

Evaluation of R&D results in the Czech Republic (and in the World)

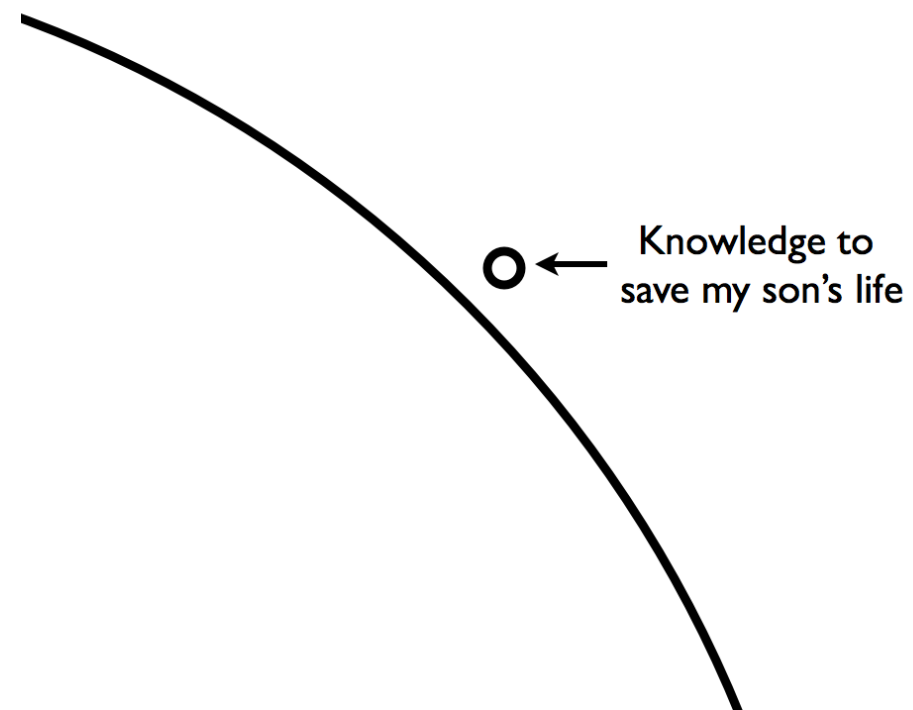
TB²PC Series

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Vice-dean for R&D and PhDs studies

Our Motivation Doing R&D

Keep pushing.



Might, M. *The Illustrated Guide to a Ph.D.* Available online: <https://matt.might.net/articles/phd-school-in-pictures/>, [ref. 2024-09-10]

Something to Read

- [Frascati Manual 2015 \(CZ - Chap. 2 only \)](#)
 - The Measurement of Scientific, Technological and Innovation Activities
 - Guidelines for Collecting and Reporting Data on Research and Experimental Development
 - 402 pages of dense text!
- [The National Research, Development and Innovation Policy of the Czech Republic \(CZ\)](#)
 - [Act No. 130/2002 Coll. on the Support of Research and Development from Public Funds \(CZ\)](#)

What is R&D?

- **Creative and systematic work** undertaken in order **to increase** the stock of **knowledge** – including knowledge of humankind, culture and society – and **to devise new applications** of available knowledge
Frascati Manual 2015, p. 44
- Always **aimed at new findings**, based on original concepts (and their interpretation) or hypotheses. It is **largely uncertain** about its final outcome (or at least about the quantity of time and resources needed to achieve it), it is **planned for** and **budgeted** (even when carried out by individuals), and it is aimed at producing results that could be either freely transferred or traded in a marketplace
Frascati Manual 2015, p. 45

The Five Core Criteria of R&D

- To call an activity an R&D activity, it must be
 - novel
 - creative
 - uncertain
 - systematic
 - transferable and/or reproducible

Novel R&D

- New advancements in knowledge
- Assessed by comparison with the existing stock of knowledge
- Results in findings that are new...not already used in the industry
- Creates knowledge in support of the development of new concepts and ideas related to the design of new products or processes

Creative R&D

- Based on original, not obvious, concepts and hypotheses
 - Hypothesis driven research (vs. data driven research, discovery based research*)
- Any **routine** change to products or processes **is excluded**
- **New methods** developed to perform common tasks **are included**

* <https://www.labxchange.org/library/items/lb:LabXchange:26d69503.html:1>

Uncertain R&D

- The kind of outcome and the cost (including time allocation) cannot be precisely determined relative to the goals
- Uncertainty about the costs, or time, needed to achieve the expected results, as well as about whether its objectives can be achieved to any degree at all
- Awareness of the possibility of not achieving the intended results
 - **Risk analysis** as „a must“ part of any project proposal

* <https://www.labxchange.org/library/items/lb:LabXchange:26d69503:html:1>

Systematic R&D

- R&D is conducted in a planned way, with records kept of both the process followed and the outcome
- For both the R&D followed process and R&D outcomes are recorded
- Clear management and reporting structure of a project

Transferable and/or Reproducible R&D

- R&D results should have the potential for the transfer of the new knowledge, ensuring its use and allowing other researchers to reproduce the results as part of their own R&D activities.
 - **Over 70%** scientists said they **had tried and failed** to reproduce another group's experiments (over 50% even own experiments!)*
- Codification of knowledge and its dissemination to prevent the risk of knowledge being lost
 - **Data Management Plan** as part of any R&D project

* Baker, M. 1,500 scientists lift the lid on reproducibility. *Nature* **533**, 452–454 (2016). <https://doi.org/10.1038/533452a>; Nature Video (28 May 2016). ["Is There a Reproducibility Crisis in Science?"](#). *Scientific American*.

Three (or Four) Types of R&D

- Basic research
- Applied research
- Experimental research
- Oriented research

Basic Research

- Experimental or theoretical work undertaken primarily **to acquire new knowledge** of the underlying foundations of phenomena and observable facts, **without any particular application or use in view**
- Formulates and tests hypotheses, theories or laws *Frascati Manual 2015*
- Experimental or theoretical work carried out with the aim of acquiring **knowledge on the basis or substance of observed phenomena**, an explanation of their causes and possible impact whilst using the findings acquired *Act No. 130*

Applied Research

- Undertaken either to determine **possible uses for the findings of basic research** or to determine **new methods or ways of achieving specific and predetermined objectives** *Frascati Manual 2015*
- Experimental or theoretical work carried out with the aim of **acquiring new findings focused on their future application in practice** *Act No. 130*

Experimental Development

- Systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is **directed to producing new** products or processes or to **improving existing products or processes** *Frascati Manual 2015*
- Systematic creative **employment of research findings** or other concepts **for the production of new or improved** materials, products or equipment, and/or for the implementation of new or improved technologies, systems and services, including the acquisition and verification of prototypes, piloting equipment or equipment for demonstrations *Act No. 130*

Oriented (Basic) Research

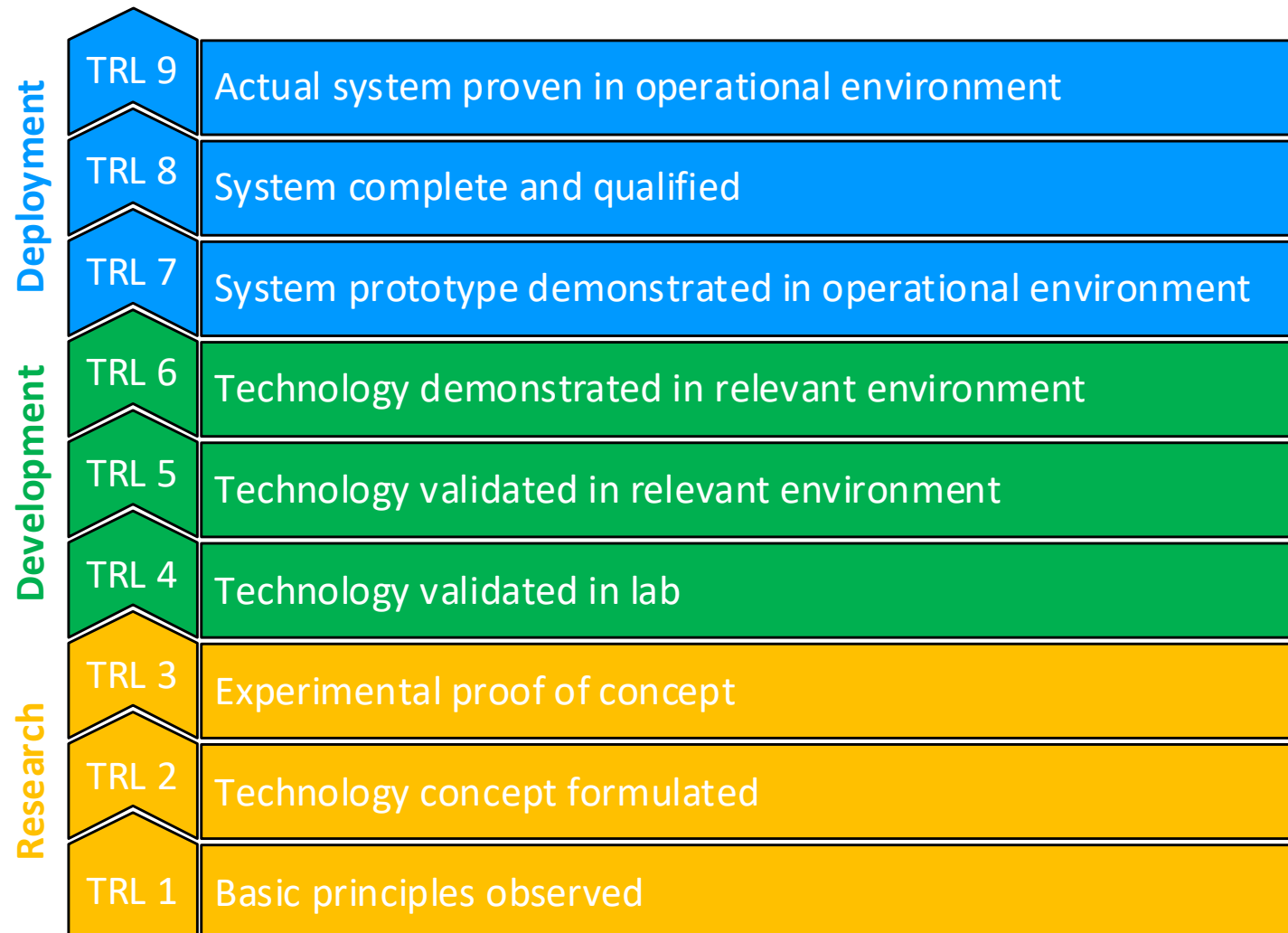
- Carried out with the expectation that it will produce a broad base of knowledge likely to form the **basis of the solution to recognised or expected current or future problems or possibilities**

Frascati Manual 2015

Technology Readiness Level (TRL)

- 9 level method for estimating the maturity of technologies
- Developed by NASA, adopted by EU
 - TRL 1-3: Research
 - TRL 4-6: Development
 - TRL 7-9: Deployment

Technology Readiness Level (TRL)



R&D Results' Types Definition - some more reading

- [Methodology 2017+ \(CZ\)](#)
 - Methodology for Evaluating Research Organisations and R&D&I Purpose-tied Aid Programmes
- [Definition of Types of Results \(CZ\)](#)
 - Category I and II: Publication and Non-publication results
 - Appendix No 4 to Methodology 2017+
- Specification of the Provider's Requirements for R&D Results ([CZ](#) only)
 - TA CR document clarifying the official definitions of the types of results

Category I: J – peer-reviewed scientific article

- Original article or review published in a **scientific periodical** (journal), regardless of the country in which it is published
- J_{imp}
 - included in [Web of Science](#) (WoS) database (probably also in SCOPUS)
 - Document type „Article“, „Review“, or „Letter“
- J_{sc}
 - included (only) in [SCOPUS](#) database
 - Document type „Article“, „Review“, or „Letter“
- J_{oth} (J_{ost})
 - not indexed in WoS nor SCOPUS, but still peer-reviewed

Scientific Periodical is not...

- neither ISSN nor e-ISSN
- **ISSN and ISBN at the same time**
- **no peer-review process**
- in the nature of daily newspapers
- popular educational periodicals
- popular science journals aimed at the broader scientific community
- published by trade unions, political parties, interest groups, etc.
- corporate and insurance periodicals
- forms and newsletters
- **special editions of journals in which conference papers are published**

Scientific Article is not...

- reprints, abstracts, etc., **even if published in scientific periodicals**, and articles of an informative or popularising type on research results
- editorial matter, corrections, reviews, research and summaries
- „pre-print“ articles
- article that has **less than 2 pages of text** excluding photographs, graphs, maps, illustrations, tables and advertisements (holds only for J_{oth}/J_{ost})

Category I: D – paper in proceedings

- **Peer-reviewed** paper presenting original results published in **proceedings** (non-periodical publication published for a conference, seminar or symposium)
- Has at **least 2 pages** excluding photographs, graphs, maps, illustrations, tables and advertisements
- Indexed in SCOPUS or in WoS

Category I: B – book, C – chapter in a book

- non-periodical scientific publication with at least 50 pages of text
- reviewed by at least one generally recognised expert in the field
- has been assigned an ISBN or ISMN code
- not based on J_{imp} , J_{SC} or J_{oth} articles

Category II: Non-publication results

- P – Patent
 - Legal protection of own original results of R&D – **not presented anywhere/anyhow so far**
 - Invention must be **novel**, have an **inventive step** and be **industrially applicable**
 - Granted by authorized body, e.g. [Industrial Property Office](#) (Czech Patent), [European Patent Office](#) (EU patent)

Category II: Non-publication results

- F_{util} (F_{uzit}) – Utility model (Užitný vzor)
 - Legal protection of technical solution in the Czech Republic (Industrial Property Office)
 - Novelty, ununiqueness nor creativity makes the results eligible for protection
 - Only **industrial application** (repeated use) is evaluated by IPO

Category II: Non-publication results

- F_{ind} (F_{prum}) – Industrial design (Průmyslový vzor)
 - Legal protection of product's appearance, in particular the lines, contours, colors, shape, structure and materials of the product itself or its ornamentation

Category II: Non-publication results

- G_{prot} – Prototype
 - **functional industrial product** produced as a single item to verify the design features of the product or a part thereof in practice or in a testing facility **immediately prior to introducing pilot, serial or mass production**
 - A condition is the **novelty** and **uniqueness** of the prototype's design, demonstrated by the **technical documentation** for the result.

Category II: Non-publication results

- G_{func} (G_{funk}) – Functioning sample (Funkční vzorek)
 - **functional industrial product** produced as a single item **not immediately followed by pilot, serial or mass production**
 - A condition is the **novelty** and **uniqueness** of the prototype's design, demonstrated by the **technical documentation** for the result.

Category II: Non-publication results

- R – Software
 - program or set of instructions serving to ensure the functioning of a computer or other hardware, including machinery and equipment and their interactions with their surroundings
 - A condition is the **novelty** and **uniqueness** of the software's design, demonstrated by the result's **technical documentation**.

Category II: Non-publication results

- Other recognized R&D results
 - Z_{pilot} (Z_{polop}) – Pilot plant (Poloprovoz)
 - Z_{tech} – Verified technology (Ověřená technologie)
 - $H_{\text{leg/nonleg/strat}}$ – Results projected into legislation and standards / to guidelines and other non-legislative regulations / strategic and policy documents
 - $N_{\text{metS/C/A}}$ – Methodology
 - S – Specialised public database
 - O – Other results
- Other-other recognized R&D results
 - Variety (Odrůda), Breed (Plemeno), Medical procedure, Conservation Procedure, Specialised map, Research report, Holding exhibition/workshop/conference

Methodology 17+

- Methodology for Evaluating R&D organizations in Czechia

- 5 modules

- **M1 – Quality of Selected Results**

- **M2 – Research Performance**

- M3 – Social Relevance

- M4 – Viability

- M5 – Strategy and Policies

Institution level

Periodicity

Faculty

Annually

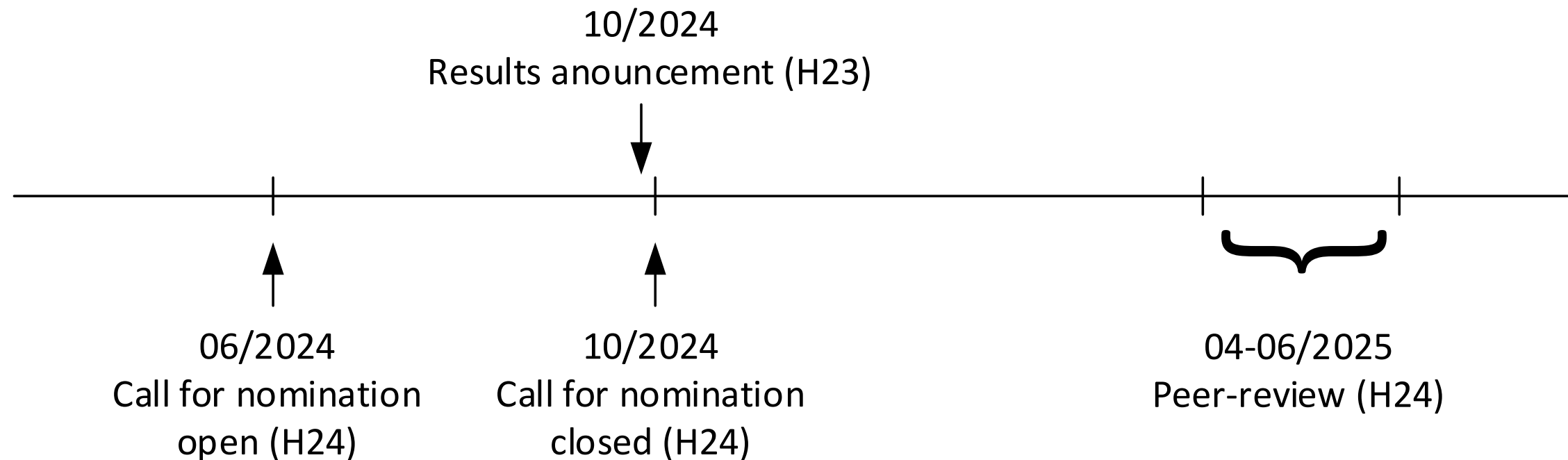
University

5-year
(currently 2019-2023)

M1 - Quality of Selected Results

- Evaluation results **selected by the institution** itself
- Nomination of any R&D is possible
- Peer-review process at national level (issue of objectivity)
- 2 categories
 - Contribution to knowledge - particularly (but not solely) for basic research results
 - Social relevance – particularly for applied research

M1 - Quality of Selected Results: time line



- For H24 nomination of results from 2019-2023

M1 - Quality of Selected Results: scoring

- Contribution to knowledge
 - L1: World-leading
 - L2: Excellent
 - L3: Internationally recognized
 - L4: Nationally recognized
 - L5: Inadequate
- Social relevance
 - L1: World-leading
 - L2: Excellent
 - L3: Very good
 - L4: Average
 - L5: Under average

M2 - Research Performance

- Just „bibliometric“ R&D results
- Just J_{imp} results (i.e. just indexed in WoS)
- Just in **D1**, **Q1**, **Q2** Journals according to AIS (Article Influence Score)
- Just indexed in **SCIE**, SSCI or AHCI
 - ESCI index is excluded (even if these Journals have AIS assigned)

Quality Metrics of Journals

- AIS – Article Influence Score
 - Average No. of citations (influence) per paper in last 5 years
 - AIS > 1: each article in the journal has above-average influence
- IF – Journal Impact Factor
 - All citations to the journal in the current JCR year to items published in the previous two years, divided by the total number of scholarly items published in the journal in the previous two years
 - IF = 1: on average, the articles published one or two years ago have been cited one time

[Glossary, Journal Citation Reports Help Center](#)

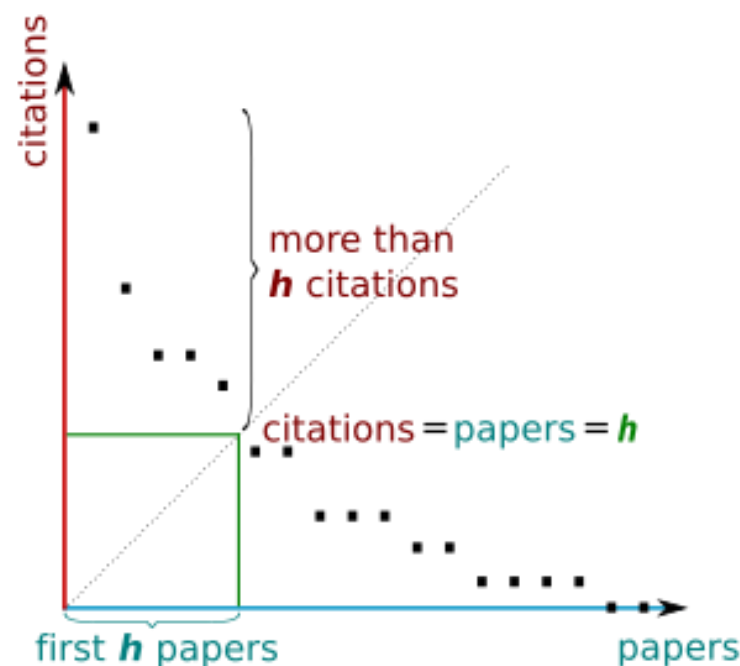
Quality Metrics of Paper (and Researcher)

- CNCI – Category Normalized Citation Impact
 - ratio of the actual count of citing items by the expected citation rate for documents with the **same** document type, year of publication and **subject area**.
 - CNCI = 2: paper is cited twice the world average
- JNCI – Journal Normalized Citation Impact
 - ratio of the actual number of citing items to the average citation rate of publications in the **same journal** in the same year and with the same document type
 - JNCI = 2: paper is cited twice the journal average

[Normalized Indicators, inCites Help Center](#)

Quality Metrics of Researcher

- h-index (Hirsch index)
 - a researcher has an h-index if they have at least **h publications** for which they received at least **h citations**



[Impact Indicators, inCites Help Center](#); Figure adopted from <https://en.wikipedia.org/wiki/H-index>

Fields of Research and Development - FORD

- Different classifying according to
 - OECD (Frascati Manual 2015, Table 2.2, p. 59) – default for M17+
 - WoS ([Categories](#))
 - SCOPUS ([ASJC - All Science Journal Classification](#))
- Hence, metric quality of journal/paper according to WoS is not absolute classifier for M17+
- Converters defined for M17+ needs
 - [OECD-WoS](#)
 - [OECD-SCOPUS](#)

In TB²PC Series

- Orientation for PhD students
- Publishing R&D results and IS Apollo
- Knowledge transfer and legal aspects (so far just in Czech)
- ...more coming up

Good luck in your R&D efforts!