,72
32.	Definition of assessment criteria through expert advisory	1	0,72
33.	Difference of disciplines in evaluations	1	0,72
34.	Probability of altmetrics usage in SRC	1	0,72
35.	Different funding sources	1	0,72
36.	Demonstrating impact of the whole HE system through altmetrics	1	0,72
37.	Comparison only of the same sources	1	0,72
38.	Aim of the funding instrument	1	0,72
39.	Collaboration indicators	1	0,72
40.	Difference between media and social media	1	0,72
41.	Scepticism towards the term altmetrics	1	0,72
42.	Expert panels for societal impact and scientific quality	1	0,72
43.	Potential higher valuation of altmetrics in impact expert panel	1	0,72
44.	Strategic choices of social media channel	1	0,72
45.	Using buzzwords to catch attention	1	0,72
46.	Organisational research strategy	1	0,72
47.	Role of different stakeholders in the HE system	1	0,72
48.	Open Science and Research Paradigm	1	0,72
49.	Immediate impact (time advantage)	1	0,72
	Total	139	100

6.3 Online Surveys

6.3.1 Researchers registered at PlumX Altmetrics Dashboard

As aforementioned, the two samples were first split to find out, if the researchers' valuation of altmetrics differ. Based on the relatively low response rate, the two samples had to be merged for the analysis part. It was surprising to discover that the PlumX altmetrics dashboard is mainly unknown and never used, and rarely used only by a little number of researchers. The

majority does not use altmetrics data in funding applications, but some do use it. For this question, the different altmetrics sources were not distinguished, in order not to confuse the respondent, and to keep the questionnaire as short as possible.

In detail, 49 out of 80 (61%) use the PlumX altmetrics dashboard never or almost never, four out of 80 (5%) use it rarely¹⁸. Further, 60 out of 76 (79%) do not check their own altmetrics counts on the dashboard, and 16 out of 76 (21%) do check them. Also, 72 out of 76 (72%) do not compare their altmetrics counts with other researchers, and only four out of 76 (5%) do so. Furthermore, 75 out of 76 (99%) do not compare their altmetrics counts with those of other research units and only one (1%) does it. Also, 74 out of 76 (97%) do not check the altmetrics ranking results, and only two (3%) do check them. And, 73 out of 76 (96%) do not try to identify research users through the dashboard, and three out of 76 (4%) do try it. Finally, 73 out of 76 (96%) do not try to improve their own altmetrics results, and only three (4%) do try it. Table 10 summarizes the findings for the usage of the PlumX dashboard by the surveyed researchers.

Table 10. *Researchers: Usage of PlumX dashboard*

		Count	Table N %
How often do you use PlumX dashboards?	Not answered	0	0%
	Do not know/cannot answer	27	34%
	Never, or almost never (0-10% of the time)	49	61%
	Rarely (11-39% of the time)	4	5%
	Sometimes (40-59% of the time)	0	0%
	Most of the time (60-89% of the time)	0	0%
	Always, or almost always (90-100% of the time)	0	0%
	Total	80	100%
Type of usage of PlumX altmetrics dashboard: Checking your own altmetrics counts	Not checked	60	79%
	Checked	16	21%
	Total	76	100%

¹⁸ The different numbers of the full sample are due to missing values.

Type of usage of PlumX altmetrics dashboard: Comparing your own altmetrics counts with other researchers' altmetrics counts	Not checked	72	95%
	Checked	4	5%
	Total	76	100%
Type of usage of PlumX altmetrics dashboard: Comparing your own altmetrics counts with other research units' altmetrics counts	Not checked	75	99%
	Checked	1	1%
	Total	76	100%
Type of usage of PlumX altmetrics dashboard: Checking of altmetrics ranking results	Not checked	74	97%
	Checked	2	3%
	Total	76	100%
Type of usage of PlumX altmetrics dashboard: Identifying of users of your research (e.g. readers of your publications)	Not checked	73	96%
	Checked	3	4%
	Total	76	100%
Type of usage of PlumX altmetrics dashboard: Trying to improve your own altmetrics counts	Not checked	73	96%
	Checked	3	4%
	Total	76	100%
	Total	80	100%
Type of usage of PlumX altmetrics dashboard: Do not know / cannot answer	Not checked	24	32%
	Checked	52	68%
	Total	76	100%

Furthermore, 10 out of 80 (13%) do use altmetrics counts for research funding applications, 44 (55%) do not use them for that purpose. This presents the only relatively considerable number of respondents, that use altmetrics counts for a certain purpose, that is in research funding application. Nevertheless, asking the respondents for the importance of altmetrics counts in research funding application did not reveal the same trend. For four out of 80 respondents (5%) altmetrics is not important at all for their research funding applications, for three (4%) they are neither important nor unimportant, and for two (3%) they are somewhat important. Three out of 70 (4%) use altmetrics to report on their funded research projects, 53 (76%) do not use altmetrics for that purpose. For each one (1%) of the respondents, altmetrics in reporting on funded research projects is not important at all, neither important nor unimportant for one (1%) or somewhat important for one (1%).

Compared to citation counts, altmetrics is not important at all for 18 out of 68 (26%) respondents, somewhat unimportant for 12 (18%) respondents, neither important nor unimportant for two respondents (3%), somewhat important for eight (12%) respondents, and very important for three (4%) respondents. Compared to citation counts, the respondents consider

altmetrics of low importance, but at least in comparison to some other questions of little importance. Further, 46 out of 80 respondents (57%) do never or almost never consider altmetrics counts when deciding whether to read a particular publication, 10 (13%) do rarely consider it, two (3%) sometimes and one (1%) most of the time. Furthermore, 47 out of 80 (59%) do never or almost never use altmetrics to evaluate another researcher's publication, eight (10%) do rarely consider it, three (4%) sometimes, and one (1%) most of the time. Table 11 summarizes the findings for the usage of altmetrics by researchers.

Table 11. *Researchers: Usage of altmetrics*

		Count	Table N %
Do you include your altmetrics counts in your research funding applications?	Not answered	11	14%
	Yes	10	13%
	No	44	55%
	Do not know / cannot answer	15	19%
	Total	80	100%
How important is your altmetrics data from PlumX dashboards for your research funding applications?	Not answered	70	88%
	Do not know / cannot answer	1	1%
	Not important at all	4	5%
	Somewhat unimportant	0	0%
	Neither important nor unimportant	3	4%
	Somewhat important	2	3%
	Very important	0	0%
Total	80	100%	
Do you use altmetrics to report on the outcomes of your funded research projects?	Not answered	1	1%
	Yes	3	4%
	No	53	76%
	Do not know / cannot answer	13	19%
	Total	70	100%
How important is your altmetrics data from PlumX dashboards for reporting on your funded research?	Not answered	77	96%
	Do not know / cannot answer	0	0%
	Not important at all	1	1%
	Somewhat unimportant	0	0%
	Neither important nor unimportant	1	1%
	Somewhat important	1	1%
	Very important	0	0%
Total	80	100%	
Compared to citation counts, how important are altmetrics counts to	Not answered	1	1%
	Do not know / cannot answer	24	35%
	Not important at all	18	26%

you for research impact?	Somewhat unimportant	12	18%
	Neither important nor unimportant	2	3%
	Somewhat important	8	12%
	Very important	3	4%
	Total*	68	100%
Do you consider altmetrics counts when deciding whether to read a particular publication?	Not answered	13	16%
	Do not know/cannot answer	8	10%
	Never, or almost never (0-10% of the time)	46	57%
	Rarely (11-39% of the time)	10	13%
	Sometimes (40-59% of the time)	2	3%
	Most of the time (60-89% of the time)	1	1%
	Always, or almost always (90-100% of the time)	0	0%
	Total	80	100%
Do you use altmetrics to evaluate another researcher's publication?	Not answered	13	16%
	Do not know/cannot answer	8	10%
	Never, or almost never (0-10% of the time)	47	59%
	Rarely (11-39% of the time)	8	10%
	Sometimes (40-59% of the time)	3	4%
	Most of the time (60-89% of the time)	1	1%
	Always, or almost always (90-100% of the time)	0	0%
	Total	80	100%

Note. *Some totals are smaller than 80, because of missing values.

The overall sample was too small to make comparisons of the results between dependent variables, such as usage of altmetrics in funding application and independent variables, such as main research field. In the end, 20 respondents provided a final comment. The final comments also confirmed the analysis of the other questions, as most researchers are unaware of altmetrics and PlumX, or have forgotten about their registration, or follow altmetrics on other platforms, such as journals. It was mentioned that only highly-ranked researchers are visible on PlumX, and to find one's own scores is time consuming, and the validity of altmetrics sources was questioned. Two respondents referred to the different valuation of altmetrics among academic disciplines and one of them to any alternative sources as being incomplete. One respondent referred to the fact there is no time to follow altmetrics due to all the other academic obligations. The most interesting final comment was given by one respondent that mentioned the usage of altmetrics at an institute-level evaluation, but not at the individual researcher or research group level, being aware of the limitations on that level.

A few respondents also use other altmetrics data providers, whereas the most common one in this sample is PLOS ALM, before Altmetric.com and Impactstory. Very rarely used are also further providers that were mentioned as a free comment by some respondents, such as altmetrics provided by journals (n=2), Kudos (a private online service to achieve higher online impact for researchers) (n=2), both Altmetric.com and Impactstory (n=1), ORCID (a unique identifier system for researchers) (n=1), Web of Science (n=2), Google Scholar (n=1), and Researcher ID (another unique identifier system for researchers) (n=1).

When it comes to distinguishing altmetrics sources, 26 out of 80 researchers (33%) do distinguish between different altmetrics sources, and 21 out of 80 (26%) do not distinguish between them. The remaining respondents did not answer this question. Table 12 gives an overview of the researchers' responses to the question "Would you distinguish between different altmetrics sources to demonstrate impact?".

Table 12. *Researchers: Would you distinguish between different altmetrics sources to demonstrate research impact?*

		Count	Table N %
Would you distinguish between different altmetrics sources to demonstrate research impact?	Not answered	13	16%
	Yes	26	33%
	No	21	26%
	Do not know / cannot answer	20	25%
	Total	80	100%

The demographics of the researchers are presented in Table 13.

Table 13. *Researchers: Demographics*

		Count	Table N %
Age	Not answered	13	16%
	30 or under	1	1%
	31-40	16	20%
	41-50	24	30%
	51 or over	25	31%
	Prefer not to say	1	1%
	Total	80	100%
Gender	Not answered	14	18%
	Male	44	55%

	Female	21	26%
	Prefer not to say	1	1%
	Total	80	100%
Main research field	Not answered	13	16%
	Physics	1	1%
	Chemistry	4	5%
	Computer science	4	5%
	Statistics	1	1%
	Astronomy	4	5%
	Biochemistry, biophysics	1	1%
	Plant biology	1	1%
	Developmental biology and physiology	1	1%
	Microbiology	1	1%
	Genetics	3	4%
	Food sciences	1	1%
	Agricultural sciences	1	1%
	Biomedicine	8	10%
	Veterinary medicine	2	3%
	Pharmacy	2	3%
	Dental science	1	1%
	Public health research	3	4%
	Clinical medicine	14	18%
	Development research	1	1%
	Women and gender studies	1	1%
	Psychology	1	1%
	Social sciences	4	5%
	Communication	3	4%
	History and archaeology	1	1%
	Art research	1	1%
	Theology	1	1%
	Prefer not to say	1	1%
	Total	80	100%
Career stage	Not answered	13	16%
	Junior Researcher (PhD)	4	5%
	Post-doctoral Researcher	6	8%
	Senior Researcher	26	33%
	Professor	26	33%
	Prefer not to say / none of the above	5	6%
	Total	80	100%
Use of social media platforms:	Not checked	55	82%
Blogs	Checked	12	18%

	Total	67	100%
Use of social media platforms:	Not checked	43	64%
Twitter	Checked	24	36%
	Total	67	100%
Use of social media platforms:	Not checked	35	52%
Facebook	Checked	32	48%
	Total	67	100%
Use of social media platforms:	Not checked	55	82%
LinkedIn	Checked	12	18%
	Total	67	100%
Use of social media platforms:	Not checked	37	55%
ResearchGate	Checked	30	45%
	Total	67	100%
Use of social media platforms:	Not checked	55	82%
Academia.edu	Checked	12	18%
	Total	67	100%
Use of social media platforms:	Not checked	62	93%
Mendeley	Checked	5	7%
	Total	67	100%
Use of social media platforms:	Not checked	62	93%
Wikipedia	Checked	5	7%
	Total	67	100%
	Total	80	100%
Use of social media platforms:	Not checked	62	93%
Prefer not to say	Checked	5	7%
	Total	67	100%

6.3.2 Reviewers at the Strategic Research Council

As it was mentioned in the survey analysis of the sample from the researchers at the University of Helsinki, altmetrics are not widely spread among the respondents of this sample either, and sometimes even unknown to the respondents. Similarly, altmetrics are not used in research funding, and the value that is attached to them is considerably low. Nevertheless, a small number of respondents gave feedback on how they follow the overall discussion on metrics and altmetrics in higher education.

To start, 15 (42%) out of 36 respondents are not at all aware of the term ‘altmetrics’, eight (22%) are slightly aware, nine (25%) somewhat aware, three (8%) moderately aware, and one (3%) extremely aware. Further, 15 out of 36 (42%) are not at all aware of the PlumX dashboards, and three (8%) are slightly aware of them. Furthermore, 13 out of 36 (36%) do never

or almost never discuss altmetrics with their colleagues, two (6%) do rarely discuss them, four (11%) do sometimes discuss them.

Further, altmetrics compared to citation counts are not important at all for seven out of 36 (19%) respondents, for four (11%) somewhat unimportant, for four (11%) neither important nor unimportant, for two (6%) somewhat important, and for one (3%) very important. Also, 15 out of 36 (42%) do never or almost never consider altmetrics counts, when deciding whether to read a particular publication, one (3%) does rarely consider them, two (6%) do sometimes consider them, and one (3%) does consider them most of the time. And, 14 (39%) out of 36 do never or almost never use altmetrics to evaluate another researcher's publication, four (11%) do rarely use it, and one (3%) does sometimes it. What is more, 19 (53%) out of 36 do not use an altmetrics dashboard at their organisation, and two (6%) do use a dashboard. Table 14 summarizes the responses regarding the reviewers' awareness and usage of altmetrics.

Table 14. *Reviewers: Awareness and usage of altmetrics*

		Count	Table N %
Are you aware of the PlumX altmetrics dashboards that some universities use?	Not answered	15	42%
	Do not know / cannot answer	3	8%
	Not at all aware	15	42%
	Slightly aware	3	8%
	Somewhat aware	0	0%
	Moderately aware	0	0%
	Extremely aware	0	0%
	Total	36	100%
Are you aware of the term 'altmetrics'?	Not answered	0	0%
	Not at all aware	15	42%
	Slightly aware	8	22%
	Somewhat aware	9	25%
	Moderately aware	3	8%
	Extremely aware	1	3%
	Total	36	100%
How often do you discuss altmetrics counts with your colleagues?	Not answered	15	42%
	Do not know/cannot answer	2	6%
	Never, or almost never (0-10% of the time)	13	36%
	Rarely (11-39% of the time)	2	6%

	Sometimes (40-59% of the time)	4	11%	
	Most of the time (60-89% of the time)	0	0%	
	Always, or almost always (90-100% of the time)	0	0%	
	Total	36	100%	
Compared to citation counts, how important are altmetrics counts to you for research impact?	Not answered	15	42%	
	Do not know / cannot answer	3	8%	
	Not important at all	7	19%	
	Somewhat unimportant	4	11%	
	Neither important nor unimportant	4	11%	
	Somewhat important	2	6%	
	Very important	1	3%	
	Total	36	100%	
	Do you consider altmetrics counts when deciding whether to read a particular publication?	Not answered	16	44%
		Do not know/cannot answer	1	3%
Never, or almost never (0-10% of the time)		15	42%	
Rarely (11-39% of the time)		1	3%	
Sometimes (40-59% of the time)		2	6%	
Most of the time (60-89% of the time)		1	3%	
Always, or almost always (90-100% of the time)		0	0%	
Total		36	100%	
Do you use altmetrics to evaluate another researcher's publication?		Not answered	16	44%
		Do not know/cannot answer	1	3%
	Never, or almost never (0-10% of the time)	14	39%	
	Rarely (11-39% of the time)	4	11%	
	Sometimes (40-59% of the time)	1	3%	
	Most of the time (60-89% of the time)	0	0%	
	Always, or almost always (90-100% of the time)	0	0%	
	Total	36	100%	

Do you use an altmetrics dashboard at your organisation?	Not answered	15	42%
	Yes	2	6%
	No	19	53%
	Do not know / cannot answer	0	0%
	Total	36	100%

The demographics of the sample of reviewers are described in table 15.

Table 15. *Reviewers: Demographics*

		Count	Table N %
Age	Not answered	1	3%
	30 or under	0	0%
	31-40	0	0%
	41-50	12	33%
	51 or over	23	64%
	Prefer not to say	0	0%
	Total	36	100%
Gender	Not answered	1	3%
	Male	25	69%
	Female	10	28%
	Prefer not to say	0	0%
	Total	36	100%
Main research field*	Not answered	2	6%
	Energy engineering	1	3%
	Geosciences	1	3%
	Construction and municipal engineering	2	6%
	Computer science	1	3%
	Industrial management	1	3%
	Environmental engineering	2	6%
	Public health research	2	6%
	Economics	3	8%
	Education	4	11%
	Women and gender studies	1	3%
	Psychology	1	3%
	Social sciences	6	17%

	Science studies	1	3%
	Political science	2	6%
	Communication	1	3%
	Environmental social science research	3	8%
	Prefer not to say	2	6%
	Total	36	100%
Career stage	Not answered	1	3%
	Junior Researcher (PhD)	0	0%
	Post-doctoral Researcher	0	0%
	Senior Researcher	4	11%
	Professor	24	67%
	Prefer not to say / none of the above	7	19%
	Total	36	100%
Use of social media platforms: Blogs	Not checked	29	83%
	Checked	6	17%
Use of social media platforms: Twitter	Not checked	25	71%
	Checked	10	29%
Use of social media platforms: Facebook	Not checked	26	74%
	Checked	9	26%
Use of social media platforms: LinkedIn	Not checked	23	66%
	Checked	12	34%
Use of social media platforms: ResearchGate	Not checked	18	51%
	Checked	17	49%
Use of social media platforms: Academia.edu	Not checked	30	86%
	Checked	5	14%
Use of social media platforms: Mendeley	Not checked	35	100%
	Checked	0	0%
Use of social media platforms: Wikipedia	Not checked	33	94%
	Checked	2	6%
Use of social media platforms: Prefer not to say	Not checked	34	97%
	Checked	1	3%
Employer	Not answered	1	3%
	University	20	56%
	Research centre/institute	4	11%
	Company	1	3%
	Other	9	25%
	Do not know/cannot answer	1	3%

	Total	36	100%
Employer: Other		27	75%
	Funding agency	1	3%
	Governmental institute	1	3%
	Innovation Funding Agency	1	3%
	Interest organisation	1	3%
	Own consultancy	1	3%
	Other	1	3%
	Public agency	1	3%
	Research funder	1	3%
	Retired	1	3%

Note. *Main research fields: excluding empty categories.

One respondent commented on the usage of altmetrics by government and / or funding agencies. The respondent mentioned the UK funding councils, and how they require some kind of altmetrics for reporting on each grant they fund, that is in the Researchfish annual returns and as Key Performance Indicators (KPIs). Research Fish Ltd is an research impact assessment platform in the UK, which provides online service for the research funding sector (Researchfish Ltd, 2017). However, according to the respondent no one knows if they are ever used for anything. As of 13 June 2017, Researchfish offers Altmetric.com badges on its platform (Altmetric.com, 2017b). Further, altmetrics are used by them to evaluate academic website usage, etc.

Further, seven respondents provided a final comment, and some of them are mentioned here. One debate on metrics was mentioned from another country, namely ‘responsible metrics’ in the UK. One respondent questioned if the purpose of research is to achieve high altmetrics scores, and that there is a different valuation of altmetrics among academic disciplines, and that it does not correlate with research quality or value. That is why, altmetrics should be used very cautiously. Bibliometrics was called a double-edged sword approach by one respondent. It helps to get a general orientation, but may replace insightful evaluations by a bureaucratic formal scrutiny; if altmetrics could overcome this dilemma it would have positive effect on academic life. One respondent commented that it is difficult to measure the respondent’s research impact, as it happens in personal interactions (e.g. with policy makers). One respondent became aware that they have promoted the altmetrics approach before knowing that the concept existed.

Chapter 6 described the collected samples that are made up of policy documents, semi-structured interviews (n=6) and four online surveys addressing reviewers at the Academy of Finland (n=80) and researchers at the University of Helsinki (n=210). It described how the data was analysed and put into context. Chapter 7 will triangulate the data sources further in a mixed methods approach to draw conclusions from them.

7 Discussion of the Results

The interview phase turned out to be useful for the research process. It was possible to explore the field, gather opinions from experts, test certain valuations on altmetrics, and improve the surveys. Certain codings from the interviews were also directly adapted for the questionnaires, such as the valuation of altmetrics in reporting of funded research. That is why, the quantitative phase would have been more challenging without this thorough preparation, and the author could acquire clearer expectations of potential survey responses. At the same time, it was also challenging to find participants that were willing to be interviewed, and the whole interview phase was quite time-consuming. All in all, it was reasonable to choose this approach, and it was worth the effort. Overall, the survey respondents tended to be to a similar extent to the interviewees unaware of the usage of altmetrics. Finally, some of the open comments given by the respondents could be coded with the codings that emerged during the interviews. That is, the cycle between the qualitative and quantitative phase could be closed.

The findings based on this sample suggest that most respondents are unaware of altmetrics, and only some are interested in it. Further, there are very few advanced altmetrics users, and some also use altmetrics in research funding applications and/or evaluations. To conclude, despite the high-level debates on altmetrics the topic is not spread at all at the research base. The higher education sphere is quite a complex one, and researchers as well as reviewers lack the time to focus on every aspect of it, and might also not consider it as important. The usage of altmetrics seems to focus on a small group of specialists. To sum it up, altmetrics are rarely known among researchers that are registered at the PlumX altmetrics dashboards. Similarly, altmetrics are rarely used by those researchers, whereas there is a small number of researchers that use them. The same can be suggested for the panel of reviewers, where altmetrics are not widely spread. Some exceptions apply, where reviewers are well aware of the implications of altmetrics. Sometimes altmetrics are also confused with some of the most prominent bibliometric online databases, such as Web of Science, Scopus and/or Google Scholar.

The data also suggests that a small number of respondents is well aware of the debates on altmetrics. If one closely follows the international debates on the usage of altmetrics, it might come as a surprise that the concept is so widely unused in this sample, for example researchers that are registered at an altmetrics system, and reviewers that assessed research impact in a funding instrument. It was expected that respondents of this sample would tend more towards the usage of altmetrics, as it was also mentioned by one interviewee. In particular, if altmetrics are promoted in high-level policy debates in EU research policy, researchers need to be made aware of it, because this might also affect their academic career to some extent. A rather unintended effect of this study might be the fact, that some respondents that had been unaware of altmetrics, might become interested in the concepts after being informed through this study.

The term ‘altmetrics’ was only shortly introduced in the beginning of the surveys. This was criticized by a small number of respondents, but the aim of the surveys was to find out how many people had been already aware of altmetrics before the survey, and not how many people would be interested to learn more about the concept as such. Given the latter case, the concept could have been misunderstood by some respondents. The concept of altmetrics was also criticized, especially in the open comments. Nevertheless, in these comments altmetrics was also supported by others.

Based on findings from the interviews and the surveys, the main research question (see chapter 1) can be answered as follows:

1. To what extent are values attached to altmetrics in research funding in Finland?

The interview and survey analysis produced similar results based on the responses given by the respondents, that is mostly unawareness and low usage of altmetrics, but also mostly an interest in the concept. This goes in line with findings by Erdt et al. (2016), namely that challenges concerning the usage of altmetrics in research funding still prevail.

Altmetrics play a marginal role in this research funding instrument, with some exceptions. These exceptions are a small number of respondents that seem to be well-aware of altmetrics, and use it to a minor extent, for instance in funding application and reports on funded projects, and even once in an evaluation on institute level. Also, the study seems to have raised interest among some survey respondents. Altmetrics might play a role in future but rather in the reporting phase of funded research than in the application phase. Altmetrics are to a great deal of little value to the respondents, with a few exceptions. Referring to the theoretical framework that is used for this study, an estimation on the value of altmetrics in research funding is a

human judgement, in this case given by different stakeholders, that is researchers, reviewers, policy-makers and staff and board members. This human judgement gives worth to objects as social construct. It seems as if stakeholders of this sample have not yet produced a matrix of worth for altmetrics, which defines “how value is produced, diffused, assessed, and institutionalized” (Lamont, 2012). As Bornmann (2017) stated, peer review is seen as the most adequate form to evaluate scientific merits to date. Further, citation counts or bibliometrics are an established method of evaluating the works of a researcher, a research group, a university or even on country level, even if shortcomings prevail (Bornmann, 2017). This was also highlighted by the interviewees. Given the recent developments of altmetrics, even researchers that study altmetrics cannot make a definite judgement on whether how altmetrics can be interpreted in a consistent manner (Erdt et al., 2016). From this, no established classification, for example altmetrics sources, and categorization, for example the value of altmetrics in general, can be stated. Nevertheless, altmetrics have clearly reached highest policy levels, which was also the rationale to investigate the valuation of altmetrics among several stakeholders in this study. The Sociology of Valuation and Evaluation turned out to be a valid focus of perspective for this study (Gauch & Blümel, 2016). However, the pragmatism as selected worldview for this study, also facilitates the usage of further theories that can be applied for interpreting the findings from the data collection. Thus, the answers to sub research questions 1.1 and 1.2 of this study will be enriched in the same section by using novel theories to explain the findings:

1.1 To what extent are altmetrics currently used and valued by reviewers, board and staff members in the Strategic Research Council at the Academy of Finland?

1.2 To what extent are altmetrics currently used and valued by researchers that are registered at the University of Helsinki’s PlumX altmetrics dashboard?

The board and staff members as well as reviewers of this funding instrument consider altmetrics of low importance in research funding, with some exceptions. Again, there is a minor extent of study participants that is well aware of the debates surrounding altmetrics, such as its potential usage in research funding. Furthermore, the topic raised a certain interest among a small amount of study participants. The sample of researchers at the University of Helsinki also consider altmetrics of low importance, with a few exceptions that show advanced users that use altmetrics, and are well aware of the concept. Given the fact, that altmetrics dashboards are supposed to show the impact of a university’s research, these findings had been merely unexpected. It had been expected that more researchers would use the dashboard regularly in some

way or the other. It had also been expected that there would be only a little number of researchers that are unaware of their registration. The fact that some researchers had not known the concept of altmetrics had also not been expected as such.

Universities are loosely-coupled systems, which means that different entities are part of the same organisation, and do not necessarily work together towards the same goal (Weick, 1976). Or as proven in this case, some university members are not aware of some developments happening in other entities. To this end, the findings can be also related to the Garbage Can Model of Organizational Choice, a model proposed by Cohen, March, & Olsen (1972). Both foci of perspectives on the special characteristics of universities introduced as early as in the 1970s are thus still topical to study such a novel development in 2017. Like research questions 1, it can also be concluded that no matrix of worth has been established for altmetrics in this sample. To conclude, one respondent formulated, that the dashboard is only used out of curiosity. This summarized the previous given analysis in good manner.

In terms of the reviewers it can be analysed with concepts by Niklas Luhmann (Bornmann, 2017), that postulate that modern societies are made up of several subsystems as their own entities. That is why, altmetrics might not spread as fast as predicted between these systems, and systems as such are quite ambiguous, and define their own boundaries. Similarly, it relates to the notion as stated by Burton Clark: “In an infinitely complex world, the higher education system has difficulties in pulling itself together” (Clark, 1986).” This can be also expanded to value ambivalence and structural ambivalence as described by Clark (1986) The samples were connected based on being related to research funding in a certain way. Still, they form autonomous systems, or as postulated by Niklas Luhmann, systems are defined by their boundaries with the outside world. Therefore, information is carefully selected, in this case the adoption of altmetrics as a not widely-spread phenomenon in some subsystems. These subsystems are ultimately formed through communication, which would also be the suggestion arising from this study. The implications of the usage of altmetrics need to be widely communicated, considering all stakeholders of the higher education system.

The differences in usage of social media platforms, such as Mendeley was described in several studies (Sugimoto et al., 2016). The usage of social media could not be divided among several demographics, such as age, career stage, gender, discipline, etc. because they were not enough respondents in each category.

Concerning the usage of altmetrics data, a valid approach was put forward by Robinson-Garcia, van Leeuwen, & Rafols (2017). It might be a fairer concept to look at how researchers and research users engage around scholarly outputs, and not to focus too much on a way to hold researchers accountable, or provide a certain measurement of impact. That is, it should focus on the networks of engagement between researchers and the wider society in case studies, but not on counting certain indicators as in bibliometrics, and comparing them to each other (Nicolas Robinson-García et al., 2017). This would be a shift away from pure auditing and would look more closely at the learning process. An example includes to examine at the networks of Twitter users, and the type of research users researchers interact with on this platform.

Finally, it is important to find out how certain metrics, in this case altmetrics are valued, as the competition for public money is a severe one, and scientists compete with various other stakeholders in the society on how to show impact to policy-makers, so that these may ideally distribute funds for research based on these findings. As aforementioned, the most recent example from June 2017 includes the report on the impact of Universities Finland (UNIFI) (BiGGAR Economics, 2017). That is why, research impact is an important area to study (Bornmann, 2017). As it was mentioned from one of the interviewees, a new indicator also always brings a change in the behaviour of scientists. That is why, such a change has to be weighted carefully. Bornmann (2017) also argues in that direction. It also needs to be weighted carefully, because evaluations costs time and money, and in the end, there should be benefit arising from them.

Chapter 7 provided a discussion of the results, and how they could be framed alongside current debates on the valuation and usage of altmetrics. From this, chapter 8 will draw final conclusions.

8 Conclusions

This master's thesis explored the valuation, that is the notion of giving worth of altmetrics in research funding. The rationale for choosing the topic were high-level policy debates on the potential usage of altmetrics and the notion of research impact in higher education systems. Strategic research funding is an instrument with the goal to achieve impact, which might be measured through altmetrics. The thesis explored these topics by drawing its findings from semi-structured interviews (n=6) and four online surveys with stakeholders (n=290) (N=296). Another mode of inquiry was focused on the review of policy papers. The interviews were used

to explore the field, and prepare parts of the questionnaires for the online survey. This turned out to be a valid approach to improve the data collection. The interviews tended to be qualitative and little in number compared to the surveys that leaned on a quantitative design. The interviews were carried out with policy makers and representatives of a research funding organisation. The surveys were addressed at the full sample of reviewers that had assessed funding application in strategic research. Further, all researchers that are currently registered at an organisational altmetrics dashboard were surveyed. The survey respondents were identified based on their function. The study collected responses from a considerable large number of respondents, and produced valid findings. Nevertheless, this only shows a fraction of stakeholders in research funding, and reviewers also change over the course of time. Still, research funding aims to be standardized to a certain extent, which make the findings also important for other similar funding instruments.

The valuation of altmetrics seems to be on the rise in policy papers and further international initiatives, such as on EU policy level. In turn, the findings that could be drawn from this particular sample of stakeholders suggest that altmetrics are not yet widely spread, and even completely unknown to the vast majority of study participants. Higher education systems are complex entities, and even if such an impact measurement is proposed on a policy level, does not mean that it also is accepted by the research base. Similarly, findings from the interviews also showed that different organisational types, academic disciplines and further categories have to be treated differently.

As discussed in several technical studies, altmetrics are not yet ready for routine use in research evaluations, and several challenges need to be addressed. Nevertheless, through altmetrics it is possible to make a certain kind of impact on the society visible. How this impact is interpreted and set into context, is essential. It was also suggested by some interviewees that altmetrics might play a larger role in reporting on funded research rather than demonstrating impact in research funding applications. Criticisms were put forward by some respondents on altmetrics, which needs to be confirmed in a larger sample. And, altmetrics should only be seen as complementary measurement compared to citation counts and especially peer review. As a tool to measure merits of open science, it might be a promising one, as traces of impact can be made available. Still, the data is provided by commercial companies, which is contrary to openness. For instance, the impact of sharing a research data set, can be made visible in timely manner, compared to citation counts. The context of altmetrics data and aggregated scores needs to be analysed as suggested by several scholars.

In certain areas, such as the explored research funding instrument, it makes sense to include altmetrics data in future to a certain extent in the reporting phase. The focus lies clearly on how research has been received by the wider public, and compared to, for instance, narrative case studies, altmetrics can provide one part of the evidence. It is important to assure the data quality and look at the context, as well as to compare it with several other sources of evidence, and most importantly to rely on expert judgement. The criticism that is usually valuable on the challenges of altmetrics does not match completely in this regard. When a research funder invests in research impact, which is also politically motivated, there needs to be a certain tool that can quantify such impact. Still, it has to be studied profoundly, and treated carefully.

As mentioned before, the research policy debates on a European level, needs to be broken down to individual researchers, as many in this particular sample are apparently not aware at all, that altmetrics are highly valued for potential use in research policy deliverables. Some advanced users of altmetrics could be identified, but the concept is mostly unknown within the scientific communities. Obviously, most researchers are mainly focused on their own discipline, and have simply little or no time to focus on such developments as well. A quotation by Burton Clark describes the findings in a pragmatic way: “In an infinitely complex world, the higher education system has difficulties in pulling itself together (Clark, 1986).”

Further research needs to widen the scope on several research funding organisations, and altmetrics users, ideally on an international context. This study provided a contribution to ongoing debates on research impact, research funding, and altmetrics. At any rate, how these debates will develop in future remains to be observed.

9 References

- Aaltojarvi, I., Arminen, I., Auranen, O., & Pasanen, H.-M. (2008). Scientific Productivity, Web Visibility and Citation Patterns in Sixteen Nordic Sociology Departments. *Acta Sociologica*, 51(1), 5–22. <http://doi.org/10.1177/0001699307086815>
- AAPOR. (2016). *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. Retrieved from [http://www.aapor.org/Standards-Ethics/Standard-Definitions-\(1\).aspx](http://www.aapor.org/Standards-Ethics/Standard-Definitions-(1).aspx)
- Aarrevaara, T., & Pekkola, E. (2012). A comparative perspective on the work content of the academic profession. In S. Ahola & D. M. Hoffman (Eds.), *Higher education research in Finland. Emerging structures and contemporary issues*. Jyväskylä University Press. Retrieved from <https://ktl.jyu.fi/julkaisut/julkaisuluettelo/julkaisut/2012/d103>
- Aarrevaara, T., & Pulkkinen, K. (2016). *Public Engagement Innovations for Horizon 2020 Societal Interaction of Science in Strategic Research Council funded projects*. Retrieved from <https://pe2020.eu/2016/09/23/societal-interaction-plans-of-the-strategic-research-council-at-the-academy-of-finland/>
- Academy of Finland. (n.d.). How to report on the impact of research Academy of Finland. Retrieved January 24, 2016, from <http://www.aka.fi/en/research-and-science-policy/research-councils/what-the-research-council-for-health-does/funding-and-guidelines/how-to-report-on-the-impact-of-research-in-the-final-report/>
- Academy of Finland. (2016). SRC in brief - Academy of Finland. Retrieved from <http://www.aka.fi/en/strategic-research-funding/src-in-brief/>
- Academy of Finland. (2017a). Academy of Finland selects 12 new Centres of Excellence. Retrieved June 5, 2017, from <http://www.aka.fi/en/about-us/media/press-releases/2017/academy-of-finland-selects-12-new-centres-of-excellence/>
- Academy of Finland. (2017b). Strategic research programmes 2016–2019. Retrieved June 6, 2017, from <http://www.aka.fi/en/strategic-research-funding/programmes/programmes-20162019/>
- Adie, E., & Roe, W. (2013). Altmetric: enriching scholarly content with article-level discussion and metrics. *Learned Publishing*, 26(1), 11–17. <http://doi.org/10.1087/20130103>
- Alhoori, H., & Furuta, R. (2014). Do altmetrics follow the crowd or does the crowd follow altmetrics? In *2014 IEEE/ACM Joint Conference* (pp. 375–378). <http://doi.org/10.1109/JCDL.2014.6970193>
- Alperin, J. P. (2015). Geographic variation in social media metrics: an analysis of Latin American journal articles. *Aslib Journal of Information Management*, 67(3), 289–304. <http://doi.org/10.1108/AJIM-12-2014-0176>
- Alperin, J. P., Fischman, G., & Cetto, A. M. et al. (2015). *Made in Latin America : open access, scholarly journals, and regional innovations*. Retrieved from <http://biblioteca.clacso.edu.ar/clacso/se/20150921045253/MadeInLatinAmerica.pdf>
- Altbach, P. G. (2006). *International Higher Education : Reflections on Policy and Practice*.
- Altbach, P. G., & Salmi, J. (2011). *The Road to Academic Excellence: The Making of World-Class Research Universities*. (P. G. Altbach & J. Salmi, Eds.). Washington, DC, USA: The World Bank. <http://doi.org/10.1596/978-0-8213-8805-1>

- Altmetric.com. (2016). Retractions and reputation: How altmetrics demonstrate the digital “ripple effect” of retractions – Altmetric. Retrieved April 30, 2016, from <https://www.altmetric.com/events/retractions-and-reputation-how-altmetrics-demonstrate-the-digital-ripple-effect-of-retractions/>
- Altmetric.com. (2017a). Real-time attention data provides new insights into the reach and influence of published research. Retrieved June 7, 2017, from <https://www.altmetric.com/press/press-releases/european-institutions-increasingly-adopting-altmetrics-to-complement-existing-bibliometric-analysis/?platform=hootsuite>
- Altmetric.com. (2017b). Researchfish Integrates Altmetric Data to Showcase Online Discussions Surrounding Research. Retrieved June 13, 2017, from <https://www.altmetric.com/press/press-releases/researchfish-integrates-altmetric-data-to-showcase-online-discussions-surrounding-research/>
- Araújo, R., Murakami, T., Leduc de Lara, J., & Fausto, S. (2015). Does the Global South have altmetrics? Analyzing a Brazilian LIS journal. *15th International Conference on Scientometrics and Informetrics*. Retrieved from <http://www.issi2015.org/files/downloads/all-papers/0111.pdf>
- Assessment & Evaluation of the Societal Impact of Science (AESIS). (2015). *Discussion paper*. Retrieved from <https://scienceworks.nl/wp-content/uploads/2015/05/AESIS-discussion-paper-201505276.pdf>
- Aung, H. H., Aw, A. S., Sin, S.-C. J., & Theng, Y.-L. (2016). A Worldwide Survey: Investigating Awareness and Usage of Traditional Metrics and Altmetrics among Researchers. [data set]. Figshare. <http://doi.org/https://doi.org/10.6084/m9.figshare.3980103.v1>
- Auranen, O. (2006). Changes in Forms of Academic Productivity. In *SSTNET Workshop “Science and Change.”* Manchester, UK. Retrieved from http://www.uta.fi/yky/tutkimus/tasti/Julkaisut/Sahkoinenkirjasto/auranen_scienceandchange_paper.pdf
- Bar-Ilan, J., Bowman, T. D., Haustein, S., Milojević, S., & Peters, I. (2015). Self-Presentation in academia today: From peer-reviewed publications to social media. *Proceedings of the Association for Information Science and Technology*, 52(1), 1–4. <http://doi.org/10.1002/pra2.2015.145052010016>
- Bar-Ilan, J., Haustein, S., Peters, I., Priem, J., Shema, H., & Terliesner, J. (2012). Beyond citations: Scholars’ visibility on the social Web. Retrieved from <http://arxiv.org/pdf/1205.5611>
- Baruch, Y., & Holtom, B. C. (2008). Survey response rate levels and trends in organizational research. *Human Relations*, 61(8), 1139–1160. <http://doi.org/10.1177/0018726708094863>
- Benner, M., & Sandström, U. (2000). Institutionalizing the triple helix: research funding and norms in the academic system. *Research Policy*, 29, 291–301. Retrieved from www.sciencedirect.com/science/article/pii/S0048733399000670%0A
- BiGGAR Economics. (2017). *Economic Contribution of the Finnish Universities*. Retrieved from http://www.unifi.fi/wp-content/uploads/2017/06/UNIFI_Economic_Impact_Final_Report.pdf
- Boon, C. Y., & Foon, J. W. F. (2014). Altmetrics is an Indication of Quality Research or Just

- HOT Topics. In *Proceedings of the IATUL Conferences* (pp. 1–9). Retrieved from <http://docs.lib.purdue.edu/iatul/2014/altmetrics/3/>
- Bornmann, L. (2012). Measuring the societal impact of research. *EMBO Reports*, 13(8), 673–676. <http://doi.org/10.1038/embor.2012.99>
- Bornmann, L. (2014). Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics. *Journal of Informetrics*, 8(4), 895–903. <http://doi.org/10.1016/j.joi.2014.09.005>
- Bornmann, L. (2017). Measuring impact in research evaluations: a thorough discussion of methods for, effects of and problems with impact measurements. *Higher Education*, 73(5), 775–787. <http://doi.org/10.1007/s10734-016-9995-x>
- Bornmann, L., & Marx, W. (2014). How should the societal impact of research be generated and measured? A proposal for a simple and practicable approach to allow interdisciplinary comparisons. *Scientometrics*, 98(1), 211–219. <http://doi.org/10.1007/s11192-013-1020-x>
- Bosch Foundation. (2016). Funding in the 21st Century. Retrieved from http://www.bosch-stiftung.de/content/language1/downloads/Funding_in_the_21st_Century.pdf
- Cambridge Big Data. (2017). Ethics, Law and Policy. Retrieved June 5, 2017, from <http://www.bigdata.cam.ac.uk/directory/research-themes/ethics-law-policy>
- Carpenter, T. A. (2017). Plum Goes Orange – Elsevier Acquires Plum Analytics. *The Scholarly Kitchen*. Retrieved from <https://scholarlykitchen.sspnet.org/2017/02/02/plum-goes-orange-elsevier-acquires-plum-analytics/>
- Cefai, D., Zimmermann, B., Nicolae, S., & Endreß, M. (2015). Introduction. *Human Studies*, 38(1), 1–12. <http://doi.org/10.1007/s10746-015-9344-6>
- Chant, I. (2016). Increasing Participation in Your Institutional Repository. *Library Journal*. Retrieved from <http://lj.libraryjournal.com/2016/02/oa/increasing-participation-in-your-institutional-repository/>
- Chigwada, J. (2016). Use of altmetrics in allocating research grants.
- Chimes, C. (2014). Researchers talk: Let’s listen. An introduction to altmetrics and Altmetric. Retrieved from http://www.unica-network.eu/sites/default/files/Catherine_Chimes_Altmetric_-_UNICA_2014.pdf
- Choudaha, R. (2015). LinkedIn: the future of global university rankings? *University World News*. Retrieved from <http://www.universityworldnews.com/article.php?story=2015050515565265>
- Clark, B. R. (1986). *The higher education system : academic organization in cross-national perspective*. University of California Press.
- Cohen, M. D., March, J. G., & Olsen, J. P. (1972). A Garbage Can Model of Organizational Choice. *Administrative Science Quarterly*, 17(1), 1. <http://doi.org/10.2307/2392088>
- Costas, R. (n.d.). Altmetrics: what is it, what do we know about it? And what can we expect?
- Costas, R., Zahedi, Z., & Wouters, P. (2014). Do altmetrics correlate with citations? Extensive comparison of altmetric indicators with citations from a multidisciplinary perspective. <http://doi.org/10.1002/asi.23309>

- Cressey, D., & Gibney, E. (2014). UK releases world's largest university assessment. *Nature*. <http://doi.org/10.1038/nature.2014.16587>
- Creswell, J. W. (2014). *Research design: qualitative, quantitative, and mixed methods approaches*. SAGE Publications.
- Cutcliffe, S. (2000). *Ideas, Machines, and Values: Introduction to Science, Technology, and Society Studies*. Lanham: Rowman & Littlefield.
- CWTS. (2017). CWTS Research Line in Altmetrics. Retrieved June 5, 2017, from <https://www.cwts.nl/research/working-groups/societal-impact-of-research/altmetrics>
- DZHW. (2017). Research System and Science Dynamics. Retrieved June 5, 2017, from <http://www.dzhw.eu/en/abteilungen/system>
- Erdt, M., Nagarajan, A., Sin, S. J., & Theng, Y. (2016). Altmetrics: an analysis of the state-of-the-art in measuring research impact on social media. *Scientometrics*, 109(2), 1117–1166. <http://doi.org/10.1007/s11192-016-2077-0>
- EUA. (2016). EUA Open Access Survey. EUA.
- European Commission. (2014). *Validation of the results of the public consultation on Science 2.0: Science in Transition*. Retrieved from <http://www.eesc.europa.eu/resources/docs/validation-of-the-results-of-the-public-consultation-on-science-20.pdf>
- European Commission. (2016). About - Research Participant Portal. Retrieved January 24, 2016, from <http://ec.europa.eu/research/participants/portal/desktop/en/support/about.html>
- European Commission. (2017a). *Commission Staff Working Document. In-depth interim evaluation of Horizon 2020*. Brussels. Retrieved from [http://ec.europa.eu/research/evaluations/pdf/archive/h2020_evaluations/swd\(2017\)220-in-depth-interim_evaluation-h2020.pdf#view=fit&pagemode=none](http://ec.europa.eu/research/evaluations/pdf/archive/h2020_evaluations/swd(2017)220-in-depth-interim_evaluation-h2020.pdf#view=fit&pagemode=none)
- European Commission. (2017b). *Europe's future – open innovation, open science, open to the world: reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group*. Brussels.
- European Commission. (2017c). *Mutual Learning Exercise on Open Science: Altmetrics and Rewards under the Horizon 2020 Policy Support Facility (PSF). Second Workshop on "How to use Altmetrics in a context of Open Science."* Retrieved from https://rio.jrc.ec.europa.eu/sites/default/files/Agenda_MLE_Open_Science_Meeting_31_May_2017_Helsinki.pdf
- European Commission. (2016). *Realising the European Open Science Cloud*. Retrieved from https://ec.europa.eu/research/openscience/pdf/realising_the_european_open_science_cloud_2016.pdf
- European Consortium of Innovative Universities (ECIU). (2017). Entrepreneurship and Societal Impact of Research. Retrieved June 5, 2017, from <https://www.eciu.org/entrepreneurship-and-societal-impact-of-research>
- European Research Council. Comparative scientometric assessment of the results of ERC funded projects (2016).
- European Research Council Executive Agency ERCEA. Belgium-Brussels: Study on open

- access to publications and research data management and sharing within ERC projects (2016).
- Fecher, B., & Friesike, S. (2014). Open Science: One Term, Five Schools of Thought. In B. Fecher & S. Friesike (Eds.), *Opening Science*. Berlin: Springer. <http://doi.org/10.1007/978-3-319-00026-8>
- Federal Government of Belgium. (2016). BELGIAN ERA-ROADMAP April 2016, (April), 1–82.
- Fraumann, G., Costas, R., Mugnaini, R., Packer, A. L., & Zahedi, Z. (2016). Twitter presence and altmetrics counts of SciELO Brazil Journals, (September). Retrieved from http://altmetrics.org/wp-content/uploads/2016/09/altmetrics16_paper_7.pdf
- Fraumann, G., Zahedi, Z., & Costas, R. (2015). What do we know about Altmetric.com sources? A study of the top 200 blogs and news sites mentioning scholarly outputs. *altmetrics15 - 9.10.2015 - Amsterdam*. Retrieved from http://altmetrics.org/wp-content/uploads/2015/09/altmetrics15_paper_19.pdf
- Gauch, S., & Blümel, C. (2016). *OPENing UP new methods, indicators and tools for peer review, impact measurement and dissemination of research results*. Retrieved from http://openup-h2020.eu/wp-content/uploads/2017/01/OpenUp-Deliverable_D5.1_Altmetrics-status-quo.pdf
- German Federal Ministry of Education and Research (BMBF). (2015). Leistungsbewertung in der Wissenschaft. Retrieved from <http://www.hochschulforschung-bmbf.de/de/1333.php>
- German Federal Ministry of Education and Research (BMBF). (2017). Bekanntmachung: Richtlinie zur Förderung der Quantitativen Wissenschaftsforschung. Bundesanzeiger vom 02.05.2017. Retrieved June 5, 2017, from <https://www.bmbf.de/foerderungen/bekanntmachung-1347.html>
- Government Communications Department. (n.d.). Tutkimus- ja innovaationeuvosto kokoontui ensimmäistä kertaa pääministeri Sipilän johdolla - Artikkelit - Valtioneuvoston kanslia. Retrieved from http://vnk.fi/artikkeli/-/asset_publisher/tutkimus-ja-innovaationeuvosto-kokoontui-ensimmaista-kertaa-paaministeri-sipilan-johdolla?_101_INSTANCE_OQ3OcOALUpyv_languageId=en_US
- Government of the Netherlands. (2016). *Amsterdam Call for Action on Open Science*. Amsterdam. Retrieved from <https://english.eu2016.nl/binaries/eu2016-en/documents/reports/2016/04/04/amsterdam-call-for-action-on-open-science/amsterdam-call-for-action-on-open-science.pdf>
- Halme, K., Saarnivaara, V.-P., & Mitchell, J. (2016). *RIO Country Report 2015: Finland*. Retrieved from <https://rio.jrc.ec.europa.eu/en/file/9415/download?token=URC8HDwV>
- Halme, K., Saarnivaara, V., & Mitchell, J. (2017). *RIO Country Report 2016: Finland*. Retrieved from <https://rio.jrc.ec.europa.eu/en/file/10754/download?token=01wcQC-I>
- Haustein, S., Bowman, T. D., & Costas, R. (2015). Interpreting “altmetrics”: viewing acts on social media through the lens of citation and social theories. *arXiv:1502.05701 [Cs]*, 1–24. Retrieved from <http://arxiv.org/abs/1502.05701%5Cnhttp://www.arxiv.org/pdf/1502.05701.pdf>
- Haustein, S., Bowman, T. D., Holmberg, K., Tsou, A., Sugimoto, C. R., & Larivière, V. (2016).

- Tweets as impact indicators: Examining the implications of automated ‘‘bot’’ accounts on Twitter. *Journal of the Association for Information Science and Technology*, 67(1), 232–238. <http://doi.org/10.1002/asi.23456>
- Haustein, S., Peters, I., Sugimoto, C. R., Thelwall, M., & Larivière, V. (2014). Tweeting biomedicine: An analysis of tweets and citations in the biomedical literature. *Journal of the Association for Information Science and Technology*, 65(4), 656–669. <http://doi.org/10.1002/asi.23101>
- Hazelkorn, E. (2008). The Impact of Global Rankings on Higher Education Research and the Production of Knowledge. In UNESCO (Ed.), *Final proceedings: Research summaries and poster presentations of the Global research seminar: Sharing research agendas on knowledge systems* (pp. 343–368). Paris, France: UNESCO. Retrieved from unesdoc.unesco.org/images/0018/001818/181836e.pdf
- Hellström, T., & Jacob, M. (2005). Taming Unruly Science and Saving National Competitiveness: Discourses on Science by Sweden’s Strategic Research Bodies. *Science, Technology & Human Values*, 30(4), 443–467. <http://doi.org/10.1177/0162243905276504>
- Hicks, Diana, Wouters, P., Waltmann, L., de Rijcke, S., & Ràfols, I. (2015). Bibliometrics: The Leiden Manifesto for research metrics. *Nature*. Retrieved from <http://www.nature.com/news/bibliometrics-the-leiden-manifesto-for-research-metrics-1.17351>
- Hoffmann, A. J. (2015). Isolated Scholars: Making Bricks, Not Shaping Policy. Retrieved June 5, 2017, from <http://www.chronicle.com/article/Isolated-Scholars-Making/151707>
- Holmberg, K. (2014). Altmetrics may be able to help in evaluating societal reach, but research significance must be peer reviewed. Retrieved from <http://blogs.lse.ac.uk/impactofsocialsciences/2014/07/09/altmetrics-evaluating-societal-reach-peer-review/>
- Holmberg, K. (2016). *Altmetrics for information professionals: Past, present and future*. Waltham, MA: Chandos Publishing.
- Hölttä, S. (1998). The Funding of Universities in Finland: Towards Goal-Oriented Government Steering. *European Journal of Education*, 33(1), 55–63.
- Hölttä, S. (1999). Regional cooperation in postsecondary education in Europe – the case of Nordic Countries. *Journal of Institutional Research in Australasia*, 8(2). Retrieved from <http://www.aair.org.au/articles/volume-8-no-2/8-2-regional-cooperation-in-postsecondary-education-in-europe-the-case-of-nordic-countries>
- Hölttä, S. (2000). From Ivory Towers to Regional Networks in Finnish Higher Education. *European Journal of Education*, 35(4), 465–474. Retrieved from <http://dx.doi.org/10.1111/1467-3435.00040>
- Hölttä, S., & Cai, Y. (2013). Pursuing Research Excellence in Finnish Universities. *Journal of International Higher Education*, 6(3), 105–109. Retrieved from [http://gse.sjtu.edu.cn/jihe/vol6issue3/JIHE2013\(3\).pdf](http://gse.sjtu.edu.cn/jihe/vol6issue3/JIHE2013(3).pdf)
- Hölttä, S., & Malkki, P. (2000). Response of Finnish higher education institutions to the national information society programme. *Higher Education Policy*, 13(3), 231–243. [http://doi.org/10.1016/S0952-8733\(00\)00010-6](http://doi.org/10.1016/S0952-8733(00)00010-6)

- Howard, J. (2013). Rise of “Altmetrics” Revives Questions About How to Measure Impact of Research. *The Chronicle of Higher Education*. Retrieved from <http://www.chronicle.com/article/Rise-of-Altmetrics-Revives/139557>
- HRK German Rectors’ Conference. (2016). *Resolution passed at the 21 General Meeting of the HRK on 8 November 2016 in Mainz: Creating a European Education, Research and Innovation Union*. HRK German Rectors’ Conference. Retrieved from https://www.hrk.de/uploads/tx_szconvention/HRK_Resolution_EU_Research_Policy_Nov._2016.pdf
- Hug, S. E., Ochsner, M., & Daniel, H.-D. (2013). Criteria for assessing research quality in the humanities: a Delphi study among scholars of English literature, German literature and art history. *Research Evaluation*, 22(5), 369–383. Retrieved from <http://rev.oxfordjournals.org/content/22/5/369.full.pdf+html>
- International Institute for Applied System Analysis (IIASA). (2017). Science and Policy Impact. Retrieved from <http://www.iiasa.ac.at/web/home/about/achievements/scientificachievementsandpolicyimpact/Science-and-Policy-Impact.en.html>
- International Public Policy Association - IPPA. (2016). IPPA - List of panels. Retrieved from <http://www.ippapublicpolicy.org/conference/icpp-3-singapore-2017/panel-list/7#topic14>
- Irish Research Council. (2017). CAROLINE MSCA COFUND Postdoctoral Fellowships. Retrieved June 5, 2017, from <http://www.research.ie/funding/caroline>
- Jobmann, A., Hoffmann, C. P., Künne, S., Peters, I., Schmitz, J., & Wollnik-Korn, G. (2014). Altmetrics for large, multidisciplinary research groups: Comparison of current tools. *Bibliometrie – Praxis Und Forschung*, 3. Retrieved from <http://www.bibliometrie-pf.de/article/viewFile/205/258>
- Journal of Valuation Studies. (2016). Valuation Studies. Retrieved from <http://valuationstudies.liu.se/>
- Kenney, M., & Zysman, J. (2016). The rise of the platform economy. *Issues in Science and Technology*, 32(2), 61–69. <http://doi.org/10.17226/21913>
- Kohtamäki, V. (2011). How do Higher Education Institutions Enhance their Financial Autonomy? Examples from Finnish Polytechnics. *Higher Education Quarterly*, 65(2), 164–185. <http://doi.org/10.1111/j.1468-2273.2010.00475.x>
- Könnölä, T. (2014). *ERAWATCH Country Reports 2013: Finland*. Retrieved from https://rio.jrc.ec.europa.eu/en/file/7887/download?token=sdSTi_Fp
- Lamont, M. (2012). Toward a Comparative Sociology of Valuation and Evaluation. *Reviews in Advance*, (April), 1–21. <http://doi.org/10.1146/annurev-soc-070308-120022>
- LEARN. (2017). *LEARN Toolkit of Best Practice for Research Data Management*. Retrieved from <http://learn-rdm.eu/wp-content/uploads/RDMToolkit.pdf%0Ahttp://discovery.ucl.ac.uk/1546518/>
- Leibniz Gemeinschaft. (n.d.). Sharing Research Data in Academia | Leibniz Research Alliance Science 2.0. Retrieved June 5, 2017, from <https://www.leibniz-science20.de/forschung/projekte/laufende-projekte/sharing-research-data-in-academia/>
- Lindholm, Å., Jacob, M., & Sprutacz, M. (2017). *RIO Country Report 2016: Sweden*. Retrieved

from <https://rio.jrc.ec.europa.eu/en/file/10787/download?token=35oWk76Y>

- Liu, J., & Adie, E. (2013). New perspectives on article-level metrics: Developing ways to assess research uptake and impact online. *Insights: The UKSG Journal*, 26(2), 153–158. <http://doi.org/10.1629/2048-7754.79>
- Madjarevic, N., & Davies, F. (2015). Altmetrics in Higher Education Institutions: Three Case Studies, 1–10. Retrieved from <https://thewinnower.com/papers/altmetrics-in-higher-education-institutions-three-case-studies>
- Markham, A., & Buchanan, E. (2012). *Ethical Decision-Making and Internet Research. Recommendations from the AoIR Ethics Working Committee (Version 2.0)*. Retrieved from <http://www.aoir.org/documents/ethics-guide>
- Matthews, D. (2016). Young researchers “strive for impact” THE News. Retrieved from <https://www.timeshighereducation.com/news/young-researchers-strive-impact>
- Max Planck Gesellschaft. (2003). Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. Retrieved June 10, 2017, from <https://openaccess.mpg.de/Berlin-Declaration>
- McKiernan, E. C., Bourne, P. E., Brown, C. T., Buck, S., Kenall, A., Lin, J., ... Yarkoni, T. (2016). How open science helps researchers succeed. *eLife*, 5. <http://doi.org/10.7554/eLife.16800>
- Meijer, I. (2012). Societal returns of scientific research How can we measure it? Societal returns of scientific research. “*New Perspectives on Enduring Research Questions in University-Society Interaction?*”, *INTERACT-UNI EU-SPRI Conference*, (i), 1–13.
- Moedas, C. (2016). What new models and tools for measuring science and innovation impact? European Commission. Retrieved from https://ec.europa.eu/commission/2014-2019/moedas/announcements/what-new-models-and-tools-measuring-science-and-innovation-impact_en
- Mollenhorst, G., Völker, B., & Flap, H. (2008). Social contexts and personal relationships: The effect of meeting opportunities on similarity for relationships of different strength. *Social Networks*, 30(1), 60–68. <http://doi.org/10.1016/j.socnet.2007.07.003>
- Mounce, R. (2013). Open Access and Altmetrics: Distinct but Complementary. *Bulletin of the American Society for Information Society and Technology*, 39(4), 14–17. Retrieved from https://asis.org/Bulletin/Apr-13/AprMay13_Mounce.html
- Mugabi, H. (2014). *Institutionalisation of the “ Third Mission ” of the University: The case of Makerere University*. Retrieved from <https://tampub.uta.fi/bitstream/handle/10024/96369/978-951-44-9644-8.pdf?sequence=1>
- Mugnaini, R. (2016). The Impact Factor: its popularity and impacts, and the need to preserve the scientific knowledge generation process. *Revista Da Escola de Enfermagem Da USP*, 50(5), 722–723. <http://doi.org/10.1590/s0080-623420160000600002>
- National Academies of Sciences. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC.
- National Information Standards Organization (NISO). (2016). *NISO Alternative Assessment Metrics (Altmetrics) Initiative*. Retrieved from <http://www.niso.org/publications/rp/rp-25-2016/>

- National Science Foundation. (2016). Broader Impacts. Retrieved January 23, 2016, from <http://www.nsf.gov/od/oia/special/broaderimpacts/>
- Network of Excellence in InterNet Science (EINS). (n.d.). Network of Excellence in InterNet Science (EINS). Retrieved June 5, 2017, from <http://www.internet-science.eu/>
- Norwegian Ministry of Education and Research. (2016). Norwegian ERA Roadmap, 2016–2020.
- Nykyri, S., & Vainikka, V. (2016). *Building Altmetrics: Challenges and Opportunities*.
- OECD. (2015). *OECD Public Governance Reviews: Estonia and Finland. Fostering Strategic Capacity across Governments and Digital Services across Borders*. Retrieved from <http://www.oecd-ilibrary.org/deliver/4215021e.pdf?itemId=/content/book/9789264229334-en&mimeType=application/pdf>
- OECD. (2016). *OECD Science, Technology and Innovation Outlook 2016*. Paris. Retrieved from <http://www.oecd.org/science/oecd-science-technology-and-innovation-outlook-25186167.htm>
- OECD. (2017). *OECD Reviews of Innovation Policy: Finland 2017* (OECD Reviews of Innovation Policy). Paris: OECD Publishing. Retrieved from http://www.oecd-ilibrary.org/science-and-technology/oecd-reviews-of-innovation-policy-finland-2017_9789264276369-en
- Open Access Directory. (2017). Declarations in support of OA. Retrieved from http://oad.simmons.edu/oadwiki/Declarations_in_support_of_OA
- Open Science and Research Initiative (ATT). (2014). Open Science and Research: The Open Science and Research Handbook, (December), 16. Retrieved from <https://avointiede.fi/documents/14273/0/Open+Science+and+Research+Handbook+v.1.0/50316d5d-440b-4496-b039-2997663afff8>
- Open Science and Research Initiative (ATT). (2015). ATT - vaikuttavuusselvitysryhmän raportti. Retrieved from <https://avointiede.fi/documents/10864/0/Vaikuttavuusraportti+ATT/aafb3bbd-416e-4bfe-98b7-43de7bbf78fb>
- Open Society Institute. (2002). Budapest Open Access Initiative. Retrieved June 10, 2017, from <http://www.budapestopenaccessinitiative.org/read>
- OSIRIS - Oslo Institute for Research on the Impact of Science. (2017). Retrieved June 2, 2017, from <http://www.sv.uio.no/tik/english/research/projects/osiris/>
- Packer, A. L., Cop, N., Luccisano, A., Ramalho, A., & Spinak, E. (2014). *SciELO - 15 Years of Open Access: an analytic study of Open Access and scholarly communication*. <http://doi.org/10.7476/9789230012373>
- Parks, S., Lichten, C., Lepetit, L., & Jones, M. M. (2017). *Open Science Monitoring*. Retrieved from http://ec.europa.eu/research/openscience/pdf/monitor/open_science_monitor_methodological_note.pdf#view=fit&pagemode=none
- Pedersen, M. J., & Nielsen, C. V. (2016). Improving Survey Response Rates in Online Panels: Effects of Low-Cost Incentives and Cost-Free Text Appeal Interventions. *Social Science*

- Computer Review*, 34(2), 229–243. <http://doi.org/10.1177/0894439314563916>
- Penny, D. (2016). What matters where? Cultural and geographical factors in science. In *3:AM in Bucharest*. Bucharest, Romania. Retrieved from https://figshare.com/articles/What_matters_where_Cultural_and_geographical_factors_in_science/3969012
- Perc, M. (2014). The Matthew effect in empirical data. *Journal of the Royal Society, Interface*, 11(98), 20140378. <http://doi.org/10.1098/rsif.2014.0378>
- Phillips, A. W., Friedman, B. T., & Durning, S. J. (2017). How to calculate a survey response rate: Best practices. *Academic Medicine*, 92(2), 269–269. <http://doi.org/doi:10.1097/ACM.0000000000001410>
- Piwowar, H. (2013). Altmetrics: Value all research products. *Nature*, 493(7431), 159. <http://doi.org/10.1038/493159a>
- Plum Analytics. (2017a). Coverage - Plum Analytics. Retrieved June 7, 2017, from <http://plumanalytics.com/learn/about-metrics/coverage/>
- Plum Analytics. (2017b). PlumX Metrics. Retrieved June 12, 2017, from <http://plumanalytics.com/learn/about-metrics/>
- Popp Berman, E., & Paradeise, C. (Eds.). (2016). *The University Under Pressure* (Vol. 46). Emerald Group Publishing Limited. <http://doi.org/10.1108/S0733-558X201646>
- Priem, J., Taraborelli, D., Groth, P., & Neylon, C. (2010). altmetrics: a manifesto. Retrieved from <http://www.altmetrics.org/manifesto>
- Ranking Web of Universities. (2017). Ranking Web of Universities. Retrieved June 5, 2017, from <http://www.webometrics.info/en>
- REF (Research Excellence Framework). (n.d.). REF 2014. Retrieved June 5, 2017, from <http://www.ref.ac.uk/>
- REF (Research Excellence Framework). (2014). Research Excellence Framework Impact Case Studies: Database. Retrieved from http://impact.ref.ac.uk/CaseStudies/Results.aspx?val=altmetric*#
- Research Research Limited. (2016). “TripAdvisor” for Framework projects mooted. Retrieved June 5, 2017, from <http://www.researchresearch.com/news/article/?articleId=1359298>
- Researchfish Ltd. (2017). Researchfish: Research Impact Assessment Platform. Retrieved June 12, 2017, from <https://www.researchfish.net/>
- Retraction Watch. (n.d.). Retraction Watch - Tracking retractions as a window into the scientific process at Retraction Watch. Retrieved April 27, 2016, from <http://retractionwatch.com/>
- Retraction Watch. (2017). Help us: Here’s some of what we’re working on. Retrieved June 11, 2017, from <http://retractionwatch.com/help-us-heres-some-of-what-were-working-on/>
- Robinson-García, N., Torres-Salinas, D., Zahedi, Z., & Costas, R. (2014). New data, new possibilities: exploring the insides of Altmetric.com. *El Profesional de La Informacion*, 23(4), 359–366. <http://doi.org/10.3145/epi.2014.jul.03>
- Robinson-García, N., van Leeuwen, T. N., & Ràfols, I. (2017). *Using Altmetrics for Contextualised Mapping of Societal Impact: From Hits to Networks*. Retrieved from

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2932944

- Saarnivaara, V.-P. (2015). *RIO Country Report 2014: Finland*. Retrieved from <https://rio.jrc.ec.europa.eu/en/file/8043/download?token=lly-9rwT>
- Saris, W. E., & Gallhofer, I. N. (Eds.). (2014). *Design, Evaluation, and Analysis of Questionnaires for Survey Research*. Hoboken, NJ: John Wiley & Sons. <http://doi.org/10.1002/9781118634646>
- Sarli, C. C., Dubinsky, E. K., & Holmes, K. L. (2010). Beyond citation analysis: a model for assessment of research impact. *Journal of the Medical Library Association : JMLA*, 98(1), 17–23. <http://doi.org/10.3163/1536-5050.98.1.008>
- Schildt, S. (2017). President of Estonia highlighted industry collaboration. Retrieved June 5, 2017, from <http://www.tut.fi/interface/articles/2017/1/president-of-estonia-highlighted-industry-collaboration>
- Science Foundation Ireland - SFI. (2016). SFI - Small Advanced Economies Gather in Dublin to Discuss Research Impact and Metrics. Retrieved from <http://www.sfi.ie/news-resources/press-releases/small-advanced-economies-gather-in-dublin-to-discuss-research-impact-and-metric.html>
- Small Advanced Economies Initiative. (2016). Small Advanced Economies Initiative. Retrieved from <http://www.smalladvancedeconomies.org/>
- Spano, D., Archuby, G., Carrizo, V. I., García, D. a., Babini, D., Packer, A. L., ... Higa, S. (2014). *Open access indicators and scholarly communications in Latin America*. Retrieved from <http://biblioteca.clacso.edu.ar/clacso/se/20140917054406/OpenAccess.pdf>
- Spinak, E. (n.d.). What can alternative metrics – or altmetrics – offer us? | SciELO in Perspective. Retrieved March 3, 2016, from <http://blog.scielo.org/en/2014/08/07/what-can-alternative-metrics-or-altmetrics-offer-us/>
- Sprenger, T. O., Tumasjan, A., Sandner, P. G., & Welpe, I. M. (2014). Tweets and Trades: the Information Content of Stock Microblogs. *European Financial Management*, 20(5), 926–957. <http://doi.org/10.1111/j.1468-036X.2013.12007.x>
- Stančiauskas, V., & Banelytė, V. (2017). OpenUP survey on researchers' current perceptions and practices in peer review, impact measurement and dissemination of research results [Data set]. Zenodo. <http://doi.org/http://doi.org/10.5281/zenodo.556157>
- STAR METRICS. (2017). STAR METRICS. Retrieved June 5, 2017, from <https://www.starmetrics.nih.gov/Star/About>
- Statistical Cybermetrics Research Group. (2017). About the Statistical Cybermetrics Research Group. Retrieved June 5, 2017, from <http://cybermetrics.wlv.ac.uk/about.html>
- Sugimoto, C. R. (2015). The failure of altmetrics and what information scientists and librarians can do about it. Retrieved from <https://scholarworks.iu.edu/dspace/bitstream/handle/2022/19208/dlbb-sugimoto.pdf?sequence=1>
- Sugimoto, C. R., Work, S., Larivière, V., & Haustein, S. (2016). Scholarly use of social media and altmetrics: a review of the literature. *JASIST*, (August). Retrieved from <https://www.researchgate.net/publication/307303664>

- Tennant, J. P., Waldner, F., Jacques, D. C., Masuzzo, P., Collister, L. B., & Hartgerink, C. H. J. (2016). The academic, economic and societal impacts of Open Access: an evidence-based review. *F1000Research*, 5, 632. <http://doi.org/10.12688/f1000research.8460.1>
- Thelwall, M., Haustein, S., Larivière, V., Sugimoto, C. R., & Bornmann, L. (2013). Do Altmetrics Work? Twitter and Ten Other Social Web Services. *PLoS ONE*, 8(5), e64841. <http://doi.org/10.1371/journal.pone.0064841>
- Thelwall, M., & Kousha, K. (2015). Web indicators for research evaluation. Part 2: Social media metrics. *El Profesional de La Información*, 24(5), 607–620. <http://doi.org/10.3145/epi.2015.sep.09>
- Thelwall, M., Kousha, K., Dinsmore, A., & Dolby, K. (2016). Alternative metric indicators for funding scheme evaluations. *Aslib Journal of Information Management*, 68(1), 2–18. <http://doi.org/10.1108/AJIM-09-2015-0146>
- Tinkler, J. (2008). Maximizing the social , policy and economic impacts of research in the humanities and social sciences, (July). Retrieved from <http://eprints.lse.ac.uk/45345/>
- Tumasjan, A., Sprenger, T., Sandner, P., & Welpe, I. (2010). Predicting elections with Twitter: What 140 characters reveal about political sentiment. *Proceedings of the Fourth International AAAI Conference on Weblogs and Social Media*, 178–185. <http://doi.org/10.1074/jbc.M501708200>
- U-Multirank. (n.d.). U-Multirank. Retrieved June 5, 2017, from www.umultirank.org
- Ulnicane, I. (2016). “Grand Challenges” concept: a return of the “big ideas” in science, technology and innovation policy? *International Journal of Foresight and Innovation Policy*, 11(1/2/3), 5. <http://doi.org/10.1504/IJFIP.2016.078378>
- UNAM. (2017). UNAM en Línea. Retrieved June 5, 2017, from <http://www.unamenlinea.unam.mx/acerca>
- UNESCO. (n.d.). Open access to scientific information | United Nations Educational, Scientific and Cultural Organization. Retrieved January 24, 2016, from <http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-access-to-scientific-information/>
- University of California Berkeley. (2015). Berkeley Research Impact Initiative (BRII): Program Description. Retrieved from <http://guides.lib.berkeley.edu/brii>
- University of Cambridge. (2016). Cambridge tops the UK league in on-line impact. Retrieved from <http://www.psychometrics.cam.ac.uk/news/our-boys-and-cambridge-top-the-uk-metric-in-on-line-impact>
- University of Chicago. (2015). The University of Chicago Campaign Inquiry & Impact. Retrieved from <http://campaign.uchicago.edu/about/>
- van Noorden, R. (2014). Online collaboration: Scientists and the social network. *Nature*, 512(7513), 126–129. Retrieved from <http://www.nature.com/news/online-collaboration-scientists-and-the-social-network-1.15711>
- van Noorden, R. (2015). Impact of UK research revealed in 7,000 case studies. *Nature*, 518(7538), 150–151. <http://doi.org/10.1038/518150a>
- Wallace, M. L., & Ràfols, I. (2015). Research Portfolio Analysis in Science Policy: Moving

- from Financial Returns to Societal Benefits. *Minerva*, 53(2), 89–115. <http://doi.org/10.1007/s11024-015-9271-8>
- WCRI. (2017). 5th World Conference on Research Integrity. Retrieved June 11, 2017, from <http://www.wcri2017.org/>
- Weick, K. E. (1976). Educational Organizations as Loosely Coupled Systems. *Administrative Science Quarterly*, 21(1), 1. <http://doi.org/10.2307/2391875>
- Wellcome Trust. (2014). Alternative impact: Can we track the impact of research outside of academia? Retrieved from <http://blog.wellcome.ac.uk/2014/11/25/alternative-impact-can-we-track-the-impact-of-research-outside-of-academia/>
- Williams, M. L., Burnap, P., & Sloan, L. (2017). Towards an Ethical Framework for Publishing Twitter Data in Social Research : Taking into Account Users ' Views , Online Context and Algorithmic Estimation. *Sociology*, 1–20. <http://doi.org/10.1177/0038038517708140>
- Wilsdon, J., Allen, L., Belfiore, E., Campbell, P., Curry, S., Hill, S., ... Johnson, B. (2015). *The metric tide: report of the Independent Review of the Role of Metrics in Research Assessment and Management*. <http://doi.org/10.13140/RG.2.1.4929.1363>
- Wilsdon, J. et al. (2016). *Next-generation altmetrics: responsible metrics and evaluation for open science*. Retrieved from https://ec.europa.eu/research/openscience/pdf/call_for_evidence_next_generation_altmetrics.pdf#view=fit&pagemode=none
- WMA (The World Medical Association). (1964). WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects –. Retrieved June 10, 2017, from <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>
- Ylijoki, O.-H. (2012). The role of basic research at the entrepreneurial university: Back to basics? In S. Ahola & D. M. Hoffman (Eds.), *Higher education research in Finland. Emerging structures and contemporary issues*. Jyväskylä University Press. Retrieved from <https://ktl.jyu.fi/julkaisut/julkaisuluettelo/julkaisut/2012/d103>
- Zahedi, Z., Costas, R., & Wouters, P. (2014). How well developed are altmetrics? A cross-disciplinary analysis of the presence of “alternative metrics” in scientific publications. *Scientometrics*, 101(2), 1491–1513. <http://doi.org/10.1007/s11192-014-1264-0>
- Zahedi, Z., Fenner, M., & Costas, R. (2014). How consistent are altmetrics providers? Study of 1000 PLOS ONE publications using the PLOS ALM, Mendeley and Altmetric.com APIS. *Altmetrics14: Expanding Impacts and Metrics*, 5–6. <http://doi.org/10.6084/m9.figshare.1041821>
- ZBW. (n.d.). Usage of Social Media Services in Science. Retrieved June 8, 2017, from <http://tigereye.informatik.uni-kiel.de/limesurvey/index.php/847788?lang=en>
- ZBW. (2017). Web Science. Retrieved June 5, 2017, from <http://www.zbw.eu/en/research/web-science/>

10 Appendices

10.1 Acronyms

AOIR: Association of Internet Researchers

CSV: Character-separated value

CWTS: Centre for Science and Technology Studies

ERC: European Research Council

FP7: the European Commission's Seventh Framework Programme

FWO: Research Foundation Flanders (*Fonds Wetenschappelijk Onderzoek*) [Belgium]

GCRF: Global Challenges Research Fund [UK]

HE: higher education

HEFCE: Higher Education Funding Council for England

HEI: higher education institution

HUT: Helsinki University of Technology

IRB: Institutional Review Board

KPIs: Key Performance Indicators

FNR: Luxembourg National Research Fund (*Fonds National de la Recherche*)

MLE: Mutual Learning Exercise

NCCP: National Coordinating Centre for Public Engagement [Australia]

NGOs: non-governmental organisations

NISO: National Information Standards Organization [USA]

OA: open access

OECD: Organisation for Economic Co-operation and Development

OSN: online social network

OSR: open science and research

NRPs: National Research Programmes [Switzerland]

PHP: Hypertext Preprocessor

RAND: Research and Development Cooperation

RCR: responsible conduct of research and procedures

RECSM: Research and Expertise Centre for Survey Methodology

REF: Research Excellence Framework

RFO: Research funding organisation

RIO: Research and Innovation Observatory [European Commission]

RIO: Research Outcomes and Ideas [journal]

STEM: Science, Technology, Engineering and Mathematics

SRC: Strategic Research Council

STI: Science, Technology and Innovation

SBO: Strategic Basic Research projects [Flanders, Belgium]

SURe: Working Group Society Using Research

TENK: Finnish Advisory Board on Research Integrity

UK: United Kingdom

UN: United Nations

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNIFI: Universities Finland

URL: Uniform Resource Locator

USA: United States of America

10.2 Introduction to the questionnaires



UNIVERSITY
OF TAMPERE

Introduction Helsinki

Survey on Altmetrics for Researchers at the University of Helsinki

The following survey is about altmetrics (alternative metrics for research impact), and PlumX altmetrics dashboards. You were selected as a respondent of this survey, because you are listed publicly on the PlumX altmetrics dashboard as researcher of the University of Helsinki. The aim of the survey is to find out from these researchers, how they use altmetrics, and how they perceive them.

The findings of the survey will be used anonymously in the master's thesis of the author, Grischa Fraumann. The thesis will be published in 2017 in the open institutional repository of the University of Tampere (TamPub), and potential further publications. The author studies in the Master's Programme in Research and Innovation in Higher Education.

There are no perceived benefits, or anticipated risks for participating in this study as your identity and responses will be anonymous. Your participation, though encouraged, is voluntary and you may decline to participate at any time. Also, you do not have to answer any questions that you do not wish to. Data and results will be analyzed and reported in aggregate form but not by individual responses.

Please kindly fill out the survey, which will take about 5-10 minutes to complete. Please kindly complete the survey latest on Friday, 26 May 2017. Thank you in advance.

If you have questions about this study, please contact Grischa Fraumann:

Fraumann.Grischa.Julius.R@student.uta.fi

By starting the survey, you do give informed consent to participate in this research. Please click "next" to start the survey.



UNIVERSITY
OF TAMPERE

Survey on Altmetrics for Reviewers at the Academy of Finland's Strategic Research Council

The following survey is about altmetrics (alternative metrics for research impact) in strategic research funding. You were selected as a respondent of this survey because you are listed publicly as a reviewer of the Strategic Research Council (SRC) at the Academy of Finland. The aim of the survey is to find out from these reviewers, what role altmetrics play in strategic research funding, and if they are used to demonstrate societal relevance and impact.

The findings of the survey will be used anonymously in the master's thesis of the author, Grisca Fraumann. The thesis will be published in 2017 in the open institutional repository of the University of Tampere/Finland, and potential further publications. The author studies in the Master's Programme in Research and Innovation in Higher Education.

There are no perceived benefits, or anticipated risks for participating in this study as your identity and responses will be anonymous. Your participation, though encouraged, is voluntary and you may decline to participate at any time. Also, you do not have to answer any questions that you do not wish to. Data and results will be analyzed and reported in aggregate form, and not by individual responses.

Please kindly fill out the survey, which will take about 5-10 minutes to complete. Please kindly complete the survey latest on Friday, 26 May 2017. Thank you in advance.

If you have questions about this study, please contact Grisca Fraumann:

Fraumann.Grischa.Julius.R@student.uta.fi

By starting the survey, you do give informed consent to participate in this research. Please click "next" to start the survey.

10.3 Example of a PHP code for filter questions within the questionnaires

PHP code

```
if (value('AD03') == 1) {  
    setNextPage('DQ Age');  
} else {  
    setNextPage('Usage home');  
}
```

10.4 Questionnaires of all 4 surveys

Section AD: Altmetrics Dashboards

[AD01] Horizontal Selection

Awareness of altmetrics dashboards

"Are you aware of the PlumX altmetrics dashboards that some universities use?"

AD01 Awareness of altmetrics dashboards

- 1 = Do not know / cannot answer
- 2 = Not at all aware
- 3 = Slightly aware
- 4 = Somewhat aware
- 5 = Moderately aware
- 6 = Extremely aware
- 9 = Not answered

[AD03] Horizontal Selection

Awareness of altmetrics

"Are you aware of the term 'altmetrics'?"

AD03 Awareness of altmetrics

- 1 = Not at all aware
- 2 = Slightly aware
- 3 = Somewhat aware
- 4 = Moderately aware
- 5 = Extremely aware
- 9 = Not answered

[AD02] Horizontal Selection

Frequency of altmetrics dashboards' usage

"How often do you visit the PlumX dashboards?"

AD02 Frequency of altmetrics dashboards' usage

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time) Rarely (11-39% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

[AD04] Selection

Difference of altmetrics sources

"Would you distinguish between different altmetrics sources to demonstrate research impact?"

AD04 Difference of altmetrics sources

- 1 = Yes
- 2 = No

- 3 = Do not know / cannot answer
- 9 = Not answered

Section AI: Altmetrics and Demonstration of Impact

[AI01] Horizontal Selection

Probability of altmetrics in funding applications

"How important is the use of altmetrics sources for demonstrating societal impact in research funding applications?"

AI01 Probability of altmetrics in funding applications

- 1 = Do not know / cannot answer
- 2 = Not important at all
- 3 = Somewhat unimportant
- 4 = Neither important nor unimportant
- 5 = Somewhat important
- 6 = Very important
- 9 = Not answered

Section U0: Usage of altmetrics

[U001] Horizontal Selection

Usage of PlumX altmetrics dashboard

"How often do you use PlumX dashboards?"

U001 Usage of PlumX altmetrics dashboard

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

[U002] Multiple Choice

Type of usage of PlumX altmetrics dashboard

"Please describe how you use the PlumX altmetrics dashboard."

U002 Type of usage of PlumX altmetrics dashboard: Residual option (negative) or number of selected options

Integer

U002_01 Checking your own altmetrics counts

U002_02 Comparing your own altmetrics counts with other researchers' altmetrics counts

U002_03 Comparing your own altmetrics counts with other research units' altmetrics counts

U002_04 Checking of altmetrics ranking results

U002_05 Identifying of users of your research (e.g. readers of your publications)

U002_06 Trying to improve your own altmetrics counts

U002_08 Other (please type in the usage in this text box)

U002_09 Do not know / cannot answer

- 1 = Not checked
- 2 = Checked

U002_08a Other (please type in the usage in this text box) (free text)

Free text

[U004] Selection

Usage of other altmetrics data providers

"Do you use tools by other altmetrics data providers apart from PlumX?"

U004 Usage of other altmetrics data providers

- 1 = Yes
- 2 = No
- 3 = Do not know / cannot answer
- 9 = Not answered

[U006] Horizontal Selection

Frequency of usage

"How often do you visit PlumX dashboards?"

U006 Frequency of usage

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time) Rarely (11-39% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

[U007] Horizontal Selection

Discussion of altmetrics counts

"How often do you discuss altmetrics counts with your colleagues?"

U007 Discussion of altmetrics counts

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

[U008] Horizontal Selection

Altmetrics results in funding applications

"Do you include your altmetrics counts in your research funding applications?"

U008 Altmetrics results in funding applications

- 1 = Yes
- 6 = No
- 7 = Do not know / cannot answer
- 9 = Not answered

[U010] Horizontal Selection

Frequency of checking researchers' rankings

"Do you check the rankings of researchers on the PlumX altmetrics dashboards?"

U010 Frequency of checking researchers' rankings

- 6 = Yes
- 11 = No
- 12 = Do not know / cannot answer
- 9 = Not answered

[U009] Horizontal Selection

Value of altmetrics data in research funding applications

"How important is your altmetrics data from PlumX dashboards for your research funding applications?"

U009 Value of altmetrics data in research funding applications

- 7 = Do not know / cannot answer
- 8 = Not important at all
- 9 = Somewhat unimportant
- 10 = Neither important nor unimportant
- 11 = Somewhat important
- 12 = Very important
- 9 = Not answered

[U016] Horizontal Selection

Value of altmetrics data in research funding applications

"How important is your altmetrics data from PlumX dashboards for reporting on your funded research?"

U016 Value of altmetrics data in research funding applications

- 7 = Do not know / cannot answer
- 8 = Not important at all
- 9 = Somewhat unimportant
- 10 = Neither important nor unimportant
- 11 = Somewhat important
- 12 = Very important
- 9 = Not answered

[U012] Selection

Usage of other altmetrics data providers

"What "other" altmetrics data providers do you use?"

U012 Usage of other altmetrics data providers

- 1 = Altmetric.com
- 2 = Impactstory

- 3 = PLOS ONE Article-Level Metrics (ALMs)
- 4 = Other (please type in the altmetrics data provider in this text box)
- 9 = Not answered

U012_04 Other (please type in the altmetrics data provider in this text box)
Free text

[U013] Selection
Frequency of altmetrics in applications
"How often do you include your altmetrics counts in your research funding applications?"

- U013** Frequency of altmetrics in applications
- 1 = Never, or almost never (0-10% of the time)
 - 2 = Rarely (11-39% of the time)
 - 3 = Sometimes (40-59% of the time) Rarely (11-39% of the time)
 - 4 = Most of the time (60-89% of the time)
 - 5 = Always, or almost always (90-100% of the time)
 - 6 = Do not know/cannot answer
 - 9 = Not answered

[U014] Horizontal Selection
Frequency of checking reearchers' rankings II
"How often do you check the rankings of researchers on the PlumX altmetrics dashboards?"

- U014** Frequency of checking reearchers' rankings II
- 1 = Do not know/cannot answer
 - 2 = Never, or almost never (0-10% of the time)
 - 3 = Rarely (11-39% of the time)
 - 4 = Sometimes (40-59% of the time) Rarely (11-39% of the time)
 - 5 = Most of the time (60-89% of the time)
 - 6 = Always, or almost always (90-100% of the time)
 - 9 = Not answered

[U015] Selection
Altmetrics for reporting
"Do you use altmetrics to report on the outcomes of your funded research projects?"

- U015** Altmetrics for reporting
- 1 = Yes
 - 2 = No
 - 3 = Do not know / cannot answer
 - 9 = Not answered

Section CA: Citation Counts and Altmetrics

[CA01] Horizontal Selection
Importance of Citation Counts and Altmetrics
"Compared to citation counts, how important are altmetrics counts to you for research impact?"

CA01 Importance of Citation Counts and Altmetrics

- 1 = Do not know / cannot answer
- 2 = Not important at all
- 3 = Somewhat unimportant
- 4 = Neither important nor unimportant
- 5 = Somewhat important
- 6 = Very important
- 9 = Not answered

[CA02] Horizontal Selection

Altmetrics counts of publications

"Do you consider altmetrics counts when deciding whether to read a particular publication?"

CA02 Altmetrics counts of publications

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

[CA03] Horizontal Selection

Evaluation researchers' publication based on altmetrics

"Do you use altmetrics to evaluate another researcher's publication?"

CA03 Evaluation researchers' publication based on altmetrics

- 1 = Do not know/cannot answer
- 2 = Never, or almost never (0-10% of the time)
- 3 = Rarely (11-39% of the time)
- 4 = Sometimes (40-59% of the time)
- 5 = Most of the time (60-89% of the time)
- 6 = Always, or almost always (90-100% of the time)
- 9 = Not answered

Section DQ: Demographic questions

[DQ01] Selection

Age

"Please select the range of years that best describes your age."

DQ01 Age

- 1 = 30 or under
- 2 = 31-40
- 3 = 41-50
- 4 = 51 or over
- 5 = Prefer not to say
- 9 = Not answered

[DQ02] Horizontal Selection

Gender

"What is your gender?"

DQ02 Gender

- 1 = Male
- 2 = Female
- 3 = Prefer not to say
- 9 = Not answered

[DQ03] Selection

Main research field

"Please select your main research field."

DQ03 Main research field

- 32 = Agricultural sciences
- 1 = Architecture
- 63 = Art research
- 20 = Astronomy
- 22 = Biochemistry, biophysics
- 34 = Biomedicine
- 49 = Business administration
- 28 = Cellular and molecular biology
- 6 = Chemistry
- 40 = Clinical medicine
- 56 = Communication
- 8 = Computational science
- 17 = Computer science
- 14 = Construction and municipal engineering
- 37 = Dental science
- 62 = Design research
- 48 = Development research
- 25 = Developmental biology and physiology
- 23 = Ecology, evolutionary biology and ecophysiology
- 46 = Economics
- 47 = Education
- 15 = Electrical engineering and electronics
- 3 = Energy engineering
- 21 = Environmental engineering
- 43 = Environmental health research
- 30 = Environmental science
- 57 = Environmental social science research
- 2 = Food engineering
- 31 = Food sciences
- 33 = Forest sciences
- 27 = Genetics
- 5 = Geosciences
- 59 = History and archaeology
- 45 = Human geography
- 16 = Industrial biotechnology
- 19 = Industrial management

- 51 = Law
- 60 = Linguistics
- 61 = Literature research
- 11 = Materials science and technology
- 10 = Mathematics
- 7 = Mechanical engineering and manufacturing technology
- 9 = Medical engineering
- 26 = Microbiology
- 12 = Nanoscience and nanotechnology
- 44 = Neuroscience
- 38 = Nursing science
- 42 = Nutrition
- 36 = Pharmacy
- 58 = Philosophy
- 4 = Physics
- 24 = Plant biology
- 55 = Political science
- 13 = Process technology
- 52 = Psychology
- 39 = Public health research
- 54 = Science studies
- 53 = Social sciences
- 41 = Sport sciences
- 18 = Statistics
- 29 = Systems biology, bioinformatics
- 64 = Theology
- 35 = Veterinary medicine
- 50 = Women and gender studies
- 66 = Prefer not to say
- 9 = Not answered

[DQ04] Selection

Career stage

"Please indicate your career stage."

DQ04 Career stage

- 1 = Junior Researcher (PhD)
- 2 = Post-doctoral Researcher
- 3 = Senior Researcher
- 4 = Professor
- 5 = Prefer not to say / none of the above
- 9 = Not answered

[DQ05] Multiple Choice

Use of social media platforms

"Please select the social media platforms that you contribute to regularly."

DQ05 Use of social media platforms: Residual option (negative) or number of selected options

Integer

DQ05_01 Blogs

DQ05_02 Twitter

DQ05_03 Facebook

DQ05_04 LinkedIn

DQ05_05 ResearchGate

DQ05_06 Academia.edu

DQ05_07 Mendeley

DQ05_08 Wikipedia

DQ05_09 Other (please type in the social media platform in this text box)

DQ05_10 Prefer not to say

1 = Not checked

2 = Checked

DQ05_09a Other (please type in the social media platform in this text box) (free text)

Free text

[DQ07] Selection

Employer

"What type of organisation do you currently work for?"

DQ07 Employer

1 = University

2 = Research centre/institute

3 = Company

4 = Other (please name the type of organisation in this text box)

5 = Do not know/cannot answer

-9 = Not answered

DQ07_04 Other (please name the type of organisation in this text box)

Free text

Section FC: Final Comment

[FC01] Text Input

Final comment

"If there is anything else you would like to comment on altmetrics and/or this survey, please elaborate here."

FC01_01 [01]

Free text

Section UA: Usage of Altmetrics for reviewers

[UA01] Horizontal Selection

Usage of Altmetrics at home institution

"Do you use an altmetrics dashboard at your organisation?"

UA01 Usage of Altmetrics at home institution

1 = Yes

2 = No

6 = Do not know / cannot answer
-9 = Not answered

[UA02] Selection

Usage of Altmetrics in other countries

"Do you know if some research funding organisations and governments use altmetrics as an indicator?"

UA02 Usage of Altmetrics in other countries

1 = Yes
2 = No
-9 = Not answered

[UA03] Text Input

Knowledge about usage in other countries

"Please describe in a few words the examples on the usage of altmetrics by research funding organisations and..."

UA03_01 [01]

Free text

10.5 Topic guide for interviews

1. What do you think about the usage of citation counts in research assessments?

2. Are you aware of the altmetrics online dashboards that some universities use?
3. If so, please name an example of an altmetrics online dashboard.
4. How would you rate the altmetrics ranking results, that are displayed, for example on PlumX dashboards?
5. What do you think of this form of assessment by using altmetrics?
6. How would you rate the potential of altmetrics in research assessments?
7. How do you discuss results of research assessments with your colleagues, or with other (foreign) stakeholders?
8. How could altmetrics counts by researchers be a source for demonstrating research impact?
9. How could altmetrics counts by researchers be a source in funding applications in Strategic Research funding? That is, research funding that tackles societal (grand) challenges.
10. How could altmetrics counts by researchers be a source to steer research activities at higher education institutions?
11. What do you think about citation counts in research assessments?
12. Compared to citation counts, how important are altmetrics counts to you?
13. Would you distinguish between different altmetrics sources, such as Wikipedia citations, tweets, mentions on news sites and blogs?
14. Do you know about a particular usage of altmetrics by funding agencies and governments abroad, in particular in other EU Member States?

10.6 Extended description of PlumX Metrics

Table 16. *PlumX Usage Metrics*

Metric	Source(s)	Description
--------	-----------	-------------

Abstract Views	Airiti Library, bepress, CABI, DSpace, EBSCO, ePrints, PLOS, RePEc, SSRN	The number of times the abstract of an article has been viewed
Clicks	bit.ly	The number of clicks of a URL
Collaborators	GitHub	The number of collaborators of an artifact
Downloads	Airiti Library, bepress, Dryad, DSpace, ePrints, Figshare, Github, Institutional Repositories, Pure, RePEc, Slideshare, SSRN	The number of times an artifact has been downloaded
Full Text Views	CABI, EBSCO, OJS Journals, PLOS	The number of times the full text of an article has been viewed
Holdings	WorldCat	The number of libraries that hold the book artifact
HTML Views	EBSCO, Forbes, PLOS, PubMedCentral	The number of times the HTML of an article has been viewed
Link Outs	EBSCO	The number of times an outbound link has been clicked to a library catalog or link resolver
Plays	Vimeo, YouTube	The number of times a video has been played.
PDF Views	EBSCO, PLOS, PubMedCentral	The number of times the PDF of an artifact has been viewed

Sample Downloads	EBSCO	The number of times an artifact's content has been sampled (e.g. pages, MP3)
Supporting Data Views	EBSCO, PLOS	The number of times the supporting data of an artifact has been viewed
Views	Dryad, EBSCO, figshare, Slideshare	The number of times the artifact has been viewed.

Note. As of 1 August 2016 (adapted from Plum Analytics, 2017b)

Table 17. *PlumX Capture Metrics*

Metric	Source(s)	Description
Bookmarks	Delicious	Number of times an artifact has been bookmarked
Favourites	Slideshare, YouTube	The number of times the artifact has been marked as a favourite
Followers	GitHub	The number of times a person or artifact has been followed
Forks	Github	The number of times a repository has been forked
Readers	Goodreads, Mendeley	The number of people who have added the artifact to their library
Exports/Saves	EBSCO	This includes the number of times an artifact's citation has been exported direct to bibliographic management tools or as file downloads,

		and the number of times an artifact's citation/abstract and HTML full text (if available) have been saved, emailed or printed.
Subscribers	Vimeo, YouTube	The number of people who have subscribed for an update
Watchers	Github	The number of people watching the artifact for updates

Note. As of 28 April 2016 (adapted from Plum Analytics, 2017b)

Table 18. *PlumX Mention metrics*

Metric	Source(s)	Description
Blog Mentions	Blog lists curated by PlumX	The number of blog posts written about the artifact
Comments	Reddit, Slideshare, Vimeo, YouTube	The number of comments made about an artifact
Economic Blog Mentions	Blog lists curated by PlumX	The number of blog posts written about the artifact within the economics discipline
Forum Topic Count	Vimeo	The number of topics in a forum discussing the artifact
Gist Count	GitHub	The number of gists in the source code repository
News Mentions	News source lists curated by PlumX	The number of news articles written about the artifact

Links	StackExchange, Wikipedia	The number of links to the artifact
Reviews	Amazon, Goodreads, SourceForge	The number of reviews written about the artifact

Note. As of 28 April 2016 (adapted from Plum Analytics, 2017b)

Table 19. *PlumX Social Media Metrics*

Metric	Source(s)	Description
Likes	Vimeo, YouTube	The number of times an artifact has been liked
+1	Google Plus	The number of times an artifact has gotten a +1
Shares, Likes & Comments	Facebook	The number of times a link was shared, liked or commented on
Ratings	Amazon, Goodreads, SourceForge	The average user rating of the artifact.
Recommendations	Figshare, SourceForge	The number of recommendations an artifact has received
Scores	Reddit	The number of upvotes minus downvotes on Reddit
Tweets	Twitter via Gnip	The number of tweets and retweets that mention the artifact

Note. As of 3 August 2016 (adapted from Plum Analytics, 2017b)

Table 20. *PlumX Citation Metrics*

Metric	Source(s)	Description
---------------	------------------	--------------------

Citation Indexes	CrossRef	The number of articles that cite the artifact according to CrossRef
Citation Indexes	PubMed Central	The number of PubMed Central articles that cite the artifact
Citation Indexes	PubMed Central Europe	The number of PubMed Central Europe articles that cite the artifact
Citation Indexes	RePEc	The number of RePEc works that cite the artifact as computed by CiTEc
Citation Indexes	SciELO	The number of SciELO articles that cite the artifact
Citation Indexes	Scopus	The number of articles that cite the artifact according to Scopus
Citation Indexes	SSRN	The number of SSRN works that cite the artifact
Patent Citations	USPTO	The number of patents that reference the artifact according to the United States Patent and Trademark Office
Clinical Citations	Dynamed Plus Topics	The number of Dynamed Plus Topics that reference the artifact
Clinical Citations	PubMed Clinical Guidelines	The number of Clinical Guidelines from PubMed that reference the artifact

Clinical Citations	National Institute for Health and Care Excellence (NICE) – UK	The number of Clinical Guidelines from NICE that reference the artifact
Policy Citations	Policy document source lists curated by PlumX	The number of policy documents that reference an artifact

Note. As of 4 January 2017 (adapted from Plum Analytics, 2017b)