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TECHNOLOGY FORESIGHT AND SCENARIO PLANNING IN ENGINEERING

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PART II

- ✓ Overview of Foresight Methodology
- ✓ Description and Explanation of Selected Foresight Methods: Bibliometrics, Webometrics, Expert Panels, Brainstorming



Overview of Foresight Methodology

There is not one single best Foresight methodology.

Foresight tries to bring together different tools and methods originally developed for other disciplines to try to understand and shape the future. The suitability of methods depends on the goals of the study and the resources available.

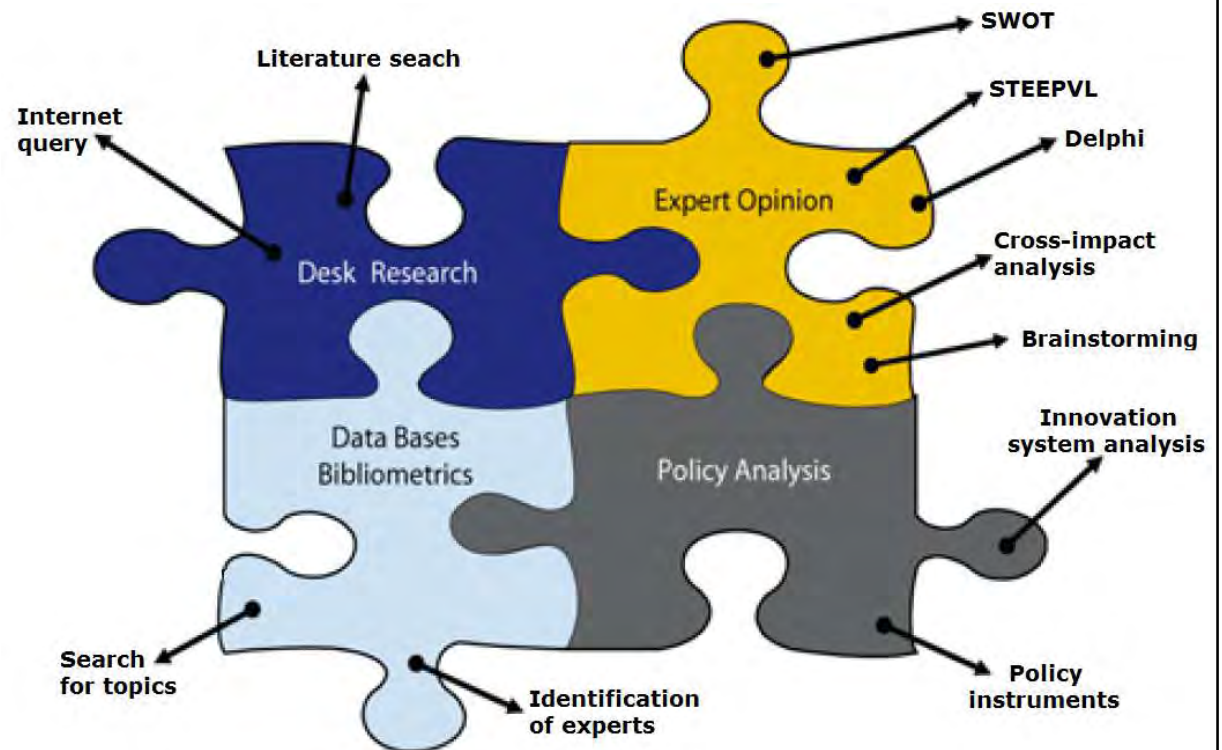
Foresight is multi- and cross-disciplinary.

In other words, the future cannot be understood if studied from one viewpoint only.



Overview of Foresight Methodology

Each foresight project is unique. They have different aims, stakeholders and resources. They also use different combinations of research methods. Those methods may be generally divided into four groups according to their main source of information.





Types of Methods

Qualitative methods can be used to investigate conditions that are difficult or impossible to measure or quantify. These methods make it possible to discuss and exchange viewpoints. Qualitative methods emphasize understanding phenomena or events based on empathy, analysis or interpretation of, for example, statements, evaluations, convictions or attitudes. The results can often be difficult to reproduce or verify. Examples of qualitative methods are brainstorming, SWOT analyses, future workshops, qualitative scenarios, interviews, and literature reviews.

Quantitative methods emphasize gathering large amounts of 'hard' data, i.e. information that is directly measurable and can be quantified. Often, the use of quantitative methods implies that the investigator considers the area of study as an object that can be investigated in relation to one or more variables. The results are often expressed in numerical values, diagrams or graphs. Examples of quantitative methods are bibliometric analyses, modelling and extrapolation.

Semi-quantitative methods use mathematical (statistical) principles to manage and quantify rational judgements, probabilities, values and viewpoints of experts and commentators. Examples of semi-quantitative methods are Delphi, cross-impact analyses, key technology and roadmapping.

Source: P. D. Andersen, B. Rasmussen, *Introduction to foresight and foresight processes in practice*, DTU Management Engineering 2014.



Overview of Foresight Methodology

Qualitative	Quantitative	Semi-quantitative
Methods providing meaning to events and perceptions. Such interpretations tend to be based on subjectivity or creativity often difficult to corroborate (e.g. brainstorming, interviews)	Methods measuring variables and apply statistical analyses, using or generating (hopefully) reliable and valid data (e.g. economic indicators)	Methods which apply mathematical principles to quantify subjectivity, rational judgements and viewpoints of experts and commentators (i.e. weighting opinions)
<ol style="list-style-type: none"> 1. Backcasting 2. Brainstorming 3. Citizens panels 4. Conferences/workshops 5. Essays /Scenario writing 6. Expert panels 7. Genius forecasting 8. Interviews 9. Literature review 10. Morphological analysis 11. Relevance trees /logic charts 12. Role play / Acting 13. Scanning 14. Scenario /Scenario workshops 15. Science fictioning (SF) 16. Simulation gaming 17. Surveys 18. SWOT analysis 19. Weak signals /Wildcards 	<ol style="list-style-type: none"> 20. Benchmarking 21. Bibliometrics 22. Indicators / time series analysis 23. Modelling 24. Patent analysis 25. Trend extrapolation / impact analysis 	<ol style="list-style-type: none"> 26. Cross-impact / structural analysis 27. Delphi 28. Key / Critical technologies 29. Multi-criteria analysis 30. Polling / Voting 31. Quantitative scenarios / SMIC 32. Roadmapping 33. Stakeholder analysis <p>Source: R. Popper, Foresight: processes, practices and methodologies, PREST, 2008</p>



Methods' Sources of Knowledge

Creativity is a combination of original and imaginative thinking and intuition. Artists, technological 'gurus', visionaries and great thinkers, or just ordinary citizens, contribute to foresight with this form of input.

Expertise is based, however, on persons' skills and knowledge within a special focus area or a specific issue. These persons can be researchers, consultants, leaders of enterprises or others with special knowledge in the relevant area.

Interaction is based on two considerations – first, recognition that experts and expertise are also to be found outside knowledge institutions and that their knowledge is both valuable and indispensable in foresight projects; and second, that new ideas and thinking have better chances of being generated when different types of experts and expertise are brought together in direct dialogue and can challenge and exchange each other's viewpoints.

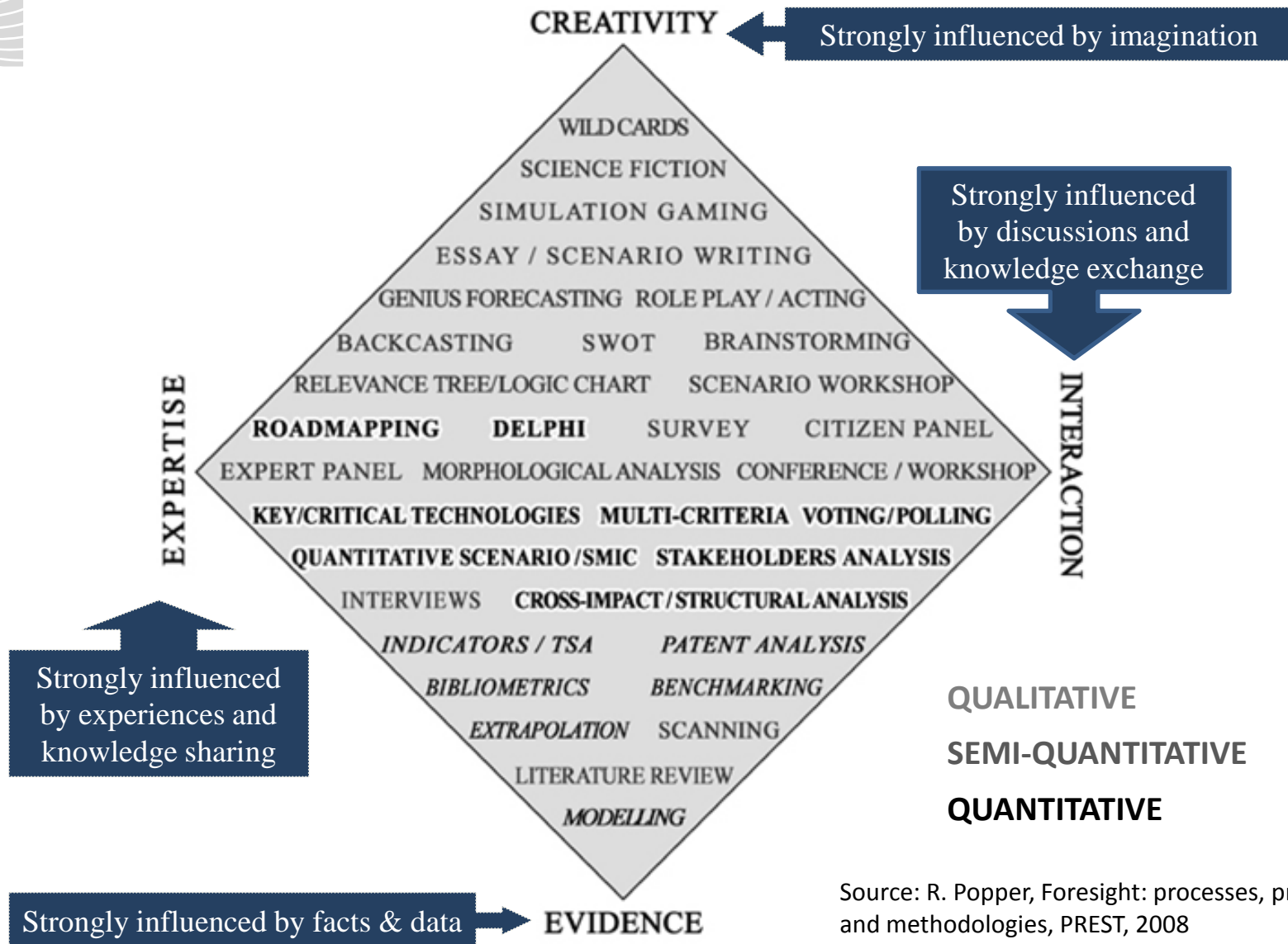
Evidence recognises the importance of supporting projections and/or explanations of phenomena with analyses of reliable data and the use of well-documented methods.

The two dimensions, type of method and sources of knowledge, can be used to present a schematic overview of foresight methods.

Source: P. D. Andersen, B. Rasmussen, *Introduction to foresight and foresight processes in practice*, DTU Management Engineering 2014.



The Foresight Diamond



Source: R. Popper, Foresight: processes, practices and methodologies, PREST, 2008



Overview of Foresight Methodology



1. Bibliometrics/Webometrics
2. Expert Panel / Workshop
3. Brainstorming
4. STEEPVL Analysis
5. SWOT Analysis
6. Delphi Method
7. Structural Analysis
8. Scenario Planning

<http://rafaelpopper.wordpress.com/futures/>



Bibliometrics



Bibliometric analysis – citations analysis; quantitative (statistical) research of the state and of the trends in publications based on the bibliographic descriptions or on the publishers' statistics.

Bibliometrics is a tool that helps to assess the state of science and technology based on the total output of scientific literature.

<http://www.rybinski.eu/?tag=intellectual-capital-pl&lang=pl>



Bibliometrics



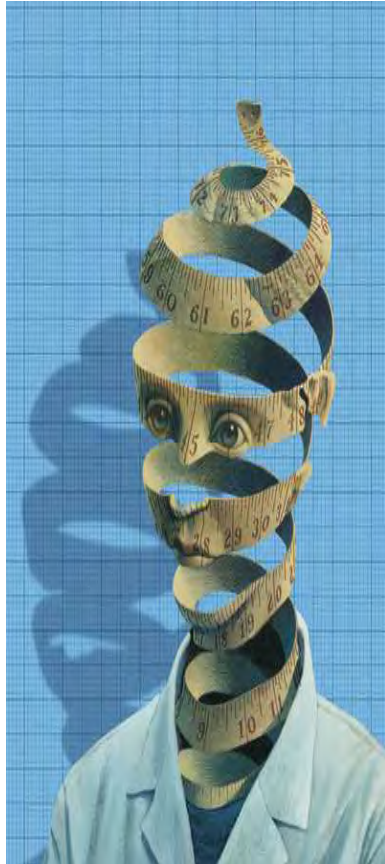
Bibliometrics is based on the analysis of data from published texts according to their characteristics (journal name, author, keywords, authors' affiliation, authors' nationality).

Bibliometrics allows you to monitor the development of science, to observe the formation of research networks (national and international), to spot new, multidisciplinary areas of science and technology and to understand the logic of the scientific progress.

<http://science.thomsonreuters.com/ausbiblioconference/>



Basic Bibliometric Indices



1. Number of publications by a particular author/institution/country
2. Number of papers in the high-ranked journals.
3. Number of citations of a publication by a particular author/institution/country
4. Normalised citation indices
5. H-index
6. Co-authorship by various authors/institutions/countries
7. Cross-citations between authors/institutions/countries

<http://science.thomsonreuters.com/ausbiblioconference/>



Selected Bibliometric Tools



<http://science.thomsonreuters.com/ausbiblioconference/>

BIBEXCEL:

<http://www8.umu.se/inforsk/Bibexcel/>

PAJEK:

<http://pajek.imfm.si/doku.php>

Publish or Perish:

<http://www.harzing.com/resources.htm#/pop.htm>

SCImago Journal & Country Rank:

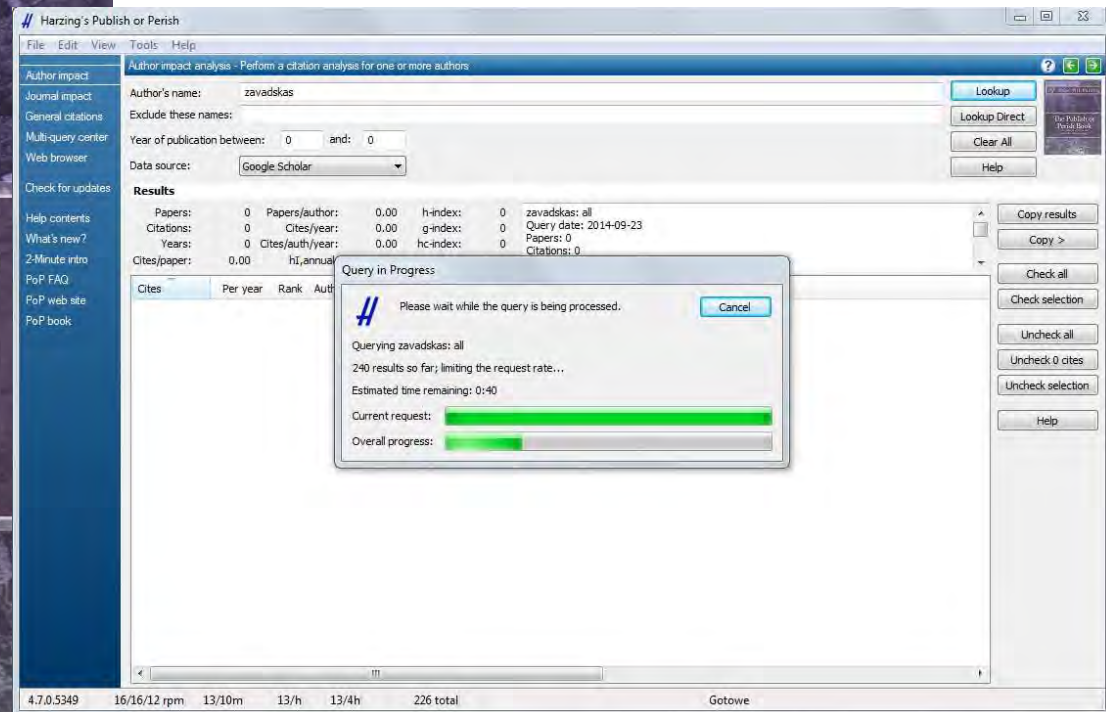
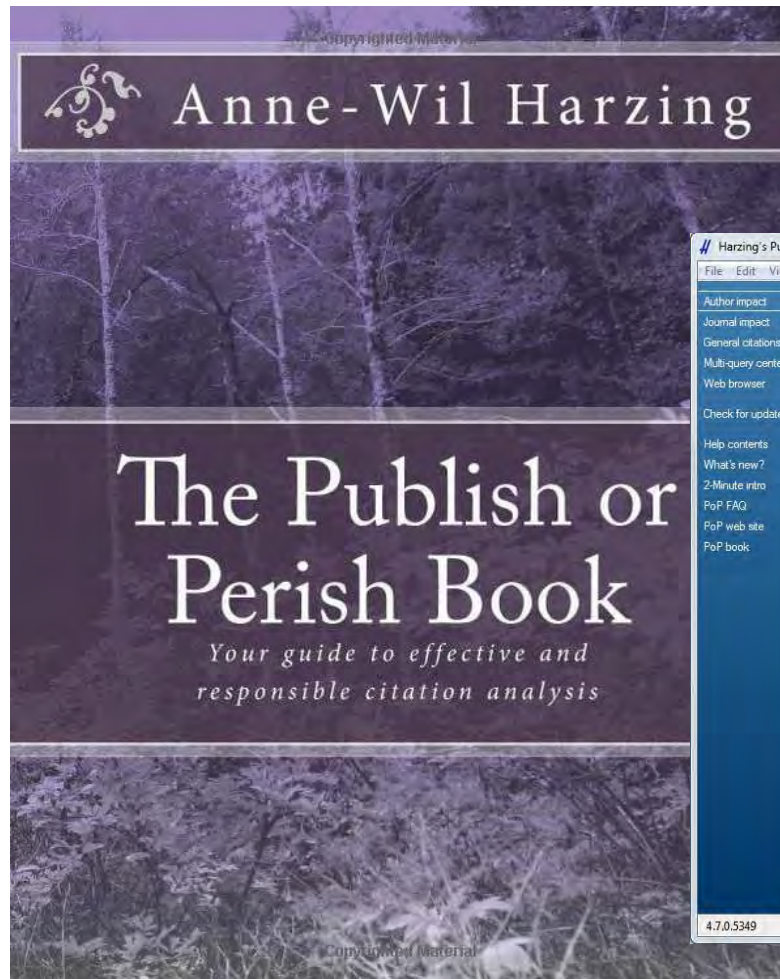
<http://www.scimagojr.com/>

Linköping University Library

<http://www.bibl.liu.se/bibliometri?l=en>



Example – Publish or Perish





Bibliographic Maps

Titles

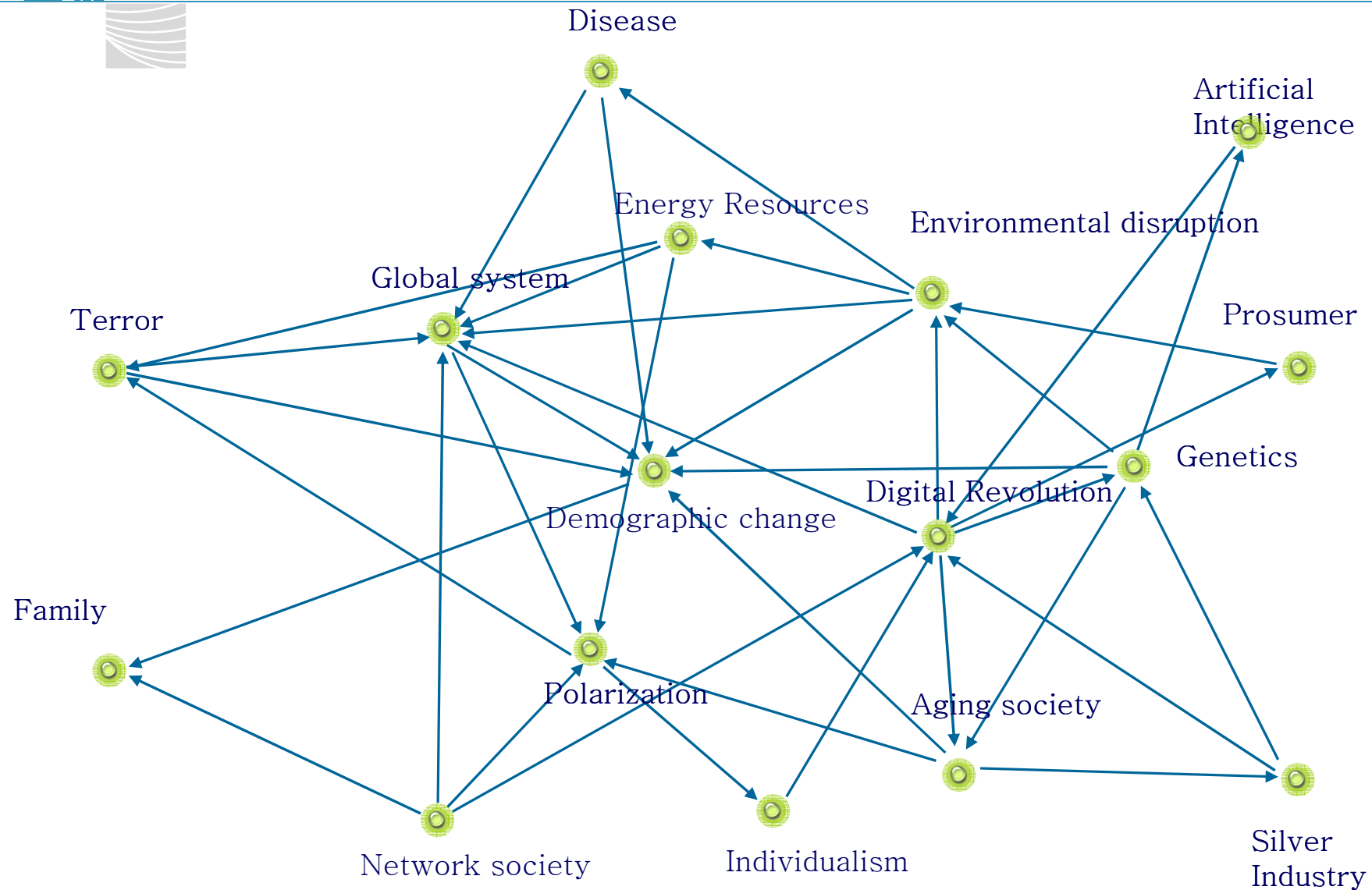


Abstracts





Theme Network Analysis



Bibliographic Databases

The screenshot displays the Web of Knowledge interface within a web browser. The browser's address bar shows the URL: http://bazy.pb.edu.pl:2749/UA_GeneralSearch_input.do?product=UA&search_mode=GeneralSearch&SID=N11CD4pn3Jdh1Akbic&preferencesSaved=. The browser's tab bar includes several open tabs, including "Gmail - Re: Odp: Procesy - jejd...", "Biblioteka Uniwersytecka w Wa...", "Jak obliczyć indeks H?", "Warszt...", "Politechnika Białostocka | Tech...", and "Web of Knowledge [v.5.5] - ...".

The Web of Knowledge interface features a header with the logo and the tagline "DISCOVERY STARTS HERE". Below the header, there are navigation links for "Go to mobile site", "Sign In", "Marked List (0)", "My EndNote Web", "My ResearcherID", "My Citation Alerts", "My Saved Searches", "Log Out", and "Help".

The main content area is titled "All Databases" and includes a "Select a Database" tab. Below this, there are search options: "Search", "Search History", and "Compound Marked List (0)". The "Search" section contains a search bar with a placeholder text "Example: oil spill* mediterranean" and a dropdown menu for "in" with options "Topic", "Author", and "Publication Name". There are also "AND" and "OR" buttons for combining search terms. Below the search bar, there are links for "Add Another Field >>" and "Search" and "Clear" buttons. A note states "Searches must be in English".

The "Current Limits" section includes a "Timespan" dropdown menu with options "All Years", "From 1945 to 2012", and "Adjust your search settings". There are also links for "Adjust your results settings".

The footer of the interface includes the text "© 2011 Thomson Reuters", "Acceptable Use Policy", and "Please give us your feedback on using Web of Knowledge".

On the right side of the interface, there is a sidebar with a "MORE INFORMATION FOR NEW USERS" button and a section titled "Questions about the new Web of Knowledge?". This section contains text about differences in citation counts and search capabilities, with a link to the "Frequently Asked Questions page". Below this, there is a section titled "Looking for Book Citation Index?" with text about accessing subscription or trial by going to "Web of Science" and choosing "Book Citation Index under search limits". There is also a "Support, Tools, Tips" section with a "Training & Support" subsection containing links for "Download quick Recorded Training", "Access additional Training Resources", and "More questions? Consult the Help files". There is also a "What's new in Web of Knowledge?" section with links for "Researcher ID is now searchable from within Web of Science SM", "Automatic spelling variations and all new Author Finder in Web of Science SM", and "More of What's New". At the bottom of the sidebar, there is a "Customize Your Experience" section with links for "Sign In" and "Register".



Webometrics



<http://www.oro-net.it/dnn/default.aspx>

Webometrics tries to measure the World Wide Web to get knowledge about the number and types of hyperlinks, structure of the World Wide Web and usage patterns. Webometrics studies the quantitative aspects of the construction and use of information resources, structures and technologies on the Web drawing on bibliometric and informetric approaches.

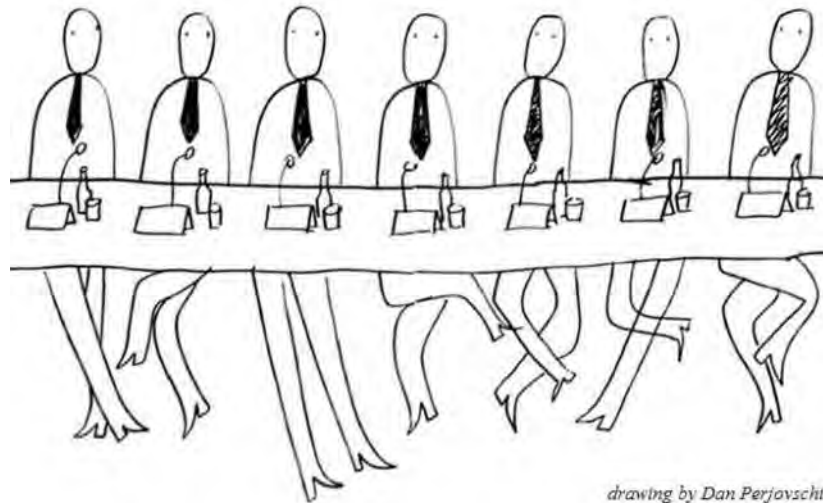
[Björneborn and Ingwersen, 2004]

One relatively straightforward measure is the "Web Impact Factor" (WIF) introduced by Ingwersen (1998). The WIF measure may be defined as the number of web pages in a web site receiving links from other web sites, divided by the number of web pages published in the site that are accessible to the crawler.

Other similar indicators using size of the institution instead of number of webpages have been proved more useful.



Expert panels

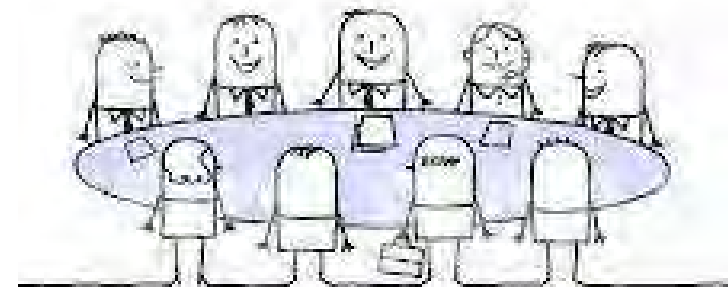


drawing by Dan Perjovschi

<http://nomoredirtylooks.com/2010/12/tata-harper-hosts-an-expert-panel-pow-wow/>

Expert panels is a method based on the opinions and the intuition of experts.

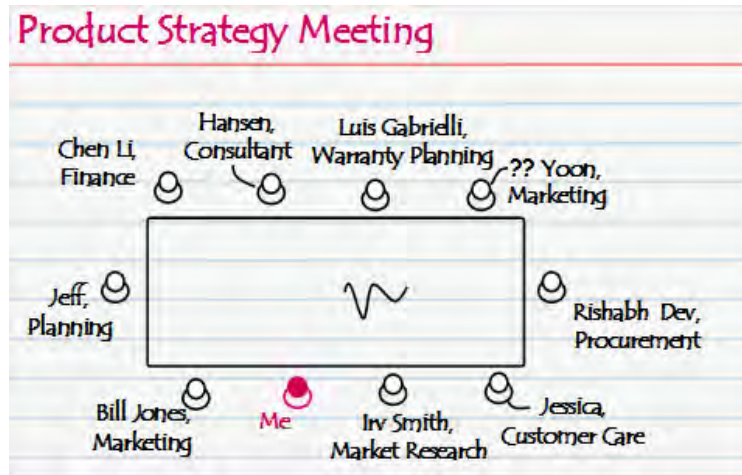
There are many shapes and sizes of expert panels. A very frequent form of an expert panel is **BOGSAT** (*Bunch Of Guys Sat Around a Table*). Such panels usually consists of 12-15 members.



<http://stickpeople.co/design/vector-graphic-of-a-happy-group-of-business-stick-figure-people-sitting-around-a-table-in-a-meeting-by-nl-shop-138>



Expert panels



The tasks of expert panels in foresight studies include:

- working out a development vision for science and technology in a particular domain
- Identifying barriers that may emerge and disturb the realisation of the vision.

Expert panels are at the core of foresight studies, therefore great attention should be paid to the process of expert selection. Experts should come from academia/science, business/industry, media and the civil society.



Expert panels – working techniques



- **Moderated discussion** (discussion led/controlled by a moderator);
- **Multiple discussion** (first: discussions in little sub-groups; afterwards: reporting back to the whole group, discussion and selection of the optimal solution);
- **Brainstorming** (*sudden mental shock*);
- **ADI** (advantages, disadvantages, interesting).

Źródło: <http://www.changing-river.com/2012/05/what-happens-during-a-facilitation/>



Brainstorming



http://www.ideachampions.com/weblogs/archives/2009/06/post_12.shtml



Brainstorming

Brainstorming – unrestricted sharing of ideas with the aim of solving a problem or coming up with something new/innovative



- Brainstorming was developed in 1950^s by an American scientist A. F. Osborn;
- He organised so called *creativity sessions* already in 1930^s. A method of solving a problem by the collective generation of spontaneous ideas was called by him **brainstorming** i.e. *sudden mental shock*.



Brainstorming



http://www.123rf.com/photo_13564580_who-what-why-when-where-signpost-shows-confusion-brainstorming-and-research.html

Brainstorming

is a heuristic method of generation of ideas, solutions and options based on free thinking and unconventional associations.

It is assumed that a high number of ideas increases the chance of generating at least one valuable solutions.



Brainstorming - steps

Step 1: Preparation – choosing the leader and the other team members, setting the time, place and duration of the brainstorming session.

Step 2: Ideas generation – the creative session. Criticism towards others' ideas (so called *idea killers*) must be avoided.



Brainstorming - steps

Step 3: **Assessment and verification of ideas** –
grouping ideas into the following groups:

- Hot ideas – ready for immediate implementation,
- Ideas that might be implemented after some more analysis,
- worthless ideas.

Step 4: **Choice of the optimal solution**



Principles of Brainstorming



<http://ideachampions.com/weblogs/archives/brainstorming/>

- 1. No criticism of ideas**
- 2. Go for large quantities of ideas**
- 3. Build on each others ideas (enrich, modify)**
- 4. Encourage wild and exaggerated ideas**



Brainstorming variation

Brainnetting – a method of gathering and processing of ideas with use of computer technologies



http://www.yourtrainingedge.com/wp-content/uploads/2013/08/Fotolia_15414583_S.jpg