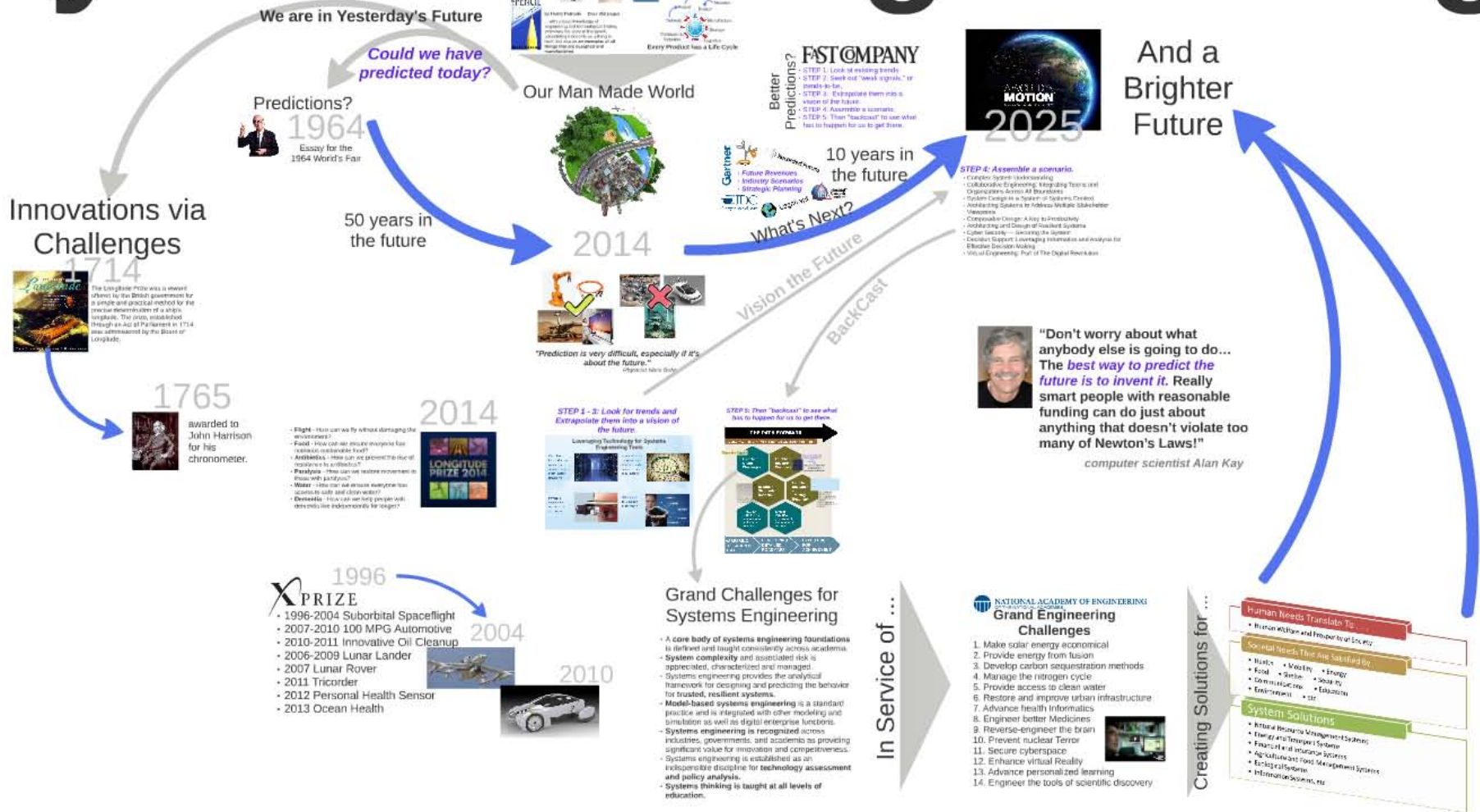
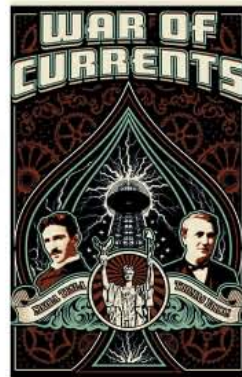


The Future of Systems Engineering



How was your day so far?



1850's



Yarn



<http://www.npr.org/series/248799434/planet-moneys-t-shirt-project>



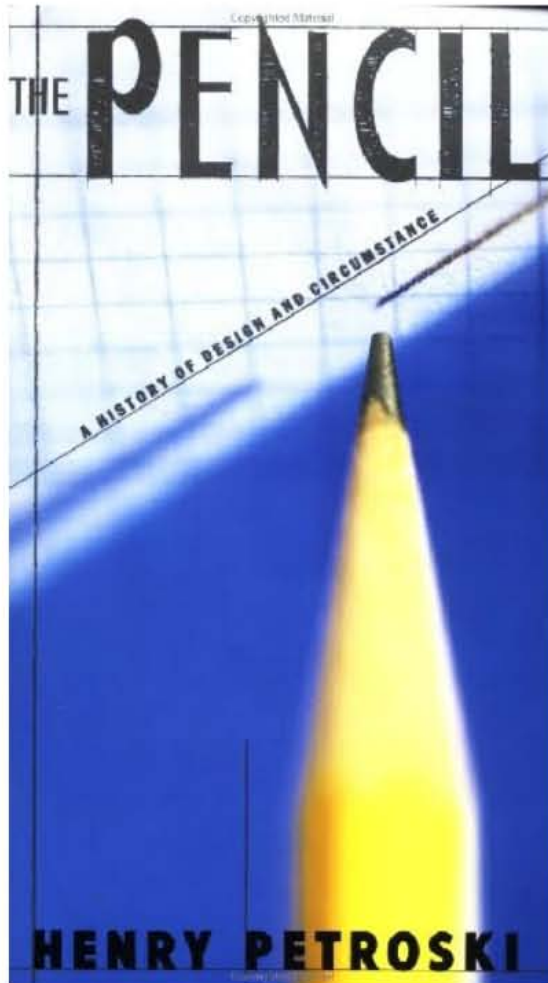
Federal-Aid Highway Act of 1956



over 1 billion vehicles

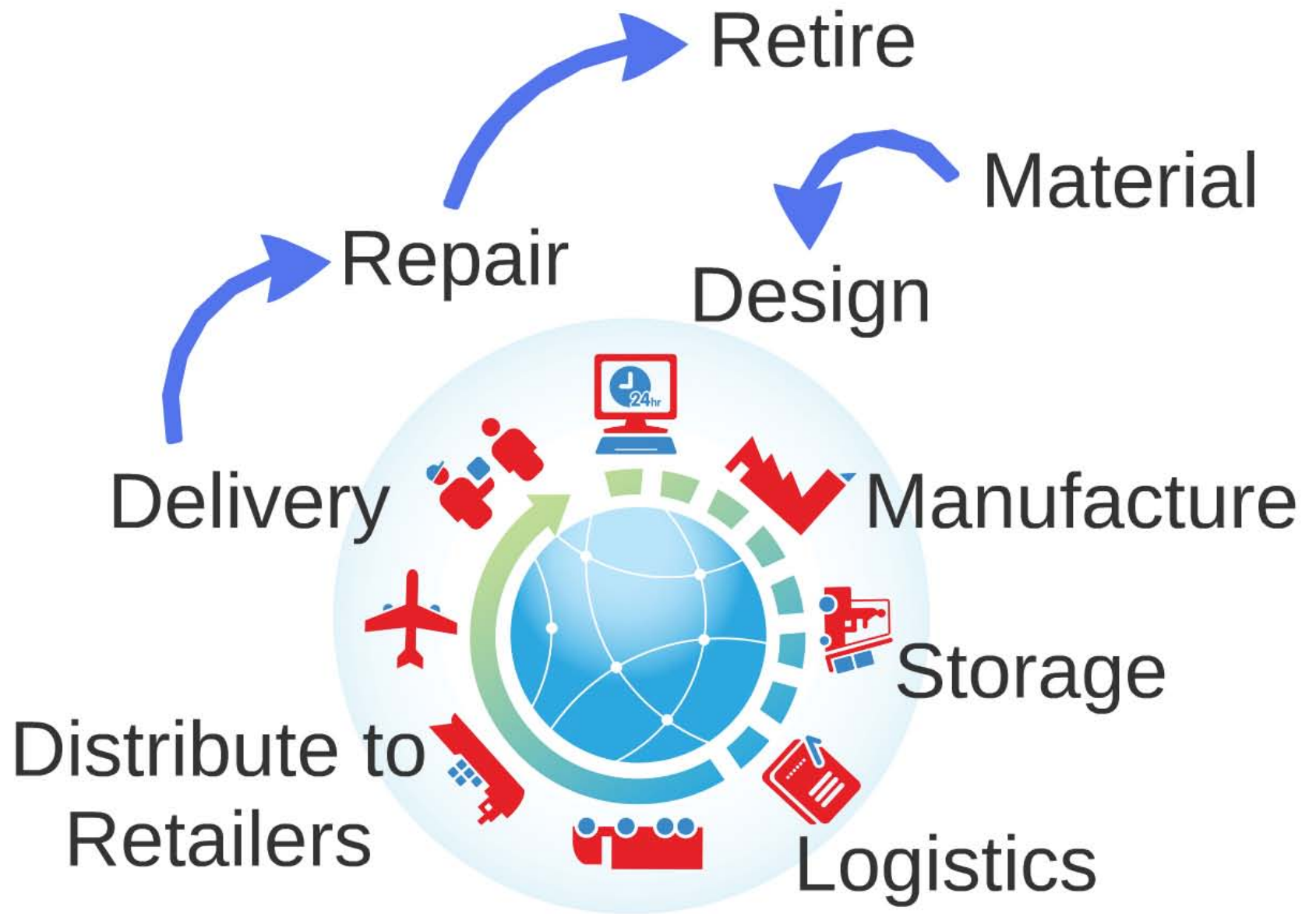


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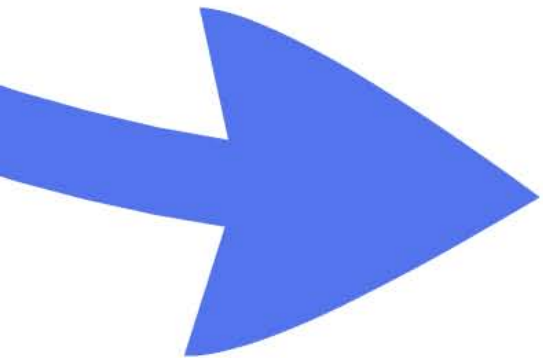
by Henry Petroski Over 350 pages

... with a deep knowledge of engineering and technological history, examines the story of the pencil, considering it not only as a thing in itself, but also as **an exemplar of all things that are designed and manufactured.**



Every Product has a Life Cycle

Our Man Made World



2014



Gartner®

ME

Analyze the

We are in Yesterday's Future

*Could we have
predicted today?*

Predictions?



1964

Essay for the
1964 World's Fair

predicted today?

Our I

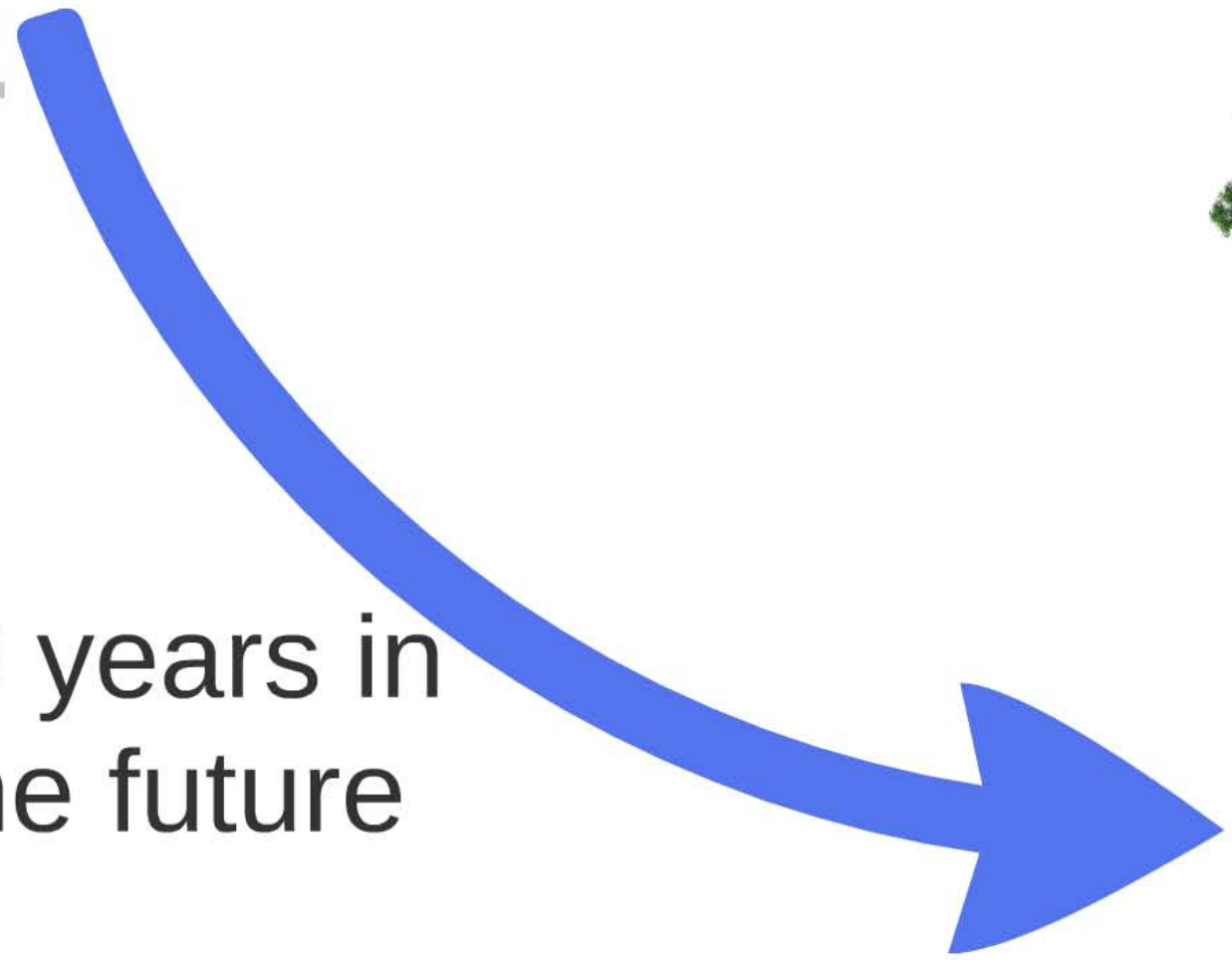
Predictions?

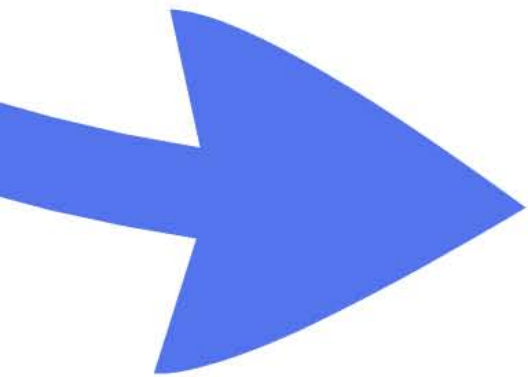
1964

Essay for the
1964 World's Fair



50 years in
the future





2014



"Prediction is very difficult, especially if it's about the future."

Physicist Niels Bohr

Forecast

- STEP 4: Assemble a scenario,
- STEP 5: Then "backcast" to see what has to happen for us to get there.

Gartner



- *Future Revenues*
- *Industry Scenarios*
- *Strategic Planning*



Cognizant



10 years in the future

What's Next?

the Future

Better

Predictions?

FAST COMPANY

- STEP 1: Look at existing trends.
- STEP 2: Seek out "weak signals," or trends-to-be,
- STEP 3: Extrapolate them into a vision of the future.
- STEP 4: Assemble a scenario,
- STEP 5: Then "backcast" to see what has to happen for us to get there.

10 years in





A WORLD IN
MOTION*

Systems Engineering Vision • 2025

2025



STEP 1 - 3: Look for trends and Extrapolate them into a vision of the future.

Leveraging Technology for Systems Engineering Tools

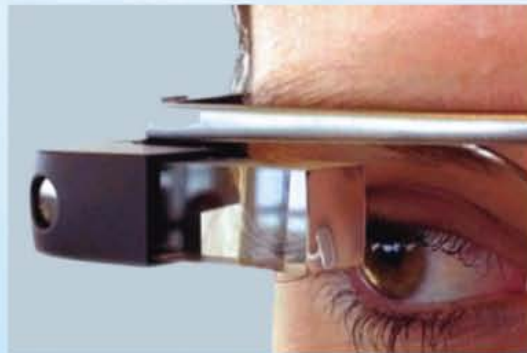
Cloud-based high performance computing supports high fidelity system simulations



Advanced search query, and analytical methods support reasoning about systems



Immersive technologies support data visualization



Net-enabled tools support collaboration



2025

STEP 4: Assemble a scenario.

- Complex System Understanding
- Collaborative Engineering: Integrating Teams and Organizations Across All Boundaries
- System Design In a System of Systems Context
- Architecting Systems to Address Multiple Stakeholder Viewpoints
- Composable Design: A Key to Productivity
- Architecting and Design of Resilient Systems
- Cyber Security — Securing the System
- Decision Support: Leveraging Information and Analysis for Effective Decision Making
- Virtual Engineering: Part of The Digital Revolution

d
of

STEP 5: Then "backcast" to see what has to happen for us to get there.



Force the Future

Establish Grand Challenges

Establish Research Roadmap

- Mature systems thinking
- Theoretical foundations



basis ↘

Advanced systems engineering methods and tools.

Establish Standards Roadmap



Identify, develop, and evolve standards for codifying the practice of systems engineering, which can contribute to the systems engineering body of knowledge.

Establish Education and Training Roadmap



- Systems thinking is introduced early
- Systems engineering is a part of every engineer's curriculum
- Systems engineering grounded in the theoretical foundations

Evolve the SEBoK to encompass new application domains

Engage industry, government, and academic leaders

methods and tools.

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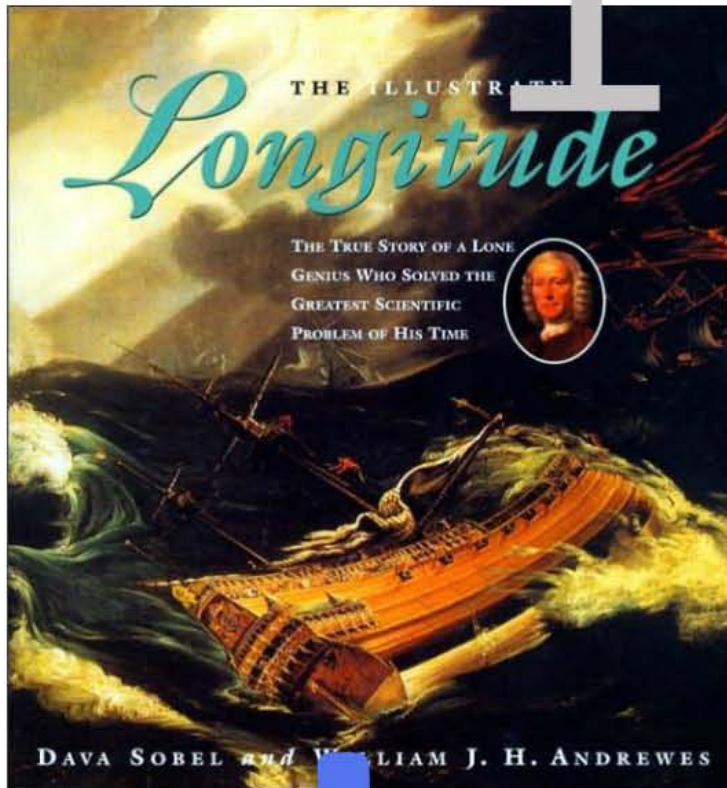
Engage industry, government, and academic leaders

Force the Future

**Establish
Grand
Challenges**

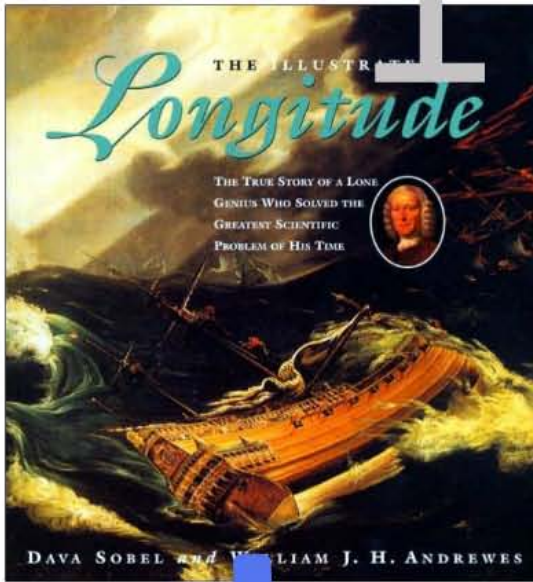
Innovations via Challenges

1714



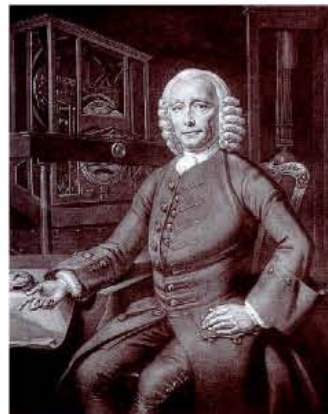
The Longitude Prize was a reward offered by the British government for a simple and practical method for the precise determination of a ship's longitude. The prize, established through an Act of Parliament in 1714, was administered by the Board of Longitude.

1714



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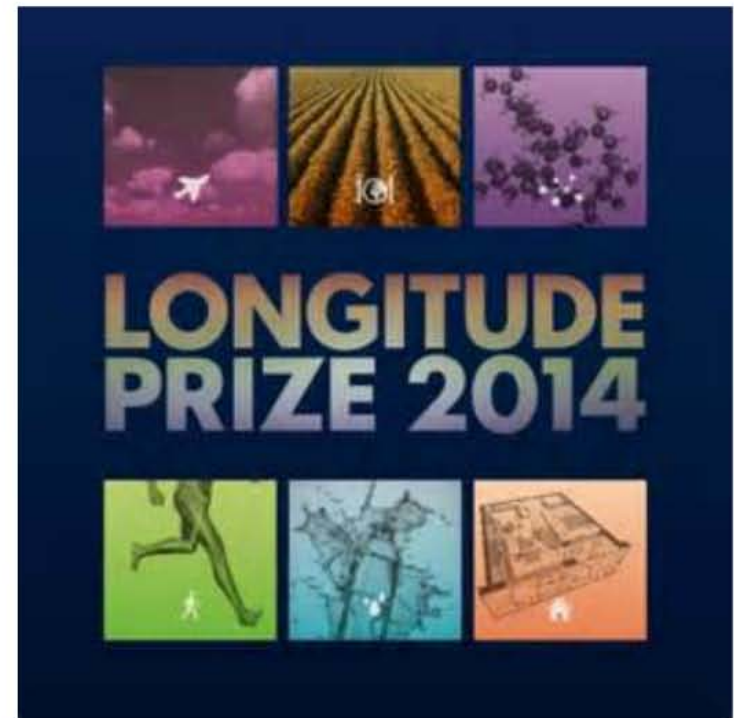
1765



awarded to John Harrison for his chronometer.

2014

- **Flight** - How can we fly without damaging the environment?
- **Food** - How can we ensure everyone has nutritious sustainable food?
- **Antibiotics** - How can we prevent the rise of resistance to antibiotics?
- **Paralysis** - How can we restore movement to those with paralysis?
- **Water** - How can we ensure everyone has access to safe and clean water?
- **Dementia** - How can we help people with dementia live independently for longer?



XPRIZE

1996



- 1996-2004 Suborbital Spaceflight
- 2007-2010 100 MPG Automotive
- 2010-2011 Innovative Oil Cleanup
- 2006-2009 Lunar Lander
- 2007 Lunar Rover
- 2011 Tricorder
- 2012 Personal Health Sensor
- 2013 Ocean Health

2004



2010

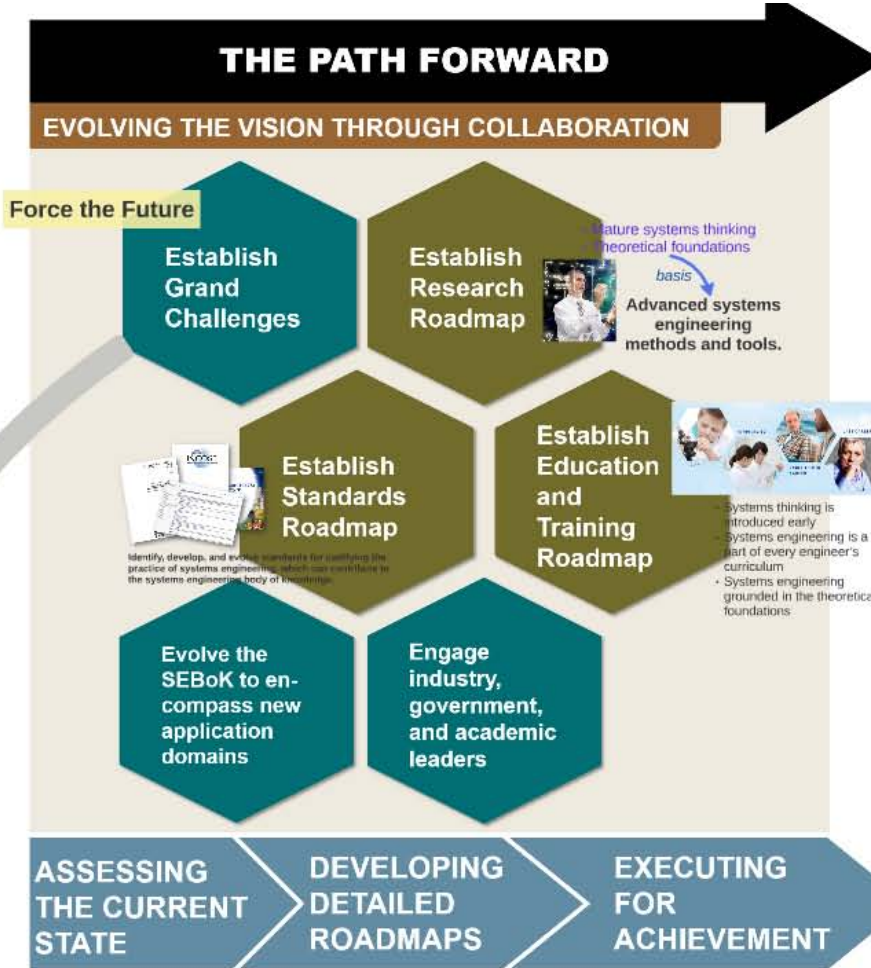


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Grand Challenges for Systems Engineering

of ...

Grand Challenges for Systems Engineering

- A **core body of systems engineering foundations** is defined and taught consistently across academia.
- **System complexity** and associated risk is appreciated, characterized and managed.
- Systems engineering provides the analytical framework for designing and predicting the behavior for **trusted, resilient systems**.
- **Model-based systems engineering** is a standard practice and is integrated with other modeling and simulation as well as digital enterprise functions.
- **Systems engineering is recognized** across industries, governments, and academia as providing significant value for innovation and competitiveness.
- Systems engineering is established as an indispensable discipline for **technology assessment and policy analysis**.
- **Systems thinking is taught at all levels of education**.

In Service of ...





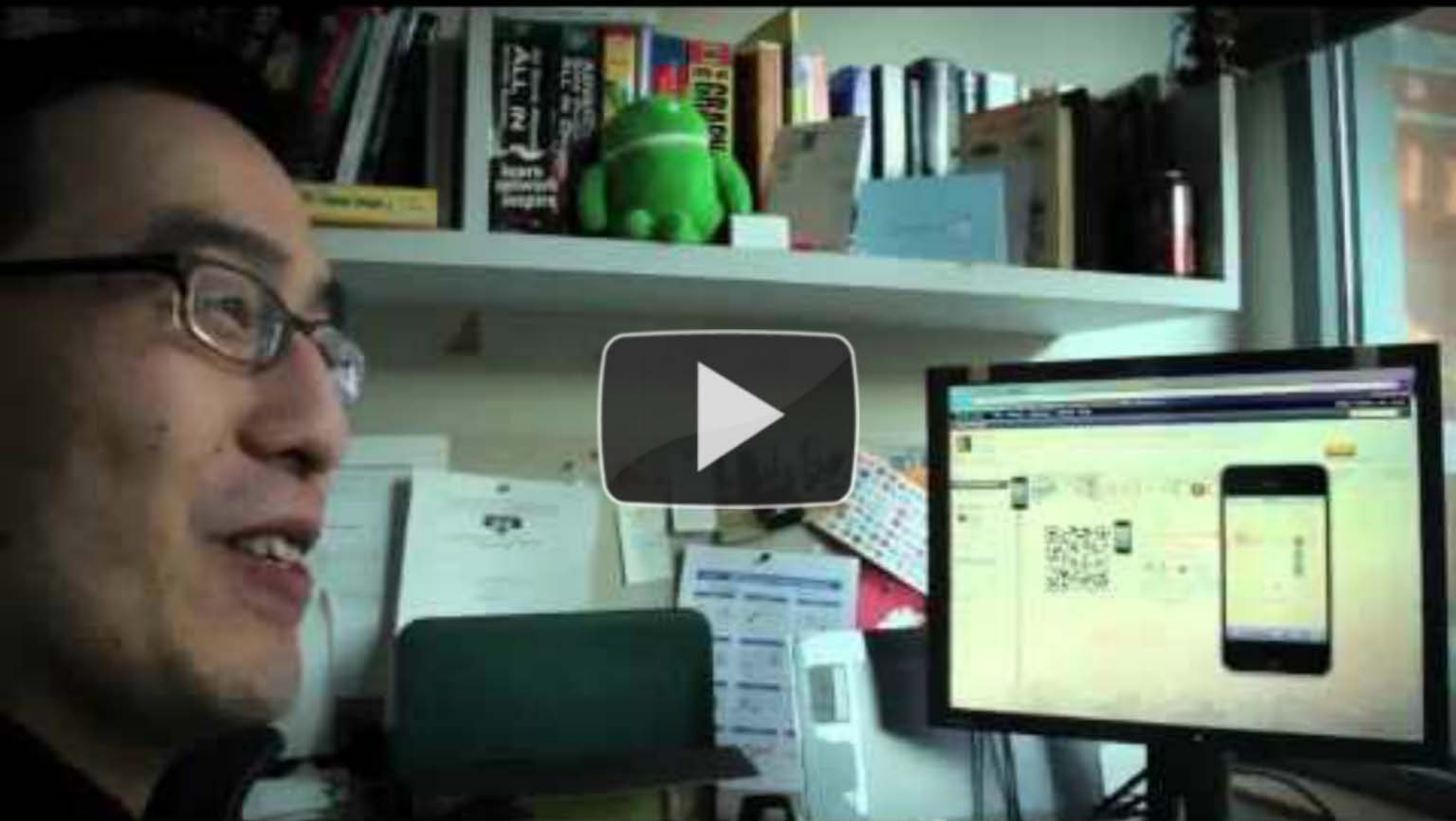
NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES

Grand Engineering Challenges

1. Make solar energy economical
2. Provide energy from fusion
3. Develop carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advance health Informatics
8. Engineer better Medicines
9. Reverse-engineer the brain
10. Prevent nuclear Terror
11. Secure cyberspace
12. Enhance virtual Reality
13. Advance personalized learning
14. Engineer the tools of scientific discovery



Creating Solutions for ...



YouTube

Creating Solutions for ...

Human Needs Translate To ...

- Human Welfare and Prosperity of Society

Societal Needs That Are Satisfied By ...

- Health
- Food
- Communications
- Environment
- Mobility
- Shelter
- etc.
- Energy
- Security
- Education

System Solutions

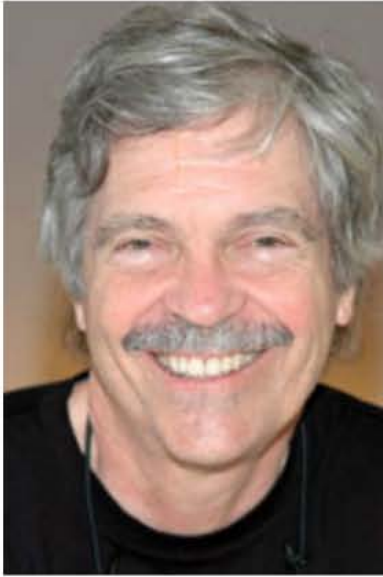
- Natural Resource Management Systems
- Energy and Transport Systems
- Financial and Insurance Systems
- Agriculture and Food Management Systems
- Ecological Systems
- Information Systems, etc



And a Brighter Future

STEP 4: Assemble a scenario.

- Complex System Understanding
- Collaborative Engineering: Integrating Teams and Organizations Across All Boundaries
- System Design In a System of Systems Context



“Don’t worry about what anybody else is going to do... The *best way to predict the future is to invent it.* Really smart people with reasonable funding can do just about anything that doesn’t violate too many of Newton’s Laws!”

computer scientist Alan Kay

The Future of Systems Engineering

