How Scientists & Researchers can become more opportunity savvy ..... anticipating the future needs of society and business

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Goal

- How Scientists & Researchers can become more opportunity savvy ..... anticipating the future needs of society and business

- Science & Technology Horizon Scanning .....Getting insight on foresight

Objectives

- approaches to opportunity recognition,
- sense and respond strategies vs anticipate & design strategies ,
- opportunity identification for scientists
- incremental vs disruptive technology-the cognitive skills need for both:
- how to become more opportunity savvy to the commercial business environment,
- how S& T foresight exercises can help your anticipatory skills,
- examples of technology transfer models, innovation clusters

Assumption

"Science and Technology (S&T) scanning as a stand alone activity is a largely ineffective, if it's not integrated and coupled with:

- sense-making activities,
- managing risk and uncertainty,
- periodic reviews of decision-making assumptions and mental models,
- ongoing strategic thinking and planning,
- foresight activities such as scenario planning or wild card exercises & consequence exercises and
- policy development
- along with a healthy dose of lateral creative thinking."

—Walter Derzko

What is Environmental Scanning?

“ The acquisition and use of information about events, trends, and relationships in an organization's external environment, the knowledge of which would assist management in planning the organizations future course of action”

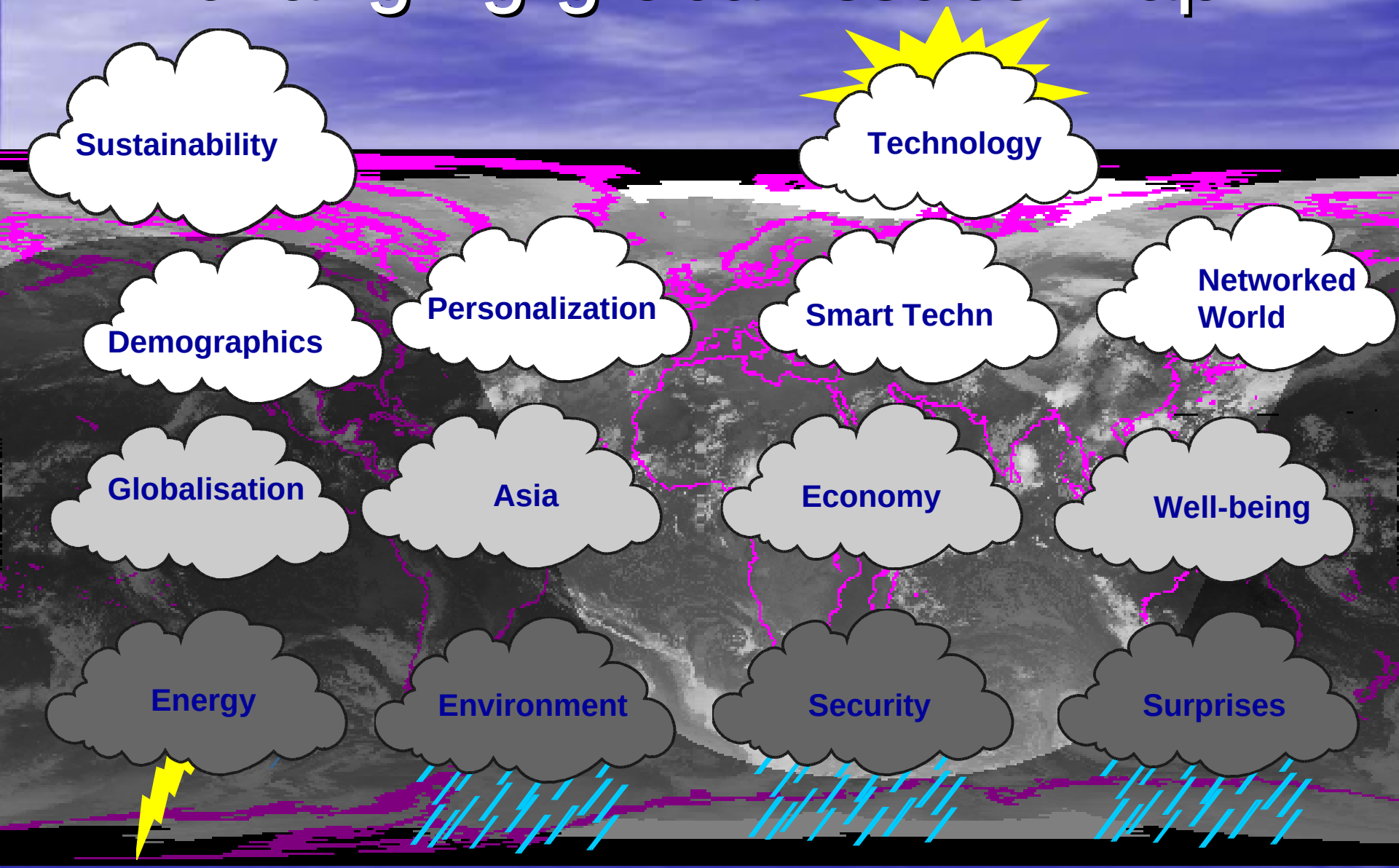
Source: Aguilar 1967 and Choo 1998a;

Scanning Objectives

- Detecting important economic, social, cultural, environmental, health, scientific, technological, and political trends, situations, and events
- Identifying the potential opportunities and threats for the organisation implied by these trends, situations, and events
- Gaining an accurate understanding of your organization's strengths and limitations
- Providing a basis for analysis of future program investments

Source: http://www.cce.cornell.edu/admin/program/documents/scanintr.htm

A changing global issues map



Source: Shaping Tomorrow (UK)

Where to Start?

- Scanning is not a monolithic activity.
- Environmental scanning includes both *looking at* information (viewing) and *looking for* information (searching).
- Research in organization science suggests that it might be helpful to distinguish between four modes of organizational scanning:
  - undirected viewing: sensing
  - conditioned viewing: sense-making
  - informal search: learning
  - formal search: deciding

Source: The Art of Scanning the Environment, ASIS Bulletin Article Pre-print,
Chun Wei Choo, Faculty of Information Studies, University of Toronto

Scanning Timeframes

- **Ad-hoc scanning** - Short term, infrequent examinations usually initiated by a crisis
- **Regular scanning** - Studies done on a regular schedule (say, once a year)
- **Continuous scanning** - (also called continuous learning) - continuous structured data collection and processing on a broad range of environmental factors
- Most commentators feel that in today's turbulent business environment the best scanning method available is continuous scanning. This allows the firm to act quickly, take advantage of opportunities before competitors do, and respond to environmental threats before significant damage is done
- Source: Wikipedia

Popular Science & Technology Sources

- Who funds research? (NSF, DARPA, DOE, NSERC etc)
- 1st annual conf on.....
- Eureka Alert (AAAS)
- Science Daily
- New Scientist, Nature, Science
- Other peer-reviewed academic journals
- MIT Technology Review
- PhysOrg Newsletter
- Various blogs
- Science Columns, NYT; Washington Post; Sydney Morning Herald Technology Daily etc.
- CNet
- Slashdot
- Wired
- IEEE Spectrum
- Fresh Patents
- Ray Kursweil
- Various blogs
- The Smart Economy
- EDS Next Big Thing
- Future Survey (WFS)
- Syndicated News Services
- Shaping Tomorrow (UK)
- Conferences & workshops

Source: The Smart Economy Blog; http://smarteconomy.typepad.com

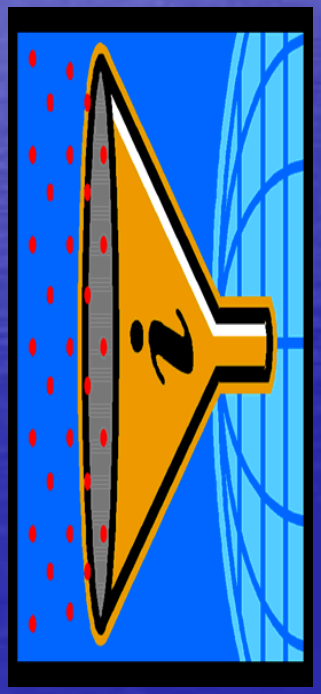
Scanning the Horizon

Surveys
- Staff
- Customers
- Non-customers
- Suppliers
- Disaffected people

Exercises
- Management
- Partners

Scans
- Knowledge portals
- Trend scouts
- Expert panels
- Consultants

Environmental Scanning



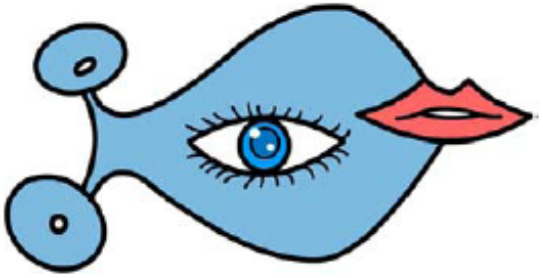
Two key questions

- How will the future be different?
- What should we be doing about it?

Source: Shaping Tomorrow (UK)

How can scientists quickly get a big picture overview on any subject?

- National Science & Technology Foresight studies
- European Foresight Monitoring Network http://www.efmn.info/
- Japan does regular international S&T foresight exercises & technology roadmaps every 4 years looking out 15 years into the future
- Review papers-"state of the art" or "future research areas or needs", "research hot spots"



EFMN

WWW.EFMN.INFO The European Foresight Monitoring Network

SMART Perspectives of European Materials Research

Foresight Brief No. 115

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Sponsors: European Commission

Type: European foresight on materials research

Organizer: Schumacher, Gerd, Project Management Juelich, Germany, Coordinator

Duration: 04/2005-03/2007 **Budget:** 480,000€ **Time Horizon:** 5-15 years **Date of Brief** Aug. 2007

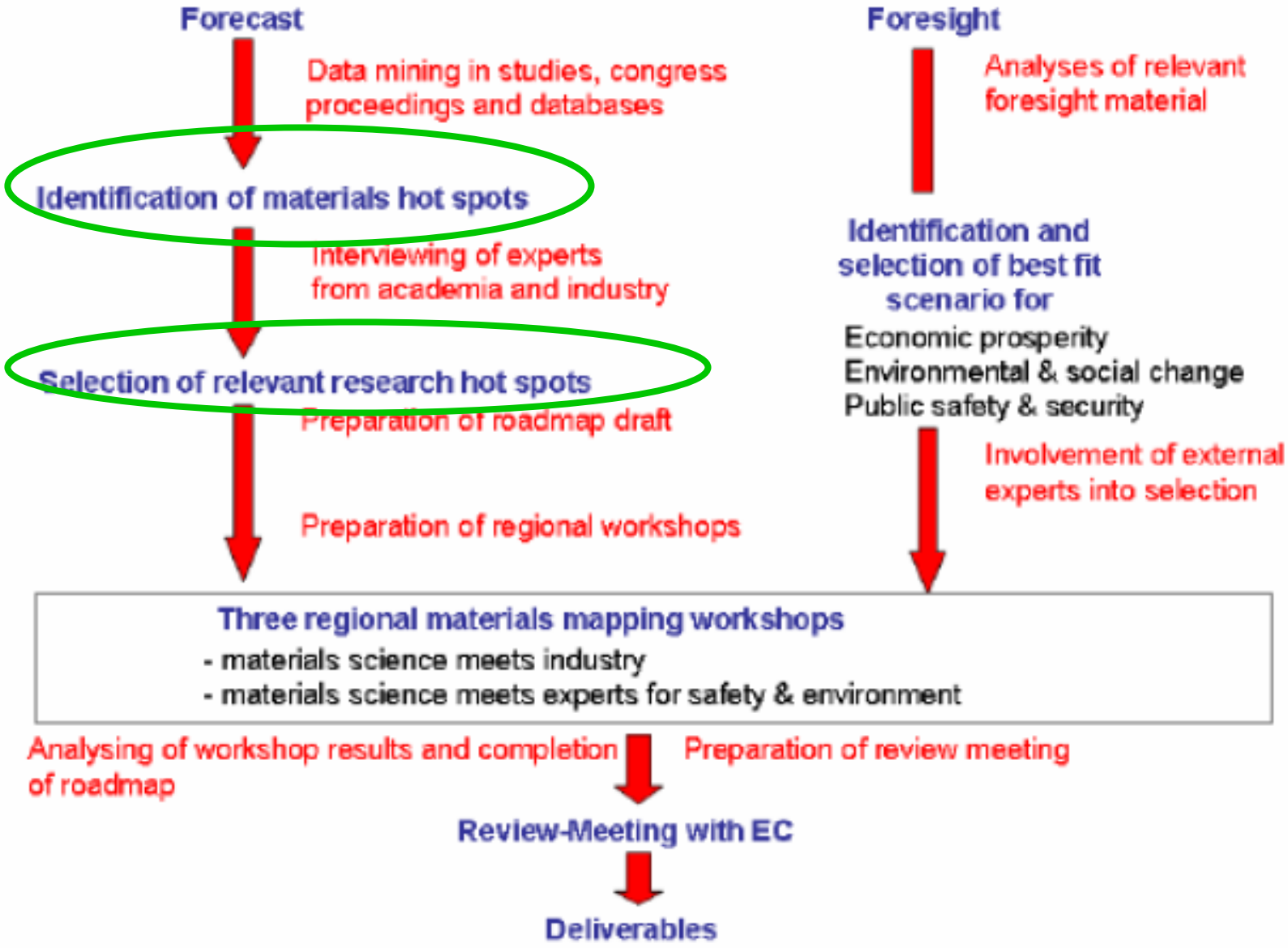
Socio-economic Topics and 'Technical Pillars'

Industrial Sectors are Dependent on High-tech Materials

Materials innovations are an important part of the cultural European heritage. This can best be seen at the typical European Design. Today, competitiveness on materials innovation is still of utmost important for the following industrial sectors:

- Automotive industry
- Aerospace industry
- Chemical industry
- Electronics
- Textile industry

- Energy technology
- Medical technologies
- Construction
- Defense & security


Forecast
Data mining in studies, congress proceedings and databases
Identification of materials hot spots
Interviewing of experts from academia and industry
Selection of relevant research hot spots
Preparation of roadmap draft
Preparation of regional workshops
Foresight
Analyses of relevant foresight material
Identification and selection of best fit scenario for
Economic prosperity
Environmental & social change
Public safety & security
Involvement of external experts into selection
Three regional materials mapping workshops
- materials science meets industry
- materials science meets experts for safety & environment
Analysing of workshop results and completion of roadmap
Preparation of review meeting
Review-Meeting with EC
Deliverables

Materials Research Priorities

For the three identified socioeconomic inputs where Materials Research can contribute heavily, the identified research priorities for materials are listed below. The specific bottlenecks identified regarding these research topics are pointed out in the final report of SMART (see Reference and Link section).

Energy

Energy is a strategic resource for industrialized countries so that the development of future energy technology is of great importance for Europe. Energy safety and CO2-reduction are the main drivers in this field. The following research priorities are among those that were identified:

- Innovative gas separation membranes for CO2-capture technology
- materials for white light emitting devices
- polymers and materials processing for organic light emitting devices
- CO2-reduction in mobility: light weight alloys, nanocomposites and biocomposites
- materials for superconducting devices
- advanced corrosion resistant (less degradable) materials for various renewable energy sources
- energy storage materials
- advanced joining techniques for manufacturing of wind generators
- ceramics for solar power tower technology
- materials for 3rd generation solar cells

Scanning Principles

- Explore "both sides of the ledger" to gain a complete picture
- Think micro and macro
- Use multiple "lenses" to look at the same information or situation
- Look for ways to “triangulate” information
- Think beyond just felt needs and immediate opportunities

Source: http://www.cce.cornell.edu/admin/program/documents/scanintr.htm

Key Success Factor in S&T scanning

- “rather than breaking up information into pieces (analysis), a researcher’s & scientist’s intuition is needed for just the opposite reason- to synthesize fragmented disparate pieces into “meaningful wholes” or “new patterns”

-Walter Derzko, The Smart Economy Blog 2006

Approaches to opportunity recognition

- sense and respond strategies (identifying and tracking weak signals of change)
- anticipate & design strategies (you become the trend leader)

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

http://smarteconomy.typepad.com/entrepreneurship_and_inno/2007/10/detaecting-weak.html

1) Read all of your industry's materials that you can, even if they don't directly relate to your job or business.

- This will give you a much larger perspective and viewpoint on which to base decisions.

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

2) Scan other industry trends.

- It is difficult to detect trends and weak signals when they begin where you least expect it ....
- That's why you have to stay on top of trends in every sector that could potentially impact your business, even if it's not immediately obvious today.

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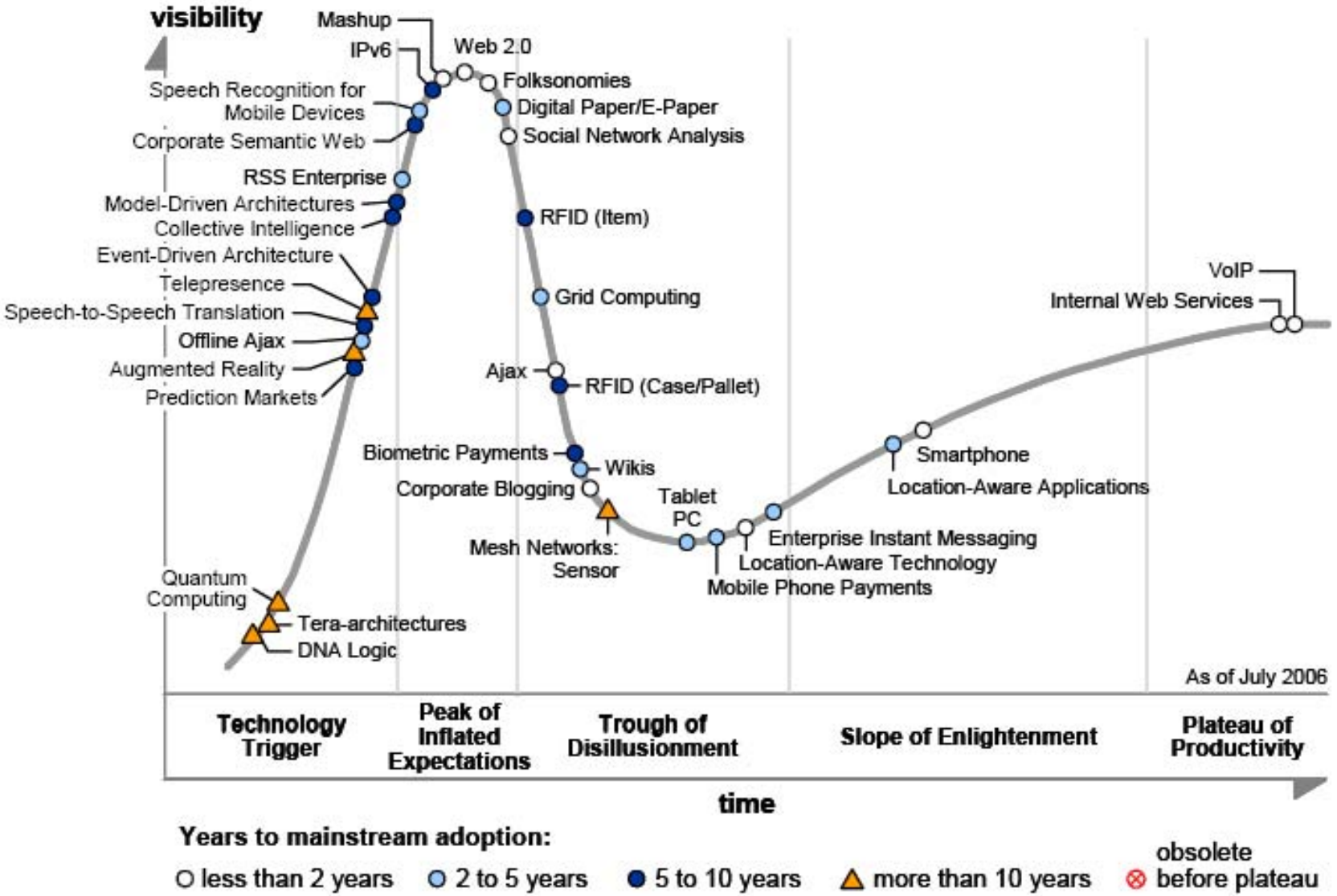
3)Rely on your leadership experience and trust your intuition.

- Watch out for early unsubstanciated hype.

Figure 1. Hype Cycle for Emerging Technologies, 2006



Source: Gartner (July 2006)

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4) Beef up your sense-making skills to determine if a signal is legitimate or irrelevant and how that changes over time.

- It's not enough just to connect the dots, if you are not sure if they are real or not

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5) Anticipate how unrelated signals could cluster together to form emerging trends.

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

- 6) Spend most of your time trying to figure out how things can go wrong, or off track
- Be ready with strategies to mitigate those negative effects.
- 7 out of 7 new technology spin-offs from the Sunnybrook Hospital Venture Capital fund guessed/picked the wrong market sector for their new technology

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

7) Be open to ideas that are thought to be irreverent and disruptive of the status quo or current paradigm

I.e. centralized energy distribution vs decentralized at point of use

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

8) Try to see the big picture or the system rather than focusing on parts.

- Construct your own personal mental model or world view.
- Where are we now?
- What do we take for granted about the situation?
- Can I challenge the norm?
- What's likely to change?
- Where are we heading?

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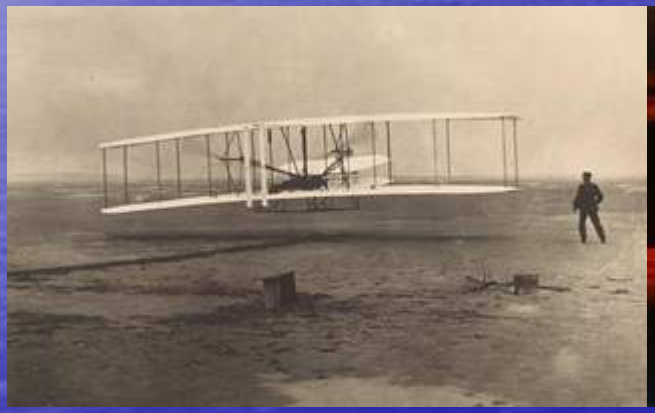
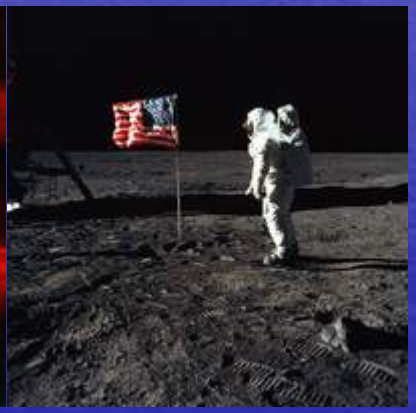
- 9) Use McLuhan's tetrad to anticipate impacts & consequences

Technology Impacts?

1) What gets Enhanced?

2) What gets Retrieved? Brought Back



3) What gets Obsolesced? Left Behind?

4) At the extreme, What gets Flipped or Reversed?

Tetrad Automobile & Infrastructure

1) What gets Enhanced?

2) What gets Retrieved? Brought Back

3) What gets Obsolesced? Left Behind?

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- 10) What is the ultimate question that your discipline would like to answer?

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

11) Be aware of biases and chains of thought, in both you and the organization, and the limitations of relying on past certainties in your industry.

- Know you industry assumptions, (the what-do-we-take-for-granted-WDWTFG's), norms, unspoken rules of thumb, and tacit information on how the industry works and why?
- Recognize when someone or something is about to challenge them.

Detecting weak signals of change inside & outside your industry -My 12 tips for Scientists

12) Know your 7 unknowns.

- What are we dealing with here? Uncertainty? Ambiguity, Complexity? Dichotomous thinking? Etc and
- How do we address each one of these?
- Look for paradoxes, anomalies and contradictions in signals, the solution to which could open up new opportunity windows.

Assumption

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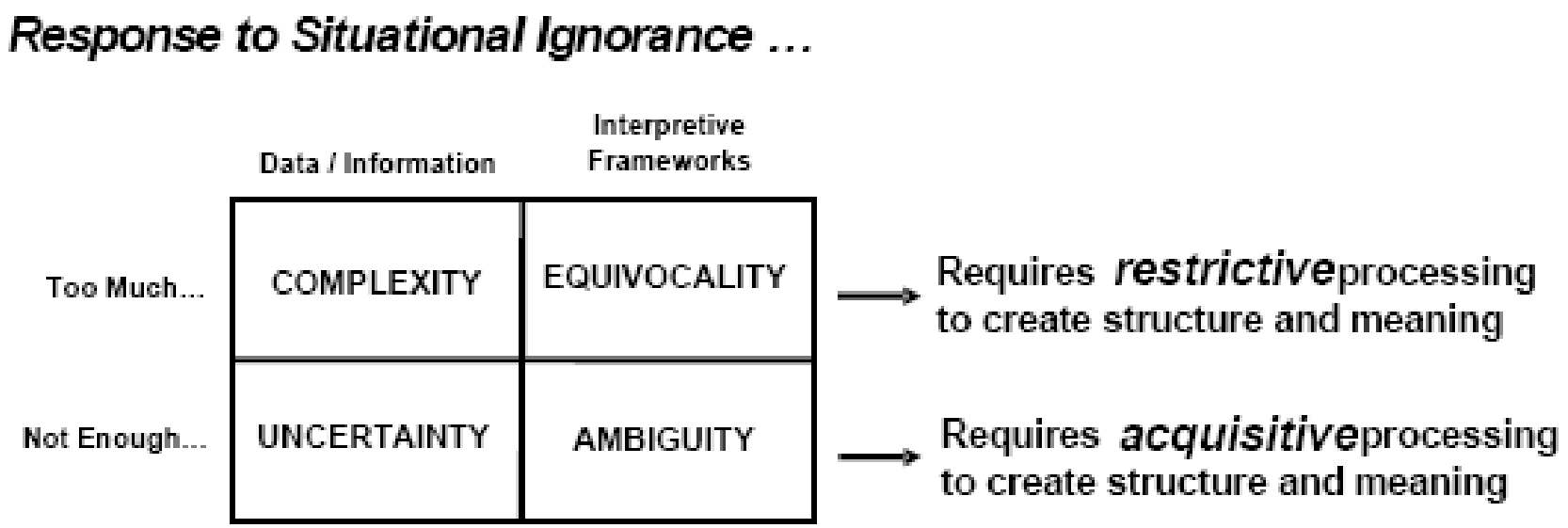
4 types of situational ignorance or unkowns....according to academics



7 levels of “Being in the Dark” Situational Ignorance, Cognitive Confusion/ Indeterminism

- uncertainty
- ambiguity
- complexity
- equivocality
- dichotomous thinking or dichotomy
- contradiction or paradox
- Info glut

Source: The SmartEconomy Blog

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Tools for Sense-Making

Key? When to use them and in what mix?

- Advice Networks and Analysis.
- Assumption Diagrams and Analysis
- Assumption Challenge Maps
- Affinity Diagrams and Analysis
- Belief Networks Diagrams and Analysis
- Balanced Score Card for Knowledge Management
- Concept Mapping and Analysis
- Concept Challenge Maps
- Consequence Maps
- Knowledge VEE Diagrams and Analysis
- Knowledge Propagation Diagrams and Analysis
- Knowledge Pool Mapping and Analysis
- Knowledge Workflow Diagrams and Analysis
- Knowledge Process Diagrams and Analysis Systems
- Thinking Diagrams and Analysis
- Simulation Development and Analysis
- Point-of-View (POV) Maps and Analysis

Source: Derzko; Idea Lab 1998

Knowledge Problem Indetermination	Strategy / tactics / cognitive skills to address problem	Tools / Methods to address problem
1.0 **Ambiguity** (lack of any framework), No Definitions	**Interpret, Classify, Clarify;** assemble diverse expert networks; Face-2-Face; asking the right questions, key issues ? key uncertainties? divergent followed by convergent thinking, lateral thinking; reframe, enact, hypothesize, test	2x2 matrix or scenario building, contradiction map, create novel framework, system dynamics modeling, tech roadmaps, 6 thinking hats, viable systems modeling (VSM),
2.0 **Uncertainty** (lack of data or even which questions to ask to find the information), One Definition with some certainty or predictability	**Interpret, Classify, Certify, Verify:** assemble Broad flexible networks, Face-2-Face, asking right questions, convergent thinking, lateral thinking; get info; infer, assume or predict, be flexible, buffer from critics	gap analysis , tech roadmaps. generic technology evolution maps, CMC, DSS, DBMS
3.0 **Dichotomous thinking** or dichotomy (seeing only two options, either -or),	**Expand world view**; divergent thinking, from black and white to full spectrum thinking & lateral thinking; expand	Point-of-View (POV) Maps and Analysis, Assumption Testing

Source: Derzko; Idea Lab 1998

Knowledge Problem Indetermination	Strategy / tactics / cognitive skills to address problem	Tools / Methods to address problem
4.0 **complexity** (too many interrelated components or events to manage or understand the specific workings of i.e. our body, climate change) One Definition with Certainty but with many related parts, elements	**Decompose; Deconstruct; Simplify**; hierarchy, directed expertise networks, system thinking, divergent thinking; add intellectual capabilities:(experts , technology, training), expand, connect, map	system dynamics maps, visualization software, CMC, DSS, Expert Systems, KMS
5.0 **contradiction or paradox** (we usually dismiss and ignore such data)	**Recognize; Seize**; **Convert;** concept mapping, assumption mapping, opportunity search	TRIZ, opportunity windows, concept maps
6.0 **equivocality** (multiple interpretations of same events or data). Multiple Definitions	**Unify**; Tight Expert Networks, make sure everyone has all definitions straight. opportunity; search, negotiate, impose	Knowledge Pool Mapping and Analysis, Knowledge VEE Diagrams and Analysis, Belief Networks Diagrams and Analysis, Opportunity Clinic, tagging, folksonomies
7.0) **Infoglut**; data flood	**Order;** create order out of complexity, chunk, parcel, categorize, organize, collect, cluster, reductionist approach, key concepts, impose Synthesis	concept maps, lists, mind maps, taxonomy engines, visualization tools, summarization engines, concept extraction engines, sentiment engines, XTM, visualization software-info contour maps & affinity maps, tagging, folksonomies

Source: Derzko Idea Lab 1998