



Understanding IEEE and IEEE's Interest in Pre-University Education

S.K. Ramesh (s.ramesh@ieee.org)

Chair, IEEE Pre-University Education
Coordinating Committee

IEEE Teacher In-Service Program Workshop

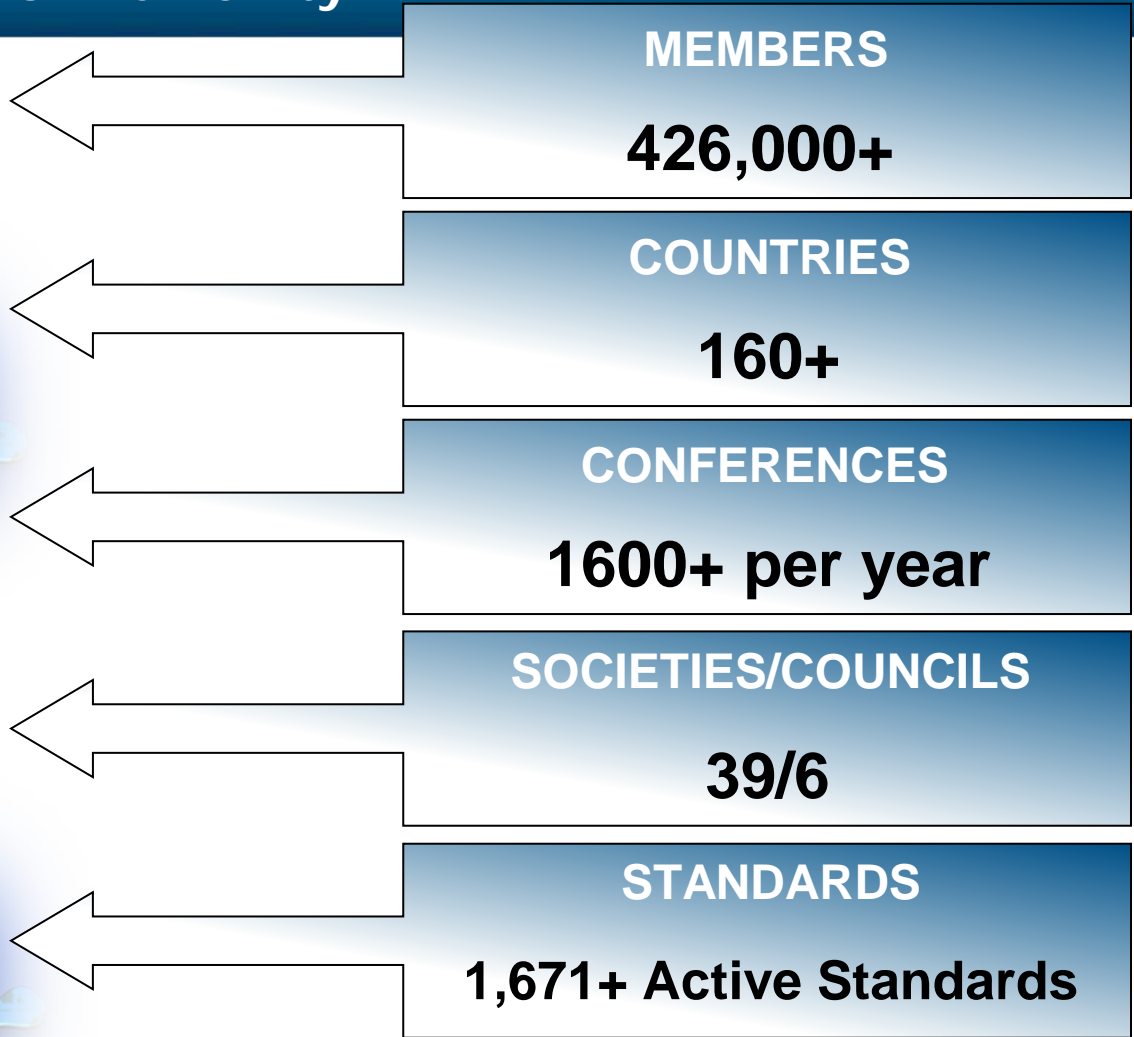
31 July & 1 August 2015

Bogotá, Colombia

- ▶ **The world's largest technical professional society, dedicated to fostering technological innovation and excellence for the benefit of humanity.** It is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology that underlie modern civilization.
- ▶ Established 130 years ago
- ▶ Has more than 426,000 members in 160+ countries
- ▶ 334 Sections in 10 geographic regions worldwide
- ▶ Employs 1000+ professional staff

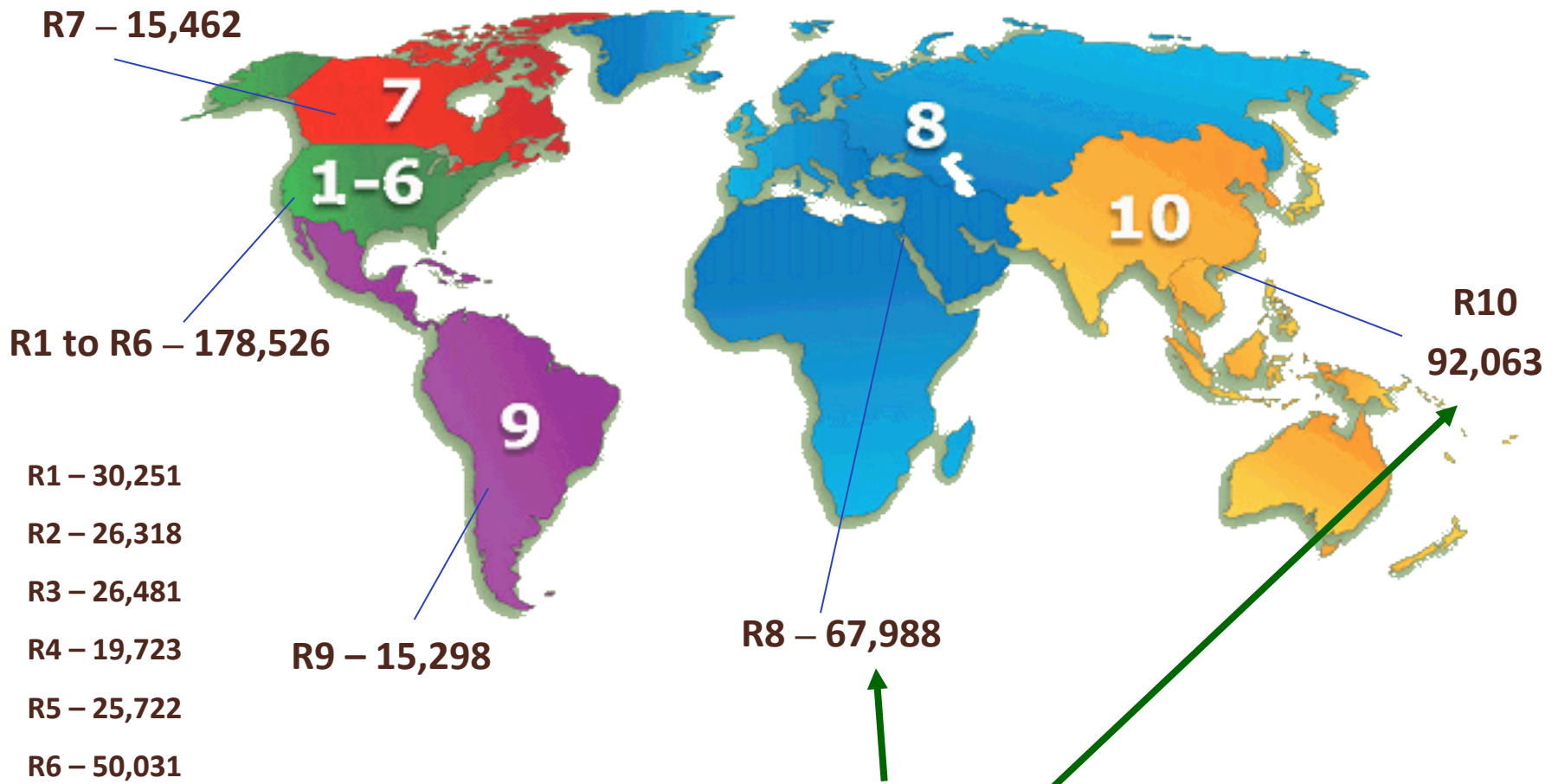
IEEE Today

Advancing Technology for Humanity



Data current as of 31 December 2014.

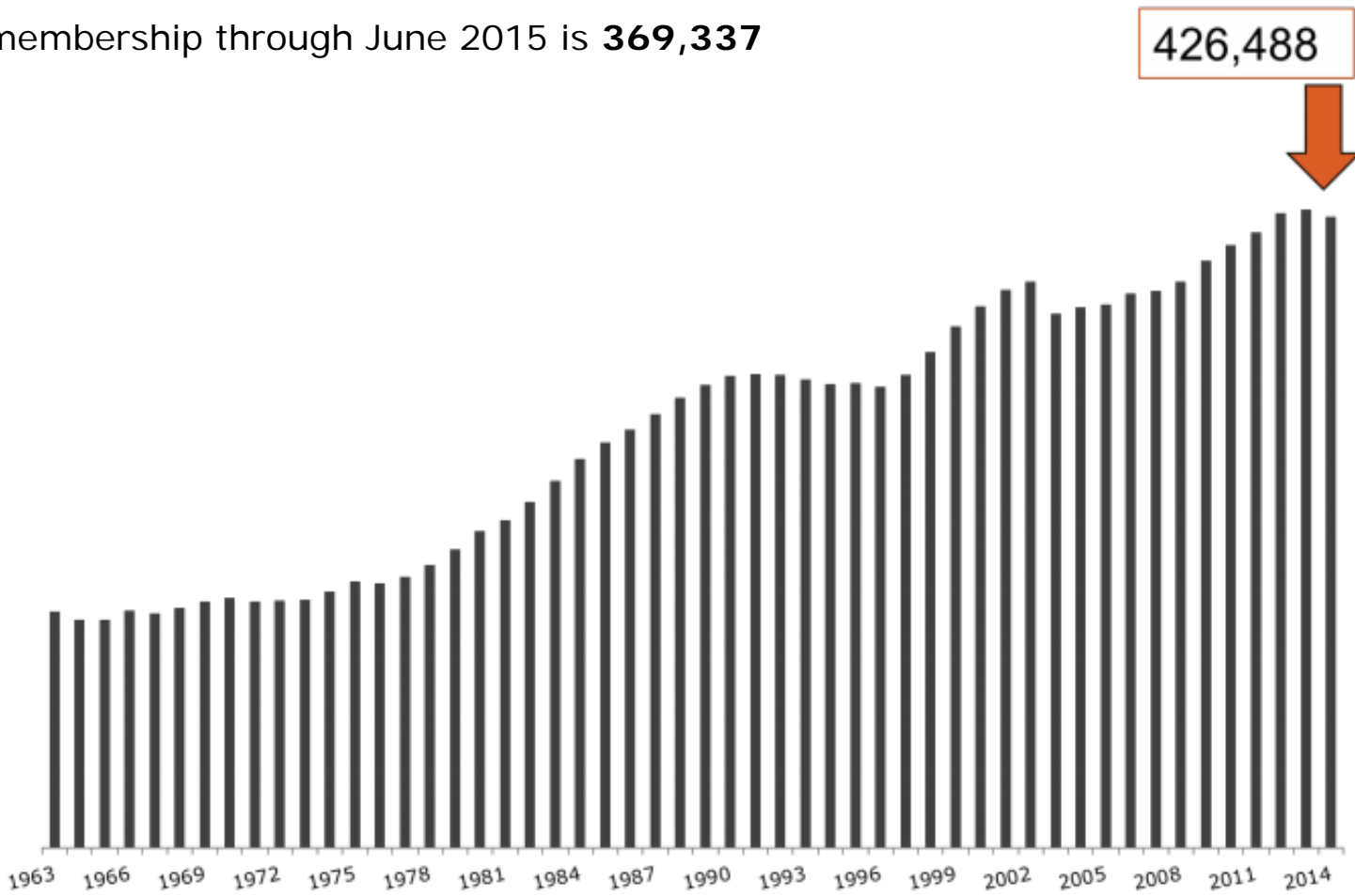
IEEE Membership By Region Through June 2015



Reflecting the global nature of IEEE, R8 and R10 are the two largest IEEE Regions

Total IEEE Membership 1963-2014

Total membership through June 2015 is **369,337**



Data from MD Monthly December 2014

Today's IEEE...

- Is not just about Electrical and Computer Engineering
- IEEE's designated fields include:
 - Engineering
 - Computer sciences and information technology
 - Biological and medical sciences
 - Mathematics
 - Physical sciences
 - Technical communications, education, management, law and policy

IEEE Volunteers



- ▶ Key to IEEE success
 - About 40,000 individuals who give at least 4 hours a week to the organization
 - Local Section Chair
 - Associate editor of a Journal
 - Member of the Financial Committee of the Technical Activities Board
 - Chair of a committee that develops a Standard

- ▶ The organization is guided by volunteers
 - From the President and CEO to the local Section Chair major decisions are made by volunteers

IEEE's Principal Activities

- **Organizing** the **professional community**
 - Based on geographic distribution and areas of interest
- **Publishing** nearly a third of the world's technical literature in electrical engineering, computer science, and electronics
 - IEEE Xplore provides access to over 2 million documents: research articles, standards and transactions 
- Organizing **conferences** on relevant technical and scientific matters (1600+ per year)
- Developing **technical standards**
 - Approximately 1,671+ standards at present

IEEE's Principal Activities

- ▶ Developing **educational activities** for professionals and for the public
 - Including students and teachers in the pre-university system
- ▶ Improving the **understanding of engineering, technology** and **computing** by the **public**
- ▶ **Recognizing** the leaders of the profession
 - Awards and membership grades

What are we trying to do?

- ▶ ...advance global prosperity by
 - Fostering technological innovation
 - Enabling members' careers
 - Promoting community worldwide
 - for the benefit of humanity and the profession



- ▶ Key to success: early recognition of new fields

- In 1884 – power engineering
- In 1912 – communications
- In 1942 – computing
- In 1962 – digital communications
- In 1972 – networking
- In 1982 – clean energy
- In 1992 – nanotechnology
- In 2002 – engineering and the life sciences



Sample Activities: Regional Organizations

- ▶ IEEE organizes professionals in its fields of interest into local Sections
- ▶ There are 334 Sections in 10 Regions worldwide
- ▶ Region 9 consists of 15,298 Members:
 - 8,441 Higher Grade Members
 - 1,302 Graduate Student Members
 - 5,555 Undergraduate Student Members
- ▶ The Colombia Section consists of 1,967 Members:
 - 949 Higher Grade Members
 - 145 Graduate Student Members
 - 1,018 Undergraduate Student Members

Why is IEEE interested in pre-university engineering education?

Why is IEEE interested in pre-university engineering education?

- ▶ Because it is in our stated and un-stated mission
- ▶ Because in many IEEE Sections there is a noticeable decline in young people interested in engineering, computing and technology
- ▶ Because we believe we can tackle the problem head-on and produce positive results

Why is IEEE interested in pre-university engineering education?

- ▶ The demands of the **21st century** will require **technological innovation** to deliver advanced technologies and infrastructure solutions in developed and developing countries
- ▶ In several countries, the level of mathematics and science literacy may be one indication of potential loss of future competitiveness
- ▶ There have been flat or declining engineering enrollments in most developed nations

- ▶ OECD Directorate for Education devotes a major effort to the development and analysis of quantitative indicators for the review of education systems and performance
- ▶ PISA = Programme for International Student Assessment
 - Surveys of 15-year-olds in the principal industrialized countries.
 - Every three years, PISA compares outcomes on measures of reading literacy, mathematics and science



	Mean
OECD Average	494
Korea	554
Japan	536
Switzerland	531
Netherlands	523
Estonia	521
Finland	519
Canada	518
Poland	518
Belgium	515
Germany	514
Austria	506
Australia	504
Ireland	501
Slovenia	501
Denmark	500
New Zealand	500
Czech Republic	499
France	495
United Kingdom	494
Iceland	493
Luxembourg	490
Norway	489
Portugal	487
Italy	485
Spain	484
Slovak Republic	482
United States	481
Sweden	478
Hungary	477
Israel	466
Greece	453
Turkey	448
Chile	423
Mexico	413
Costa Rica	407
Brazil	391
Argentina	388
Colombia	376
Peru	368

PISA average scores on mathematics literacy scale, by country

Level 2 is considered the baseline level of mathematical proficiency that is required to participate fully in modern society. Only around one in four students in Colombia attains this benchmark.

Mathematics literacy: An individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognizing the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged, and reflective citizens.

	Mean
Manizales	404
Medellin	393
Bogota	393
Cali	379





	Mean
OECD Average	501
Japan	547
Finland	545
Estonia	541
Korea	538
Poland	526
Canada	525
Germany	524
Netherlands	522
Ireland	522
Australia	521
New Zealand	516
Switzerland	515
Slovenia	514
United Kingdom	514
Czech Republic	508
Austria	506
Belgium	505
France	499
Denmark	498
United States	497
Spain	496
Norway	495
Hungary	494
Italy	494
Luxembourg	491
Portugal	489
Sweden	485
Iceland	478
Slovak Republic	471
Israel	470
Greece	467
Turkey	463
Chile	445
Costa Rica	429
Mexico	415
Argentina	406
Brazil	405
Colombia	399
Peru	373

PISA average scores on science literacy scale, by country

In Colombia, more than half of all 15-year-olds perform at a science proficiency Level 1 or below.

Science literacy: An individual's scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence based conclusions about science-related issues; understanding of the characteristic features of science as a form of human knowledge and inquiry; awareness of how science and technology shape our material, intellectual, and cultural environments; and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen

	Mean
Manizales	429
Medellin	418
Bogota	411
Piauí	403



Undergraduate Enrollment and Degrees Awarded



UNESCO Institute for Statistics is the primary source for cross-nationally comparable statistics on education, science and technology, culture, and communication for more than 200 countries and territories.

Undergraduate Enrollment in Colombia by Field of Study

Education	Humanities and Arts	Social Sciences, Business and Law	Science	Engineering, Manufacturing and Construction	Agriculture	Health and Welfare	Services
7%	4%	48%	5%	23%	2%	8%	3%

Percentage of students enrolled

Undergraduate Degrees Awarded in Colombia by Field of Study

Education	Humanities and Arts	Social Sciences, Business and Law	Science	Engineering, Manufacturing and Construction	Agriculture	Health and Welfare	Services
9%	3%	53%	4%	17%	2%	8%	4%

Percentage of students enrolled



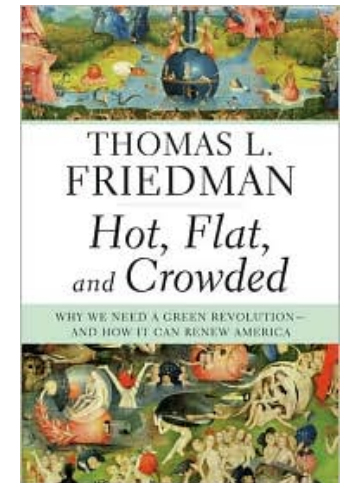
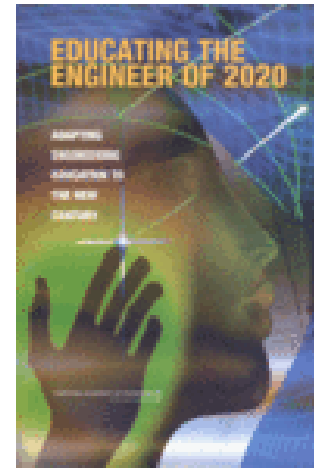
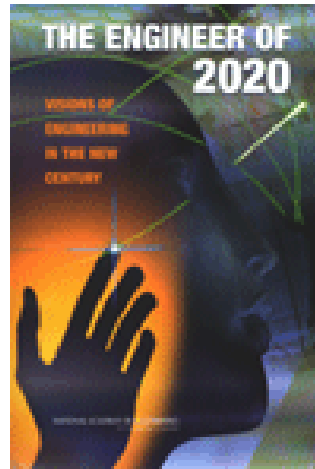
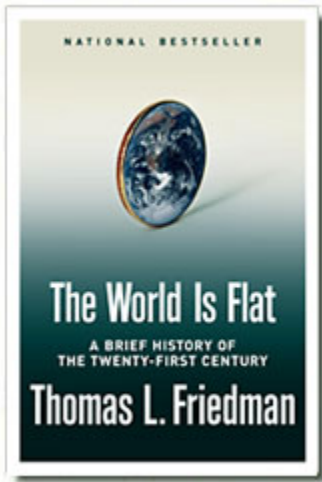
So how can we motivate students to pursue STEM majors-specifically in Engineering and Computer Science?



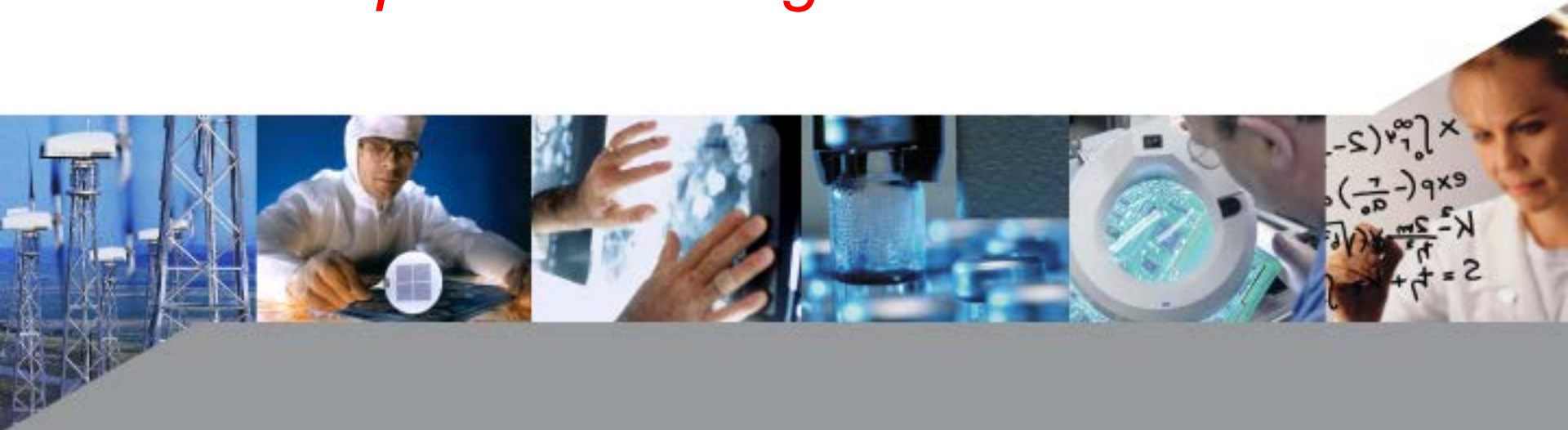
We need programs like EPICS in IEEE



Globalization



We need programs that are outward focused entrepreneurial engines of innovation



In conclusion the Overall Objectives of Pre-University Education and Outreach are

- To increase the **propensity of young people** to select engineering, computing and technology as a program of study and career path
- Increase the level of technological literacy



We recognize the Challenge and the Approach we need to take

- ▶ Challenge:
 - **Public perception** of engineers/engineering/technology is often misinformed resulting in early decisions that block the path leading children to engineering
- ▶ Approach:
 - **Reach** major groups of influencers who impact students and their decisions
 - Teachers, counselors, parents, media...
 - **Online** Presence – TryEngineering.org, TryComputing.org, TryNano.org, IEEE Spark
 - **Engineering** in the **Classroom** – Teacher In-Service Program
 - **Community Service** Projects – EPICS in IEEE



Can we do it?

You bet! And we'll do it the IEEE way

Inquire, **E**ngage, **E**xcite, **E**nergize
Questions?