



5th IFEES Global Engineering Education Summit

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Lisbon – Portugal

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Hopi saying: does this talk grow corn?

THE NUMBER ONE

**One Planet
One Environment
One Chance!!!!!!!!!!!!**

Act Locally – Think Globally

It's Not a Side-line Hobby; It's Not a Game

21st Century Challenges

- Population
- Water
- Food
- Energy
- Health
- Environment
- Terrorism/Conflict
- Climate change
- Biodiversity
- Wellbeing
- Sustainability

World Bank, June 2007

**OECD, UN Millennium,
other**

NAE Challenges

Engineering's Grand Challenges

X

WHAT
DO YOU
THINK?

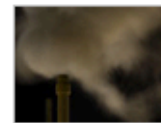
Click on the engineering challenge you think is the most important:



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



Engineer the tools of scientific discovery

<http://www.engineeringchallenges.org/>

Technical Challenges

- **Complex, non-linear, chaotic, scalability...**
- **Infrastructure**
IT equalizer?, connectivity, access, services, broadband...
- **Security**
Privacy, conflict resolution, tolerance, reconciliation...
- **Resources**
Water, energy, food, oil, environment, minerals, funding...

Social Challenges

- **Socio-economic development**
Poverty, social responsibility, sustainability, design for recovery vs. throw-away, corruption, speculation, wealth generation, values, ethics, accountability, policies, funding, education, volunteer economy, health...
- **Political awareness**
Apathy, interest groups, lobbying, political parties, international & multilateral organizations...
- **Diversity**
Religion, culture, gender, ethnical, human rights, languages...
- **Health**
Affordable, quality, universal, traditional, non-traditional...

Educational Challenges

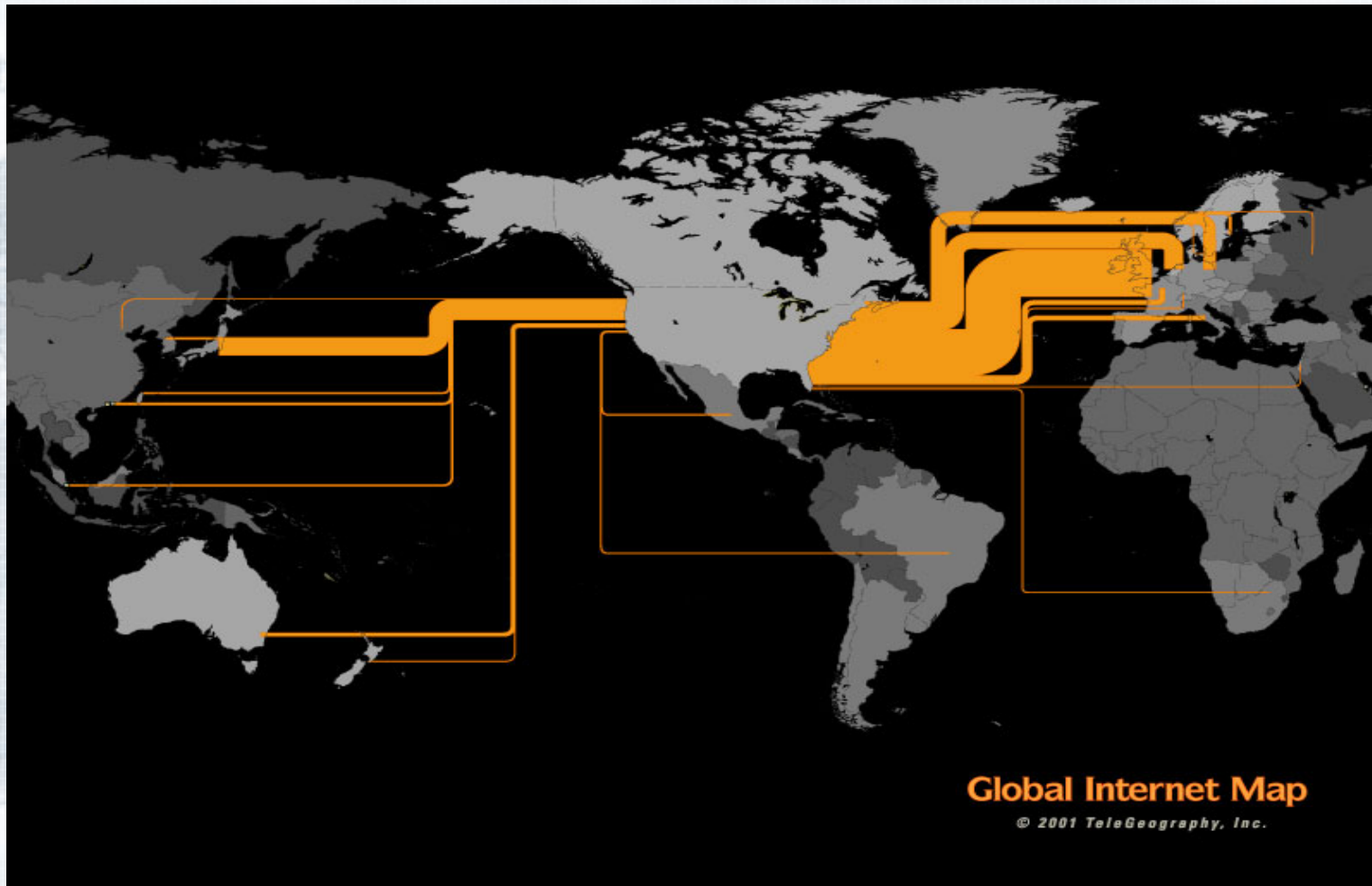
- **Education**

Internationalization, mobility, collaboration, quality, funding, public vs. private, university-industry-government-society relations, entrepreneurship, IP, meta-universities...

- **Culture of Quality**

Accreditation, certification, standards, metrics...

Digital Divide



Collaboration



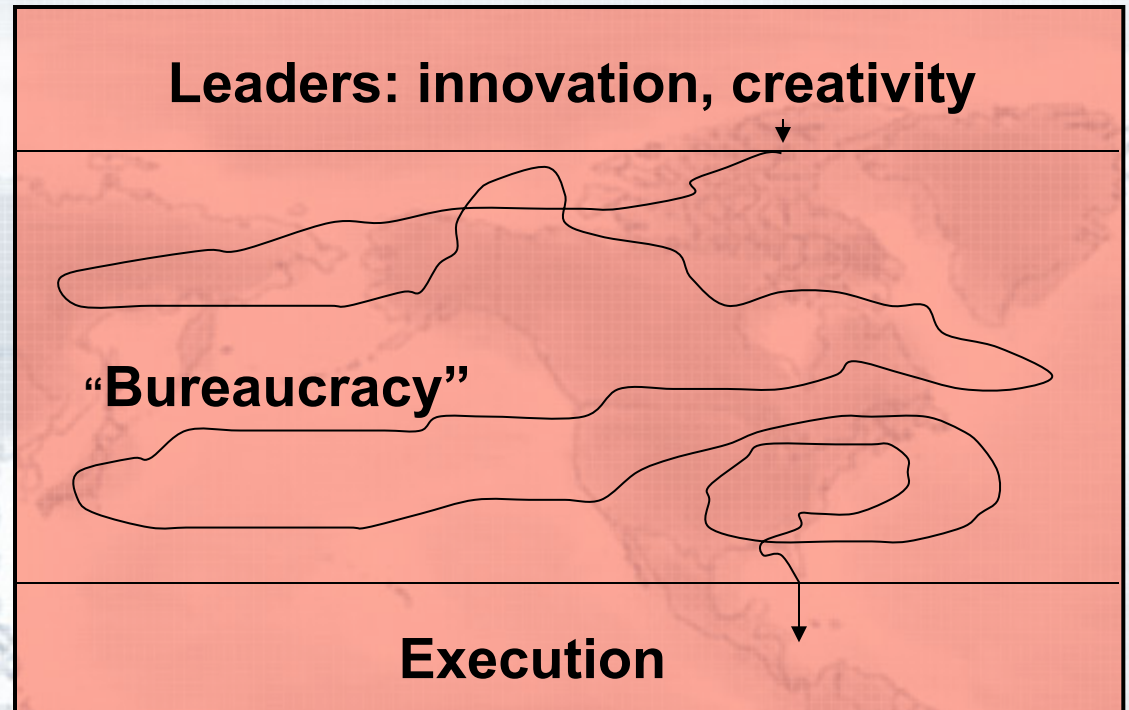
Collaboration $\propto T \times \frac{1}{d^n}$

T = Tropicalization, d = Distance, n = Bureaucracy

Synergy

- Transparency
- Efficiency
- Effectiveness
- Professionalism
- Knowledge
- KNOW-HOW vs KNOW-WHO
- TRUST

ICT contributes to the cultural change of the user, institution, government



Sustainable development = rule of law + efficient and credible private and public institutions

A Not so New Approach

Medical doctors use a four step process:

- **Observation**
- **Diagnosis**
- **Prognosis**
- **Prescription**

Scientists and Engineers can use a similar process to solve our challenges:

- **Observation**
- **Challenge**
- **Forecast**
- **Idea/Innovation/Solution**

The Greatest Engineering Challenge

Observation: Humans spend about \$US 2 trillion on the global military-industrial complex.

In the 21st century we are likely to see a number of peaks: peak population, peak oil, peak natural gas, peak uranium, peak carbon.

Challenge: Identify a problem or challenge that is so awesome and compelling that it makes people, companies, and governments eager to join forces to meet the challenge.

Forecast: Without this, richer countries will go bankrupt, reducing the chance for developing countries to achieve their full potential.

The Big Idea: Peace Engineering

Peace Engineering

Financial Engineering
Social Engineering
Cultural Engineering
Infrastructure Engineering
Future Engineering

Peace Engineering:

The creation, integration, and replication of civilization scale modular functions that will cause the redeployment of capital, technology, information, and expertise away from applications that are limited to war and security, and towards dual-use and civilian applications.

Defining, designing, developing, deploying, and debugging new and novel applications of science, technology, organization, and narrative to engage groups into ever greater challenges that will require ever greater cooperation to rise to successful resolution of the challenge.

Peace Engineering

- Transparency
- Efficiency
- Effectiveness
- Competence
- Knowledge
- Diversity
- Social responsibility
- Sustainability
- Accountability
- Ethics
- Collaboration

TRUST

NEW LEADERSHIP NEEDED!!!!

- ❑ **Social entrepreneurs**
- ❑ **Business entrepreneurs**
- ❑ **Leadership building**
- ❑ **Mobility**
- ❑ **Teamwork, Collaboration**
Inter/multi/transdisciplinary
- ❑ **Tolerance**
- ❑ **Ethics**
- ❑ **Diversity**

The Big Idea: Civilization Innovation

Gandi: “Consider the poorest person you know, and ask whether your next action will make any difference to that person.”

A big question:

What’s the single greatest way to improve the world?

A big answer no. 1:

Connect all seven billion people with wireless broadband Internet and let anyone buy, sell, borrow, loan, swap, learn, teach, talk with anyone anywhere, anytime.

A big answer no. 2:

Improve wireless broadband Internet so that the marginal cost falls toward zero, and the poor get the whole Internet almost for free.

Deconstructing/Reverse Engineering to achieve the objectives:

Accelerate the deployment of 4G wireless broadband by defining it. Base it on an all-IP, end-to-end architecture (IPv6), that allows use of new and novel spectrum, air interfaces, and more.

Civilization Innovation

**GIVE PEOPLE ACCESS TO THE
INFORMATION THEY NEED**

SO

**THEY CAN FOCUS ON
SOLUTIONS**

Peace Engineering Needs

Instant access to information (i.e. Internet)

High bandwidth (>20mbps)

- **4G**
- **IPv6**

Ubiquitous coverage

Ubiquitous availability of service (including BoP efforts)

Peace Engineering Issues

Current telecom infrastructure – insufficient

Current bandwidths – marginal (at best)

Current technology – ??? (CDMA, HSDPA, UMTS, etc.)

WHAT DO WE NEED?

- **NEW INFRASTRUCTURE**
- **NEW BUSINESS MODEL**
- **NEW TECHNOLOGY**

The Big Idea: 4G as Peace Engineering

Why 4G?

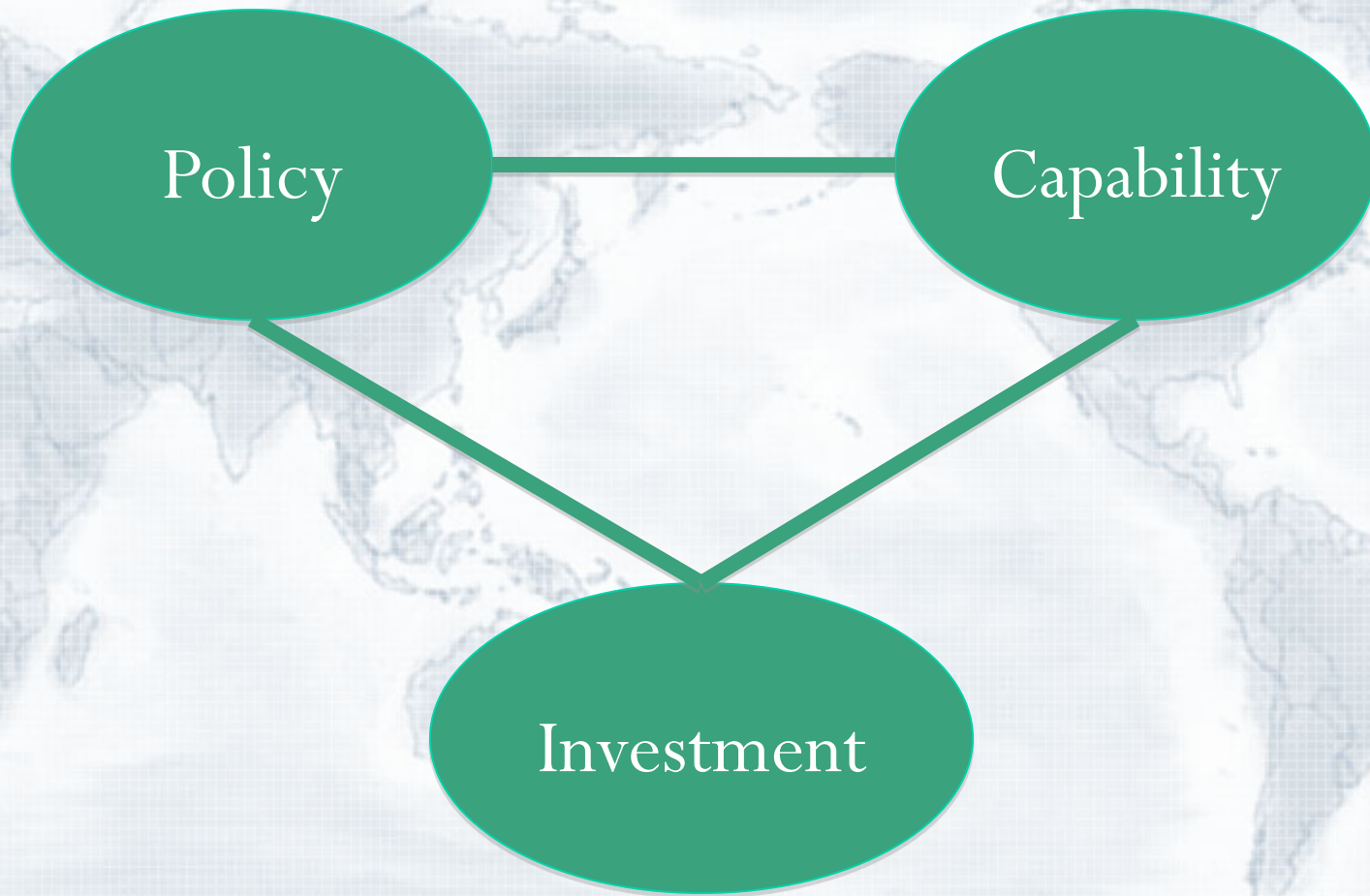
Because 4G is a global challenge. The entire world can participate in the creation of new and novel 4G infrastructure.

What Lessons?

Organizations should support the creation of Peace Engineering curriculum, based on the creation, integration and replication of challenges that will lead directly to universal wireless broadband as the first of 100 new infrastructures that will be affordable and available to all humanity.

Next Generation Wireless

KEY FACTORS TO SUCCESS



Policy – OSTP*

...In 2011, the President (Obama) announced the National Wireless Initiative, noting that "***we can't expect tomorrow's economy to take root using yesterday's infrastructure...***"

*Office of Science and Technology Policy (OSTP)

In the United States and beyond...

Policy

- 2010 - President Obama initiates “wireless innovation”

Capability

- 2011 NSF gets commissioned to carry out the initiative – EARS Program

Investment

- Budget approved for \$14M for EARS
- Budget approved for \$3B over 5 year for Wireless Innovation
- Working with Fortune Nest Corporation
 - Focus on Middle East
 - Focus on China

What is EARS?

ENHANCED ACCESS TO RADIO SPECTRUM

Two parts to the investment

- **Basic Research (University, R&D centers, Companies)**
 - Multi-disciplinary
 - R&D (more “R”) and Science
- **Commercialization**
 - Small Business Technology Transfer (STTR)
 - University/Industry collaboration
 - Industry leads to commercialize basic research
 - To transition to Small Business Innovative Research (SBIR) program

Next Steps

Replicate model in emerging markets

- Emerging markets now have the opportunity to leapfrog technology – become a leader
- Human capital exchange is the ISTEAC model
- Work on carving up the problem, build clusters of expertise

Collaboration

- Must be established through policy, capability and investment

THIS IS A VERY BIG PROBLEM!

Summary/Questions/Opinions

What do we need?

- New wireless infrastructure, business models, technology needed to support Peace Engineering initiative and curriculum – the solution is not in one place

How do we get it?

- Shift in existing communication infrastructure will require investment and partnerships on a global scale – this is not easy to do, manage, or even execute – need talent

What are the challenges – harmonization?

- Imagine no roaming, instant access, coverage everywhere
- Standard vs. open source
- Paid service vs. free service

How can Engineering Education Respond to these Challenges?

Understand the education process

Innovate/reform the curriculum to better respond to the needs of all stakeholders: students, industry, faculty, society

Focus on learning rather than teaching and student learning outcomes

Build/nurture an innovation culture across the education ecosystem

Engage in meaningful R&D and tech transfer to solve global problems and respond to society's needs

Establish a healthy balance between education and innovation (R&D)

Build and nurture multi-stakeholder partnerships

Develop a culture of continuous improvement

Develop the engineering educator of 2020 now!

A blend of two professions: engineering and education

EDUCATE and DEVELOP PEACE ENGINEERS!!!

Peace Engineering



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Go Green



DD ... to ... DO IT!!!!

Digital Divide to Digital Opportunities with IT!!!

www.istec.org