The Art of Doing Science

December 2020

https://meet.jit.si/InterfacialPhenomena

George Kaptay

Professor, corresponding member of the Hungarian Academy of Sciences

MISKOLCI EGYETEM

Timing

2 December 3-6 pm

~~4 December 3-6 pm~~

~~7 December 3-6 pm~~

10 December 3-6 pm

11 December 3-6 pm

16 December 9-12 am
17 December 9-12 am

15 hours total, with recording

Content

1. **Framework of science: degrees, jobs, financing**
2. **How to do science: from a knowledge gap to a claim through a hypothesis**
3. **Communication in science: journal papers and a PhD Thesis**
4. **Scientometrics: scientific excellence of journals and individuals**
5. **Planning your career as a scientist (from which position to retire?)**
6. **Ethics in science: the integrity of science and the never-do-sins**
7. **The patenting game (want to be rich or famous?)**
8. **TRL = the 9 levels of technology readiness / hot cash for your project?**
9. **Ranking the universities: global and regional**

1. Framework / a

Language

no English = no science (sorry for that)

The difference between the scientist and the artist:

reproducibility

In arts: be original, do not reproduce.

In science: be original, but also be reproducible, at the same time.

R+D+I = research + development + innovation

Innovation: Improving anything for a higher profit. It can be a scientific research / development, but not necessarily. It can also be an innovative way of selling washing machines or running a government. As anything new, it can be used for good and for bad.

R+D = research + development

1. Framework / b

Types of research:

1. Basic / discovery research = „blue sky research”, no immediate application. Financed by the government (Ministry of Education, Academy). Result: opened publications.

2. Targeted basic research (the big subject promises application, but for better understanding basic things should be better understood / known / measured / calculated). Financing by the Ministry of Industry / Trade. Result: opened publications (partly restricted).

3. Applied research / development (focused on developing a new product / technology). Financed by investing capital (money-men). Result: patenting.

4. Resolving industrial problems (problem-shooting overnight / technology development for cheaper / greener / lighter product / building a technology model). Financed by the company. Result: not-publishable. (Be careful: there is good chance your supervisor will push you into this direction).

1.Framework / c

Types of researchers:

As their function: basic researcher / applied researcher / consultant

As their profession: chemist – biologist – engineer, etc…

As their method: experimental „guy” / theoretician / simulation „guy”

A theoretician needs only a paper + pencil + maybe a computer with WORD / EXCEL (+ books). The simulation guy also needs expensive commercial software. The experimentalist needs extra-expensive labs and materials. Advice: start in a lab. Later you can do simulation or theory, but your experience in a lab will be mostly valuable for life-time.

1.Framework / d

Types of bosses in science

The scientific supervisor (such as me): A senior scientist; a lot depends on his ideas (or lack of them), his supervision; he is responsible (mostly), he is the corresponding author, his name brings in the cash, he collects young people to work with, to grow with (in Japan: „Kimura-lab", etc…)

The project manager: Not a scientist, rather a manager, responsible for all non-scientific issues (fiscal rules, taxation, millions of „small problems"). If all this is done by the scientific supervisor, than he/she can appear soon in a prison (for breaking / forgetting / confusing all fiscal rules), and then his group collapses, the young people loose their jobs... (a professional is preferred).

Institutional manager (dean, rector, chancellor, president…). An ex-scientist, who prefers to have two business lunches and two business dinners + 10 super-important meetings per day. Responsible for the whole institution (strategy, financing, public relations). Better if not an ex-scientist, rather a professional top-manager (pluses: he is not envy of us researchers; minuses: he does not understand us researchers).

MTA = Magyar Tudományos Akadémia = Hungarian Academy of Sciences

1. Framework / e

Educational degrees: BSc (Bachelor of Sciences) – MSc (Master of Sciences).

Scientific degrees: PhD (philosophical doctor). In Hungary + DSc (= doctor of sciences, MTA doktora). In old days: university doctor – candidate (= PhD) – academy doctor (MTA doktora).

Degrees obtained from Hungarian Universities: PhD and habilitation (= basic requirement for becoming a full professor, measures the „ability to teach" and less the „ability to supervise research")

Degrees obtained from MTA: DSc **(**MTA doktora). Members of MTA (normal, corresponding, foreign). Maximum of 365 normal and corresponding members, filled to maximum number per 3 years (they obtain life-long pension)

Positions in universities: for education: assistant (= tanársegéd), assistant professor (= adjunktus), associate professor (= docens), full professor (= egyetemi tanár), professor emeritus (an excellent ex-full-professor above 70 years). **For research:** young research fellow (= tud. segéd-munkatárs), research fellow (= tud. munkatárs), senior research fellow (= tud. főmunkatárs), research professor (= kutató-professzor).

1.Framework / f

Young researchers: a PhD-student (2+2 years) + a post-doc (max 3 years duration to be started within 5 years after PhD + 2 years per baby for ladies but maximum 4 years even if there are more babies).

Jobs for researchers: 1. Universities (mostly for education). 2. ex-MTA network of institutions (now Eötvös Institute) + research groups. 3. Bay Zoltán Nonprofit Ltd for Applied Research (200 researchers nationwide + professional management). 4. Industrial research institutions / groups / departments. 5. Private research – development Ltd-s.

Financing research - development. 1. Immediately from the budget of the government (universities + ex-MTA: virtually 100 %, BAY = 0 %). 2. Government (HU or EU) financed projects. 3. Industry.

R+D / GDP = 4-5 % (developing countries), 3 % (average EU), 0.8 % (Hungary). Average GDP of Europe = 3 times of HU GDP = 10 times of Miskolc-GDP.

R+D financing per capita, average EU = 40 times that of Miskolc.

1.Framework / g

Possessing (scientific) **information** is essential for **decision-making.**

Forms of scientific information: a historical shift from writing single books to establishing scientific journals and publishing collections of single scientific papers in those journals. The first scientific journal: Philosophical Transactions (Phil Trans) of the Royal Society (of Britain), established in 1665 (Nature: 1869)

How to find papers of our interest: By the help of indexing.

- Subject indexing (needed intelligent man-power)
- Title-word-indexing or key-word-indexing (could be made by a machine)
- Citation – indexing (Eugene Garfield, in 1955-Science-paper, ISI started in 1963 as business). This lead to IF of the journal.
- Today: https://scholar.google.com/ OR https://www.scopus.com/search/form.uri?display=basic OR https://apps.webofknowledge.com OR https://www.scimagojr.com/

2. How to do science / a

0. Select your supervisor with his/her field of research. He/she tells you the subject, but you check if there is real knowledge gap there.

1. Make literature review and set the research goal. Describe what is written by others in the given subject in a critical way (underline missing information, strange results, contradiction between various sources, bad experiments, poor logic, etc…). Identify a knowledge gap (it is meant world-wide, not locally). The goal is to create new knowledge, i.e. to fill the knowledge gap. If there is no well-defined knowledge gap, there is no sense to start the research in the given subject.

2. Create a hypothesis. A hypothesis = your best guess how the new knowledge looks like. All later experiments / simulations / theories are performed to prove / disprove / improve the hypothesis. If your first hypothesis is disproven, be happy: your final finding will be not obvious. If your second hypothesis is disproven, be twice happy. If your 10-th hypothesis is disproven, go to vacation.

2. How to do science / b

3. Create an experimental / simulation plan. This is planned to prove / disprove the hypothesis set before. Plan all details of the experiment / simulation. Prepare a decision matrix: „What if the result is this or that?" If none of the expected results of the experiment / simulation can be decisive regarding the hypothesis, then this is not a good plan.

4. Perform and document the experiment. Based on the plan, perform the experiment with minimum possible deviation from the plan. If needed, ask a friend to help manually, or in documentation (the friend can even take photos, or make a film). Document and measure everything measureable (time, weight, any visible phenomenon). Document everything in written into a thick laboratory notebook with non-removable pages (with title including your name, page numbers, date, title of experiment, all details, hand-written, make it signed by witnesses). After it is finished, prepare a report electronically.

2. How to do science / c

5. Possible conclusions after each experiment
(or series of experiments):

A). Everything is OK, nothing unexpected, let us go on to the next experiment (if a series of experiments was planned), or

B). The experiment has proven the validity of the hypothesis at least for one set of parameters (party-time!!); reproduce it at least ones, extend its validity by extending the values of the experimental parameters and then publish.

C). The experiment has excluded the validity of the hypothesis; do not worry, the results probably can help you to modify your original hypothesis, or to create a new hypothesis (go back to task 2). If the same is happening too many times, consider other options (change the subject, change the supervisor, change your profession, but keep being happy).

2. How to do science / d

6. Modelling: „lift it up" to a higher level, make your result more general than your experimental data.

A. Empirical modelling / story-telling / hand-waving: make a table or a graph and create a „story" explaining what happened and why.

B. Semi-empirical modelling: fit the experimental points on a graph by an as simple as possible equation. EXCEL (or another similar software) will provide the values of the semi-empirical parameters (a and b in $y = a + b*x$. Explain why is it linear (if it is linear). It is a more advanced story than above, although you still do not understand why $a = 3$ and $b = -25$.

C). Theoretical modelling: theoretical explanation of why $a = 3$ and/or $b = -25$, connecting these values with some other, known parameters of the same material (it is useful if the latter parameters are better known compared to the modelled property / phenomenon). This might be a separate „profession", using others published experimental data, or the data measured by your friend in the lab (then you can be co-authors).

2. How to do science / d1: Example of a theoretical model

Suppose we know the Avogadro number and the molar masses, but we do not know the size of atoms. Estimate the size of an Al atom, if its molar mass is 27.0 g/mol and if its density is 2.70 g/cm3,

1. Calculate the molar volume of Al as molar mass / density = 27.0 g/mol / 2.70 g/cm3 = 10.0 cm3/mol = 1.00 E-5 m3/mol.

2. Make the simplest model, supposing Al atoms are spherical: Vm = 4/3*PI*r3*NAv. From here r = (1.00E-5*3/4*PI*6.02 E23) 1/3 = 1.58 E-10 m = 0.158 nm. Compare to experimental value of 0.143 nm. Think about the difference (+10.4 %).

3. Maybe the atoms are cubic? Vm = a3*NAv. From here a = (1.00E-5/6.02 E23) 1/3 = 2.55 E-10 m = 0.255 nm. Compare to experimental value of 0.143*2 = 0.286 nm (-10.8 %).

4. Improve your spherical model taking into account the volume packing fraction of fcc crystals of 0.740: r = (1.00E-5*3*0.740/4*PI*6.02 E23) 1/3 = 1.43 E-10 m = 0.143 nm (0 %): so Al is probably fcc. Note that the packing fraction of equal cubes is 1, no correction of the above model is possible. Check the same for other fcc metals. Find the bulk volume fraction for other crystal structures. Group metals with the same crystal structure.

René Descartes (1596 – 1650)
Discourse on the Method and Principles of Philosophy:

1. accept only information you **know** to be true (through your mind, not by definition)
2. breaking down these truths into smaller units (to model them step by step)
3. solving the simple problems first (there is no such thing as „a too simple problem")
4. making complete lists of further problems (to keep your mind on what to do next)

(Cogito ergo sum = I think, therefore I am)

2. How to do science / e

7. Exit options in case of a positive result (when a new knowledge has been successfully created):

A). The result has some practical application, so let us file a patent first (see later how) and publish it later (but rather do not kill your PhD),

B). It is not worth, or it cannot be patented (see conditions below), so let us publish it in the best international journal of the world.

C). You simply forget about it, because you meanwhile found a new, „more interesting" subject; my best advice: do not do it. If you really have reached a new knowledge in the present (previous) subject, then please, sacrifice some more time and at least publish your results. Otherwise you will end up with hundreds of forgotten, never published results.

D). Keep it in BIG SECRET; my advice: do not. Make it always public, but do so in a clever way (see A or B above + conferences after A / B).

2. How to do science / f

The scientific claim (conclusion, summary)

Formulating the claim is the last stage of the research process

(a dot on i)

Claim (= tézis in Hungarian) = it is the proven, finalized, improved version of your hypothesis (do not call it „Thesis" in English, as it is the for the book you submit).

The claim is made of one (several) sentences, usually a half of a page or so. If needed, a new equation, or a table or a graph with new data can be part of the claim (but one info only in one form).

The claim is the basis for a claim in a patent, a conclusion in a paper, PhD thesis, conference presentation. If you have no finalized claim yet, do not publish anything in any form (patent, paper, PhD thesis, conference (except if you must).

2. How to do science / g

Possible subjects of a claim / thesis

1. Measured property,

2. Measurement procedure,

3. Laboratory procedure to synthesize a material,

4. Production technology,

5. Modell or equation or relationship between different properties, or relationship between state parameters and any property,

6. Algorithm of a calculation, or its result, especially if generalized,

7. Result of a simulation, especially if generalized (questionable)

etc….

Specific + novel + proven + better

2. How to do science / h

A right claim must be specific

A wrong claim is a story about the subject, or about your heroic activities („I was doing this or that like a hero…” – but who cares?).
A right claim is a statement about the new results.

A wrong claim: „I was very busy with studying the shape of the Earth” (who cares?).
A right claim: „I found that Earth is close to be a sphere and not a disc”

A wrong claim: „I found the crystal structure of pure iron” (who cares?)
A right claim: „I found that the crystal structure of pure iron at standard pressure and temperature is bcc”

A wrong claim: „I measured the density of pure liquid Al” (who cares?)
A right claim: „The density of pure liquid Al at its melting point (933 K) and at 1 bar pressure in argon atmosphere is found to be 2.380 plus/minus 10 kg/m^3”.

Specific + novel + proven + better

2. How to do science / i

A right claim must be novel

It is novel, if at the moment of submission of the patent / paper it is not known in the world literature to the best of our knowledge (for PhD thesis: it was not known when the student started the PhD studies)

The meaning of being „not known”:

- For a measured value: i). the same has never been measured, ii). a different result is found by us, iii). our result is more accurate, i.e. it is obtained with a lower uncertainty (ii-iii must be proven).
- For a new equation: i). if $Y = 10\ X$ is not known even as $X = 0.1\ Y$, ii). if obtained from a combination of known equations for the first time, iii). if its derivation or prove is new,
- For algorithms / measurement procedures / production routes / technologies: i). If it includes a new step, ii). If a new order of known steps is established,

Specific + novel + proven + better

2. How to do science / j

A right claim must be proven

„to be proven” follows from the main text of the paper / patent / PhD thesis. All experimental / simulation(?) / theoretical details must be given.

For experimental results: full characterization of initial and final materials, the way the experiment was conducted with all measured and observed phenomena / values (including tables and diagrams), and with all logic and calculations by which the final conclusion is reached. Detailed analysis of uncertainty must be included.

For models / equations: all initial conditions listed + derivation + comparison with previous models and measured values.

For a new method / technology: provide all details with all properties of initial and final material.

Be thorough: write it in a way that your worse enemy cannot criticize it (it will be criticized, anyway....).

Specific + novel + proven + better

2. How to do science / k

A right claim must be better than a corresponding previous result

(it is easier to do anything worse than before, but who cares?)

For experimental results: it has not been known before, or our result is more accurate or measured with higher precision (maybe due to a better sample)

For measuring methods: it measures something absolutely new; if it measures the same as existing other methods, the new method must provide higher precision, sensitivity, speed, or lower cost, must need less material or less energy, or reduces environmental pollution

For an equation / model: reproduces a larger ratio of known experimental data with a higher accuracy and with a smaller number of semi-empirical parameters, in a more simple way.

For algorithms: provides results faster, with higher accuracy and higher convergence probability

For a method / procedure / technology: cleaner, faster, cheaper, with smaller specific consumption of materials and energy, with lower environmental risk.

Specific + novel + proven + better

2. How to do science / I

A step-by-step creation of a claim / thesis (select important info)

Subject of the claim: Contact angle of NaCl measured on glassy carbon

+ 1: using the method of sessile drop (well known in literature)
+ 2: purity of sodium chloride melt is at least 99.98 w%
+ 3: purity of glassy carbon is at least 99.9 w%, with density of 2.10 ± 0.05 g/cm^3 at room temperature, with roughness below 10 nm
+ 4: under Ar atmosphere of purity at least 99.9999 w%, 1 bar pressure,
+ 5: measured in T-interval of 810 and 950 ^{o}C
+ 6: the measured values decrease linearly from 110 to 100 degrees
+ 7: each measurement has an uncertainty of ±3 degrees
+ 8: heating rate: 1 ^{o}C / min, no hysteresis observed.
+ 9. According to XX (Surf Sci, 253 (2011) 128-136), the contact angle of pure NaCl on glassy carbon is 115 ± 5 degrees in the T-interval of 820-1000 ^{o}C, on sample of 10 micron roughness.

+10. A thermodynamic model of the adhesion energy by van-der-Waals forces using the Young-Dupré equation with surface tension values from Janz et al with conclusion: contact angle decreases with T.

Specific + novel + proven + better

2. How to do science / m

The final claim formulated from the previous small details:

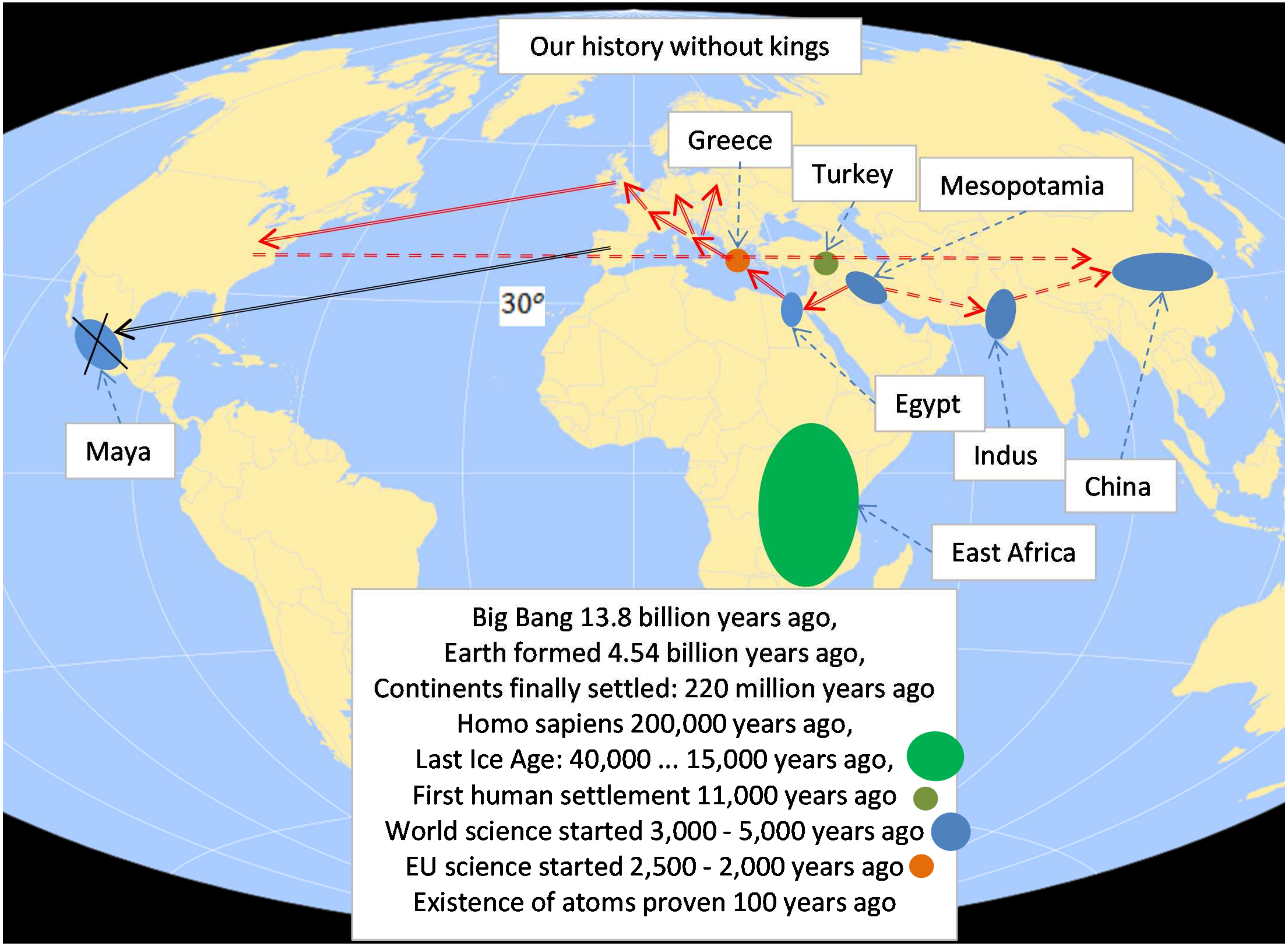
„The contact angle of pure (99.98 w%) liquid NaCl (sodium chloride) is measured on the surface of glassy carbon (99.9 w% purity, 2.10 ± 0.05 g/cm^3 room temperature density, roughness below 10 nm) in argon atmosphere (1 bar pressure, 99.9999 w% purity) to decrease linearly as $\Theta = 168 - 0.0714 \cdot T \pm 3$ degrees (T in ^{o}C, T-range: 810 - 950 ^{o}C) with heating rate of 1 ^{o}C/min, without finding any hysteresis upon cooling the system by the same rate. This result is significantly different from the only previous literature result of XX et al. (Surf Sci, 253 (2011) 128-136), who found that the contact angle in the same system is constant at 115 ± 5 degrees in the temperature range of 820 ^{o}C - 1000 ^{o}C, using a glassy carbon sample with roughness of around 10 microns. My results are supported by a thermodynamic model in which the adhesion energy is modelled using the known van-der-Waals interaction model, while surface tension values are taken from Janz et al. (bibliography), and the Young-Dupré equation is applied. This model predicts (in agreement with my measured values and in contrary to the values of XX et al.) that contact angle in this system must decrease with increasing temperature. The difference between my experimental conditions from those of XX et al. is the too high roughness in experiments of XX et al., which probably did not allow the measurement of equilibrium contact angle values by XX et al.”

Specific + novel + proven + better

2. How to do science / claims extras

Comment 1. Do not be afraid to provide the same figures / tables / equations in major text and in claims. In the major text you must have them all, as they should be supported by the explanation how your measured / got them. However, some of them might be useful also in claims, and in this case you should copy them into claims (no new figs / tables / equations are allowed in claims). Remember: most people read only your claims, and so everything should be crystal clear even from reading your claims. Also, in the 20-page PhD booklet those figs/tables/equations are usually not repeated, as they are missing from the „main text" of the 20-page booklet.

Comment 2: Style of the claims. Although in Hungarian we say „I did" (megcsináltam, felfedeztem, stb…), scientific English comes from polite British English (not from Trump-like selfish American English), so you should never say „I did" or even „I have done" or even „it was done by me". You rather say only that „it was done"; as the Thesis has an Author, and so everyone (who speaks scientific English) should understand that it was you, who did it. The same style should be used in all scientific writings (in your scientific papers). In oral conference talks you can say „we measured" (do not say „I measured"), especially if you are not native British or Australian. But rather say „it was measured".


Our history without kings
Greece
Turkey
Mesopotamia
30°
Egypt
Indus
China
Maya
East Africa
Big Bang 13.8 billion years ago,
Earth formed 4.54 billion years ago,
Continents finally settled: 220 million years ago
Homo sapiens 200,000 years ago,
Last Ice Age: 40,000 ... 15,000 years ago,
First human settlement 11,000 years ago
World science started 3,000 - 5,000 years ago
EU science started 2,500 - 2,000 years ago
Existence of atoms proven 100 years ago

2. How to do science / n

A short history of science

The real origin is lost (many times). After the last Ice Age (40,000 – 15,000 BCE) people came out of caves and the agricultural revolution started, bringing new civilizations, and science about 5,000 years ago around the „belt”: Babylon, Egypt, Indus, China, Maya. Then, it shifted to Greece (500 BCE), and to Roman Empire (29 BCE – 476 CE). Then, after 1,000 years of „dark ages”, Europe started to give signals of life:

Gutenberg (1389 – 1468)	Renaissance: 1450 - 1700
Copernicus (1473 – 1543)	Reformation (Luther): 1517
Bruno (1548 – 1600)	Church of England independent 1530
Galilei (1564 – 1642)	
Newton (1642 – 1727)	Enlightenment: 1700 - 1800
Young (1773 – 1829)	Patenting + Industrial Revolution: 1760 – 1840
Faraday (1791 – 1867)	Democratization of Europe: 1848 -
Darwin (1809 – 1882)	

Modern science in Western Europe (BR, FR, GE, IT). After WW-s the Europeans (especially the Germans) „killed” themselves, and the center of science shifted to USA. Nowadays it is being shifted towards China.

2. How to do science / o

How science evolves (Kuhn)

Evolution of science is similar to evolution of societies. After long silent periods revolutions lead to (paradigm) changes.

A paradigm: a complex model / understanding on a scientific subject. In its framework teachers can teach in peace and scholars can develop small things further also in peace. This development reveals more and more contradictions to the existing paradigm. Meanwhile, new theories are being developed. One of them is able to explain „everything” (old and new observations). Then, a paradigm shift can take place (together with a generation shift). ((Copernicus / Kelvin / 4th law))

Big science – small science

Today „big science” is truly international. Doing „small science” or „’local science” has no sense at all. Doing science today is a life-time profession of tens of millions of people around the world.

The task of the scientist

The truth is „there”, hidden in Nature. Our task is „only” digging it out.

3. Communication / a

The forms of scientific communication:

- written or oral

- **In written form:** patent, know-how, journal paper, conference proceedings paper, published manuscript, monograph, textbook, teaching material, industrial report, technological description, etc.

- **In oral form:** conference talks (poster or oral, including plenary), seminar talks, project-presentations, etc… For example, this one here is an oral seminar presentation, supported by a ppt file.

- Keep your records (on the same day, otherwise you forget).

- My list of publications (the public version and the private full version).

3. Communication / b

Manuscripts / books:

They are written with a purpose

- to participate in a competition (student-s research work, etc…):

- to obtain an educational / scientific degree:
  BSc Thesis (szakdolgozat),
  MSc Thesis (diplomamunka),
  PhD Thesis (disszertáció),
  Thesis for Habilitation (habilitációs tézisfüzet),
  DSc Thesis (MTA doktori értekezés).

- to summarize / transfer some knowledge:
  in a monograph
  in a textbook…

3. Communication / e

The ideal process to write a PhD Thesis / a

- Start only after the research is finished, i.e. all the claims are ready.
- Download, study and remember all the actual formal requirements.
- Writing should be a concentrated process: 1 day/paper, 1 month/Thesis, 1 year/book (if all files are ready in advance); no long breaks between writing periods.
- Compete with time and yourself (open a diary)
- First to write: the claims (in their preliminary form). You must decide their number (3 - 5 -7 is optimum) and the major message of each.
- Second to write: the title (and the title page). It must be short, but should not promise too much (optimum). Start with keywords, and create a title. Avoid sub-title(s). It must involve all claims as an umbrella. If it is not possible, think to reduce the number of claims. A possible title: „Phenomena upon brazing of steels by copper”. Avoid words „research”, „investigation”, „study”, etc…

3. Communication / c

Chapters of a PhD Thesis (page numbers)

Title page (1)
Motto (not necessary),
Content (1)
1. Introduction (1)
2. Literature review (for knowledge gap) (20)
3. Goals (1)
4a. Experimental work: Experimental conditions, materials (10)
4b. Theoretical / simulation work: Conditions of model / algorithm (10)
5. – 6 – 7 – 8 – 9. Primary results + discussion (model) per claim (50)
10. Claims (3)
11. Outlook (1)
12. Acknowledgement (1)
13. List of references (10)
14. Appendices (x)

3. Communication / d

The title page of the PhD Thesis

- title of the thesis,

- name of the author,

- previous degree(s) of the author (MSc),

- affiliation of the author (if any),

- „PhD Thesis”,

- to whom it is submitted: „Antal Kerpely Doctoral School of the University of Miskolc”

- name(s) of the supervisor(s)

- place and date of submission (December 2020, Miskolc, Hungary

3. Communication / f

The ideal process to write a PhD Thesis / b

Chapter 1. Introduction (1 page)

The goal is to put your subject on the big map of scientific knowledge of humans in a way that anyone can understand if it is about sexology or rocket science. Explain that it is materials science, which part of it, which sub-problem of it, and why it is EXTREMELY IMPOOOOORTANT.

Describe the subject of your claim, do not provide your final claim yet.

Key-words to be used: „interesting”, „important”, „needed”, etc.

Your goal: to make yourself and the Readers (= the supervisor + the reviewer) enthusiastic about your subject, so none of you fall sleeping, while writing / reading your Thesis.

3. Communication / i

The ideal process to write a PhD Thesis / c

Chapter 2. Literature review (20 pages)

Your story on the state of the art of human knowledge in the subjects of your claims, with an introduction about the (umbrella)-subject of your research.

The number of sub-chapters = the number of your claims.

No phantasy, describe precisely what is written by whom (only those details, which are important for your final claim), use proper citations [1], [2-3], [3, 7-9]. Minimize copy-paste (in this case use „….”). Provide your opinion in a way that the Reader can easily see the difference between what the authors wrote and what you think about it.

Focus: you write not a story book or a novel. Your goal in each sub-chapter is to identify a knowledge gap to prepare your final claim.

3. Communication / j

The ideal process to write a PhD Thesis / d

Chapter 3. Goals (1 page)

It is built on the gaps of knowledge identified in previous sub-chapters.

It prepares the final claims.

The number of goals = the number of claims. The goals should be numbered (by the same number as the claims are numbered)

Key words: „my goal is to measure …”, „my goal is to make a model for / improve the existing models for …”, „my goal is to develop a measuring method for… / laboratory synthesis method to produce …. „, etc.

3. Communication / k

The ideal process to write a PhD Thesis / e

Chapter 4a. Materials, equipment and methods (10 pages)

Each material should be characterized: origin, average chemical composition, phase composition (how many phases, which phases, their phase ratio, their composition), color, odor, shape, size, mass, volume, etc.

Each equipment should be described: producer, year, type, measuring principle, measuring interval, measuring accuracy, last calibration and details (who calibrated and how, which etalon was used).

Each method should be described: which material(s), how much, which equipment, what was the exact procedure.

Analysis of expected uncertainty in % (error-analysis).

3. Communication / I

The ideal process to write a PhD Thesis / f

Chapter 4b. Details of simulation software **(10 pages)**

Each software should be characterized: producer, year, principle, basic equations, data-bank, etc…

Each software should be characterized in such details, which would allow to program it yourself (if you wanted), but programming details are out of interest.

If a software is a black box for you, it is fine for engineering, but it is not good enough to reach scientific results, as the criterion of „reproducibility” is not obeyed.

A black-box software can be used for preliminary simulation, if the claim is based on final experiments.

3. Communication / m

The ideal process to write a PhD Thesis / g

Chapters 5 . Results and discussion (claim by claim)

Primary results: description + tables.

Discussion of the results (graphs to help the understanding), including possible modeling (even if it is a simple model).

Comparison of the results with previous measurements (see literature review).

Comparison of the results with predictions of known models (see literature review).

Formulation of the claim.

3. Communication / n

The ideal process to write a PhD Thesis / h

Chapter *6. Claims (in their final form)*

Collection of the claims as given at the end of each sub-chapter 5.

Chapter 7. Outlook: How you would go on / how it could be applied

8. Acknowledgement: relatives, friends, colleagues (not supervisors)

9. List of references (in the proper format):

Authors. Title. Journal, volume (year) pages

10. List of your own publications on the same subject

11. Appendices: detailed information (tables, graphs, derivations, which do not fit into 100 pages, but increase the credit of the claims).

3. Communication / o

The PhD Thesis booklet

The Thesis is 100 pages A4 format, printed only in 5 copies.

The booklet is 10-20 pages B1 format, issued in 100 copies.

Title page

Introduction including gaps of knowledge and goals

Description of major methods (shortened version)

List of claims (same as in the PhD Thesis: copy-paste)

Usually no references, except if needed very much for comparison with your claims.

List of your papers in the subject (copy-paste)

3. Communication / p

A journal, as a business product

- Publishing houses (Elsevier, Springer, etc..), or professional bodies (UM, OMBKE, DGM, ASM, TMS, etc.)
- The bigger, the better for us (higher visibility, larger network of dissemination).
- It is usually a business unit (Ltd), with owner, manager, employees.
- Key person for us: (chief) editor. He should be the „best" in the field. He is responsible for what is published and what is not.
- The authors submit their paper free of charge. In best places no publication fee.
- Reviewers: work free of charge (see later)
- Format editors (improve broken English + make your paper good looking in the format of the journal (usually „Far-East overseas")
- Profit: selling journal or open access
- How to maximize profit: maximize the impact, measured through impact factor, Q1-Q4, D1, etc (see later). The higher impact factor the journal has, the more profit it can make. Competition, tricks, free market.

3. Communication / q

Types of journal papers

- *Regular paper:* „one paper = one claim", but no „salami slicing", pls.

- *Short paper, or Communication.* Same as regular paper, but smaller, usually without chapters (Scr. Mater vs Acta Mater)

- *Review paper* = only upon invitation (in good journals, not for you, yet)

- *Discussion paper.* Critical comments relative to a previous paper in the same journal. Possible (part of a democratic game), but better to avoid. You will probably get a „Reply to the discussion paper", which might not be nice, and the last word is with the original authors (editor). Maybe it is worth to do, if your previous paper is not cited, or ill-cited. But first things first: make a portfolio of your own papers before you start discussing others.

3. Communication / r

Selection of the best journal

- List of journals fitting your paper (look at your own list of references and check with scopes of the journal)

- Prefer journals of large publishing houses (Elsevier or Springer).

- Prefer journals with open access (government covers fee)

- Prepare a publication plan each 1st January (what to publish where?)

- Make your preference list with decreasing impact factor

4. Scientiometrics / a

Measuring the impact of journals / a

- It is serious business: it has impact on the profitability of journals
- How we know if a journal / paper has any influence? From the number of citations. The definition of impact factor: $$IF_{2020} \equiv \frac{Cit_{2020}}{Papers_{2018+2019}}$$
- IF characterizes a given journal in year x, based on its performance in years (x-1) and (x-2), which will be known only in year (x+1).
- Only the values of ISI (Clarivate Analytics) are of importance. All other self-calculations are meaningless, as CA not only counts, it also selects the best journals.
- Above 12,000 journals are with IF, so each paper can be sent to at least 100 different journals with IF-s.
- Different fields cannot be compared. The comparison is meaningful only within fields.
- Review papers and review journals have a higher IF by 2-3 times
- Our interest is to publish in top journals, but move step by step.

4. Scientiometrics / b

Measuring the impact of journals / b

http://www.scimagojr.com/

- Quarters (Q1 – Q4) within a field: it is good. (Uni-Miskolc, PhD in materials: minimum one paper in Q2 is requried)
- Could be based on IF, but there are legal problems; the Q-system is run by Elsevier / Scopus data, based on SJR (Scimago Journal Rank)

Scopus (4 categories / 30 subject areas / 22,400 journals):

Life Sciences (3950 titles): Agricultural and Biological Sciences; Biochemistry, Genetics and Molecular Biology; Immunology and Microbiology; Neuroscience, Pharmacology, Toxicology and Pharmaceutics.

Physical Sciences (6350 titles): Chemical Engineering; Chemistry; Computer Science; Earth and Planetary Science; Energy; Engineering; Environmental Science; Materials Science; Mathematics; Physics and Astronomy.

Social Sciences (5900 titles): Arts and Humanities; Business, Management and Accounting; Decision Sciences; Economics, Econometrics and Finance; Psychology; Social Sciences.

Health Sciences (6200 titles): Medicine; Nursing; Veterinary; Dentistry; Health Professions.

Scientific fields	USA papers	HUN rank	HUN pa	HUN/USA %
(Population)	300 M		10 M	3,00
All sciences	9.165.270	39	152.787	1,67
Veterinary	71.974	27	2.927	4,07
Mathematics	581.585	35	15.865	2,73
Physics and Astronomy	1.138.049	35	26.412	2,32
Agriculture / Biological Sciences	697.070	39	16133	2,31
Pharmacology / Toxicology	317.337	30	7.108	2,24
Chemical Engineering	304.198	38	6.787	2,23
Neuroscience	358.544	26	7.072	1,97
Materials Science	795.945	38	13.775	1,73
Biochemistry, Genetics, Molecular	1.474.614	34	24.876	1,69
Computer Science	904.212	41	14.547	1,61
Earth and Planetary Sciences	481.546	37	7.688	1,60
Decision Sciences	91.742	39	1427	1,56
Chemistry	610.511	35	9.470	1,55
Immunology / Microbiology	335.278	38	5.048	1,51
Environmental Science	453.628	44	6.257	1,38
Arts and humanities	402.928	38	5.238	1,30
Medicine	2.856.911	39	35.564	1,24
Engineering	1.685.951	42	19.826	1,18
Multidisciplinary	109.843	40	1.269	1,16
Energy	232.137	50	2.395	1,03
Social Sciences	749.528	42	7.034	0,94
Economics, Econometrics, Finance	155.405	47	1.365	0,88
Dentistry	41.865	48	314	0,75
Psychology	350.953	36	2.283	0,65
Business, Management	216.320	52	1.351	0,62
Health Professions	193.130	38	1.179	0,61
Nursing	189.846	46	744	0,39

3. Communication / s

The structure of a „regular" journal paper / a

Title: should be short, but specific enough.

Authors: those, who have significant role in the paper. Possible functions: identification of the knowledge gap, creation of a hypothesis, making the experimental plan, performing the experiments, their evaluation, making a model, writing a paper. Additional characterization (SEM, XRD, ICP, etc…) go to acknowledgement, if it is routine; if anything special, they can be co-authors. First author: who performed the key experiments (PhD student). The last author = the professor. No coauthors: prime-minister, his wife, rector, dean, head of anything, money-men, girl-friend, boy-friend, mother, mother-in-law…

Affiliation: Working places of the authors, with e-mail-addresses

Corresponding author: the professor with a good name, who is best friend of the editor, who is pushing the paper through, who communicates with the anoninomous reviewers and editor. (PhD students are not suggested, unless….)

3. Communication / t

The structure of a „regular” journal paper / b

Abstract: half – full page. Not the Introduction, rather the Conclusion, but written as a story. Key phrases: „Here we show for the first time….”. No citation, no equation, no table, no figure. Only Latin letters and Arabic numbers, no other symbols („Theta”).

Keywords: around 5, divided by semi column (;), giving a hint about the subject of the paper. In old times it was useful (referative journals). Today they are requested, but useless (see Google). Some journals have their own list, you can select only from this list)(check before you format your paper under this journal).

1. Introduction: same as introduction + literature survey + goal of your PhD Thesis summarized in 1-2 pages. Sentence 1: „how interesting”. Sentences 2-15: who did what before? Sentences16-18: identification of the knowledge gap. Sentences 19-20: the goal of the paper is the creation of new knowledge, which will fill the knowledge gap (make sure this is true from the Conclusions).

3. Communication / u

The structure of a „regular" journal paper / c

2. Materials and Methods / Experimental conditions: this part provides the credit for the claims. All small details on materials, equipment, procedures, error analysis.

3. Experimental results: description of the primary results, no philosophy, measured data in tables (except when the equipment provides a graph).

4. Discussion = interpretation of the results. Explanation, model, summary graphs (not primary graphs), comparison with literature, preparation of the claim. („good journals do not publish numbers and SEM photos only")

5. Conclusions = claims, numbered, not story-like (vs. Abstract, remember Goals)).

6. Acknowledgement: for those, who made additional routine characterizations (SEM, XRF, ICP, etc…) + to the financing bodies – guys + companies (not to you girl-friend, or mother).

3. Communication / v

The structure of a „regular" journal paper / d

7. References: „We all stand on the shoulder of Giants" [Newton] (not on the shoulders of your friends). Prefer fresh ones (from those authors, who are still alive) – they can cite you back. Can be a little bit patriotic (does not mean 100 % of one nation). Maximum 20 % of self-citations. Formatting: all journals are different even within major publishing houses (see special softwares).

8. Appendix: Anything, which is too boring, but needed (mathematical derivation, too much details, too many graphs, or tables). Danger: electronic supplementary material to be downloaded separately.

9. List of tables and figures
10. Highlights
11. Graphical abstract
12. Supplementary data / material
13. Letter to the Editor

Example: J218 for theory and J220 for experiments

3. Communication / w

Submission and tracking your paper

-3. the research is finished, the claims are ready.
-2. the journal is selected.
-1. „Guide for Authors" + „ Guide for Reviewers" (J Mater Sci)
https://www.editorialmanager.com/JMSC/default.aspx /
0. Writing the paper within a day or so + get agreement of all co-authors.
1. Electronic submission of a paper by the corresponding author
2. Formal check, ethical check,
3. Editor pre-review (3 days, rejection or passed) 2 reviewers (2 weeks),
4. Reviewers (1-3 months): rejection / major revision / minor revision, accept as it is – my submission statistics
5. If rejected (60 %): never give up (and do not worry); next journal….
6. If not rejected (40 %): letter to the reviewers, re-submission: J218
7. If accepted: doi number, proofs, queries, open access, order reprints / offprints, page charge, order color in print, copyright transfer agreement, on-line version, tracking, advertising (Linkedin, conferences, e-mails, personal website).

3. Communication / x

Review (not a review paper)

- Letter from the Editor (Would you please review the following manuscript….): Accept / Deny (suggest another reviewer); If accept, download paper, keep deadline (2-4 weeks)

- Major decisions: 1). Does the paper fit the scope of the journal? 2). Is there any (self-) plagiarism?, 3). Are the claims good enough? (specific + novel + proven + better?) If any answer is NO, then reject.
- If it is worth to publish, then suggest corrections (1-20),
- Minor revision: only formal suggestions (does not come back)
- Major revision: good experiments, poor model (will come back)

- Motivation: have an influence of the development of your field, building relationship with the editor, see fresh results (but do not steal them!), + 1 month Scopus free of charge
- Me: 1 review per week, spending 2-4 hours / review.
- Accept for review only what you know (or want to know)
- My Review-file + a sample review

4. Scientiometrics / d

Measuring the scientific excellence of individuals

It has a serious impact (appointments, funds, prizes, cutting staff), but what shall we measure?

i. the number of papers?

ii. the number of papers with IF ?

iii. the number of papers in Q1 (Q2, etc…) journals?

iv. the cumulative IF = the sum of IF-s of our papers?

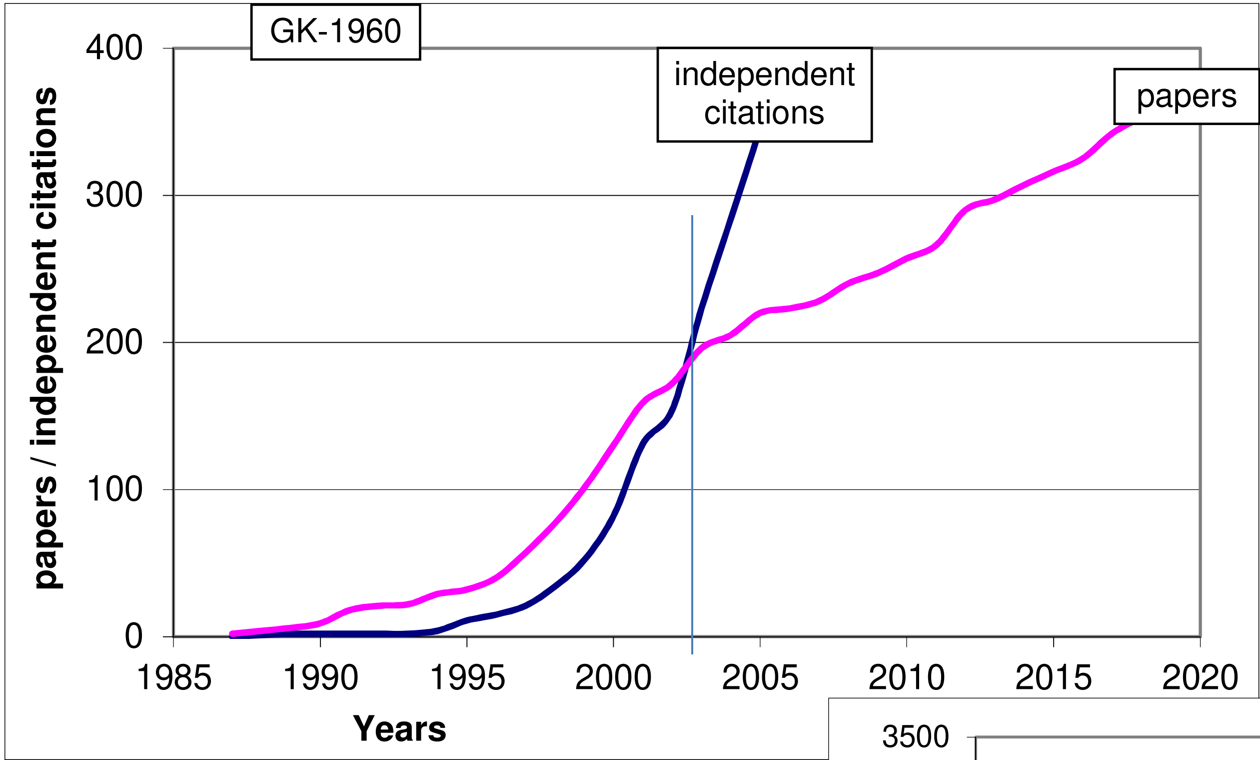
v. the partial cumulative IF? (the same, but each IF is divided by the number of authors before summing them).

vi. the number of (independent*) citations?

vii. the h-index (Hirsch-index) = the number of papers, having at least the same number of (independent) citations.

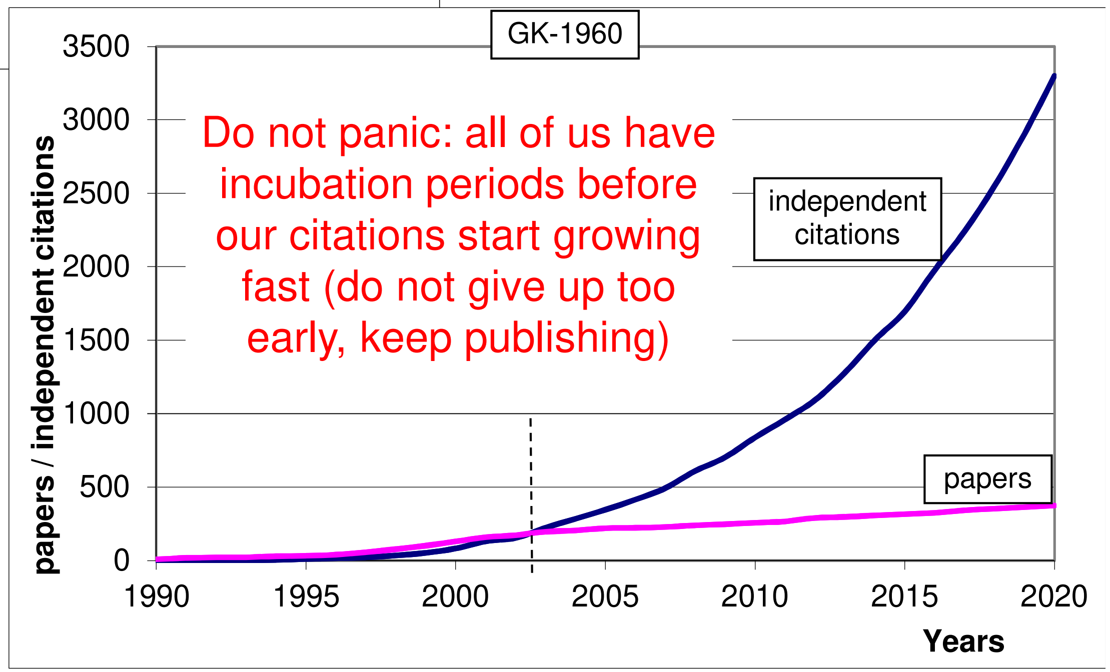
*(Independent: no overlap in authors of citing and cited paper, or no self-citation from myself?)

4. First you write your papers then you count your citations

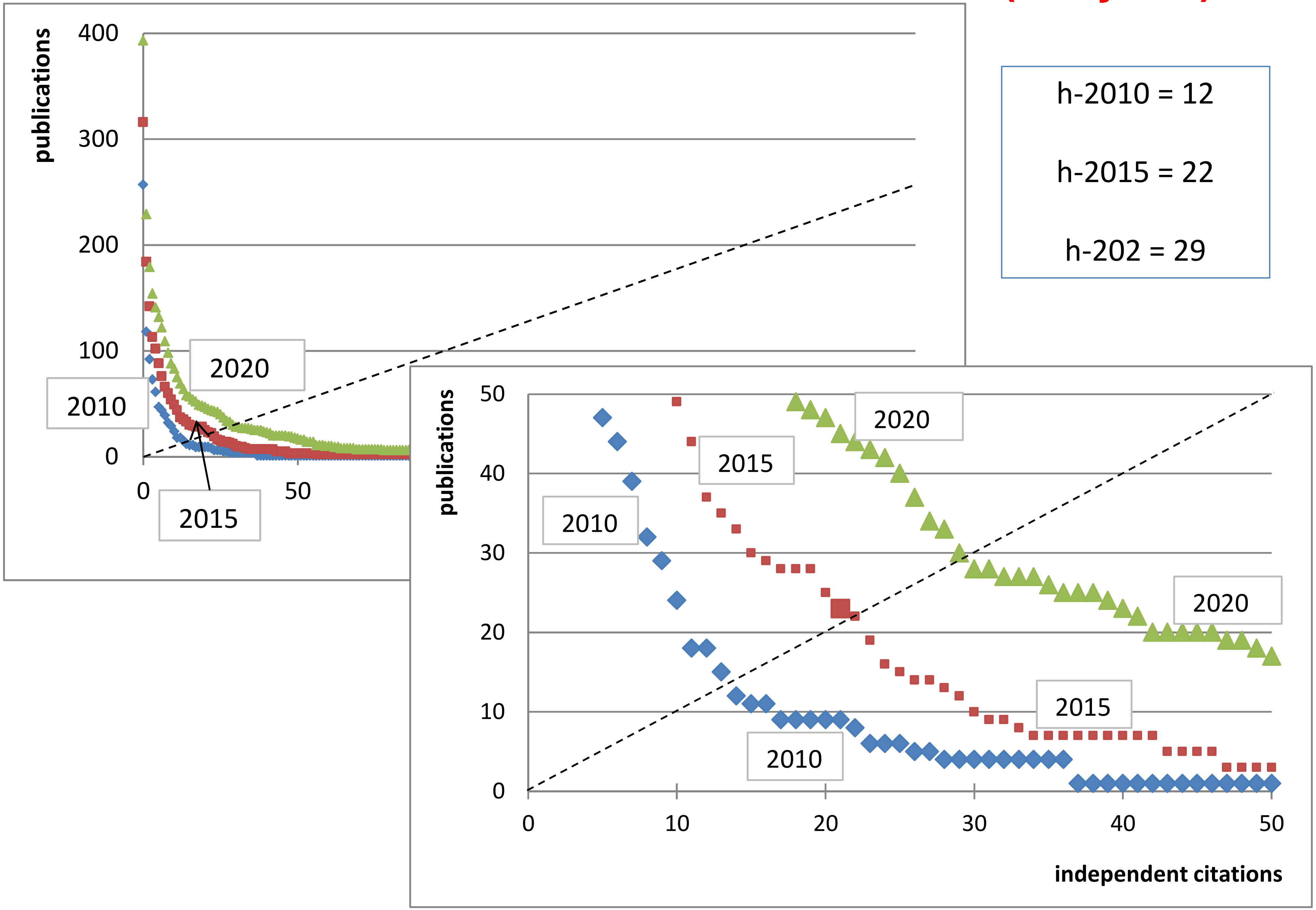


… but keep writing your papers even if you have more citations than papers

Remember: only published papers can be cited. Papers published in Q1 journals are cited with 8 times higher probability than papers hidden in Q4 journals



4. Scientiometrics / the h-index (+ my list)

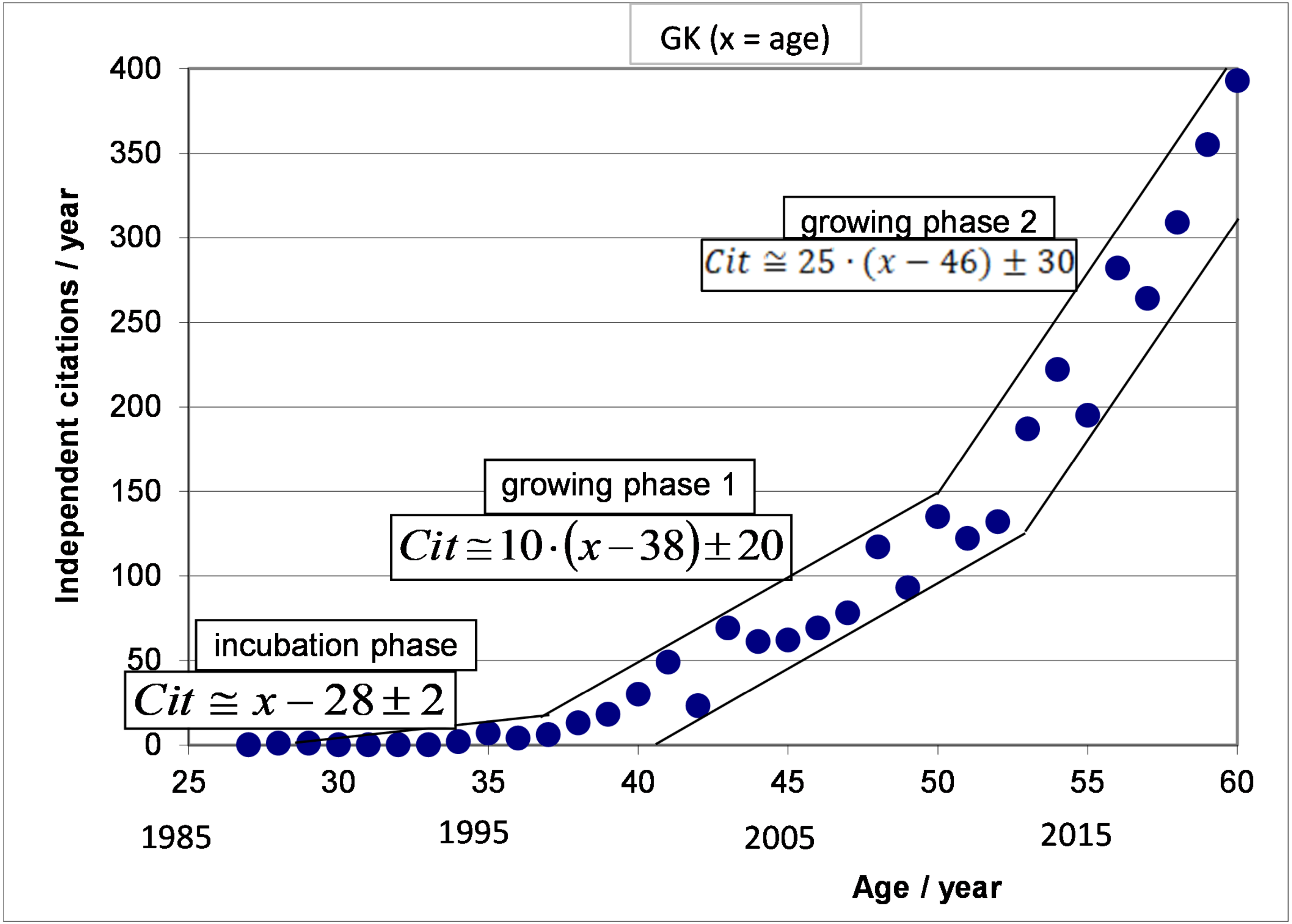


h-2010 = 12

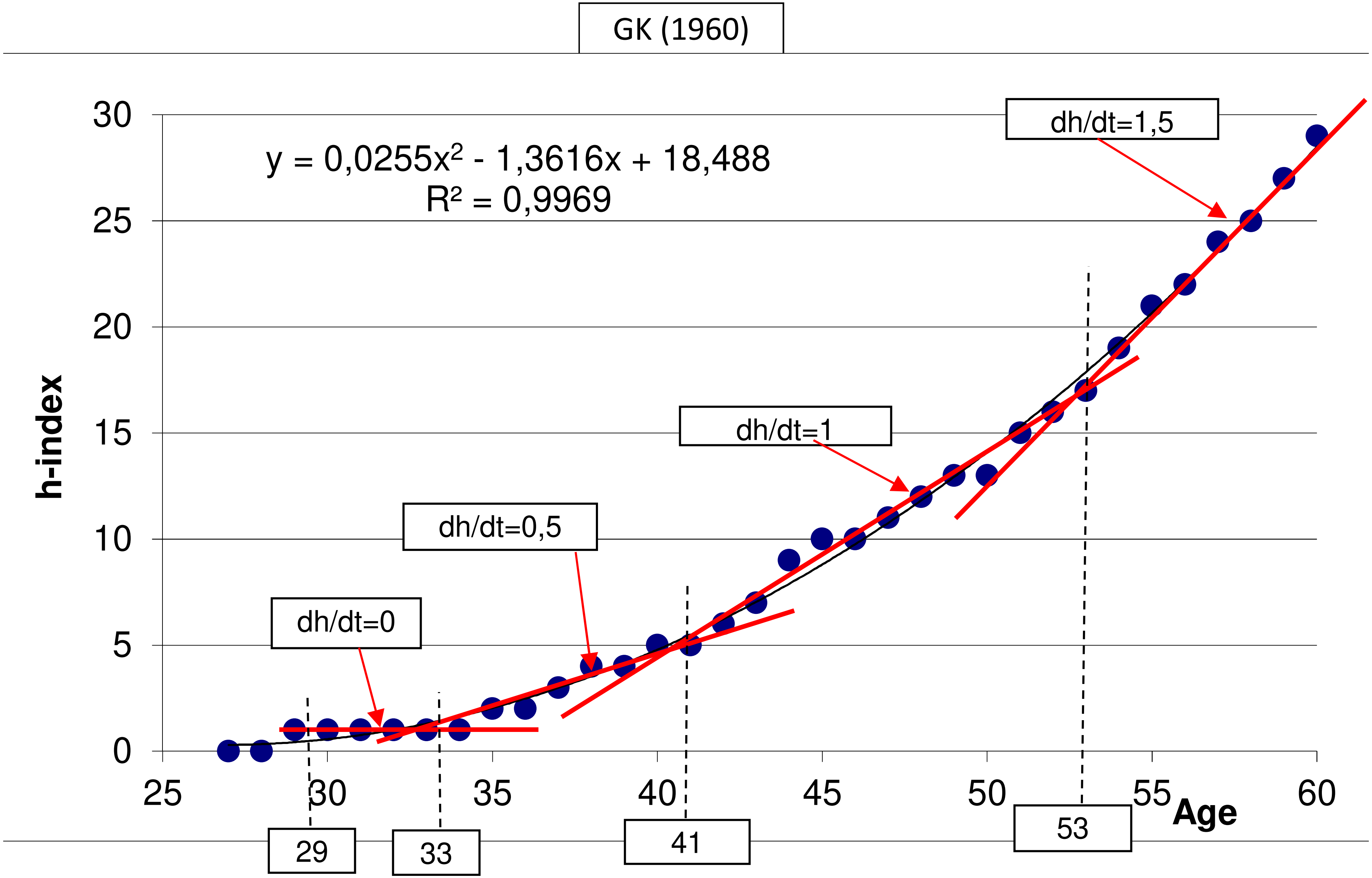
h-2015 = 22

h-202 = 29

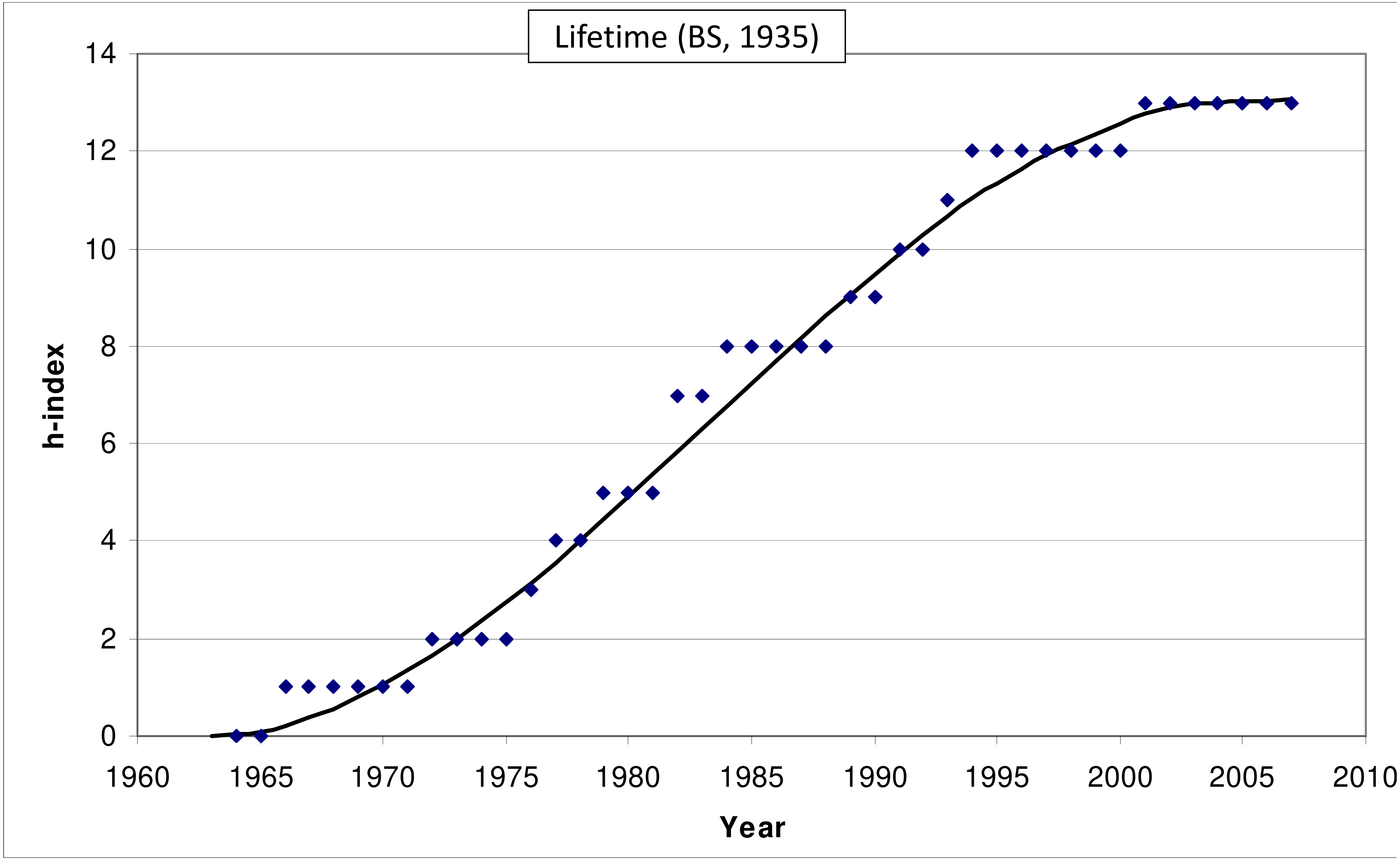
4. Scientiometrics / f1



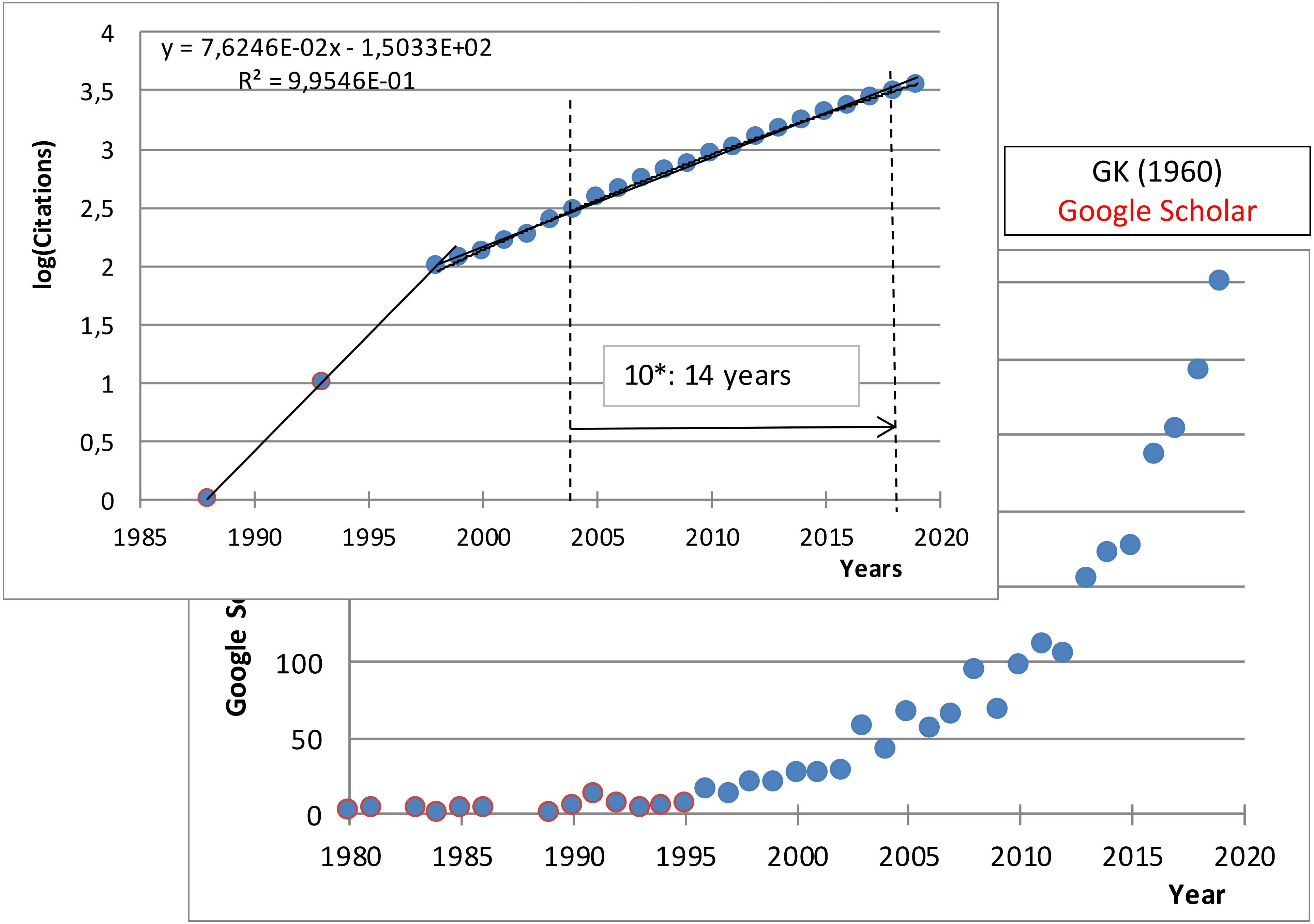
4. Scientiometrics / f2 (in active period)



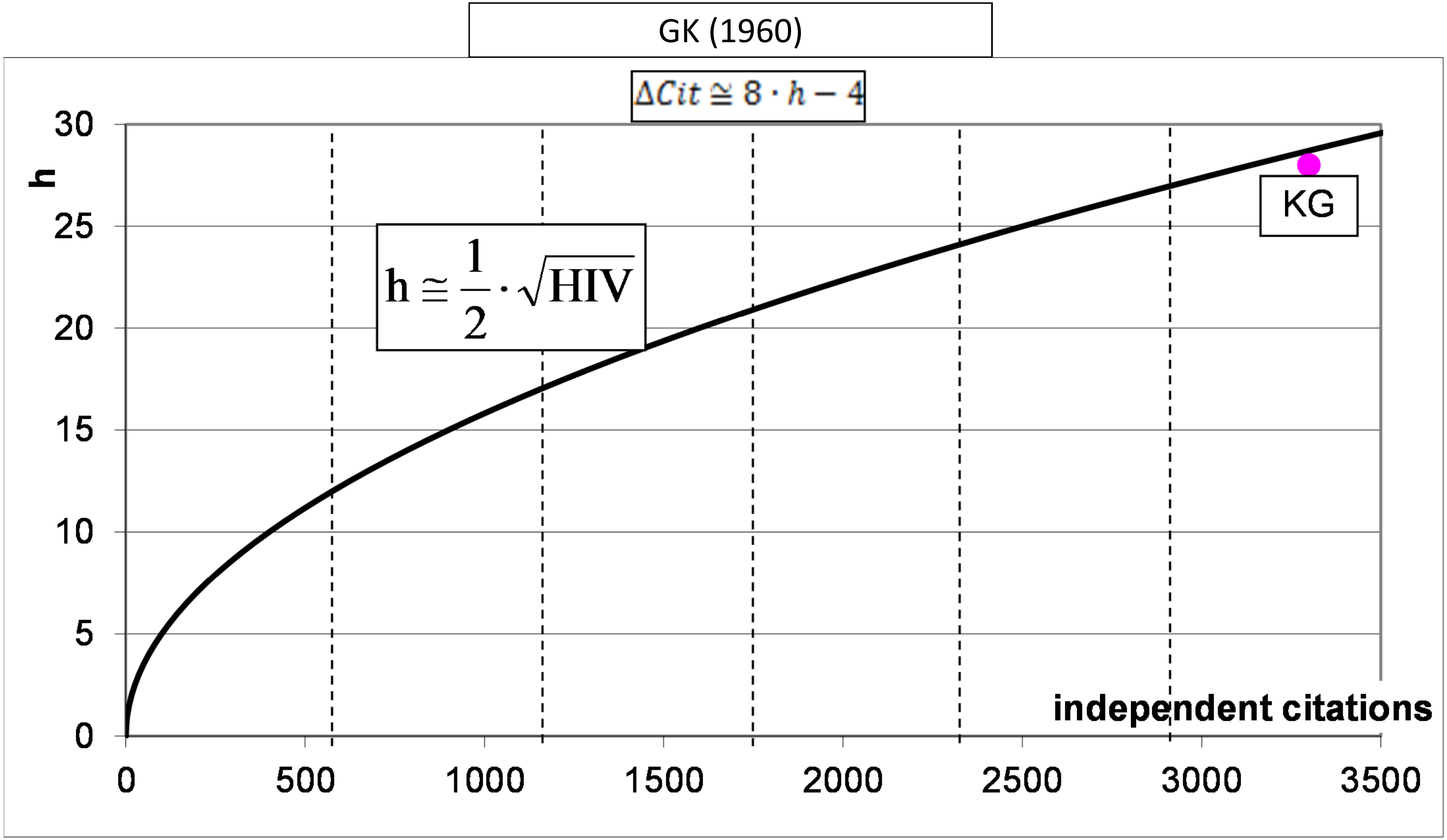
4. Scientiometrics / g (active period is over)



4. Scientiometrics / i

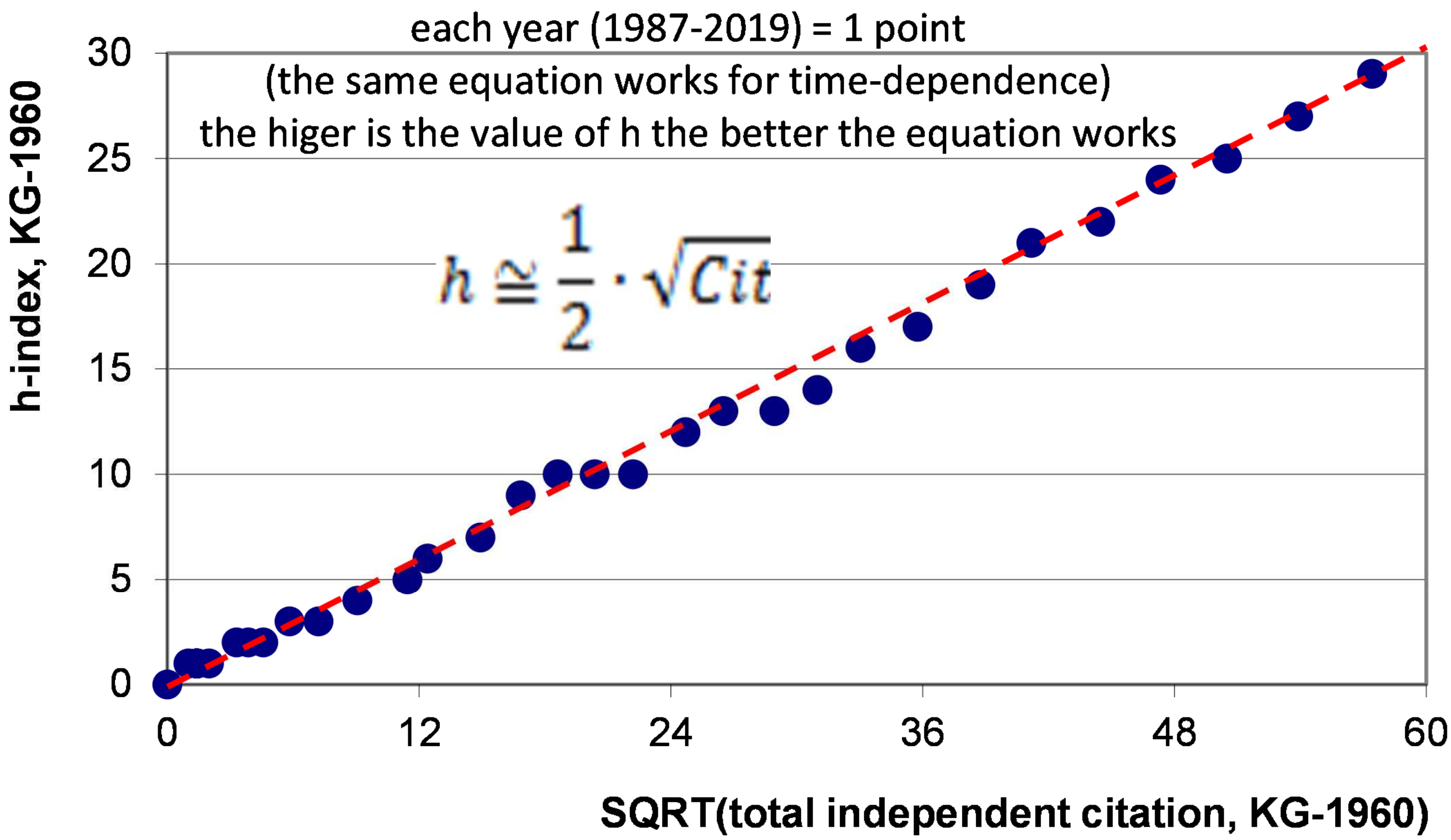


4. Scientiometrics / j



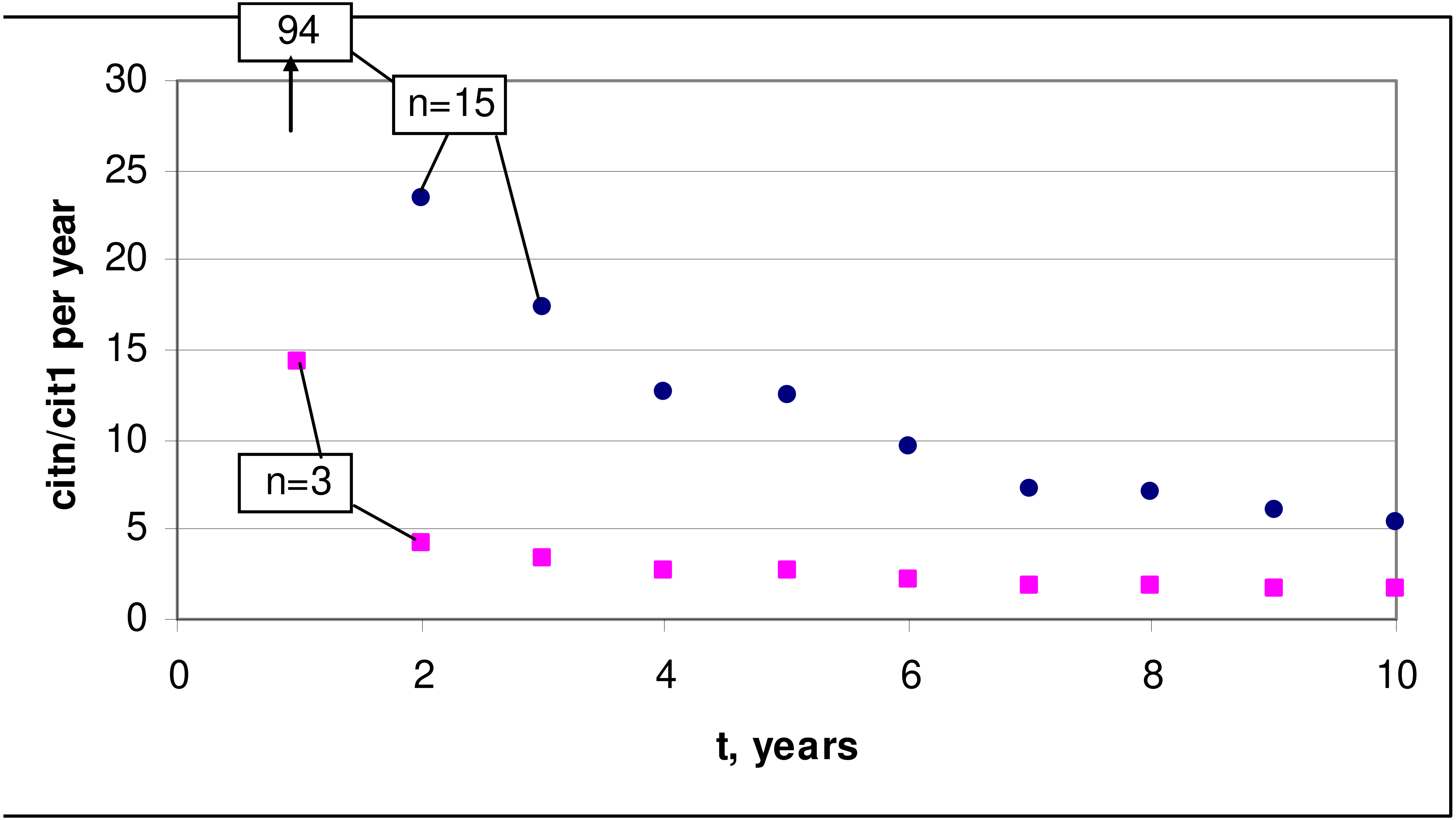
The higher is your h-index, the more new citations you need to increase it further; each additional h-index requires more citations by 8 (statistically) compared to the previous h-index

4. Scientiometrics / j



4. Scientiometrics / k

The effect of citations of „best friends”



4. Scientiometrics / I

FEMS gold medal

$$h_{corr} = \frac{48.3}{k_{field}} \cdot \sqrt{\frac{C_{ind}}{0.392 + n}}$$

Same age, field coefficient:

20 (steel, iron, other metals metallurgy, slags, molten salts),

30 (physical metallurgy, metals science, ceramics technology, composites, electrometallurgy, metals chemical thermodynamics, casting, interfaces),

40 (plastic deformation, non-metallic physical chemistry, solidification, combustion),

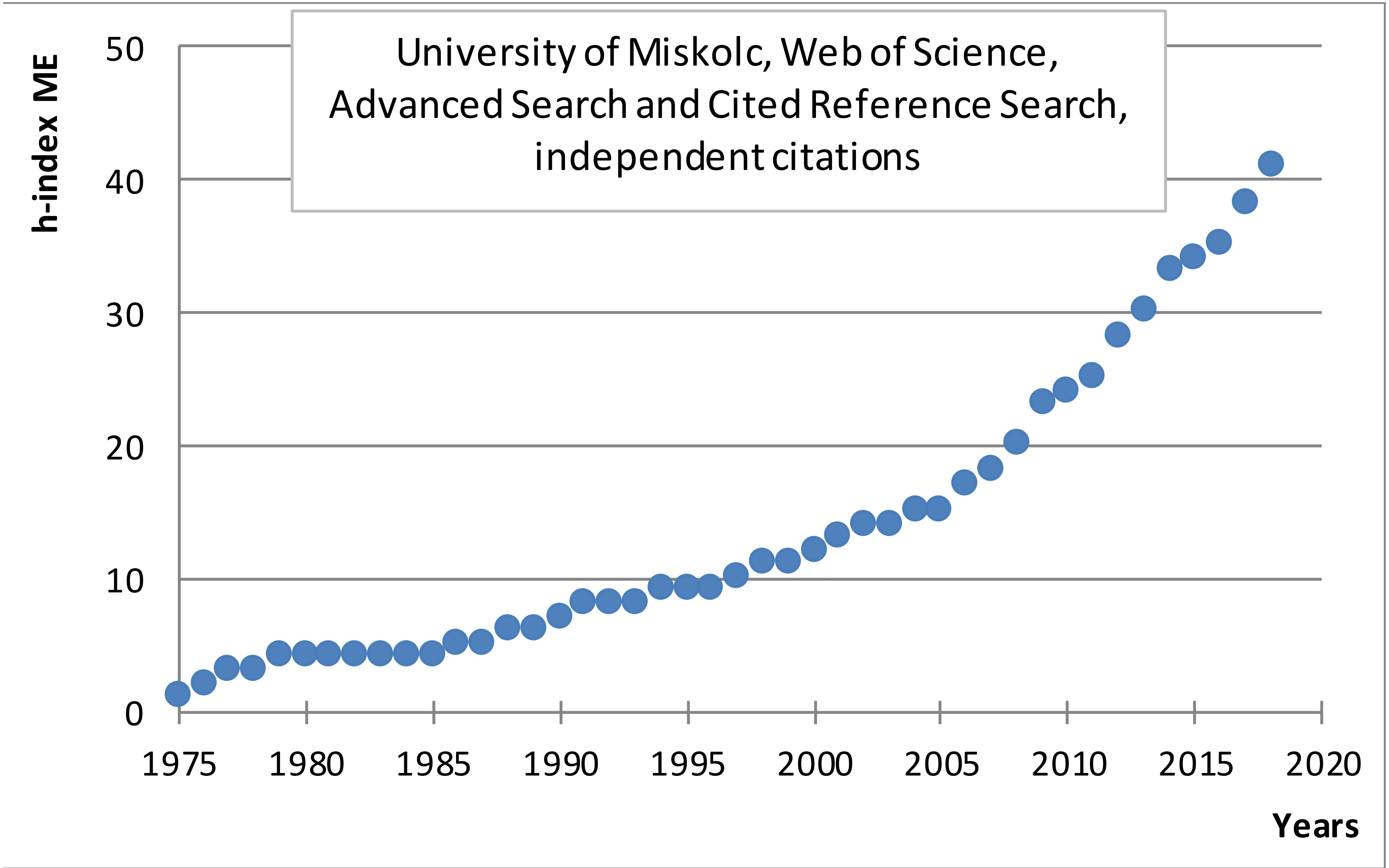
50 (polymers, chemistry, environment, ionic liquids, severe plastic deformation, colloid chemistry),

60 (biomaterials),

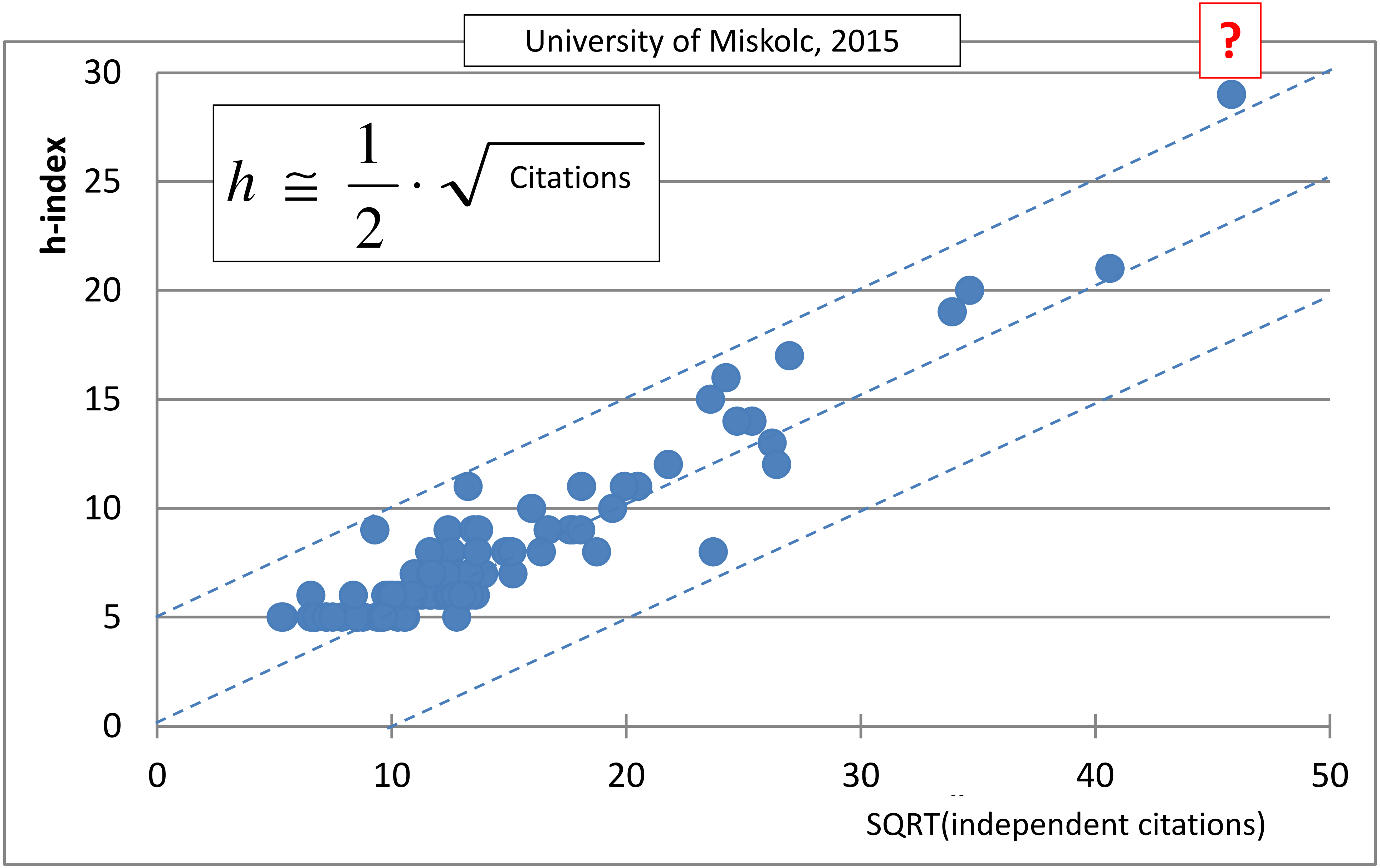
80 (nanomaterials, bulk metallic glasses)

Gold Medal above 30, n = 3-10, k = 40-80: C = 2.000 - 25.000

4. Scientiometrics for institutins / h



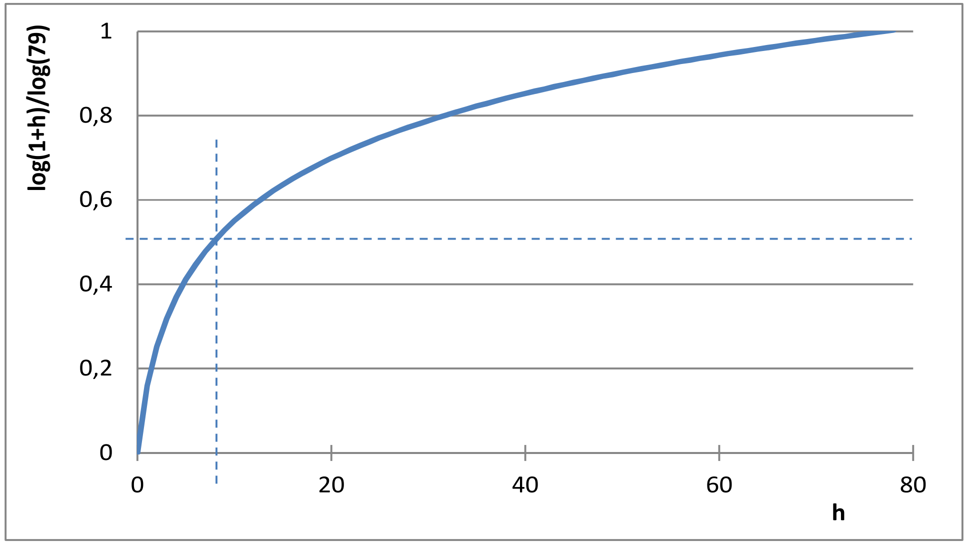
4. Scientiometrics for people of ME / i



4. Scientiometrics / j: The „composite score”

The declared goal: to fix the problem of multi-authorship, which poisons the measurement of personal scientific excellence. The composite score (C) is defined as:

$$C \equiv \sum_{i=1}^{6} \frac{\log(1+F_i)}{\max(\log(1+F_i))}$$



The problem with log: the first 50 % of C for h = 0 – 8, the second 50 % of C for h = 8 – 78?

The 6 terms are: i). total number of citations, ii). h-index, iii). modified h-index by co-authors, iv). citations to single-authored papers, v). citations to single-first-authored papers, vi). citations to single-first-last authored papers. This is a mixed compromise, as i-ii). are better for authors with many co-authors, iii-iv). are better for authors with less co-authors, and v-vi). are perfect only for first / last authors, but fully neglect other authors (???). Additional problem: although independent citations are preferred, they are mixed with the results from self-citations, leading to great confusion. In 2019-tables also the top 2 % / field is given (this is good, although mixed again with self-citations, which is not good at all).

Ioannidis JPA, Boyack KW, Baas J. Updated science-wide author databases of standardized citation indicators. PLoS Biol 18 (2020) e3000918.

4. Scientiometrics / k: on the 6 public excel tables by Ioannidis et al.

Dates	number of „best" scientists	Types of „best"
2013	84.116	A*
2017	106.368	A, B
2019	161.441	A, B, C, D
1960-2017	105.026	A, B
1960-2018	105.000	A, B
1960-2019	159.683	A, B, C, D

A, A*, C: independent citations only,
B, D: all citations, including self-citations,
C-D: top 2 % of the field.

The 174 subfields and the role of Hungary in them are given below

Domain	Field	Subfield	World	% in 100k	HUN
Applied Sciences	Agriculture, Fisheries & Forestry	Agronomy & Agriculture	56850	0,77%	0
Applied Sciences	Agriculture, Fisheries & Forestry	Dairy & Animal Science	48043	0,54%	1
Applied Sciences	Agriculture, Fisheries & Forestry	Fisheries	27800	0,93%	0
Applied Sciences	Agriculture, Fisheries & Forestry	Food Science	48453	0,84%	1
Applied Sciences	Agriculture, Fisheries & Forestry	Forestry	24091	0,38%	0
Applied Sciences	Agriculture, Fisheries & Forestry	Horticulture	5248	0,32%	0
Applied Sciences	Agriculture, Fisheries & Forestry	Veterinary Sciences	46255	0,52%	0
Applied Sciences	Built Environment & Design	Architecture	1133	0,00%	0
Applied Sciences	Built Environment & Design	Building & Construction	27014	0,64%	0
Applied Sciences	Built Environment & Design	Design Practice & Management	8617	0,57%	2
Applied Sciences	Built Environment & Design	Urban & Regional Planning	8522	1,37%	0
Applied Sciences	Enabling & Strategic Technologies	Bioinformatics	18548	1,63%	0
Applied Sciences	Enabling & Strategic Technologies	Biotechnology	50343	0,63%	0
Applied Sciences	Enabling & Strategic Technologies	Energy	186014	0,58%	5
Applied Sciences	Enabling & Strategic Technologies	Materials	177931	0,72%	4
Applied Sciences	Enabling & Strategic Technologies	Nanoscience & Nanotechnology	75210	1,12%	0
Applied Sciences	Enabling & Strategic Technologies	Optoelectronics & Photonics	99488	0,38%	1
Applied Sciences	Enabling & Strategic Technologies	Strategic, Defence & Security Studies	17157	0,66%	0
Applied Sciences	Engineering	Aerospace & Aeronautics	45833	0,35%	0
Applied Sciences	Engineering	Automobile Design & Engineering	1915	0,21%	0
Applied Sciences	Engineering	Biomedical Engineering	50331	0,91%	0
Applied Sciences	Engineering	Chemical Engineering	55697	0,76%	0
Applied Sciences	Engineering	Civil Engineering	42054	0,35%	0
Applied Sciences	Engineering	Electrical & Electronic Engineering	87611	0,31%	2
Applied Sciences	Engineering	Environmental Engineering	42482	1,04%	0
Applied Sciences	Engineering	Geological & Geomatics Engineering	44176	0,82%	0
Applied Sciences	Engineering	Industrial Engineering & Automation	87535	0,81%	3
Applied Sciences	Engineering	Mechanical Engineering & Transports	92645	0,61%	0
Applied Sciences	Engineering	Mining & Metallurgy	27568	0,12%	0
Applied Sciences	Engineering	Operations Research	23455	1,54%	0
Applied Sciences	Information & Communication Technologies	Artificial Intelligence & Image Processing	215114	0,76%	2
Applied Sciences	Information & Communication Technologies	Computation Theory & Mathematics	16572	1,59%	10
Applied Sciences	Information & Communication Technologies	Computer Hardware & Architecture	17080	0,60%	0
Applied Sciences	Information & Communication Technologies	Distributed Computing	9666	0,48%	0
Applied Sciences	Information & Communication Technologies	Information Systems	16581	1,41%	0
Applied Sciences	Information & Communication Technologies	Medical Informatics	13000	0,69%	0
Applied Sciences	Information & Communication Technologies	Networking & Telecommunications	161179	0,56%	2
Applied Sciences	Information & Communication Technologies	Software Engineering	21211	1,13%	0

Domain	Field	Subfield	World	% in 100k	HUN
Arts & Humanities	Communication & Textual Studies	Communication & Media Studies	9005	1,22%	0
Arts & Humanities	Communication & Textual Studies	Languages & Linguistics	11932	0,88%	0
Arts & Humanities	Communication & Textual Studies	Literary Studies	10211	0,12%	0
Arts & Humanities	Historical Studies	Anthropology	7098	1,78%	0
Arts & Humanities	Historical Studies	Archaeology	10479	0,57%	0
Arts & Humanities	Historical Studies	Classics	2213	0,14%	0
Arts & Humanities	Historical Studies	History	9209	0,07%	0
Arts & Humanities	Historical Studies	History of Science, Technology & Medicine	2361	0,42%	0
Arts & Humanities	Historical Studies	History of Social Sciences	1781	0,62%	0
Arts & Humanities	Philosophy & Theology	Applied Ethics	4946	1,46%	0
Arts & Humanities	Philosophy & Theology	Philosophy	7775	0,81%	0
Arts & Humanities	Philosophy & Theology	Religions & Theology	6320	0,13%	0
Arts & Humanities	Visual & Performing Arts	Art Practice, History & Theory	1512	0,00%	0
Arts & Humanities	Visual & Performing Arts	Drama & Theater	789	0,13%	0
Arts & Humanities	Visual & Performing Arts	Folklore	399	0,00%	0
Arts & Humanities	Visual & Performing Arts	Music	2057	0,00%	0

Domain	Field	Subfield	World	% in 100k	HUN
Economic & Social Sciences	Economics & Business	Accounting	4675	1,60%	0
Economic & Social Sciences	Economics & Business	Agricultural Economics & Policy	4873	1,81%	0
Economic & Social Sciences	Economics & Business	Business & Management	36319	2,57%	0
Economic & Social Sciences	Economics & Business	Development Studies	3506	1,80%	0
Economic & Social Sciences	Economics & Business	Econometrics	1043	7,19%	0
Economic & Social Sciences	Economics & Business	Economic Theory	1516	1,98%	0
Economic & Social Sciences	Economics & Business	Economics	33447	2,34%	2
Economic & Social Sciences	Economics & Business	Finance	9626	1,67%	0
Economic & Social Sciences	Economics & Business	Industrial Relations	1900	0,74%	0
Economic & Social Sciences	Economics & Business	Logistics & Transportation	21274	0,52%	0
Economic & Social Sciences	Economics & Business	Marketing	10464	2,09%	0
Economic & Social Sciences	Economics & Business	Sport, Leisure & Tourism	6302	1,59%	0
Economic & Social Sciences	Social Sciences	Criminology	9174	1,96%	0
Economic & Social Sciences	Social Sciences	Cultural Studies	5297	0,13%	0
Economic & Social Sciences	Social Sciences	Demography	2604	1,73%	0
Economic & Social Sciences	Social Sciences	Education	58316	0,76%	0
Economic & Social Sciences	Social Sciences	Family Studies	2997	1,53%	0
Economic & Social Sciences	Social Sciences	Gender Studies	1759	0,91%	0
Economic & Social Sciences	Social Sciences	Geography	12879	2,51%	0
Economic & Social Sciences	Social Sciences	Information & Library Sciences	10391	0,61%	0
Economic & Social Sciences	Social Sciences	International Relations	6136	1,37%	0
Economic & Social Sciences	Social Sciences	Law	8100	0,41%	0
Economic & Social Sciences	Social Sciences	Political Science & Public Administration	16018	2,13%	0
Economic & Social Sciences	Social Sciences	Science Studies	3964	1,94%	3
Economic & Social Sciences	Social Sciences	Social Sciences Methods	2354	3,65%	0
Economic & Social Sciences	Social Sciences	Social Work	6138	0,36%	0
Economic & Social Sciences	Social Sciences	Sociology	7606	2,88%	0

Domain	Field	Subfield	World	% in 100k	HUN
Health Sciences	Biomedical Research	Anatomy & Morphology	5832	0,22%	0
Health Sciences	Biomedical Research	Biochemistry & Molecular Biology	135836	2,66%	13
Health Sciences	Biomedical Research	Biophysics	18401	1,52%	1
Health Sciences	Biomedical Research	Developmental Biology	105600	2,99%	2
Health Sciences	Biomedical Research	Genetics & Heredity	32641	1,78%	0
Health Sciences	Biomedical Research	Microbiology	134369	1,87%	3
Health Sciences	Biomedical Research	Microscopy	3455	0,87%	0
Health Sciences	Biomedical Research	Mycology & Parasitology	20926	1,02%	2
Health Sciences	Biomedical Research	Nutrition & Dietetics	35927	2,06%	0
Health Sciences	Biomedical Research	Physiology	19817	2,31%	4
Health Sciences	Biomedical Research	Toxicology	45124	1,18%	0
Health Sciences	Biomedical Research	Virology	58416	1,66%	1
Health Sciences	Clinical Medicine	Allergy	14689	2,08%	0
Health Sciences	Clinical Medicine	Anesthesiology	34440	1,20%	0
Health Sciences	Clinical Medicine	Arthritis & Rheumatology	29160	2,25%	1
Health Sciences	Clinical Medicine	Cardiovascular System & Hematology	152312	2,23%	2
Health Sciences	Clinical Medicine	Complementary & Alternative Medicine	9518	0,26%	0
Health Sciences	Clinical Medicine	Dentistry	55471	1,00%	0
Health Sciences	Clinical Medicine	Dermatology & Venereal Diseases	41196	1,58%	0
Health Sciences	Clinical Medicine	Emergency & Critical Care Medicine	28564	1,24%	0
Health Sciences	Clinical Medicine	Endocrinology & Metabolism	69094	3,18%	2
Health Sciences	Clinical Medicine	Environmental & Occupational Health	12252	0,74%	0
Health Sciences	Clinical Medicine	Gastroenterology & Hepatology	76367	1,89%	3
Health Sciences	Clinical Medicine	General & Internal Medicine	106795	0,77%	0
Health Sciences	Clinical Medicine	General Clinical Medicine	16340	0,43%	0
Health Sciences	Clinical Medicine	Geriatrics	9241	2,03%	0
Health Sciences	Clinical Medicine	Immunology	108509	2,52%	3
Health Sciences	Clinical Medicine	Legal & Forensic Medicine	10158	0,31%	0
Health Sciences	Clinical Medicine	Neurology & Neurosurgery	227881	2,89%	17
Health Sciences	Clinical Medicine	Nuclear Medicine & Medical Imaging	84246	1,08%	5
Health Sciences	Clinical Medicine	Obstetrics & Reproductive Medicine	66536	1,53%	2
Health Sciences	Clinical Medicine	Oncology & Carcinogenesis	230678	1,78%	2
Health Sciences	Clinical Medicine	Ophthalmology & Optometry	52338	1,40%	0
Health Sciences	Clinical Medicine	Orthopedics	57183	1,30%	0
Health Sciences	Clinical Medicine	Otorhinolaryngology	33662	0,81%	0
Health Sciences	Clinical Medicine	Pathology	19713	1,59%	0
Health Sciences	Clinical Medicine	Pediatrics	49820	1,04%	0
Health Sciences	Clinical Medicine	Pharmacology & Pharmacy	94611	0,98%	4
Health Sciences	Clinical Medicine	Psychiatry	56373	3,12%	4
Health Sciences	Clinical Medicine	Respiratory System	52718	1,95%	0
Health Sciences	Clinical Medicine	Sport Sciences	22602	1,18%	0
Health Sciences	Clinical Medicine	Surgery	80940	1,11%	0
Health Sciences	Clinical Medicine	Tropical Medicine	28529	0,74%	0
Health Sciences	Clinical Medicine	Urology & Nephrology	64516	1,80%	0
Health Sciences	Psychology & Cognitive Sciences	Behavioral Science & Comparative Psychology	9767	3,74%	1
Health Sciences	Psychology & Cognitive Sciences	Clinical Psychology	11919	2,74%	0
Health Sciences	Psychology & Cognitive Sciences	Developmental & Child Psychology	15236	4,08%	0
Health Sciences	Psychology & Cognitive Sciences	Experimental Psychology	23081	4,68%	4
Health Sciences	Psychology & Cognitive Sciences	General Psychology & Cognitive Sciences	2802	1,21%	0
Health Sciences	Psychology & Cognitive Sciences	Human Factors	13251	1,31%	0
Health Sciences	Psychology & Cognitive Sciences	Psychoanalysis	2712	0,63%	0
Health Sciences	Psychology & Cognitive Sciences	Social Psychology	16884	4,02%	0
Health Sciences	Public Health & Health Services	Epidemiology	9540	2,68%	0
Health Sciences	Public Health & Health Services	Gerontology	8873	1,97%	0
Health Sciences	Public Health & Health Services	Health Policy & Services	16521	1,65%	0
Health Sciences	Public Health & Health Services	Nursing	35893	0,50%	0
Health Sciences	Public Health & Health Services	Public Health	48533	1,92%	0
Health Sciences	Public Health & Health Services	Rehabilitation	21192	0,94%	0
Health Sciences	Public Health & Health Services	Speech-Language Pathology & Audiology	8890	1,01%	0
Health Sciences	Public Health & Health Services	Substance Abuse	12500	3,09%	0

Domain	Field	Subfield	World	% in 100k	HUN
Natural Sciences	Biology	Ecology	48166	0,0321	3
Natural Sciences	Biology	Entomology	25735	0,0099	0
Natural Sciences	Biology	Evolutionary Biology	23541	0,0358	1
Natural Sciences	Biology	Marine Biology & Hydrobiology	37726	0,0208	1
Natural Sciences	Biology	Ornithology	5559	0,0108	0
Natural Sciences	Biology	Plant Biology & Botany	113961	0,0119	4
Natural Sciences	Biology	Zoology	13250	0,0024	0
Natural Sciences	Chemistry	Analytical Chemistry	87137	0,0088	7
Natural Sciences	Chemistry	General Chemistry	44508	0,0065	0
Natural Sciences	Chemistry	Inorganic & Nuclear Chemistry	57598	0,0118	0
Natural Sciences	Chemistry	Medicinal & Biomolecular Chemistry	80622	0,0054	2
Natural Sciences	Chemistry	Organic Chemistry	111388	0,0161	5
Natural Sciences	Chemistry	Physical Chemistry	32198	0,0123	4
Natural Sciences	Chemistry	Polymers	80670	0,0113	5
Natural Sciences	Earth & Environmental Sciences	Environmental Sciences	66925	0,0082	0
Natural Sciences	Earth & Environmental Sciences	Geochemistry & Geophysics	70197	0,0236	1
Natural Sciences	Earth & Environmental Sciences	Geology	12609	0,0131	0
Natural Sciences	Earth & Environmental Sciences	Meteorology & Atmospheric Sciences	54940	0,027	0
Natural Sciences	Earth & Environmental Sciences	Oceanography	14390	0,0161	0
Natural Sciences	Earth & Environmental Sciences	Paleontology	18345	0,0246	1
Natural Sciences	Mathematics & Statistics	Applied Mathematics	15805	0,0146	0
Natural Sciences	Mathematics & Statistics	General Mathematics	48314	0,0088	3
Natural Sciences	Mathematics & Statistics	Numerical & Computational Mathematics	14329	0,0117	0
Natural Sciences	Mathematics & Statistics	Statistics & Probability	16942	0,0229	0
Natural Sciences	Physics & Astronomy	Acoustics	27952	0,0079	0
Natural Sciences	Physics & Astronomy	Applied Physics	224856	0,0116	2
Natural Sciences	Physics & Astronomy	Astronomy & Astrophysics	42624	0,0322	1
Natural Sciences	Physics & Astronomy	Chemical Physics	73903	0,0268	11
Natural Sciences	Physics & Astronomy	Fluids & Plasmas	43218	0,0227	6
Natural Sciences	Physics & Astronomy	General Physics	62527	0,0116	1
Natural Sciences	Physics & Astronomy	Mathematical Physics	4956	0,0174	1
Natural Sciences	Physics & Astronomy	Nuclear & Particle Physics	110499	0,0148	5
Natural Sciences	Physics & Astronomy	Optics	56325	0,0074	0

4. Science in numbers

(2019, Ioannidis et al.)

Domain of science	Scientists, M	In top 100k	% in top 100k
Health Sciences	2.87	54,293	1.89
Economic / Social Sciences	0.289	4,641	1.61
Natural Sciences	1.74	25,917	1.49
Applied Sciences	2.00	13,811	0.69
Arts / Humanities	0.088	587	0.67
Unassigned	0.94	751	0.080
Total	7.93	100,000	1.26

Definition of the scientist: an individual with at least 5 Scopus papers. According to this definition, there are about 8 million scientists world-wide. Thus, being in the top 100,000 scientists means being in about the top 1 %.

4. Uni-Miskolc people in the best 100,000 (and beyond)

(Ioannidis et al.)

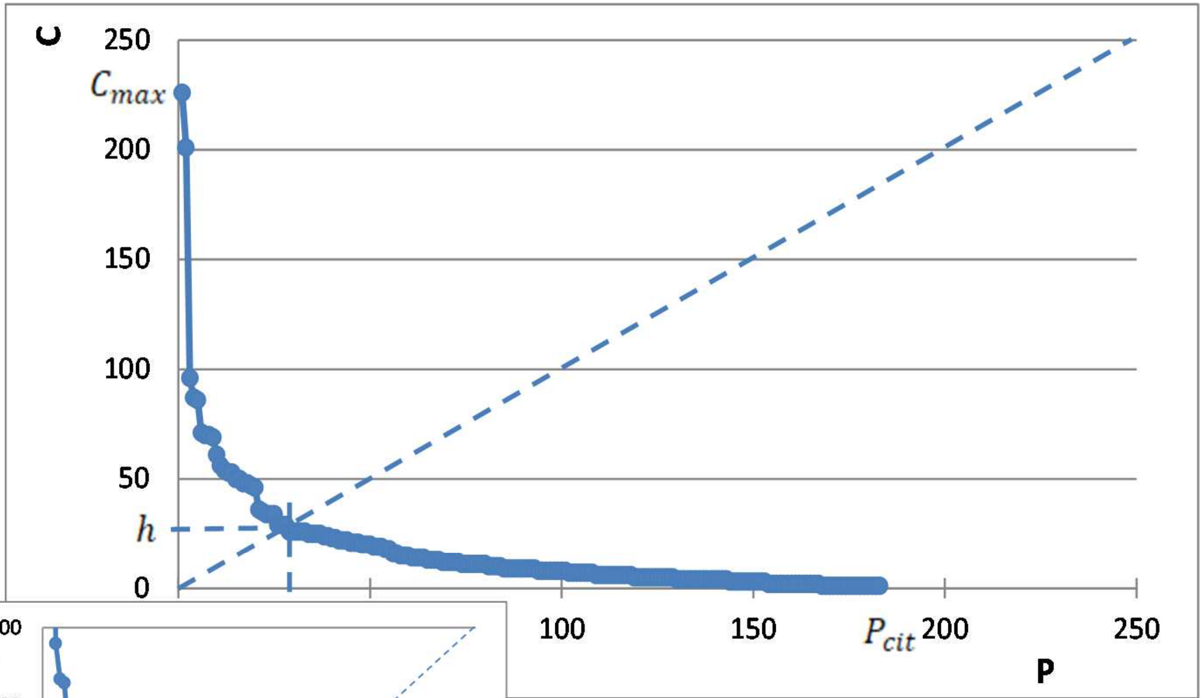
Name	Field	Year(s)	Ranking*
János Szebeni**	Pharmacology	1960 – 2018	36,999
George Kaptay**	Materials	1960 – 2017 1960 – 2018 1960 – 2019 2013 2017 2019	86,607 77,793 69,171 38,060 39,804 25,503
Gábor Mucsi***	Mining – Metallurgy	2019	391,865
József Farkas****	Mining – Metallurgy	1960 - 2019	932,810
Tamás Kékesi****	Mining – Metallurgy	1960 – 2019	999,566

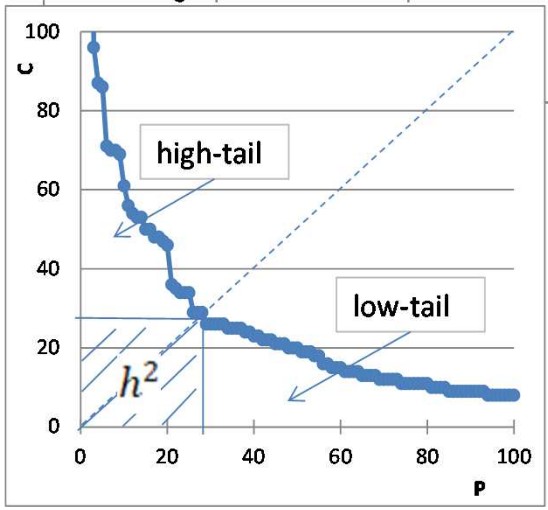
*Ranking calculated from independent citations,
**In the best 100,000 by their independent citations (+ in the top 2 % of their fields),
***In the list because in best 2 % of Mining-Metallurgy with independent citations,
****In the list because in best 2 % of Mining-Metallurgy with self-citations.

4. Scientiometrics / m

Problems with the h-index: Use the k-index instead of the h-index

G.Kaptay. The k-index is introduced to replace the h-index to evaluate better the scientific excellence of individuals. Heliyon 6 (2020) e04415 (9 pages). (Q1 in 2019 in Multidisciplinary).





$$C_{tot} = h^2 \cdot (1 + k_{high} + k_{low})$$

$$k_{high} \equiv C_{high}/h^2$$

$$k_{low} \equiv C_{low}/h^2$$

$$h = \sqrt{\frac{C_{tot}}{a}}$$

$$a = 1 + k_{high} + k_{low}$$

Problems with the h-index:

- practically it does not depend on number of papers (trick)
- it ignores average of 75 % of citations (why?)
- it leads to stops as function of time (misleading)
- It depends on citation distribution (misleading)
- It ignores the role of co-authors and independent citations.

4. Scientiometrics / o

The k-index of an individual:

$$k_i = \sqrt{\sum_j p_j \cdot C_j}$$

where k_i is the k-index of an individual i, j is the serial number of a paper of individual i, p_j is the author-share of the individual i in paper j (it should be given in the paper or if not, it is the inverse of the number of authors in the given paper), C_j is the number of independent citations of paper j of individual i (the citation is independent if there is no overlap in the authors list of the citing and cited papers).

$$k_i = \sqrt{\sum_j \frac{C_j}{N_j}}$$

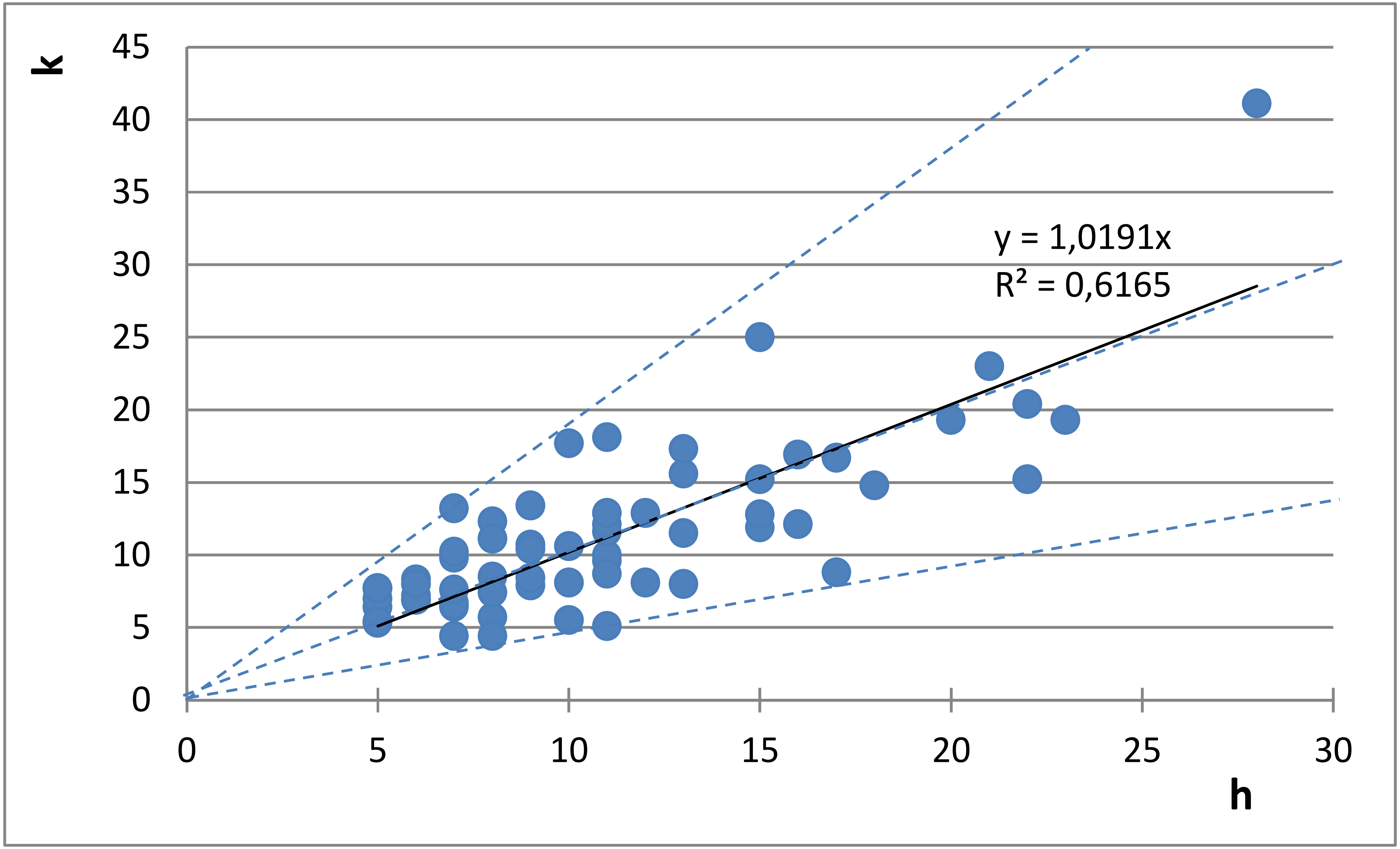
$$k_{i,max} = \sqrt{C_{tot}}$$

$$k_i^* \equiv \frac{k_i}{A_i - A_o}$$

$$k_i = \sqrt{\frac{k_{ind,i} \cdot C_{tot,i}}{N_{av,i}}}$$

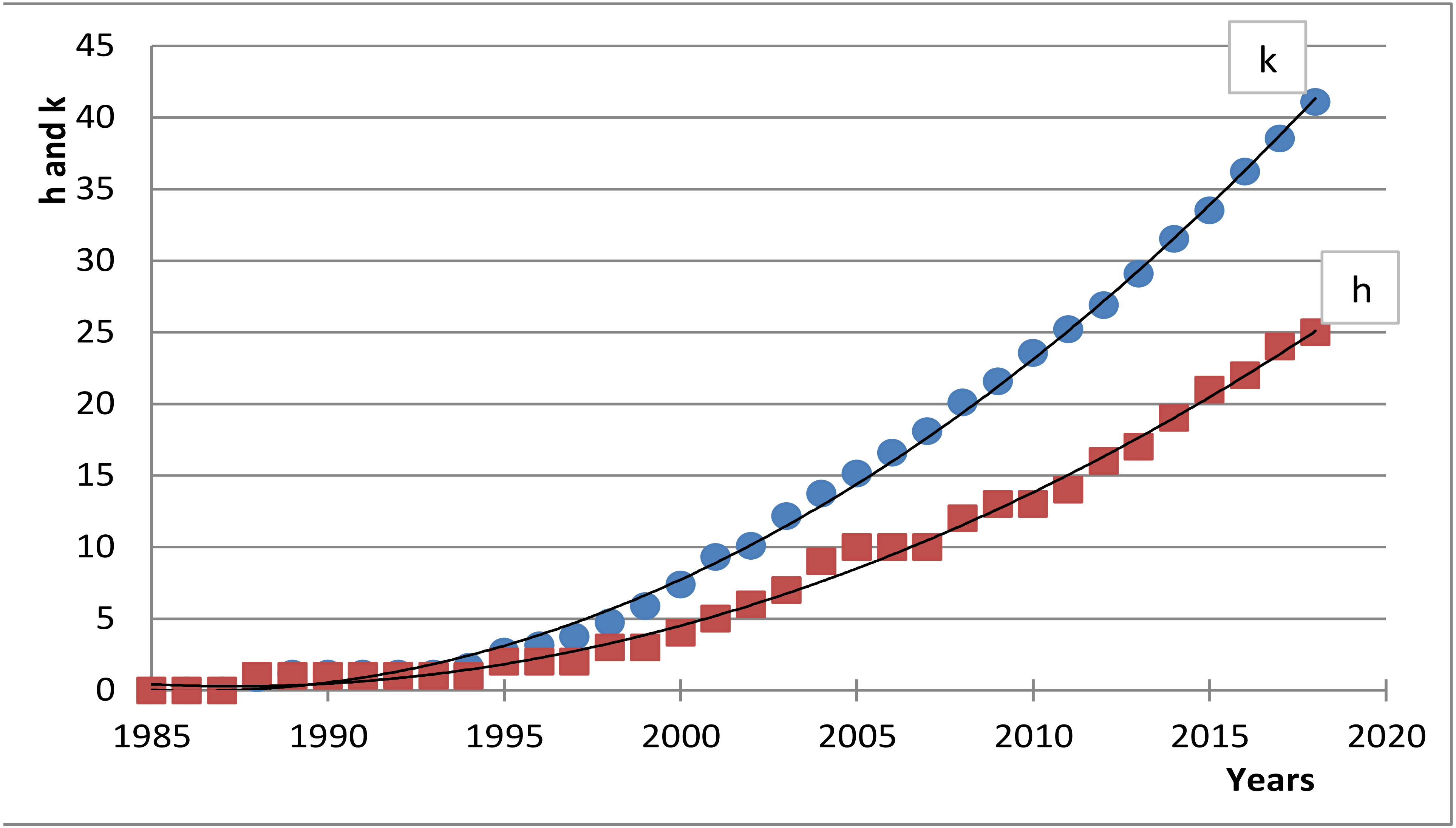
4. Scientiometrics / p

The k-index is statistically the same as the h-index, BUT!!!



4. Scientiometrics / r

The k-index is statistically the same as the h-index, BUT!!!



4. Scientiometrics / 0

The k-index can be extended to:

Journals: $$k_J = \sqrt{\sum_j C_j}$$

publishing houses: $$k_P = \sqrt{\sum_J k_J^2}$$

Departments: $$k_D = \sqrt{\sum_i k_i^2}$$

Institutions: $$k_I = \sqrt{\sum_D k_D^2}$$

Countries: $$k_C = \sqrt{\sum_I k_I^2}$$

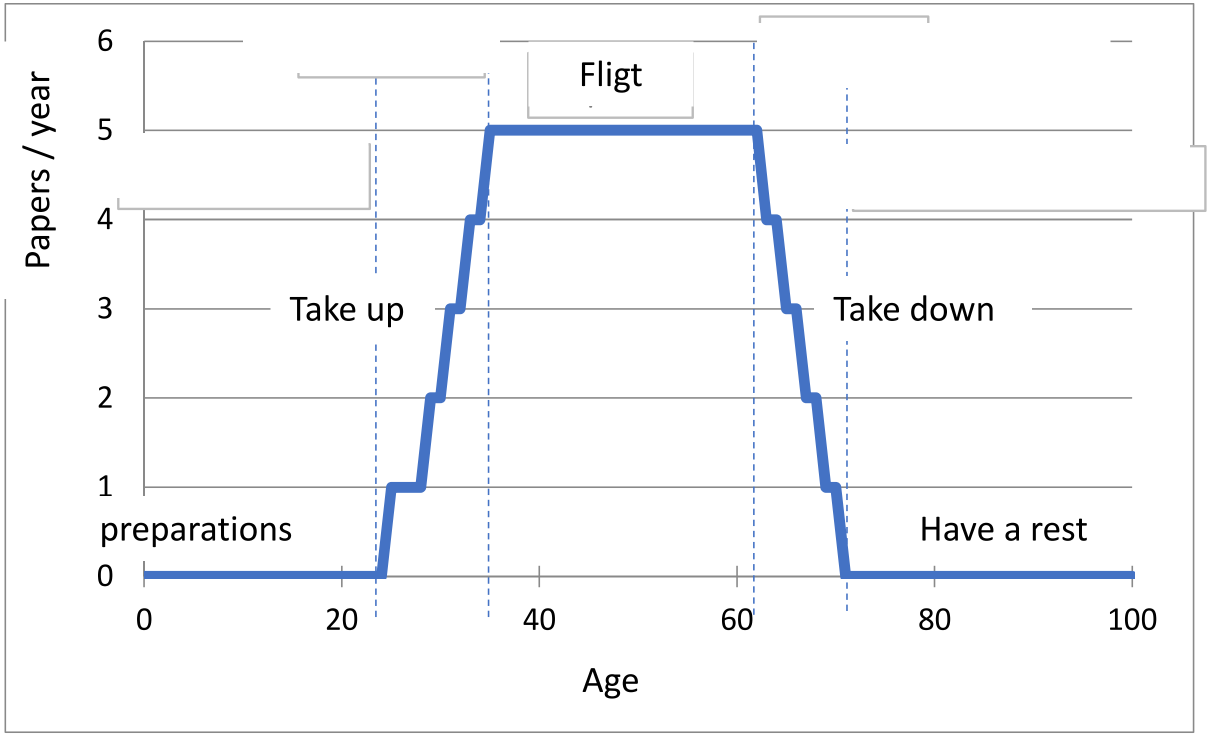
Continents: $$k_T = \sqrt{\sum_C k_C^2}$$

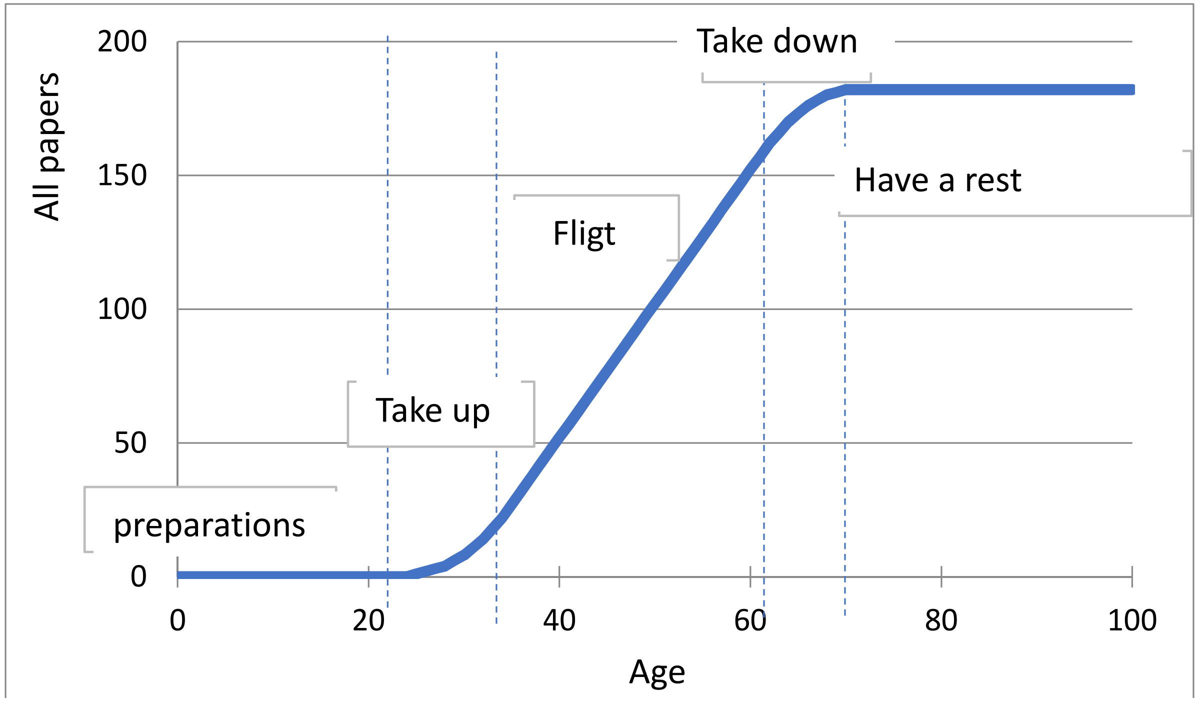
Mankind: $$k_M = \sqrt{\sum_T k_T^2}$$

5. Planning your career as a scientist

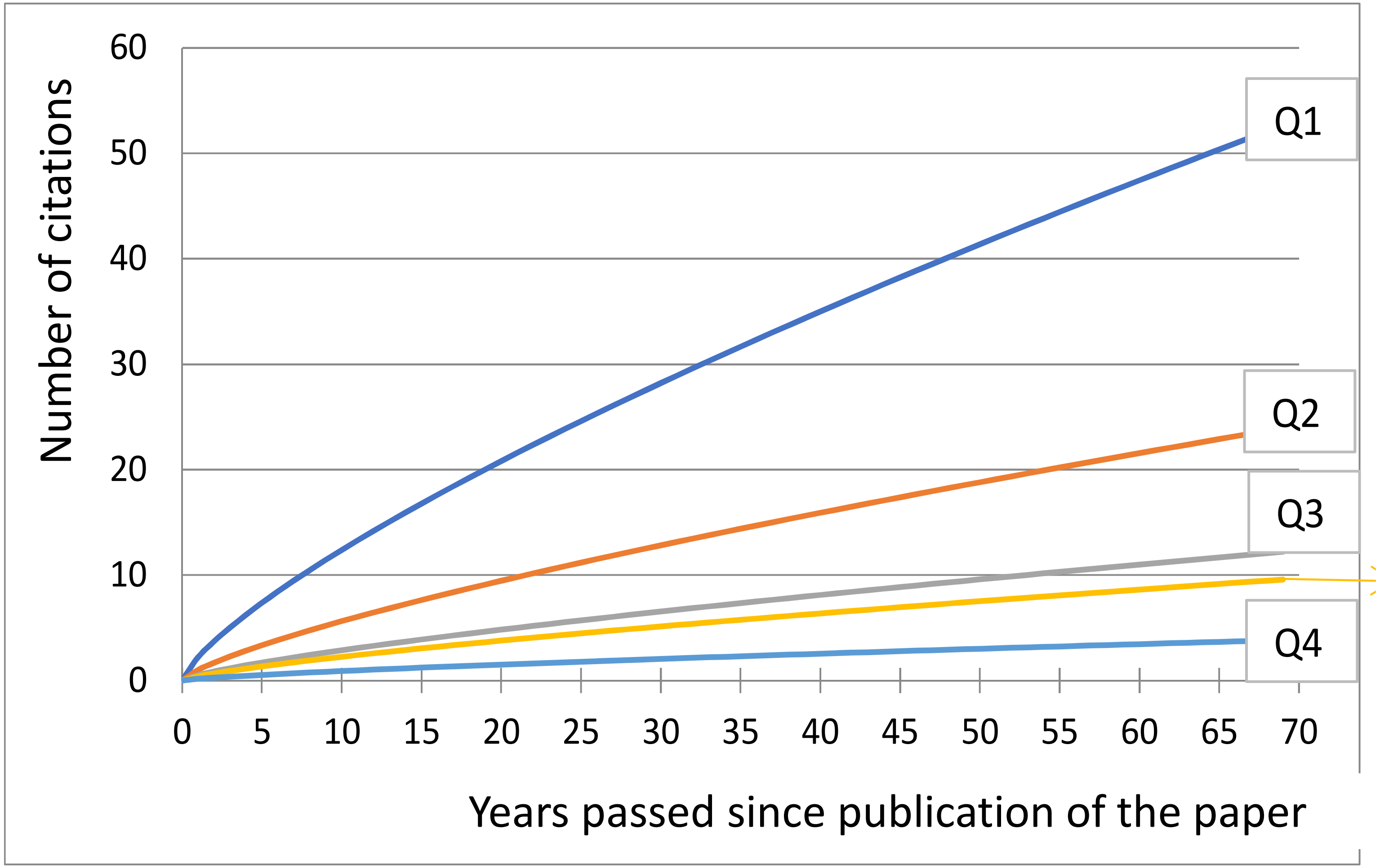
(Sasvári P., Kaptay Gy. Paradigmaváltás a műszaki tudományos értékelésben: egy műszaki oktatói / kutatói életpálya-modell különböző lehetséges kimenetelekkel, avagy Ön docensként, professzorként, vagy akadémikusként akar nyugdíjba menni?. Anyagvizsgálók Lapja, 2019, II. szám, 28-36. oldal.)

5. An idealized scientific career



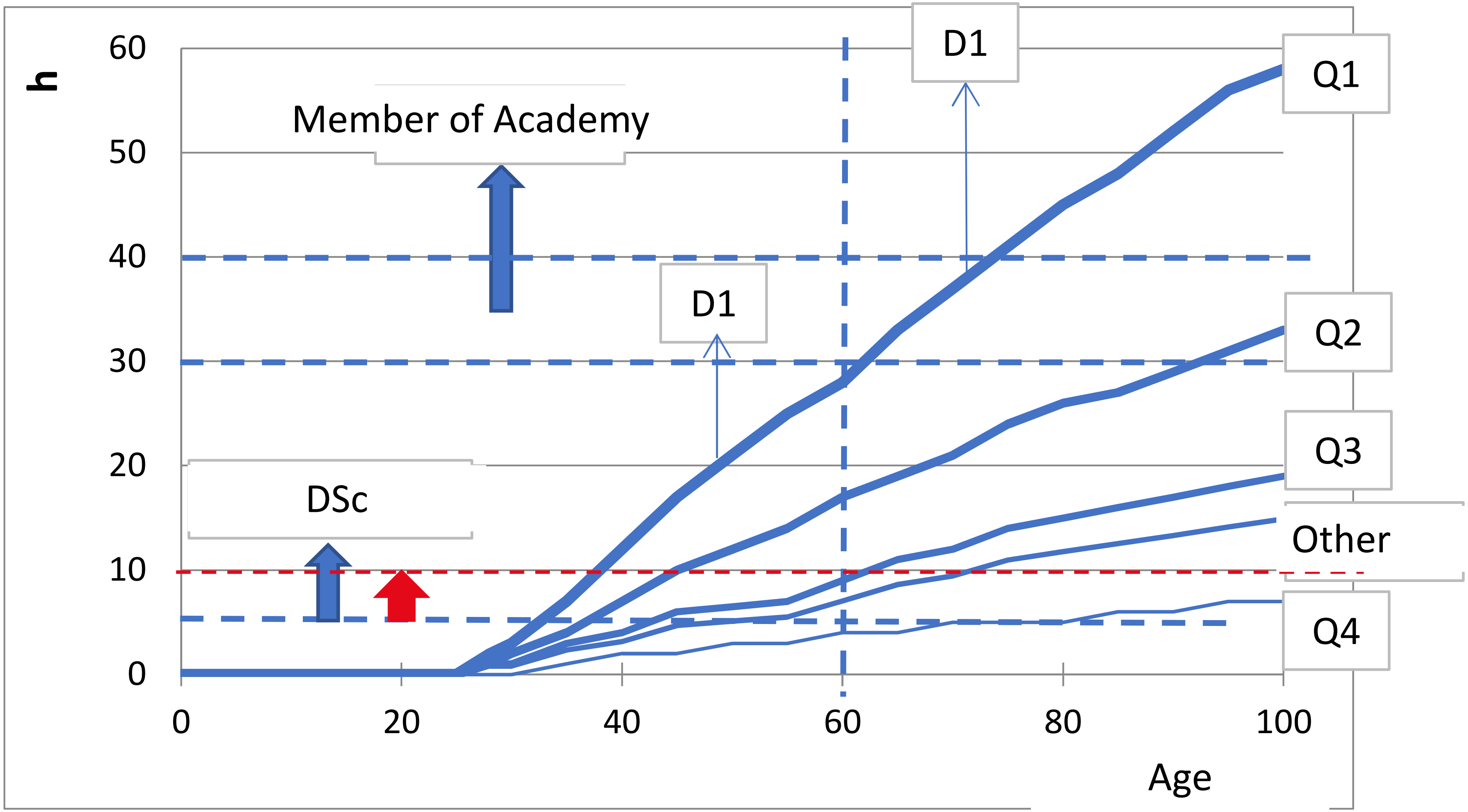


5. Citation-attracting abilities of papers published in different journals (Scopus / Uni-Miskolc)

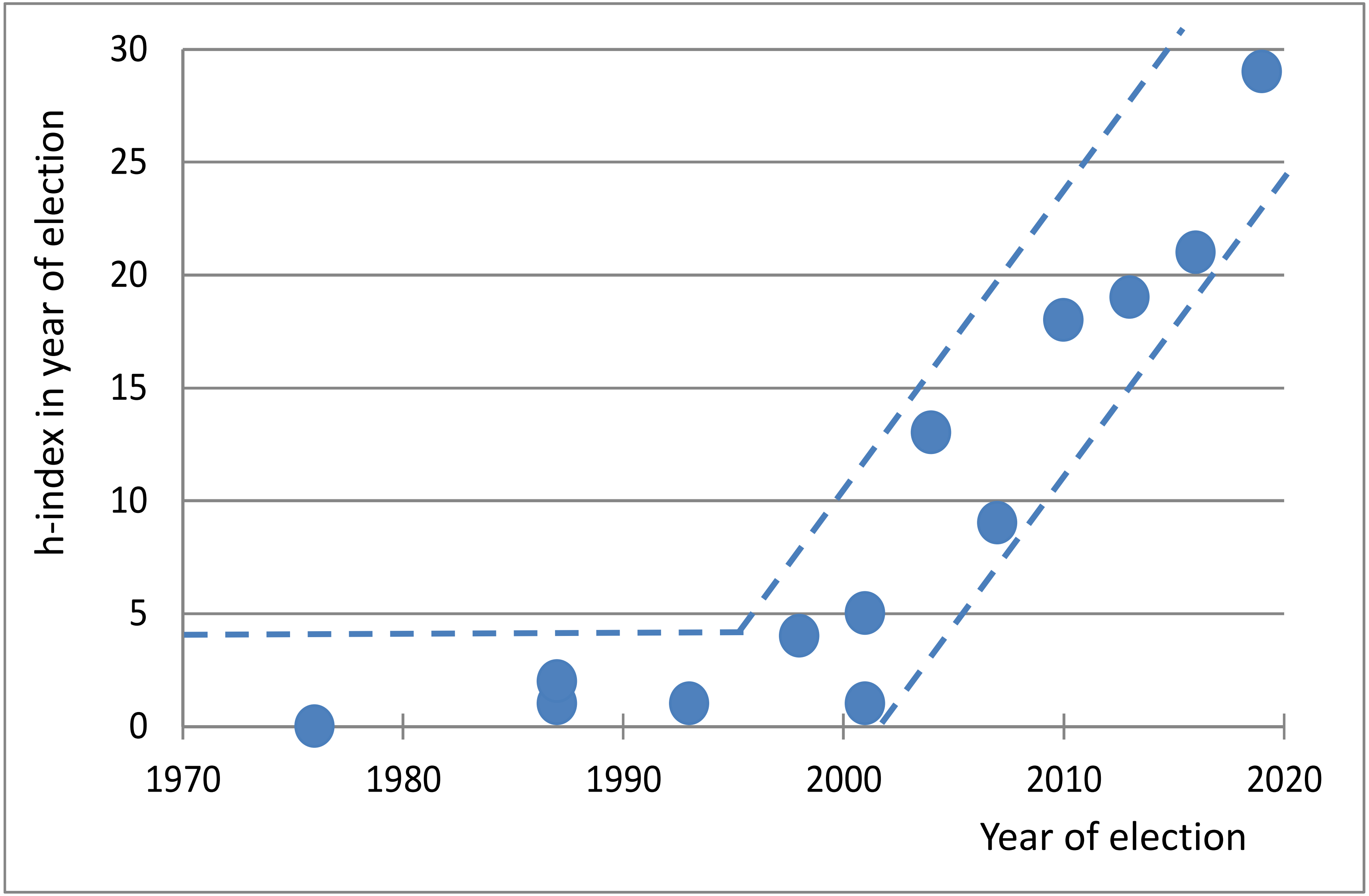


That is why you should prefer publishing in Q1 journals (the same Q1-index exists for each discipline separately)

5. An average h-index as function of your age if you publish papers in journals of different ranks



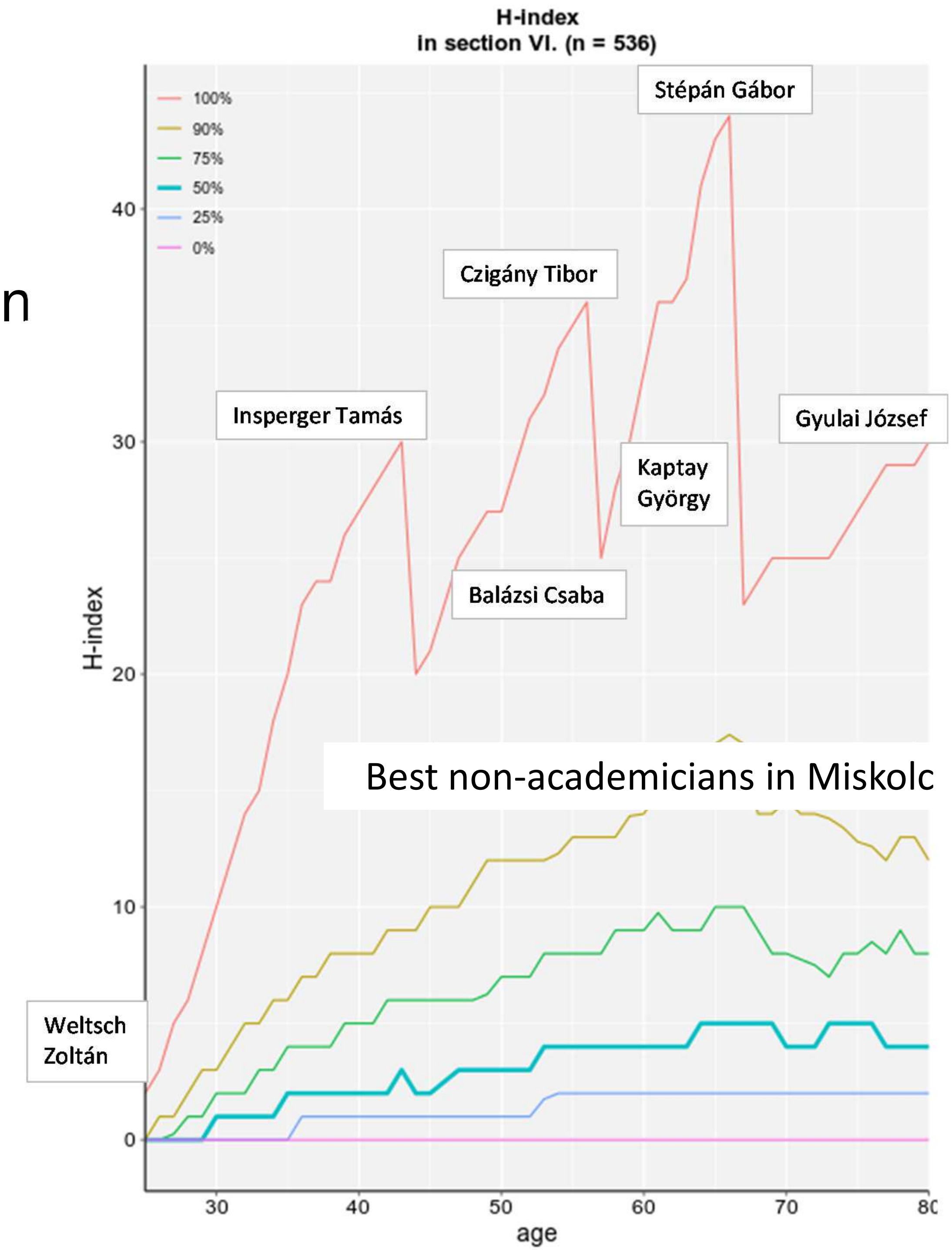
5. The h-index in the year of being elected as a corresponding member of the Hungarian Academy of Sciences



* Among mechanical – metallurgical – materials engineers

5. Top-h-indexes among engineers at the Hungarian Academy (2019)

(data after MTMT)



6. Ethics / a

According to Office of Research Integrity, USA

Major sins (not to do-s):

Falsification (altering your original results to make it look better),

Fabrication („creating" the results instead of measuring them),

Plagiarism (stealing others results without reference / software!)

Self-plagiarism (text re-cycling from you own previous paper)

Illegitimate or Guest Authorship (indicating as author a person who has no significant scientific contribution in your paper for „other" reasons, such as your relative, your boss, the financing guy, etc…)

+1: blocking scientific discussion / criticism as a chair-person on a conference / defence (PhD, etc.…)

6. Ethics / b

The ethical rules of publishing (According to Elsevier)

i. be the authors' own original work, which has not been previously published elsewhere (checked by the text-similarity detection service CrossCheck)

ii. reflect the authors' own research and analysis and do so in a truthful and complete manner,

iii. properly credit the meaningful contributions of co-authors and co-researchers,

iv. not be submitted to more than one journal for consideration (ensuring it is not under redundant simultaneous peer review),

v. be appropriately placed in the context of prior and existing research.

7. Patenting / a

Publishing = sharing my new knowledge free worldwide

Patenting = excluding others from using my new knowledge (if not paid for it).

Patenting = a social deal (a researcher makes his invention public, but gets a right to make financial use of it during 20 years; after 20 years anyone can use it free of charge).

This is a business of rich, even the first filing in Hungary costs 3,000 – 5,000 Euros + fees each year + extensions to other countries. This is a clear business for lawyers, a questionable business for the inventors. First year: kept in secret, then publicized (but before the end of 1st year it can be extended to other countries: PCT). First evaluation takes 3 years in Hungary, 1 year in USA.

The United States of America

The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Joseph Matal

Performing the Functions and Duties of the
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office

7. Patenting / b

It is worth filing a patent, when ...

1. your invention is new, and not obvious for a specialist,
2. your invention can become a marketable product,
3. the expected income is higher than the expected costs,
4. your invention cannot be kept secret, as it becomes obvious at first sight (otherwise it is cheaper to keep it secret),
5. if not published yet in any form.

What is patentable?

Any new invention in any field of technology, which is based on a process of invention, and can be used in industry

What is not patentable?

Law of Nature, its discovery, theory, model, equation, piece of art, software, procedure, rule …

7. Patenting / c

Key players of a patent

Inventor(s) = people who created the patent (with % of their share). The inventorship cannot be sold.

Owner(s) = usually a company (or companies), but can be a person (or persons). The ownership can be sold.

A contract between them: if the owners get some income for the patent, how the inventors are paid (if at all).

Parts of a patent

Title („Process … , material, etc...…)

Summary

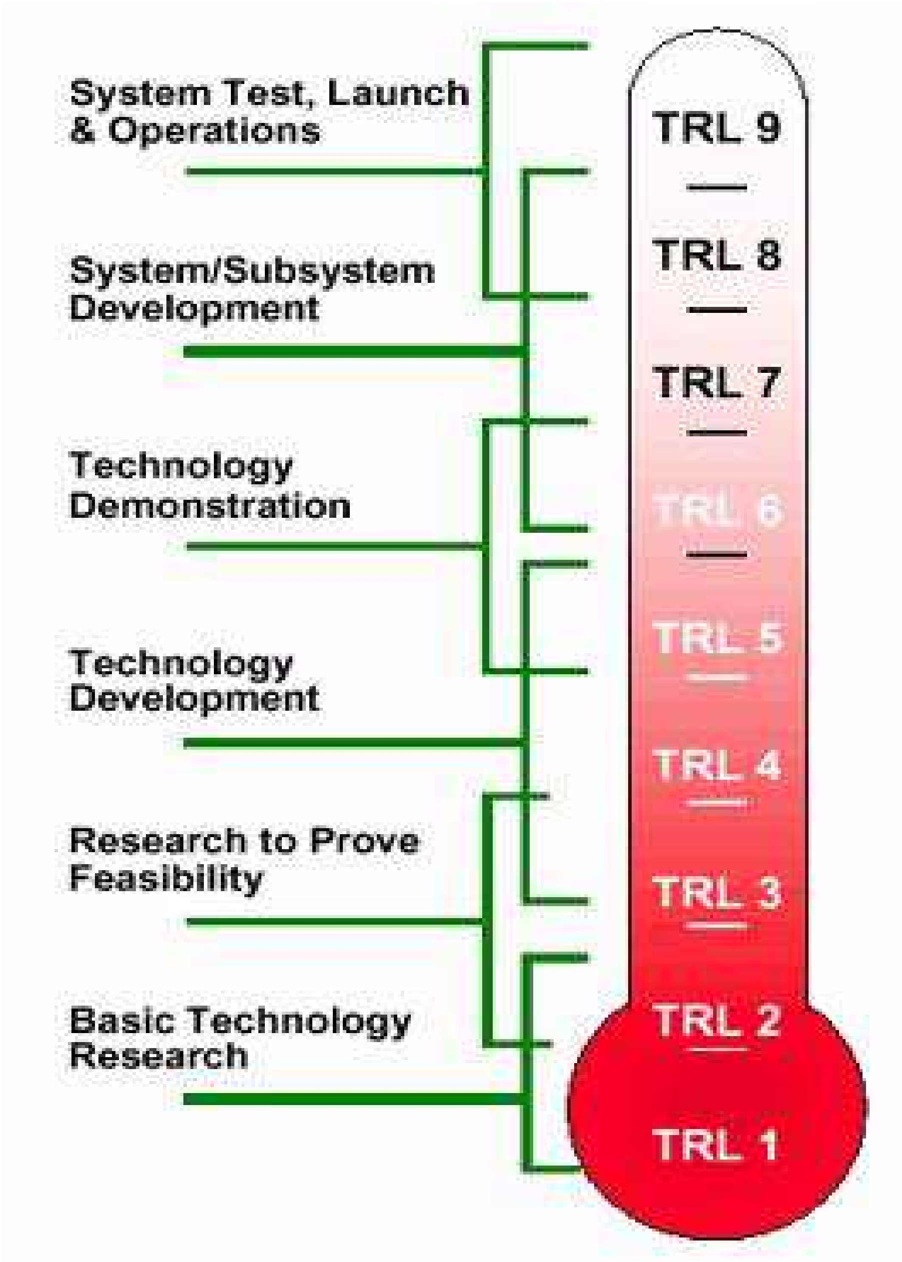
State of the art

What is surprising / unexpected? (in a paper we are clever, in a patent we a stupidly surprised; no surprise, no patent)

Examples (both negative and positive)

Claims

8. TRL / NASA



Technology readiness levels (TRLs) are measures used to assess the maturity of evolving technologies (devices, materials, components, software, work processes, etc.) during their development and in some cases during early operations. Generally speaking, when a new technology is first invented or conceptualized, it is not suitable for immediate application. Instead, new technologies are usually subjected to experimentation, refinement, and increasingly realistic testing. Once the technology is sufficiently proven, it can be incorporated into a system.

8. TRL / EU

Technology readiness levels (TRLs) in EU

1: basic principles observed
2: technology concept formulated
3: experimental proof of concept
4: technology validated in lab

5: technology validated in industry
6: technology demonstrated in industry
7: system prototype demonstration in operational environment
8: system complete and qualified
9: actual system proven in operational environment (competitive manufacturing)

Only now you can start production and making profit

8. TRL / a

TRL = Technology readiness level

Important to talk to investors (or special industrial projects) to say clearly where we are and how much time and money is needed to make a product or technology from the idea:

TRL level	Years needed	Cash needed (M Euro)
1	„0”	„0”
2	0.3	0.01
3	1-3	0.1
4	1-3	0.3
5	1-3	1
6	1-3	3
7	1-3	10
8	1-3	30
9	1-3	100

8. TRL 1
US Department of Defense

Basic principles observed and reported

Description: Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties.

Supporting info: Published research that identifies the principles that underlie this technology. References to who, where, when.

8. TRL 2
US Department of Defense

Technology concept and/or application formulated

Description: Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.

Supporting info: Publications or other references that outline the application being considered and that provide analysis to support the concept.

8. TRL 3
US Department of Defense

Technology concept and/or application formulated

Description: Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.

Supporting info: Publications or other references that outline the application being considered and that provide analysis to support the concept.

8. TRL 4
US Department of Defense

Component and/or breadboard validation in laboratory environment

Description: Basic technological components are integrated to establish that they will work together. This is relatively “low fidelity” compared with the eventual system. Examples include integration of “ad hoc” hardware in the laboratory.

Supporting info: System concepts that have been considered and results from testing laboratory-scale breadboard(s). References to who did this work and when. Provide an estimate of how breadboard hardware and test results differ from the expected system goals.

8. TRL 5
US Department of Defense

Component and/or breadboard validation in relevant environment

Description: Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include “high-fidelity” laboratory integration of components.

Supporting info: Results from testing laboratory breadboard system are integrated with other supporting elements in a simulated operational environment. How does the “relevant environment” differ from the expected operational environment? How do the test results compare with expectations? What problems, if any, were encountered? Was the breadboard system refined to more nearly match the expected system goals?

8. TRL 6
US Department of Defense

System/subsystem model or prototype demonstration in a relevant environment

Description: Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.

Supporting info: Results from laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. How did the test environment differ from the operational environment? Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?

8. TRL 7
US Department of Defense

System prototype demonstration in an operational environment

Description: Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in space).

Supporting info: Results from testing a prototype system in an operational environment. Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?

8. TRL 8
US Department of Defense

Actual system completed and qualified through test and demonstration

Description: Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation (DT&E) of the system in its intended weapon system to determine if it meets design specifications.

Supporting info: Results of testing the system in its final configuration under the expected range of environmental conditions in which it will be expected to operate. Assessment of whether it will meet its operational requirements. What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before finalizing the design?

8. TRL 9
US Department of Defense

Actual system proven through successful mission operations.

Description: Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation (OT&E). Examples include using the system under operational mission conditions.

Supporting info: OT&E (operational test and evaluation)reports.

9. Ranking of universities (QS)

QS-2021 (only the first 1,000 are mentioned from the 1604 universities evaluated:

SZTE (Szeged): ranked No 510,
DE (Debrecen): ranked No 527,
ELTE (Budapest): ranked No 608,
PTE (Pécs): ranked No 695,
BME (Budapest): ranked No 821,
CORVINUS (Budapest): ranked No. 825,
SZIE (Gödöllő): ranked No. 887,
ME (Miskolc): ranked No 975.

To be on the list (as high as possible) is very important for marketing.

Criteria	Weight, %	Uni-Mis-2021, %
Academic reputation (questionary)	40	5.5
Employer reputation (questionary)	10	6.4
Student : staff ratio (the lower the better)	20	34.1
Citation per faculty (Scopus, 2014-2018 papers)	20	2.7
International faculty	5	4.9
International students	5	3.9
Total	100	10.64

9. Ranking b: Citations per staff

Number of independent Scopus citations in 2014-2019 obtained for Scopus papers (with at least 1 affiliation from the given institute) published in 2014-2018. No more than 10 affiliations! (except „Hospitals”). Additional weighing: 1). arts and humanities, 2). social sciences and management, 3). engineering and technology, 4). natural sciences, 5). life sciences and medicine (with decreasing weights to compensate for their high numbers of citations).

Results of Uni-Miskolc in 2021:

- 1,165 Scopus papers in 2014-2018,
- 13 (1,1 %) excluded for too many affiliations,
- Minimum 1 independent citation for 767 papers,
- Total 2,540 independent citations for767 papers (3.3 cit/paper)
- QS multiplied this by 1.54 = 3,904 „effective citations”
- QS divided it by 652 staff = 6.0 citations per staff.
- This is 2.7 points out of maximum 100 points (best average: 222 citations per staff)
- We have only 2 such people (not 652)
- Our life-scientists: 38 cit / staff (14 %)
- Our engineers: 14 cit / staff (80 %)
- Our social scientists: 4 cit / staff (6 %)
- 30 % with at least 1 citation (70 % passive).
- Two best: 200 – 230 cits.
- The third best: 80 cits (others below 80 cits).

9. Ranking c: how to motivate?

The NTL (Hungarian acronym for International Scientific Visibility) is calculated for each faculty member of the University of Miskolc:

$$NTL = \sum q \cdot \frac{k}{N}$$

- Summation per Scopus papers published in previous year
- Ccondition: Uni-Miskolc as affiliation in the paper (max 10 affils),
- ***N*** is the number of authors from Uni-Miskolc in the paper,
- ***q*** = the quality factor, see below,
- ***k*** = the faculty weight factor, after THE (see right and bottom).

Publication categories	q
Visible in Scopus, with no SJR	0.5
Visible in Scopus, Q4 (75 … 100 %)	1
Visible in Scopus, Q3 (50 … 75 %)	1.5
Visible in Scopus, Q2 (25 … 50 %)	4
Visible in Scopus, Q1 (best 10 … 25 %)	8
Visible in Scopus, D1 (best 1 … 10 %)	16
Visible in Scopus, C1 (best 1 %)	32

Field of science	k
ENGINEERING + NATURAL + LIFE + PSYCHOLOGY	1
ARTS + HUMANITIES	2
ECONOMY + SOCIAL SCIENCES	2.5
EDUCATION + LAW	5

Minimum required number of papers

ENGIN	500
NATUR	500
LIFE	500
PSYCH	500
ART	250
HUM	250
ECON	200
SOCI	200
EDUC	100
LAW	100

9. Ranking: Components of success

(personal success of many = the success of a university)

1. Educated and motivated young people, whose dream is to become a professor and who do the everything (within the limits of ethical rules) to become No. 1 in the world in his/her field.

2. Internationally recognized supervisors – professors publishing minimum 5 papers yearly in Q1 journals (+ 1 in Hungarian), involving students from the BSc level, teaching them „by doing" how to make „big science" (as „Miskolc-science" does not exist)

3. Motivating / recognizing background of bosses at all levels, who recognize personal scientific excellence based on h-index / k-index (calculated from independent citations), providing all kinds of recognition from a warm handshake to top salaries. The highly motivated people become professors at relatively young age, stabilizing the university for accreditation and push the university to the very top of world university rankings.

Thanks for your attention

Prof. Dr. George Kaptay

kaptay@hotmail.com

+36 30 415 0002