Fire Science:
Research for citizen safety

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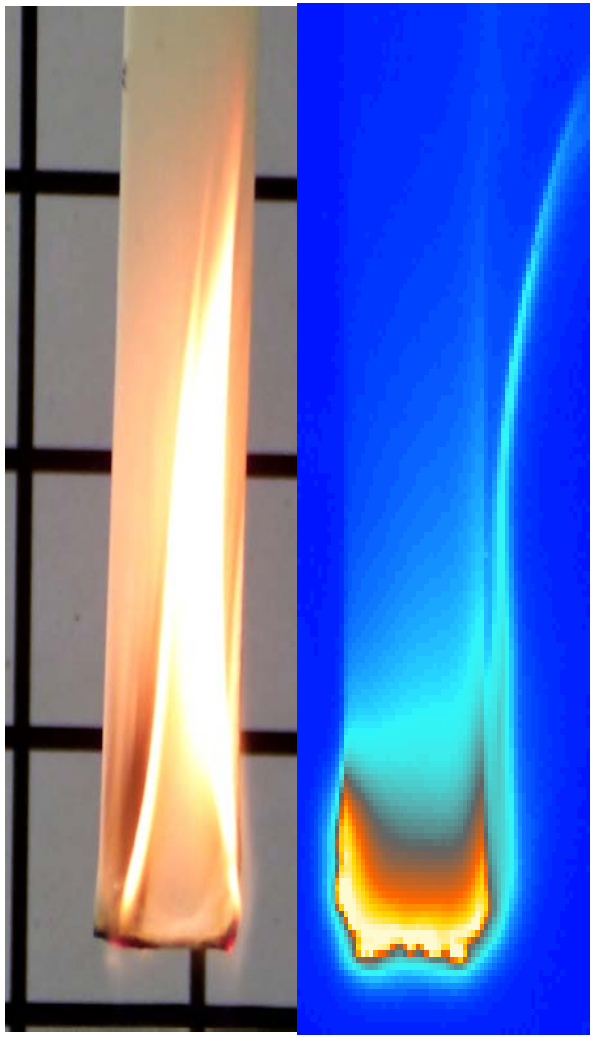
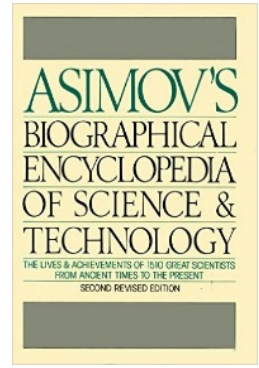


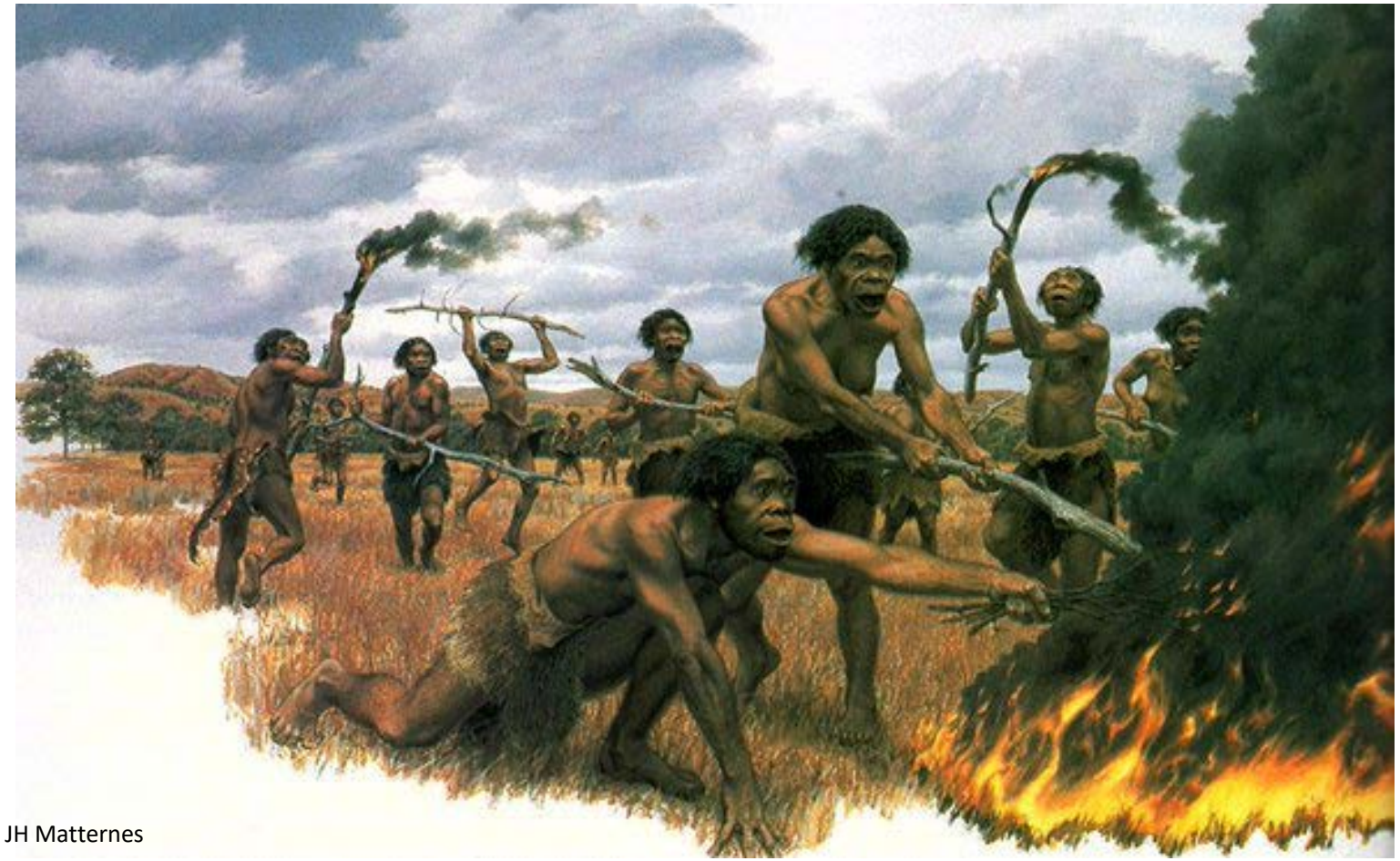
Fire Safety Mission Europe.
Brussels, 3 Dec 2018.

Fire Science 1.5 million years ago

"Fire is the greatest single discovery in human history"

Prof. Isaac Asimov (1920-1992)





JH Matternes

Fire is a good servant...
... but fire is a bad master

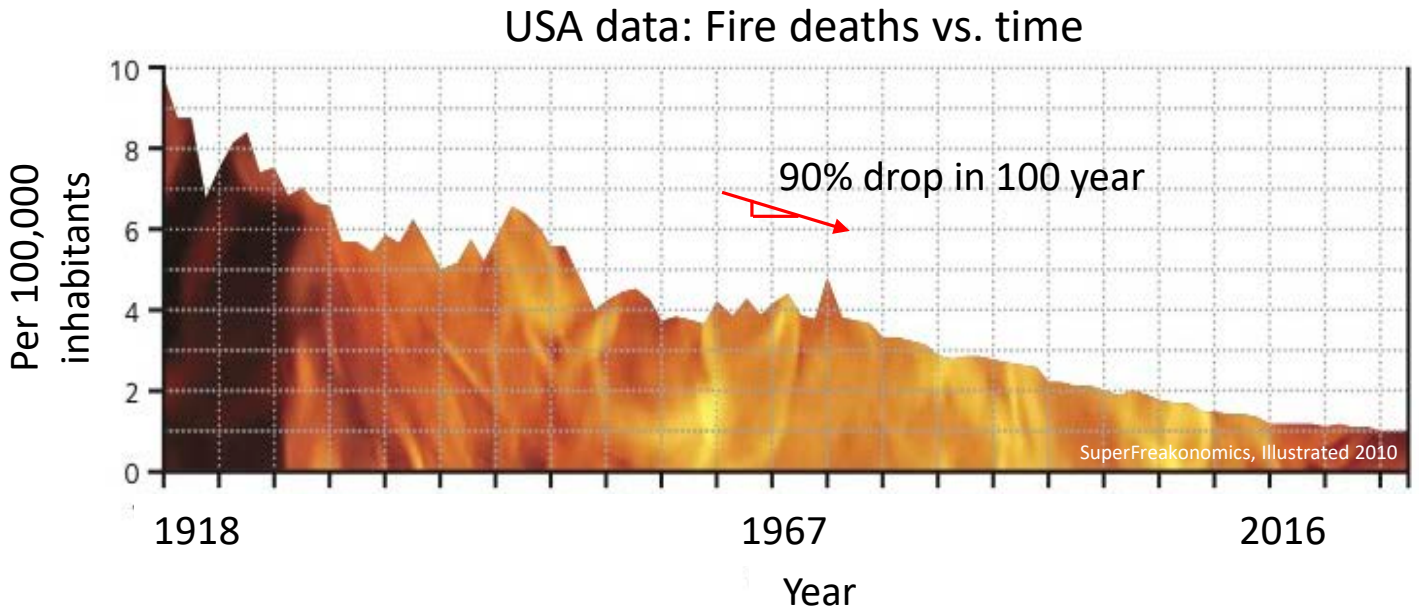
BRE

What is fire science?

- Fire Science is the study of unwanted combustion with the aim of creating **new knowledge**.

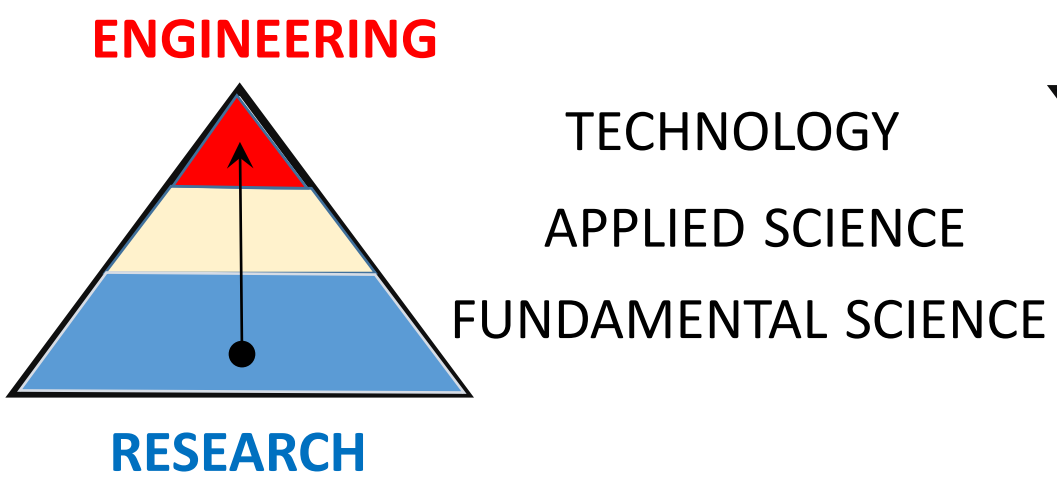
- This new knowledge is then transferred to **Fire Engineers** so they can make the world safer from fire: protecting people, their property, and the environment.

Cost of fire is always very high

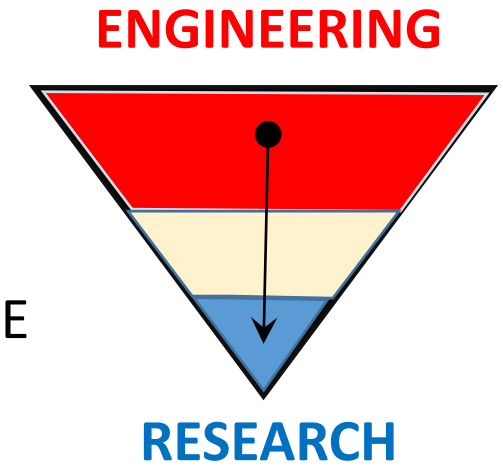


- Despite tremendous progress in protecting lives from fire, it still **causes 5% of injury deaths** worldwide (war causes 2%).
- Losses, injuries, and number of fires always on the rise…
- 95% of fire deaths are in low and middle income countries.
- **Protection from fires is very costly** (in UK: £10 billion/yr).
- **Cost of fire is always very high, either in deaths or in protection. Can we do better?**

Two Paradigms for Engineering Innovation

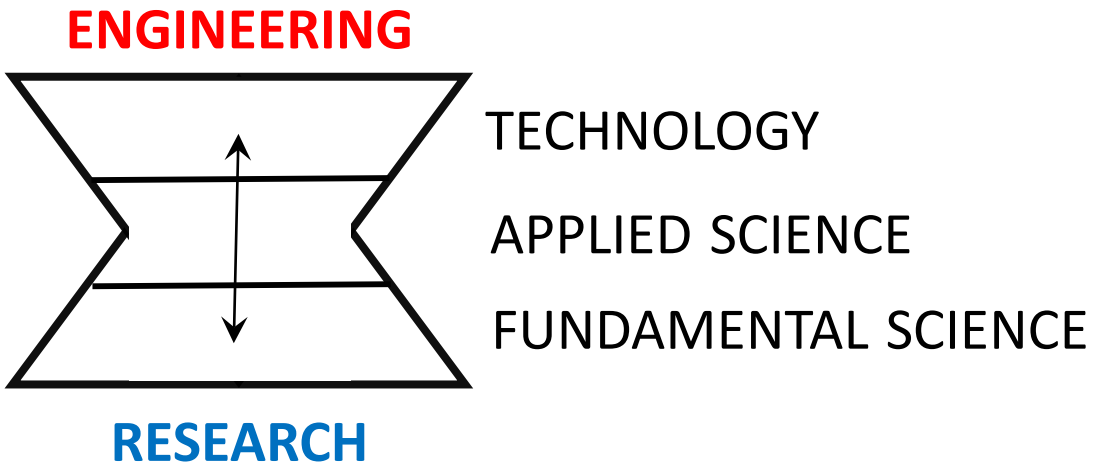


1. Anterior Paradigm (aka textbook version): Fundamental science enables the translation from applied science into engineering innovation.

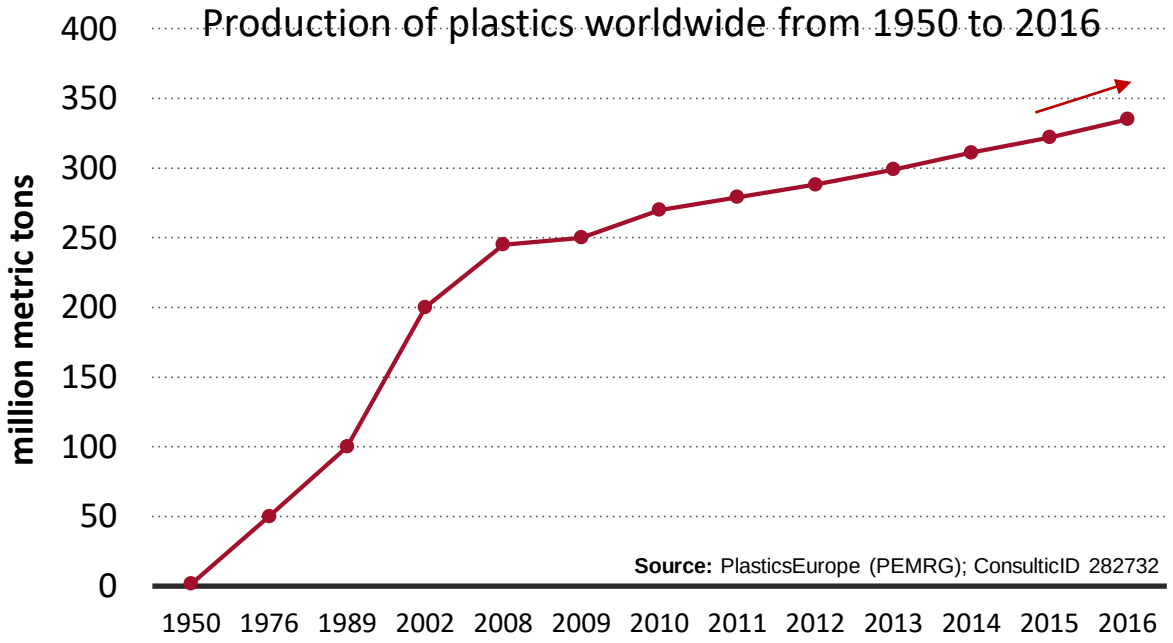


2. Posterior Paradigm (aka industrial version): Engineering innovation is made first, and then passed on to applied science for improvements and to fundamental science for explaining.

3. Hyperbole Paradigm (aka probable reality): Engineering innovation and research are interconnected both ways, and all combined, they lead to more and better innovations.



Challenge 1: Worldwide Polymer Addiction



Layers of Protection:

‖ Prevention ‖ Detection ‖

‖ Evacuation ‖ Compartmentation ‖Suppression ‖

‖ Structural Resilience ‖

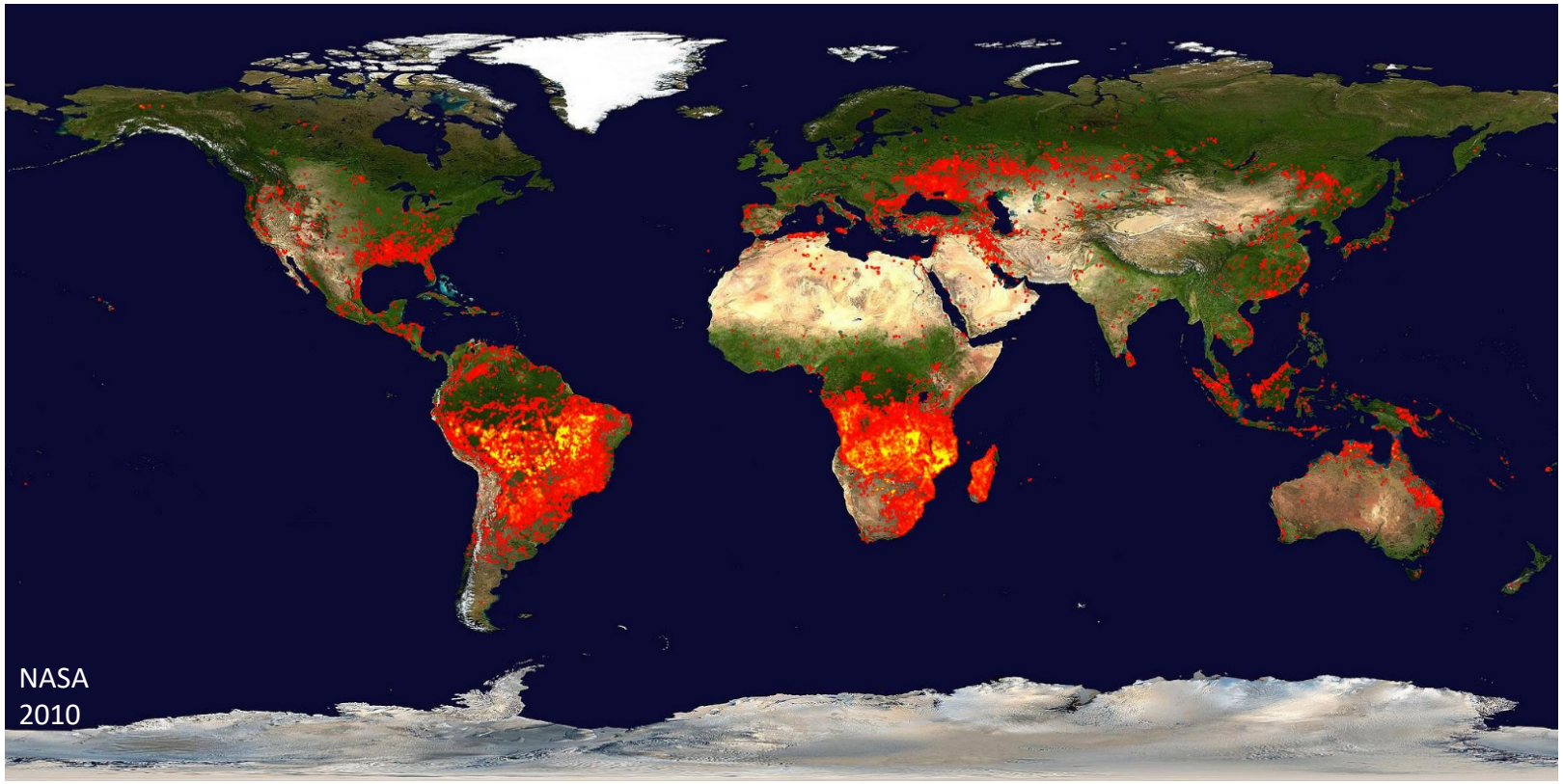
- There are ever increasing amounts of plastics around us. **Breakthrough modern technology**.
- But all polymers are flammable and involved in most residential fires. It is just a matter of degrees **of flammability**.
- **Solution:** Invest in research-led innovation based on the **layers of fire safety.**

Challenge 2: Safety of buildings is changing

- Architect dreams of impossible buildings, which the engineer has to built (taller, lighter, faster).
- Novel materials and systems arriving at unprecedented rate.
- E.g. green buildings, flammable facades, li-ion batteries, timber.

- **Solution:** invest into **smart firefighting** (Smart Buildings, Artificial Intelligence, Big Data, Internet of Things, Robotics)

Challenge 3: Wildfires and the new normal



- Multiple € billions are spent annually worldwide to protect communities and ecosystems from wildfires.
- **Solution:** Invest in research-led innovation for **new generation of computer models** (which are hindered because there is still no theory of flame spread).

Concluding Remarks

- Fire is the **greatest discovery** of humankind, but also a natural and technological hazard.
- **Fire Engineers** make the world safer: protecting people, their property and the environment.
- Multidisciplinary field rapidly evolving but **underfunded**.
- In dire need for high-fidelity experiments and embracing the digital revolution.
- The field belongs to the forefront of technology and innovation. But it must grow substantially its scientific base. **EU can lead.**

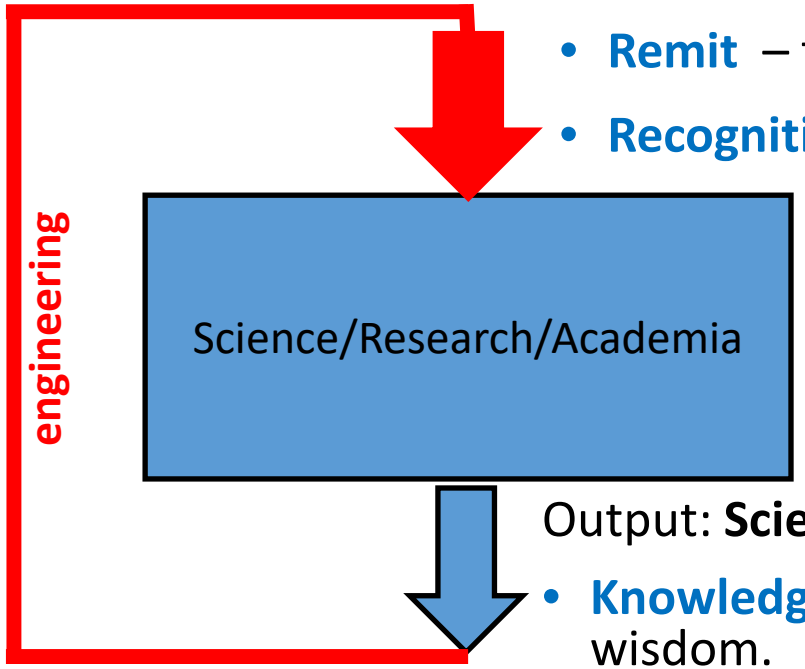
Thank you

Cartoon by Floris Oudshoorn @MySwampThing (Comic House, 2018).

Science & Engineering: Powerful Partnership

Engineering/Industry is the creation and application of technology to improve society.

Science/Research is the attempt to create new knowledge using the scientific method.



Input: **Science** needs from **engineering**:

- **Remit** – formulate the problems worth studying.
- **Recognition** – the esteem and investment to grow.

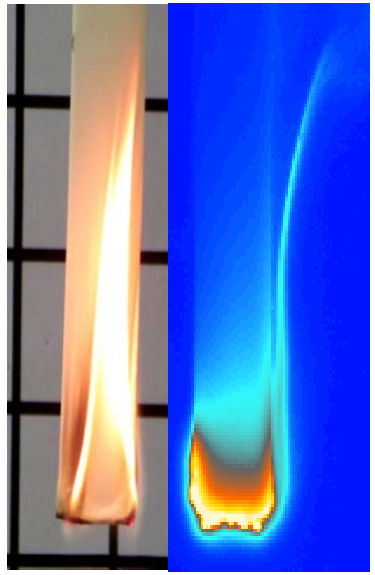
Output: **Science** contributes to **engineering**:

- **Knowledge** – Previously unknown to the collective human wisdom.
- **People** –The next generation of engineers.

Fire Safety Regulations

Legislation sets only **the minimum safety requirement**, not the best. Which leads to two issues:

1. Prof. Brannigan, Univ. Maryland: *"The **Titanic** complied with all codes. Lawyers can make any device legal, only engineers can make them safe"*.



2. **Scale matters**. Fire regulations are imposed for small samples exposed to small ignition sources. How much does it work at large sample and large ignition sources?

Fire Engineering

Fire Engineers make the world safer from fire: protecting people, their property, and the environment.

Layers of Protection* **(after Prof Drysdale):**

1. **Prevention****
2. Detection
3. Evacuation
4. Compartmentation
5. Suppression
6. Structural Resilience

*Not all layers must be present in a building, but all must be considered as least.

Not all layers contribute equally or cost equal amounts, but **the single most important layer of protection is prevention (avoid the fire from taking place, disrupt the fire triangle)