OPEN SCIENCE:
HOW LIBRARIES CAN SUPPORT INCLUSIVE AND INNOVATIVE RESEARCH COMMUNITY

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INTRODUCTION

- Open science practices are breaking barriers that prevent the free flow of knowledge produced by researchers

- Countries worldwide have established the open science agenda and initiative to promote availability of open research information and open publication procedures.

- Academic libraries advocates openness in science and research, believing that open science will deliver increased transparency, better quality research, and faster scientific discovery; thus enabling the more effective utilization of research data and results for the greater benefit of society.
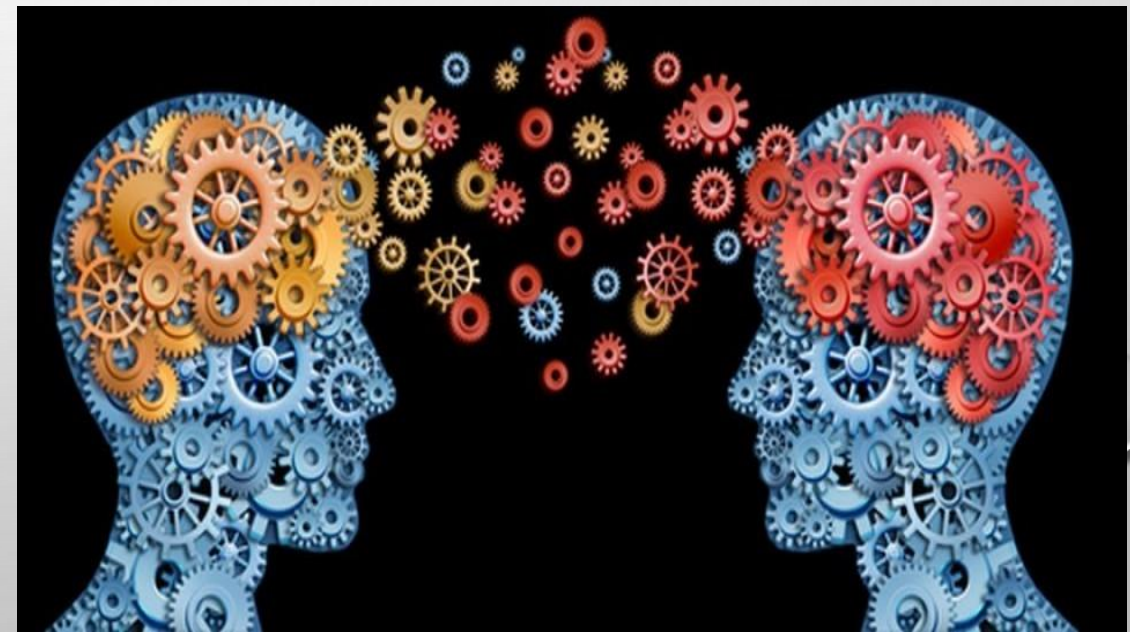
LIBRARIES AND OPEN SCIENCE

- The OECD (2015) explicitly includes libraries, repositories and data centres as key actors on open science.

- The role of libraries on open science has been recognised. and discussed at multiple platforms, and endorsed publicly by international organisations and stakeholders.

- Libraries have adapted their role and are now active in the preservation, curation, publication and dissemination of digital scientific materials, in the form of publications, data and other research-related content.

- Libraries and repositories constitute the physical infrastructure that allows scientists to share use and reuse the outcome of their work, and they have been essential in the creation of the open science movement

- Academic libraries in Malaysia are already supporting a good part of what constitutes open science as open access to publications and more recently, open data.

OPEN SCIENCE

"TO MAKE THE PRIMARY OUTPUTS OF PUBLICLY FUNDED RESEARCH RESULTS – PUBLICATIONS AND THE RESEARCH DATA – PUBLICLY ACCESSIBLE IN DIGITAL FORMAT WITH NO OR MINIMAL RESTRICTION"

(OECD, 2015, P.7).

OPEN SCIENCE – INCLUSIVE AND INNOVATIVE RESEARCH SOCIETY

A SOCIETY THAT LEAVES NO RESEARCHERS AND THE STAKEHOLDERS BEHIND

A SOCIETY THAT CREATE A FERTILE GROUND FOR INNOVATION AND THE DEVELOPMENT OF NEW TECHNOLOGIES AND NEW ECONOMIC MODELS IN RESEARCH

OBJECTIVES

- To conceptualize open science and explore the effect of open science to the research community and general society;

- To provide evidence to support the idea that academic librarians play an important role as enablers of open science; and

- To describe researchers' general understanding about open science and the perceived roles of the academic library.

METHOD

- This paper identifies, analyses and synthesize the available relevant and important professional and scientific literature to address the research objectives.

- It also uses findings from Abrizah (2016; 2017) on Malaysian early career researchers' (ECRs) understanding of open science to provide evidence to support the idea that university librarians play an important role in this technological innovation undertaken by their organisations. The study (the Harbingers, which is a part of a larger international study conducted in seven countries (China, France, Malaysia, Poland, Spain, UK and USA) provided a benchmark of ECR behaviours and attitudes against which future changes in scholarly communication could be measured. The results have been disseminated extensively.
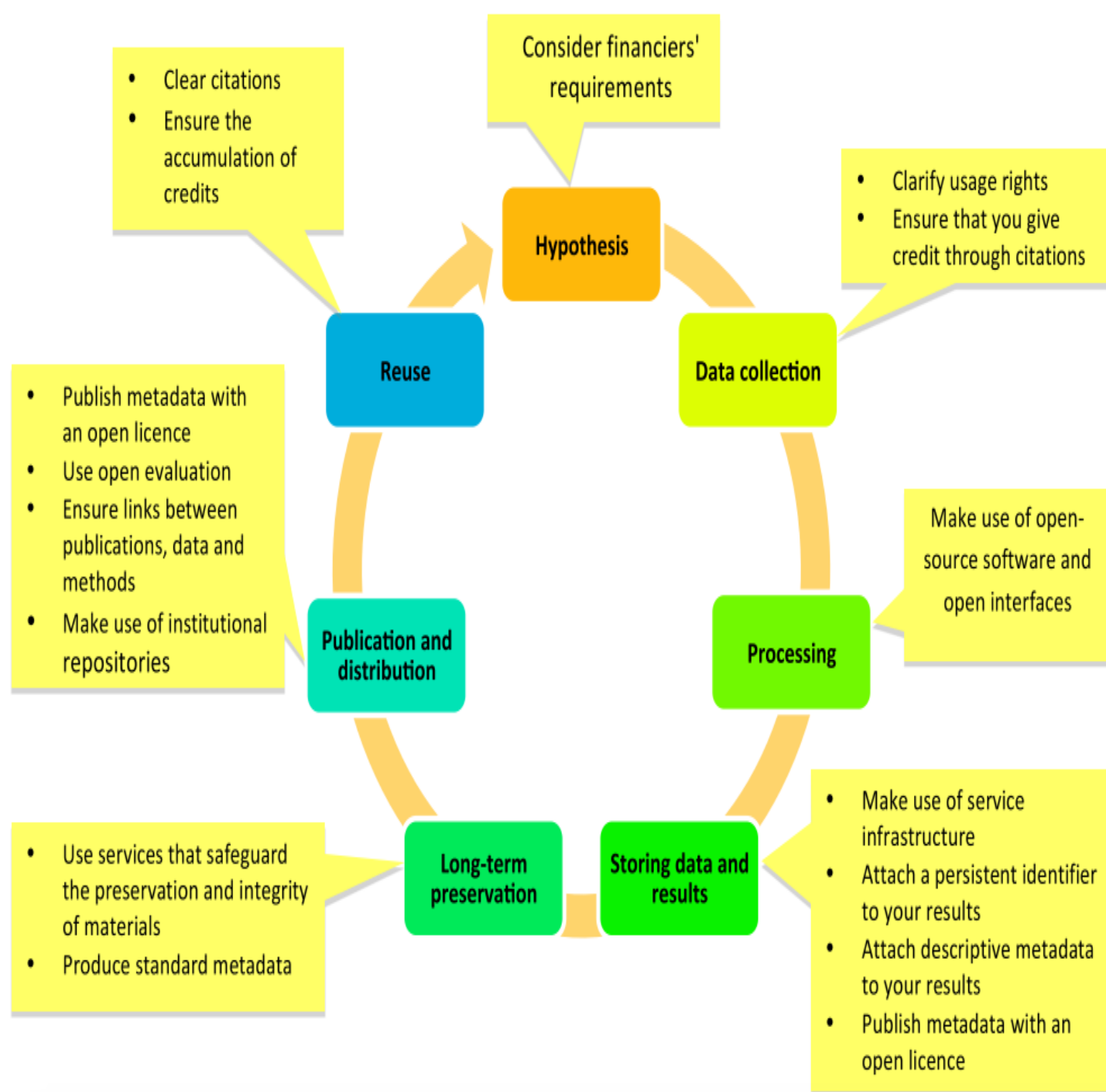
OPEN SCIENCE AS A RESEARCH PROCESS

OPEN SCIENCE IS ABOUT **EXTENDING THE PRINCIPLES OF OPENNESS TO THE WHOLE RESEARCH CYCLE** (OPEN SCIENCE AND RESEARCH INITIATIVE 2014).

ACHIEVING OPEN SCIENCE REQUIRES **EXTENDING THE PRINCIPLES OF OPENNESS TO** AT ALL STAGES OF THE RESEARCH PROCESS

LIBRARIES ARE MAINLY INVOLVED IN LONG TERM PRESERVATION, PUBLICATION & DISTRIBUTION, AND REUSE

OF LATE IN STORAGE OF DATA AND RESEARCH OUTPUT; RELATED TO PUBLIC AVAILABILITY AND REUSABILITY OF SCIENTIFIC DATA.
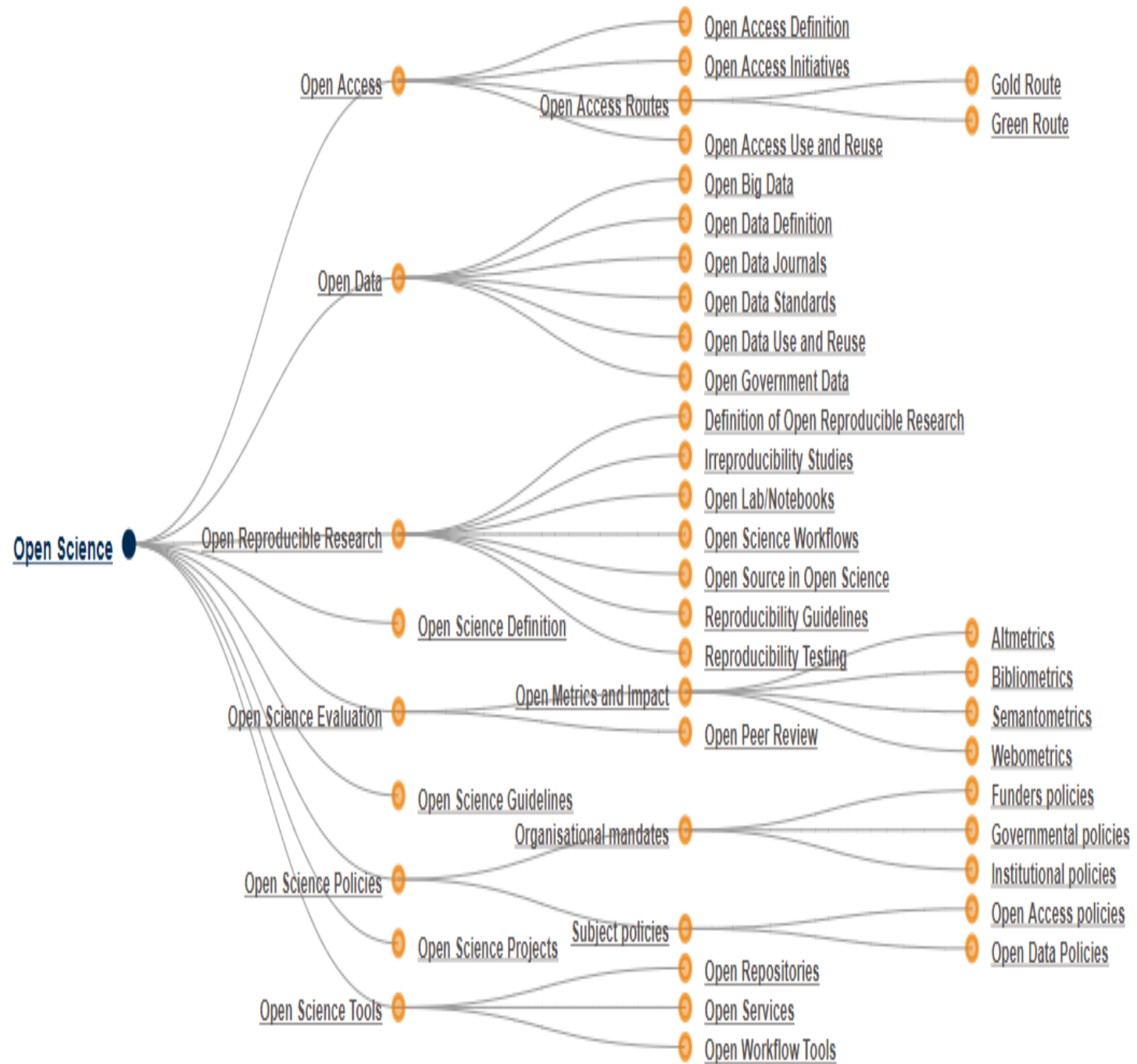
OPEN SCIENCE AS A TAXONOMY

IT IS STILL UNCLEAR TO MANY LIBRARIANS AND REPOSITORY MANAGERS AS WELL AS RESEARCH STAKEHOLDERS ON HOW OPEN SCIENCE CAN BE ACHIEVED.

FOSTER (FACILITATE OPEN SCIENCE TRAINING FOR EUROPEAN RESEARCH) INITIATED AN E-LEARNING PLATFORM TO ADVANCE THE STAKEHOLDERS' KNOWLEDGE ON THE USEFULNESS OF OPEN SCIENCE AND EXPLAIN THE TECHNICALITIES, STRATEGIES AND BEST PRACTICES USING WHICH OPEN SCIENCE CAN BE APPLIED.

THE CREATION OF **A RELATIONSHIP BETWEEN BROAD AND NARROW TERMS** WOULD BE ESSENTIAL TO ACHIEVE THE GOALS FOR THE TAXONOMY CREATION AND **EDUCATE USERS ON OPEN SCIENCE DOMAIN AND THE CONCEPTS AROUND IT.**

OPEN SCIENCE AS A MOVEMENT

MOVEMENTS AIMING TO REMOVE THE BARRIERS FOR SHARING ANY KIND OF OUTPUT, RESOURCES, METHODS OR TOOLS, AT ANY STAGE OF THE RESEARCH PROCESS

CITIZEN SCIENCE WHERE **CITIZENS BECOME NEW PLAYERS OF THE RESEARCH ECOSYSTEM**. THEY WILL SHAPE SCIENCE POLICIES AND CONTRIBUTE TO SCIENTIFIC RESEARCH THROUGH CITIZEN SCIENCE ACTIONS AND BY FUNDING RESEARCHERS.

NEW SERVICES HELP RESEARCHERS COMMUNICATE THEIR RESEARCH TO NON-RESEARCHERS
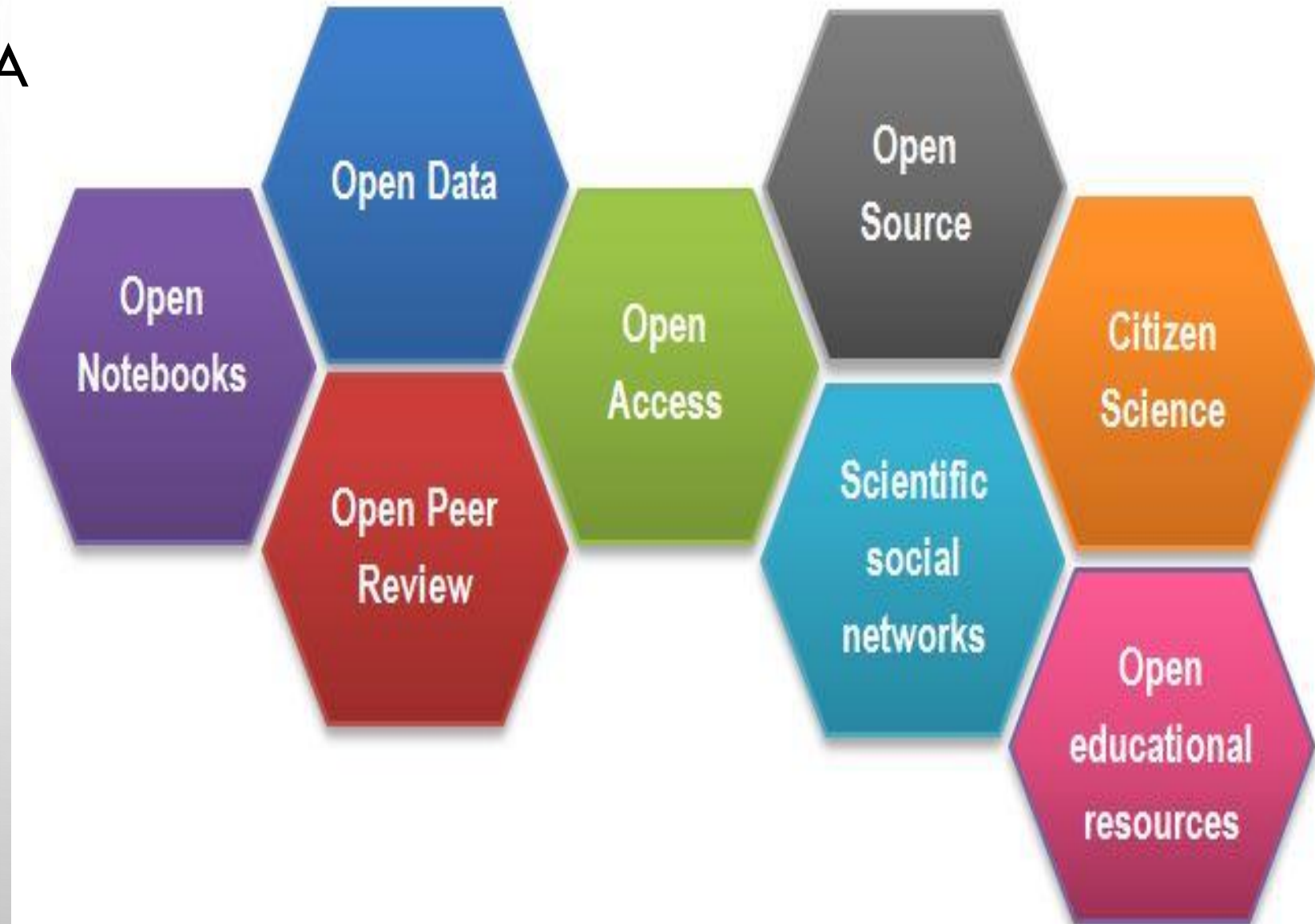
OPEN SCIENCE AS A SCHOOL OF THOUGHT

ENCOMPASSING A MULTITUDE OF ASSUMPTIONS ABOUT **THE FUTURE OF KNOWLEDGE CREATION AND DISSEMINATION.**

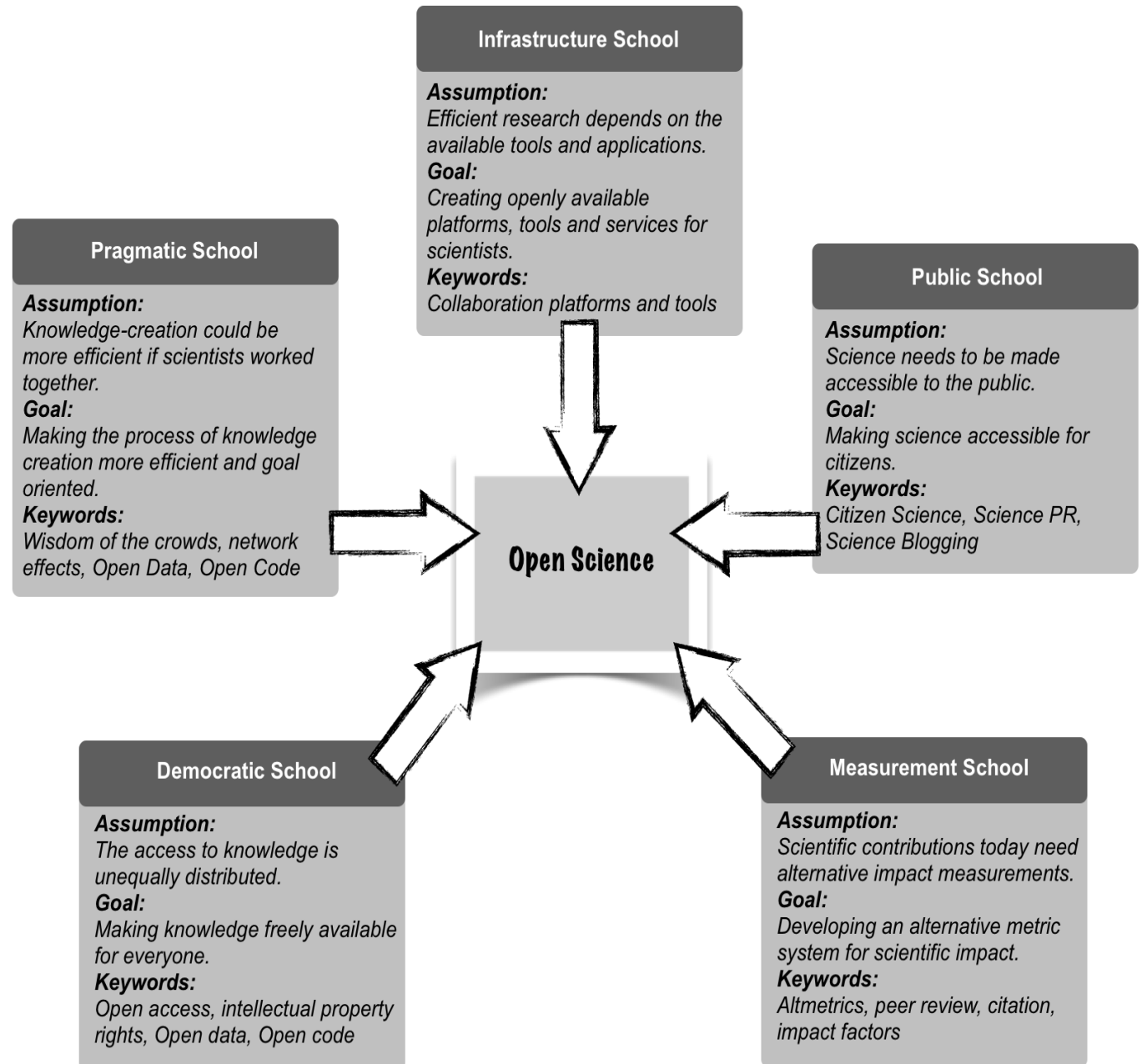FECHER AND FRIESIKE (2014) SUGGESTED *FIVE OPEN SCIENCE SCHOOLS OF THOUGHT.*

THE *INFRASTRUCTURE SCHOOL* - CONCERNED WITH THE TECHNOLOGICAL ARCHITECTURE,

THE *PUBLIC SCHOOL* - CONCERNED WITH THE ACCESSIBILITY OF KNOWLEDGE CREATION,

THE *MEASUREMENT SCHOOL* - CONCERNED WITH ALTERNATIVE IMPACT MEASUREMENT

THE *DEMOCRATIC SCHOOL* - CONCERNED WITH EQUAL ACCESS TO KNOWLEDGE

THE *PRAGMATIC SCHOOL* - CONCERNED WITH COLLABORATIVE RESEARCH

Infrastructure School

Assumption:
Efficient research depends on the available tools and applications.
Goal:
Creating openly available platforms, tools and services for scientists.
Keywords:
Collaboration platforms and tools

Pragmatic School

Assumption:
Knowledge-creation could be more efficient if scientists worked together.
Goal:
Making the process of knowledge creation more efficient and goal oriented.
Keywords:
Wisdom of the crowds, network effects, Open Data, Open Code

Public School

Assumption:
Science needs to be made accessible to the public.
Goal:
Making science accessible for citizens.
Keywords:
Citizen Science, Science PR, Science Blogging

Open Science

Democratic School

Assumption:
The access to knowledge is unequally distributed.
Goal:
Making knowledge freely available for everyone.
Keywords:
Open access, intellectual property rights, Open data, Open code

Measurement School

Assumption:
Scientific contributions today need alternative impact measurements.
Goal:
Developing an alternative metric system for scientific impact.
Keywords:
Altmetrics, peer review, citation, impact factors

School of thought	Central assumption	Involved groups	Central Aim	Tools & Methods
Democratic	The access to knowledge is unequally distributed.	Scientists, politicians, citizens	Making knowledge freely available for everyone.	Open access, intellectual property rights, Open data, Open code
Pragmatic	Knowledge-creation could be more efficient if scientists worked together.	Scientists	Opening up the process of knowledge creation.	Wisdom of the crowds, network effects, Open Data, Open Code
Infrastructure	Efficient research depends on the available tools and applications.	Scientists & platform providers	Creating openly available platforms, tools and services for scientists.	Collaboration platforms and tools
Public	Science needs to be made accessible to the public.	Scientists & citizens	Making science accessible for citizens.	Citizen Science, Science Blogging; Science social networks
Measurement	Scientific contributions today need alternative impact measurements.	Scientists & politicians	Developing an alternative metric system for scientific impact.	Altmetrics, usage metrics, peer review, citation, impact factors

Increased citations; credits; funding; improved networking

Reproducibility of research; Reduce duplication & cost of creating; transferring & re-using data; more research on the same data

Collaborative efforts and faster knowledge transfer; Require coordinated international actions

Validate the research process & result; Identification of malpractices; Increased transparency and quality in research

Promote awareness & trust among citizen; participation of citizen to scientific experiments & data collection

Increased knowledge spillover to the economy

Reduce delays in the re-use of the results of scientific research ; swifter path from knowledge to innovation; products & services

BENEFITS OF OPEN SCIENCE

Increased visibility & reputation

Efficiency – greater access to scientific input & output

Global benefits

Quality & Integrity

Public disclosure & engagement

Economic benefits

Innovation & knowledge transfer

COMPETENCIES NEEDED FOR SUBJECT AND LIAISON LIBRARIANS TO EFFECTIVELY SUPPORT THE EVOLVING INFORMATION NEEDS OF RESEARCHERS IN OPEN SCIENCE

advise on preserving research outputs;

advise on data management and curation, including ingest, discovery, access, dissemination, preservation, and portability

support researchers in complying with the various mandates of funders, including open access requirements;

advise on potential data manipulation tools used in the discipline/ subject;

advise on data mining

advocate, and advise on, the use of metadata;

advise on the preservation of project records (e. g. correspondence);

assist researchers to identify potential funders and sources of research funding

develop metadata schema, and advise on discipline/subject standards and practices, for individual research projects

Open Science components	Its meaning to the ECRs	2016 No of mentions	2017 No of mentions
Open workflows	Transparent research workflow	3	3
	Better return ROI for public funding	3	3
Open access	Optimise use and reuse of research output	3	3
	Open access of research output / scientific papers	4	5
	Making sure that your research work can be read	2	2
	Making scientific research, data and dissemination accessible to all levels of society	1	1
	Science is publicly funded, so research output should be publicly accessible	1	1
Open source tools	Free research tools e.g. Mendeley, Plagiarism detection software	3	5
Citizen science	Increase collaborators and research network	3	3
	Research contributing to societal impact	3	3
	The public having access to the scientists/output	-	1
Open reputation	Having stronger research profile	3	5
	Citation advantage	2	2
Open data	Data sharing to increase impact	4	6
Open peer review	Post-publication peer-review, provide comments after a paper has been published	-	1

SELECTED EXCERPTS ON THE ROLES / IMPORTANCE OF LIBRARIES

- The first year findings (Abrizah 2016) revealed that ECRs believed journals will still have a central role five years down the line in open science, however not everyone thought so for libraries.

- However, in Abrizah (2017) more researchers believe that the library will still have a central role and equate the importance of libraries to journals. All still believed that WoS and Scopus indexed-journals will still have a central role five years down the line. *"Journal will still be the core of evaluation tool"*.

- ECRs felt that indexation status is a priority and journals that are not indexed in citation databases would not be getting enough submissions and finally will die off. As journals and publication it in has become more expensive, they are absorbing a greater percentage of library budgets and library would be more selective in journal subscription. As one non-science ECR put it *"if the library manage to kill of the journals, then the library will go as well"* (ECR11).

SELECTED EXCERPTS ON THE ROLES / IMPORTANCE OF LIBRARIES

- *"THE LIBRARY IS CHANGING. I RECENTLY CAME FOR THE THESIS, AND THEN I STAY FOR THE TECHNOLOGY".(ECR11)*

- *"I GO THERE PHYSICALLY AND VIRTUALLY" (ECR4)*

- *"THE LIBRARIANS ARE MORE PROACTIVE, THEY GO OUT TO THE FACULTY AND ASK US FOR OUR RESEARCH OUTPUTS, WE DO NOT HAVE TO SEND TO THEM!"(ECR7)*

- *"THE THESIS IS NOW AVAILABLE ONLINE, FULL-TEXT, ACCESS TO THE ONLINE DATABASES MUST BE SUSTAINED" (ECR3)*

- *"THE LIBRARY NOW HAS RESEARCH LIBRARIAN, THEY PROVIDE CUSTOMIZED SOLUTIONS TO RESEARCH GROUP! HE HELPS SEARCHING LITERATURE, ANALYZING, SCOPING OR SUMMARIZING LITERATURE, AND MAINTAINING CURRENT AWARENESS FOR OUR RESEARCH GROUP. (ECR1)*

THE PERCEIVED ROLES OF ACDAEMIC LIBRARIES THAT EMERGED:

- DEVELOP OPEN ACCESS POLICIES AND ROADMAPS

- CONTRIBUTING TO THE DEVELOPMENT OF RESEARCH DATA MANAGEMENT (RDM) POLICIES AND STRATEGIES FOR HOME INSTITUTIONS AND HOSTING THE RDM;

- TRAINING AND SUPPORTING FOR RESEARCHERS TO OPEN THEIR RESEARCH WORKFLOWS, SHARING AND REUSING RESEARCH OUTPUT PRODUCED BY OTHERS;

- PROVIDING SUPPORT TO THE OPEN SCIENCE INFRASTRUCTURES AND TOOLS

CONCLUSION

- The benefits of open science to the research community provided evidence to support the idea that academic libraries play an important role as enablers of open science and ultimately support an inclusive and innovative research community

- Libraries involvement in open science will support a research society for all, that leaves no researchers behind, the one in all individuals and groups, irrespective of age, gender, academic position and disciplines can take part.

- Libraries involvement will also ultimately support innovation in open scholarly communication, which is often viewed as the application of better solutions, accomplished through more-effective products, processes, services, technologies, or business models that are readily available to the research community.

- This adds up to the constant and generalised debate for academic librarians and libraries to identify, define and defend their roles as key players in the propagation of open science, even though, especially for the library and information domain, the focus is usually placed on two of these movements: **open research data** and **open access to scientific publications.**

- This calls for academic librarians whose jobs involve supporting or conducting research, to develop research competencies, and the academic libraries to source research training for research data management and open science, and ultimately serve as hubs for scientific collaboration.

THANK YOU

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