

Technology Dynamics & Sustainable Innovation



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January 7, 2010

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Technologiedynamica & Duurzame Ontwikkeling

Technology Dynamics & Sustainable Innovation

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Material

Mulder, KF, 2005, Managing the dynamics of technology in modern day society, In: Robert Verburg, Roland Ortt, Willemijn Dicke, 2006, Managing Technology and Innovation, An Introduction, London/New York: Routledge isbn 0415362288, pp. 109-129

- Technology Dynamics for Sustainable Innovation, MOT 1410
- Abstracts, that you make yourself

Requirements to pass course

Participate in the information search exercise and visits

Lead a discussion on an article and make summary (in groups of 3, to be determined in the classroom)

Pass the assessment

Submit a socio-technical map of an innovation (max 10 pages text)

Technology Dynamics for Sustainable Innovation

Technology Dynamics is broad and relatively new scientific field that has been developed in the framework of the postwar [Science and Technology Studies](#) field. It studies the process of [technological change](#). Under the field of Technology Dynamics the process of technological change is explained by taking into account influences from “internal factors” as well as from “external factors”. Internal factors relate technological change to unsolved technical problems and the established modes of solving technological problems and external factors relate it to various (changing) characteristics of the [social environment](#), in which a particular [technology](#) is embedded.

*Engineers know as little of
technology development as fish know
of hydrodynamics*

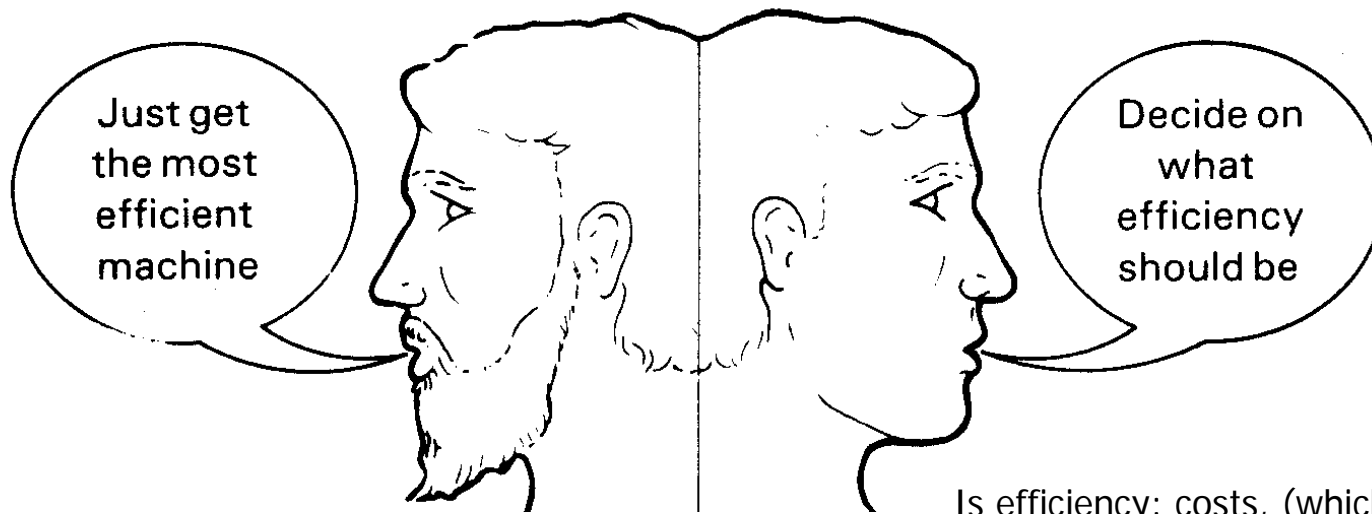
MOT is a social science based training program

This course aims at providing the basic theories regarding technological change, innovation, and the organization of innovation

Looking as a social scientist to technology:

- Relativism
 - From “what is best?” to “what do people consider to be best?”
- Reflexive:
 - How does my innovation/technology change the context and what will it imply?
 - How will new technologies contribute to future opportunities?

So from being a good swimmer as an engineer you need to become an analyst of flow patterns as a manager of technology!

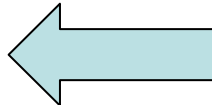


Is efficiency: costs, (which) product quality, for which consumer group, security of supply, service?

The world of the engineer/designer

The world of strategy & policy

options



Steering/goal setting

MOT

Engineers have always been good in doing things efficiently, but....

If you are not doing the right thing, don't do it efficiently, because then you are doing things efficiently wrong

Michael Braungart

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- Engineers are often focusing on doing things right, however, we should also learn to do the right thing
 - Right for society at large
 - Right for our corporations
- In the long run, companies cannot afford to be in conflict with general interests of society at large

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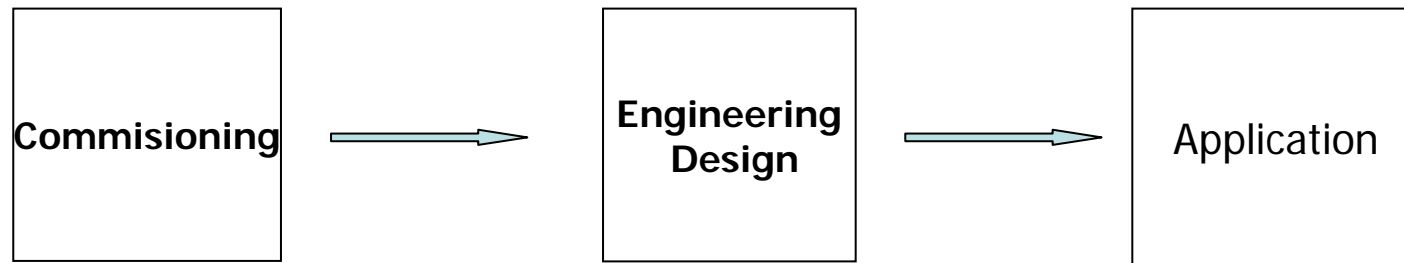
What is good Science/Technology?

Janus' third dictum:



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A questionable division of engineering design responsibilities



Interaction and feedback loops are key!

Red line of this course: Technology Dynamics for Sustainable Innovation

The relation between technology & social factors in the society at large

The relation between technology & the wider technological systems

The relation between technology and scientific knowledge

The relation between technology & economy

The relation between technology & policy and legal issues

Technology, history & future

Technology strategy

Sustainable Development as challenge for technological innovation

Relevant aspects

- The organization of science
- Ownership of technology
- Forecasts of technological change
- large systems
- Social groups influencing technological change
- Interaction with stakeholders/the public in innovation
- Sustainability of Technologies
- Technology Policy

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Some Terminology

Technology: The body of knowledge that describes the effectiveness of techniques

Technique: a procedure to manipulate the world

Artifact: a purposeful man-made object

Black box: an element that is not analyzed further

Innovation: a new product, service, or production process (not necessarily new technology)

Why study technological change and Innovation?

Product failure

OMO power,
dentabs,
'kunstvlees', (artificial meat)
optical disc
artificial leather
floating airports

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Why Study Technological Change and Innovation?

Many companies failed in their adapt at technological change:

In the Netherlands

Fokker, Rijn Schelde Verolme (RSV), Daf, Spijker, Koolhoven, Cardboard industry

Internationally

Western Union, Holzmann, Cockerill-Sambre, World Com



Why study technological change and Innovation?

National Policy:

- How could we stimulate innovativeness?
 - How to stay competitive with high costs of labor?
 - How to stimulate innovations to improve quality of life?
 - How to become 'sustainable'?
-
- What role for basic science?

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What is Science

Science:

knowledge that is generated by 'scientific method'

What method?

Empirical cycle

Technology Dynamics for Sustainable Innovation Science

Empirical cycle

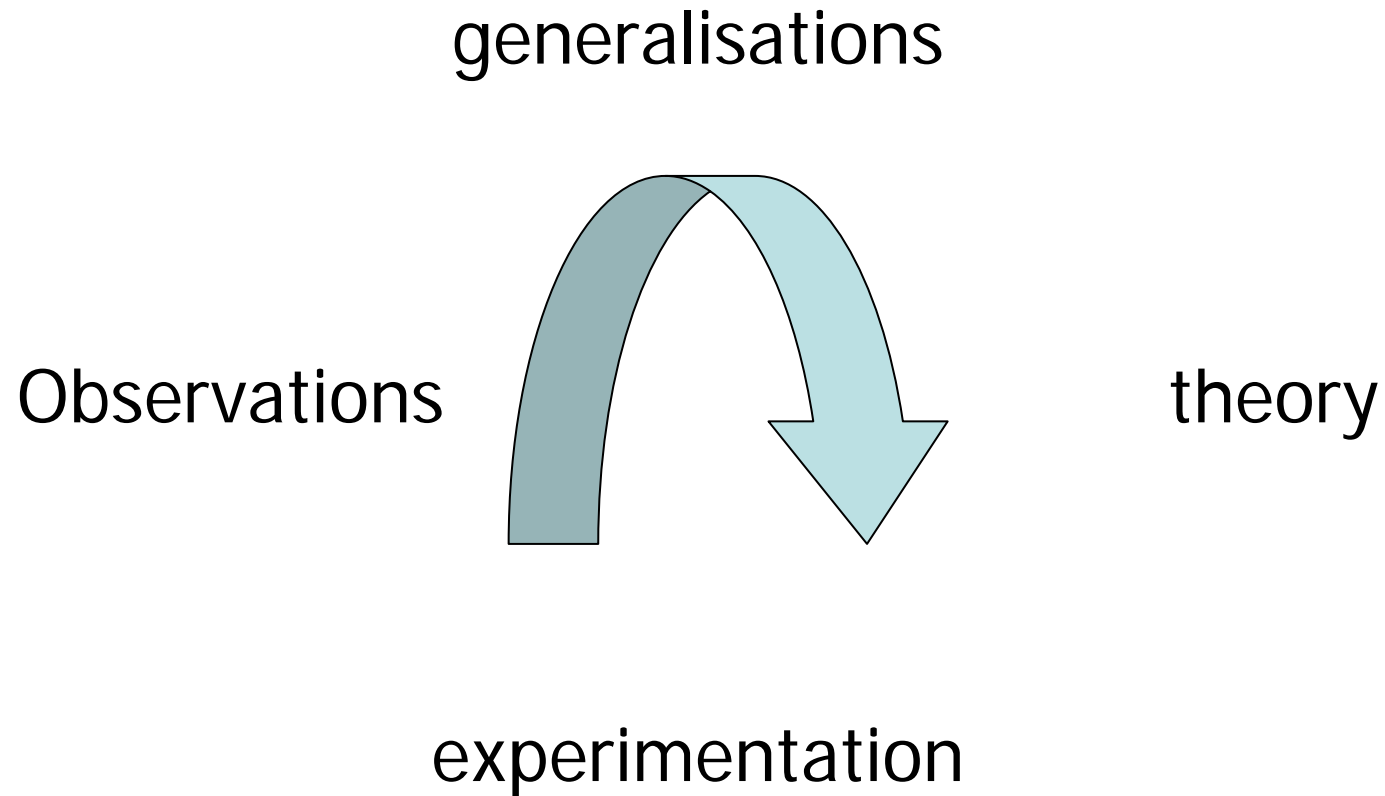
Falsificationism

Progressiveness of research programs

Paradigms

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WHAT IS SCIENCE? Empirical Cycle





Problem:

- Perception is not independent from theory

Therefore: What are the relevant facts?



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Problems:

- Induction**: no matter how often a theory is confirmed, a next experiment might always falsify it
- Observation** is theory laden

As confirmation of scientific theory is no proof, scientific theory should be **falsifiable** (and not yet falsified)

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Falsification

Question:

Is astrology falsifiable?

Is creationism or Big Bang falsifiable?

Axioms are by definition not falsifiable

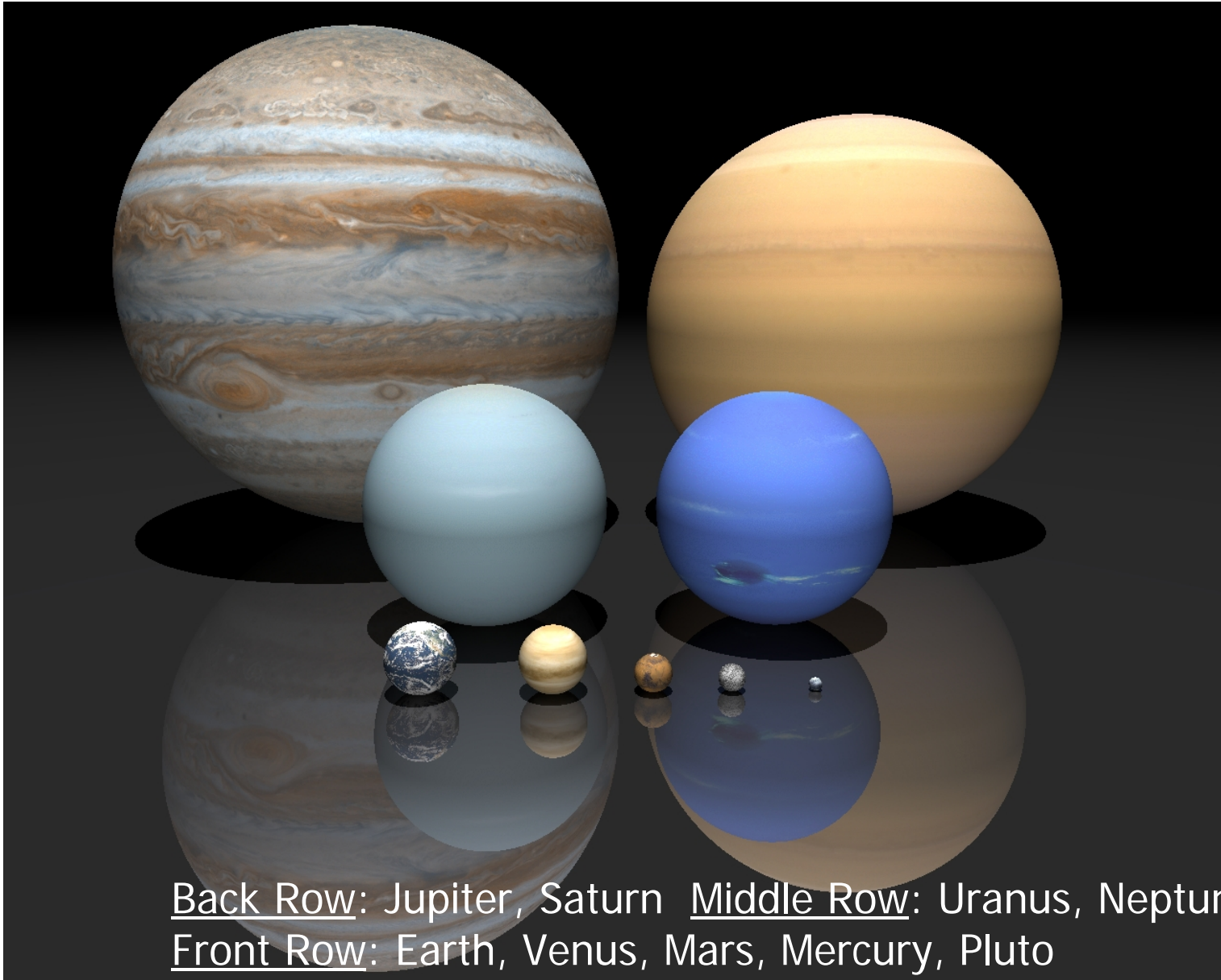
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Problem Falsificationism:

A falsification is usually solved by hypothesizing an ad hoc phenomenon

Example: orbit of Uranus, solved by the discovery of Neptune

Lakatos: progressiveness of research programs



Example: the history of astronomy

Back Row: Jupiter, Saturn Middle Row: Uranus, Neptune
Front Row: Earth, Venus, Mars, Mercury, Pluto

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Kuhn

Paradigm defining normal science:

phenomena

method

heuristics

Scientific revolutions are a struggle for domination between clans



<http://huizen.daxis.nl/~henkt/plaajtjes/philosophy-kuhn-thomas-mirror-02.jpg>

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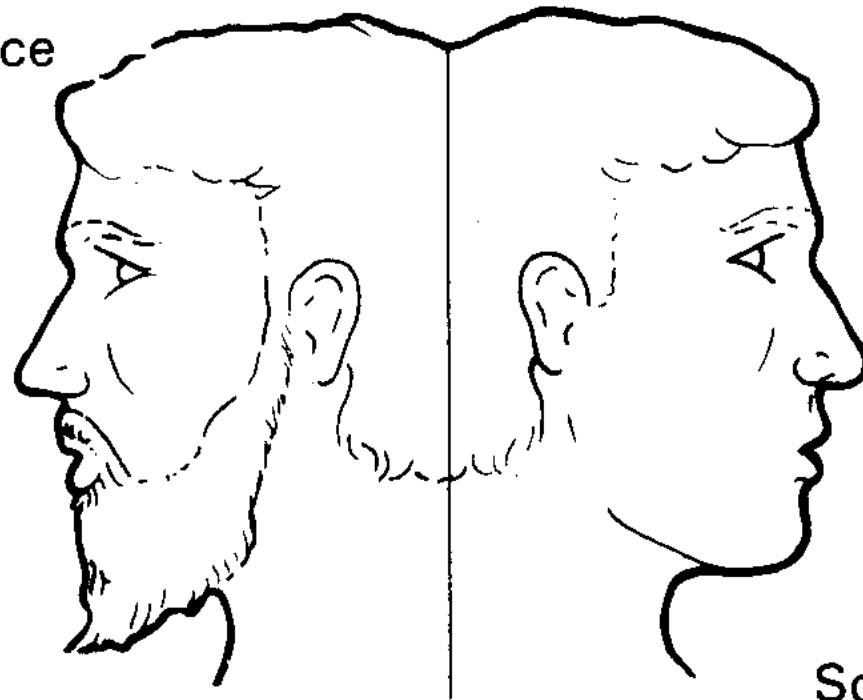
Science as knowledge that is accepted by the scientific community

What defines scientific community?

Mertonian norms:

- *Communism*: science is not private property
- *Universalism*: science is about universal phenomena
- *Disinterestedness*: science is not influenced by interests
- *Organized Skepticism*: science should be checked before acceptance

Ready Made Science



Science in the Making

- context of justification

- context of discovery

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Scientific reward structure

Science is a collective effort: we build upon the results of others, but individuals receive the 'honor' for their contributions

However, all contributions of others to our work should be properly acknowledged

Therefore: Copying the work of others, without a good reference, is plagiarism and will be punished!!!!!!!

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What is a reference?

Rip, A., 1995, Introduction of new technologies: Making use of recent insights from sociology and economics of technology, In: Technology Analysis & Strategic Management, Vol. 7, no.4, pp. 417-431

What is a Quote:

"If laboratories and research sites are to the twentieth century what monasteries were to the twelfth, then the sources of their power and efficacy remain a mystery. How is it that the ideas and writings that issue from these institutions are able to revolutionize, if only gradually, conditions of work in industry, the universe of consumer goods and lifestyles ? How are the discoveries made in Stanford, Gif-sur-Yvette, and Cambridge diffused such that they become universally known and recognized ?" (Callon, M., 1986, THE SOCIOLOGY OF AN ACTOR-NETWORK: THE CASE OF THE ELECTRIC VEHICLE, in: Michel Callon, John Law, Arie Rip (eds.), "Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World", Mcmillan, London, pp. 19)

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Is Technology Applied Science?

History

Does science preclude technology?

Steam engine, aircraft, polymers, nuclear power

SCIENCE & TECHNOLOGY interact like a map and a traveler

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Science based industry

Physics, Chemistry, Biochem, Pharma,
Successful mergers of science and industry

But:

Some tension with the values of science:

Science in corporate labs:

Relying on experience and instinct, Stephanie Kwolek invented one of the modern world's most readily recognized and widely used materials: Kevlar®. DuPont put its Pioneering Lab to work finding a viable commercial version of Kwolek's new crystalline polymers, the potential applications for which were obvious. The result was Kevlar® (first marketed in 1971), a fiber five times stronger once for ounce than steel, but about half the density of fiberglass.

Wisdom with Hindsight.....

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Invention of PBA

1964, Paul Morgan assigned his assistant, Stephanie Kwolek to make all para aromatic poly-amides in order to make heat resistant fibers.

She succeeded to make PBA

In January 1965, a fiber was spun from this low viscosity solution.

Kwolek was afraid of making a blunder. For a while, she did not dare to tell her colleagues about this result.

Nobel prize winner Paul Flory was called to the laboratory as a consultant and helped to interpret Kwolek's data.



Kwolek, Blades, Morgan, Rivers

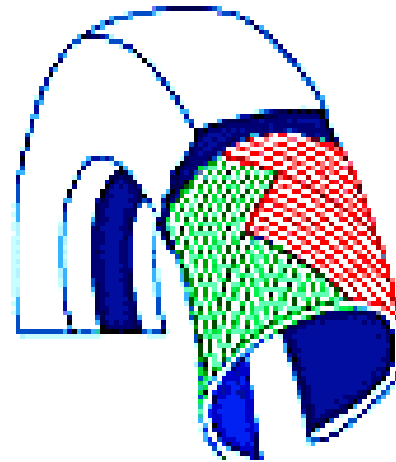
www.chemheritage.org

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1968 Tire Cord Crisis

Safety

Cross ply tires



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1970, wrong choice

PBA, turn to PPDT

Kevlar is the solution:

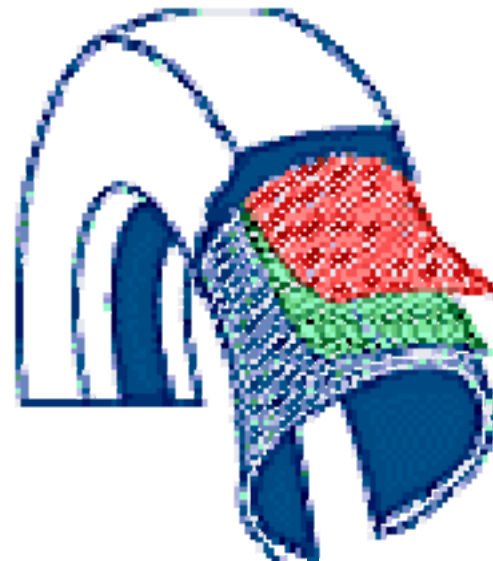
Safety

Sofas on Wheels

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Tires

Radial architecture
invented by
Michelin



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Tires

1974-76

Radials conquer USA by: **Reinforced steel**

Kevlar barely survives

Then gradually:

anti-ballistics,
composites, and
asbestos replacement

Science & Technology

- Invention Kevlar based on science done in corporate lab.
- Technological application was an invention as well
- Later, company uses Kevlar for its public image
- Innovation process not straightforward but with many trial & error