



International Conference on Higher Education 2014  
*Globalization and Integration*

# The PhD: Educating Future Educators and Innovators

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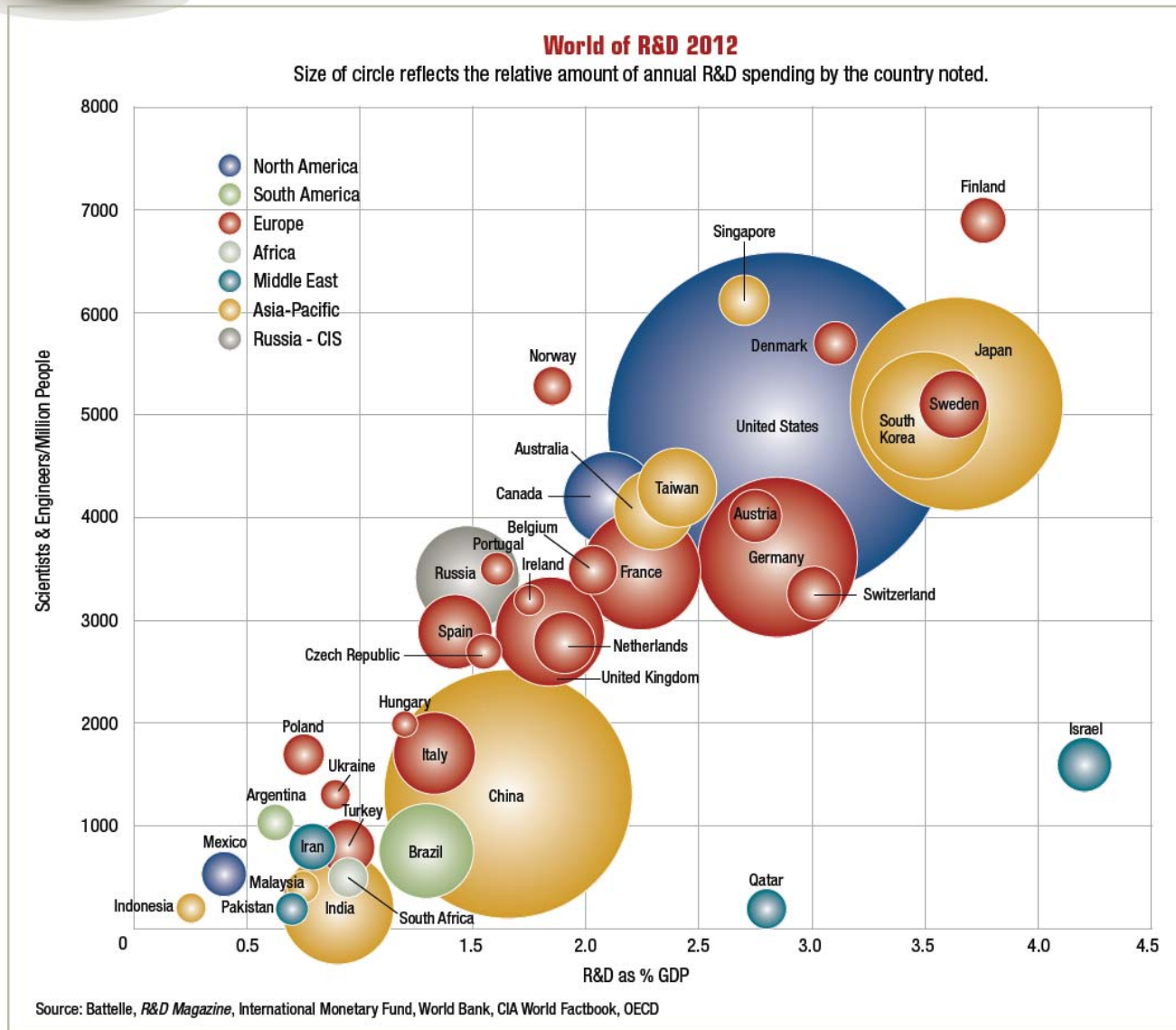


# Graduate Education vs. National Goals

- Universities are responsible for producing the teachers, researchers and innovators of the future
- Graduate education contributes directly to the broader national goals of technological, economic, and cultural development
- Graduate schools of science and engineering are ... an indispensable underpinning of national strength and prosperity

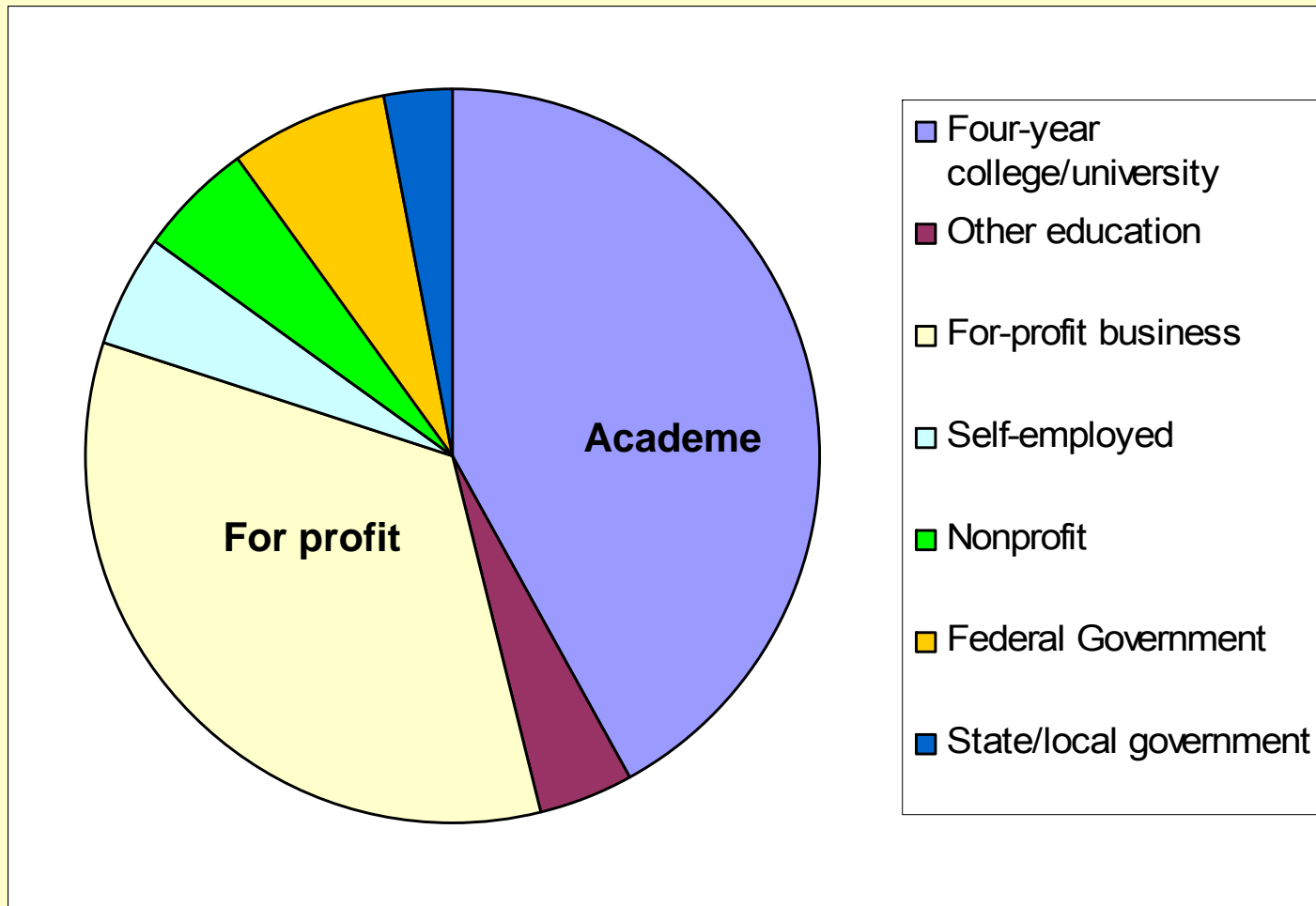


# 2013 Global R&D Funding Forecast





# Science and Engineering PhD Employment in the USA





# Perceptions & Criticisms

## Customers & Stakeholders

- Non-Academic Employers
  - PhD students are educated and trained too narrowly
  - They lack key professional skills
    - effective collaboration, working in teams,
    - organizational and managerial skills;
    - appreciation of applied problems;
    - knowledge *and culture* of other fields
- Academic employers (Teaching institutions)
  - Ill-prepared to teach
- National policy makers
  - Too long to complete their degrees
- Current and former students
  - Ill-informed about non-academic employment opportunities



# Desired Attributes of a PhD

## An Incomplete List

- World class knowledge in some specialty
- Ability to develop world class knowledge in related areas
- Understanding how their specialized knowledge fits within the larger context of knowing and understanding.
- Aware of *all* effects of globalization and technology – and the price with which it comes. .
- Leadership, as reflected in breadth of knowledge and ability to articulate ideas, confidence, poise, and focus.
- Can deal with predicaments and not just problems
- A thinker, a strategist

*A Renaissance PhD*

**Bilkent University**



# Impediments to Broader Preparation

- Requires breadth of knowledge and expertise that most advisors may not possess.
- Takes away student time from research project
  - That provides financial aid to student
  - That has to produce to meet deadlines
- No clear incentives or road-map for the education providers
- Students are self-selected, assisted by
  - Admission requirements
  - Types of perceived employments that await them



# Students

- Return on Investment
- Hunt for talent
- How to make it more attractive and add value?





# Value-Added Education

- Focus on big problems
- Connect
- Breadth



## Humanity's Top Ten Problems for next 50 years

1. Energy
2. Water
3. Food
4. Environment
5. Poverty
6. Terrorism & War
7. Disease
8. Education
9. Democracy
10. Population

Richard Smalley, Nobel Laureate

# Grand Global Challenges



# Connectedness

- Connections across the Globe
- Connections with Sciences & Technologies
- Connections with Individual and Societal Needs

Give rise to a high degree of complexity.



# Specialization vs. Breadth

- A contentious issue -- Particularly for PhD education
- Tradition dictates that it is better to go into depth in an area of specialty
- Teachers, researchers and even students within each subfield are becoming more and more isolated from each other by the requirements of escalating specialization.

## Breadth and More Breadth

Why should a sociologist learn about computers?

Why should an engineer need to study and learn about arts, sciences and humanities?



# Cognitive Complexity

Capacity to observe, understand and see relationships among disparate fields of knowledge, referred as cognitive complexity, greatly increases the potential for making a major discovery. Major discoveries were made by scientists who were not highly specialized but “**by those who internalized considerable scientific diversity.**”

Those scientists with high cognitive complexity tend to have different styles of research than those who did not have a high cognitive complexity, perhaps in part because those with high cognitive complexity **understand a problem they study in multiple ways.**

Cognitive complexity develops not so much through education but through a social and psychological process. Indeed, two such processes are observed by Hollingsworth are **internalization of multiple cultures** and having **non-scientific avocations**. This argues for consideration of new criteria in the selection of PhD students for research.

How do we have students to acquire complex cognitvity?



# Students

## Diverse Individuals

- Multiple Intelligences \*
  - Musical intelligence
  - Bodily-Kinesthetic intelligence
  - Logical-Mathematical intelligence
  - Linguistic intelligence
  - Spatial intelligence
  - Interpersonal intelligence
  - Intra-personal intelligence
  - Naturalist intelligence
  - Existential intelligence
- Customized (individualized) education
  - Flexibility in the curriculum

*“Train a child according to his way.” (Book of proverbs 22:6)*

\* H. Gardner



# Learning, Memory, and Individuality

## How Brain Processes Information

- Human memory
  - Declarative (explicit) – Facts & Events
  - Nondeclarative (Implicit) – Procedural (skills and habits); Priming; Simple classical conditioning; Nonassociative learning
- Acquired information remains in the short-term memory for a period; during transition to long-term memory its context may be stripped.



# It is a Global Community Responsibility

- **Government**
  - Minimize legislating degree requirements
  - Support systemic changes in PhD education
- **Industry/Business**
  - Participate in the education enterprise – fellowships, traineeships
- **Academe**
  - Reduce the conflict between institutional needs (teaching & research) and PhD education
  - Establish clear incentives for PhD education – separate from research
  - Ignore or improve the various ranking methods
- **Faculty**
  - Awareness of how important PhD education is to the well being of the nation.





Thank you

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