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between Higher Engineering
Education and Industries

Supply-Side Structural Reform for HR Market and Some Roles of ICT in Professional Education

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Supply-Side Structural Reform for HR Market



1. Big gap between Supply and demand sides: NO sufficient / complete data to know real needs
 - ✓ Considering importance of engineering... it is surprising that **better data is not available** on these most important drivers of social and economic development
 - ✓ Statistics and indicators for engineering **are in serious need of refining and redefining**
 - ✓ Develop information on engineering, **highlighting urgent need for better statistics and indicators** in engineering (such as how many and what types of engineers a country has and needs)

UNESCO 2010 Report “Engineering: Issues, Challenges and Opportunities for Development”

UNESCO Headquarter sets up a key project in 2016 for next 10 years to build up engineering statistics among member states

Supply-Side Structural Reform for HR Market



2. Over production— Actually should be interpreted as

- ✓ Over-built low quality graduates -- High unemployment rate among new graduates
- ✓ Insufficient high quality graduates -- Great shortage of talents in HR market for industry and society

3. Unbalanced allocation of education resources between academic and professional—oriented education

Supply-Side Structural Reform for HR Market



4. Isolated education environment from society and industry: self-entertainment

Target, Process, Assessment

5. Structural transition and upgrading of professional education

Academic-oriented to Application-oriented

Professionalism in education process

Innovation and entrepreneurship education

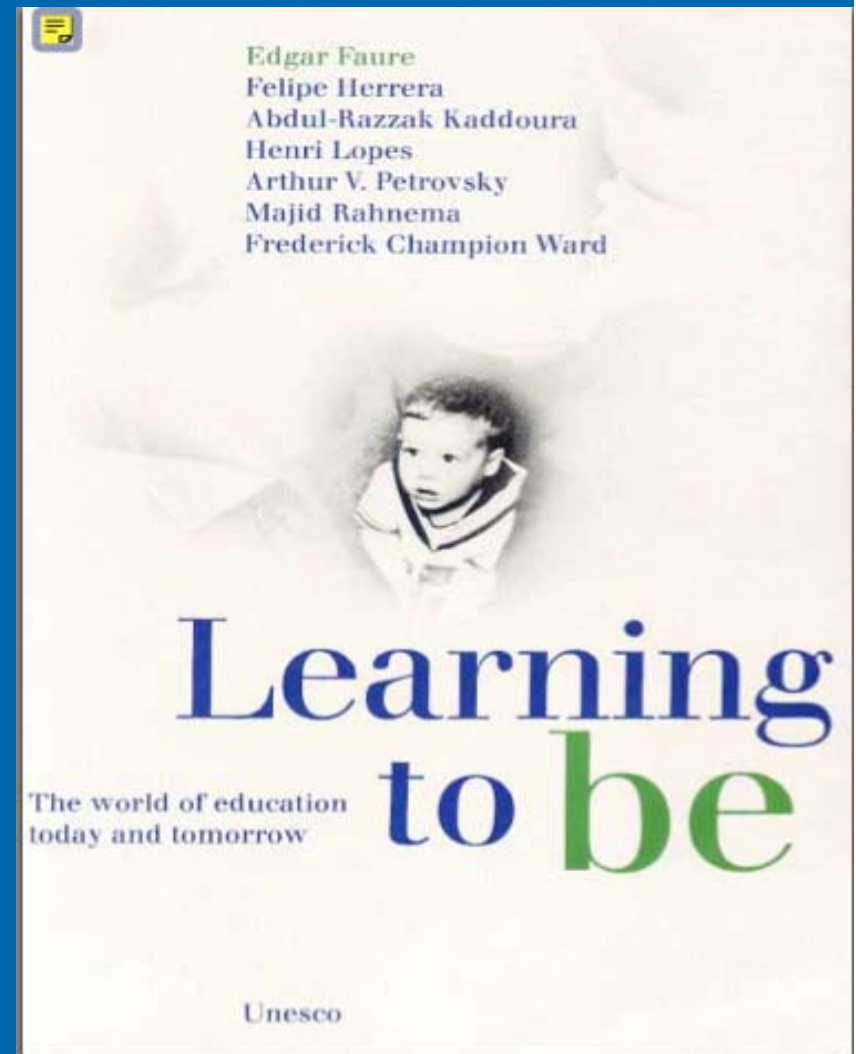
Teacher-centered to student-centered

Infusion of technical contents and humanism and culture contents

UNESCO Report (1972)

- “For the first time in history some societies are beginning to reject many of the products of institutionalized education. ... This shows how easily educational systems can become out of phase.”

Source : Edgar Faure, etc. “Learning to be: The world of education today and tomorrow”, UNESCO, 1972



Talent Shortage - Manpower 2015 Survey



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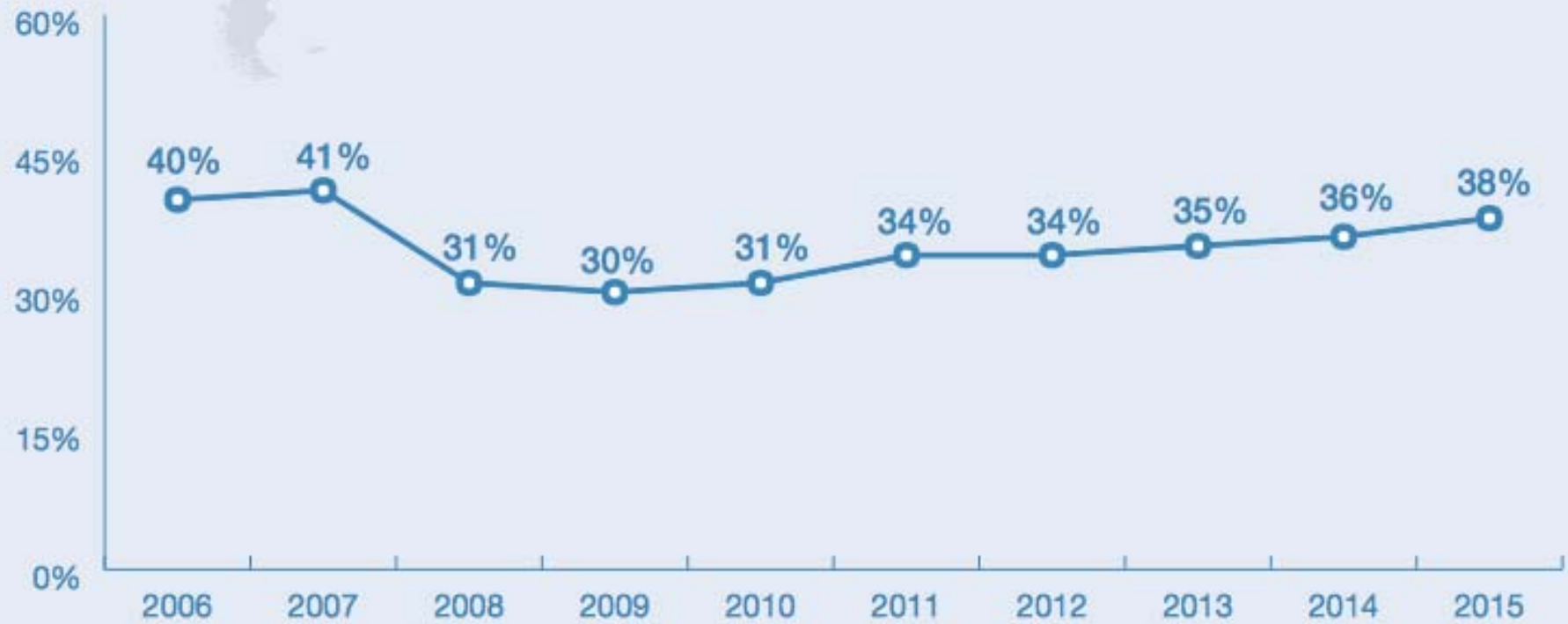


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GLOBAL: % HAVING DIFFICULTY FILLING JOBS



URE 1

Top 10 Jobs Employers Are Having Difficulty Filling

GLOBAL: TOP 10 JOBS EMPLOYERS ARE HAVING DIFFICULTY FILLING

- 1 | Skilled Trade Workers
- 2 | Sales Representatives
- 3 | Engineers
- 4 | Technicians
- 5 | Drivers
- 6 | Management/Executives
- 7 | Accounting & Finance Staff
- 8 | Secretaries, PAs, Administrative Assistants & Office Support Staff
- 9 | IT Staff
- 10 | Production/Machine Operators

- ✓ 2015 surveyed 41000 companies in 42 countries
- ✓ Talent shortage at Higher, middle and lower end positions
- ✓ Correlated professional education level

✓ Middle vocational:

1, 5, 10 (5.3 X 3)

✓ Higher vocational:

2, 4, 7, 8, 9 10 (6.0 X 5)

✓ Undergraduate study:

✓ 2, 3, 6, 7, 8, 9
(5.8 X 6)

Top 10 talent shortage in mainland of China



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CHINA

TOP 10 JOBS EMPLOYERS ARE HAVING DIFFICULTY FILLING

- 1 | Technicians
- 2 | Sales Representatives
- 3 | Sales Managers
- 4 | Management / Executive (Management / Corporate)
- 5 | Laborers
- 6 | Skilled Trades
- 7 | Engineers
- 8 | IT Personnel
- 9 | Production Operators / Machine Operators
- 10 | Researchers (R&D)

GLOBAL: TOP 10 JOBS EMPLOYERS ARE HAVING DIFFICULTY FILLING

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talent shortage is different
which reflects
China to upgrade

professional education

)
onal:

(8X5)



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GLOBAL: TOP JOBS EMPLOYERS ARE HAVING DIFFICULTY FILLING 2006-2015

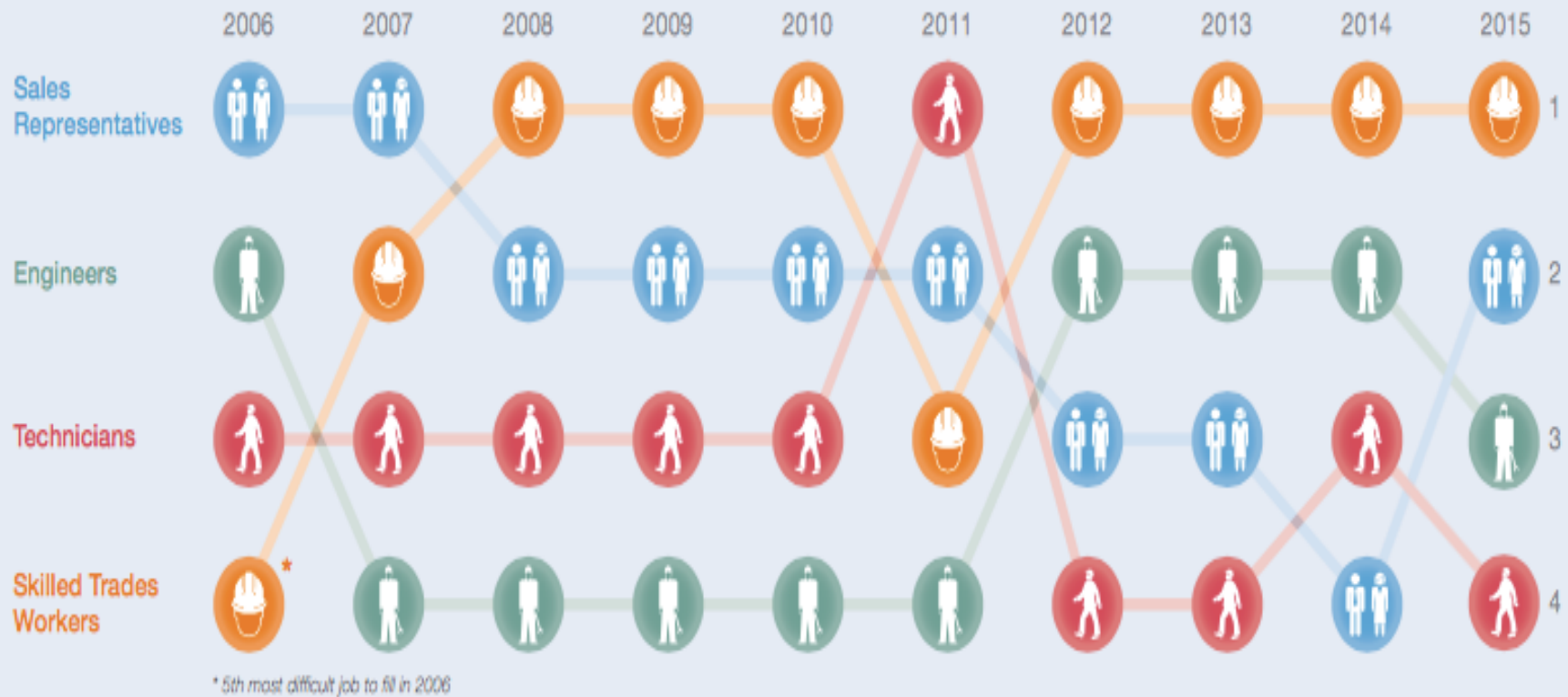


FIGURE 3

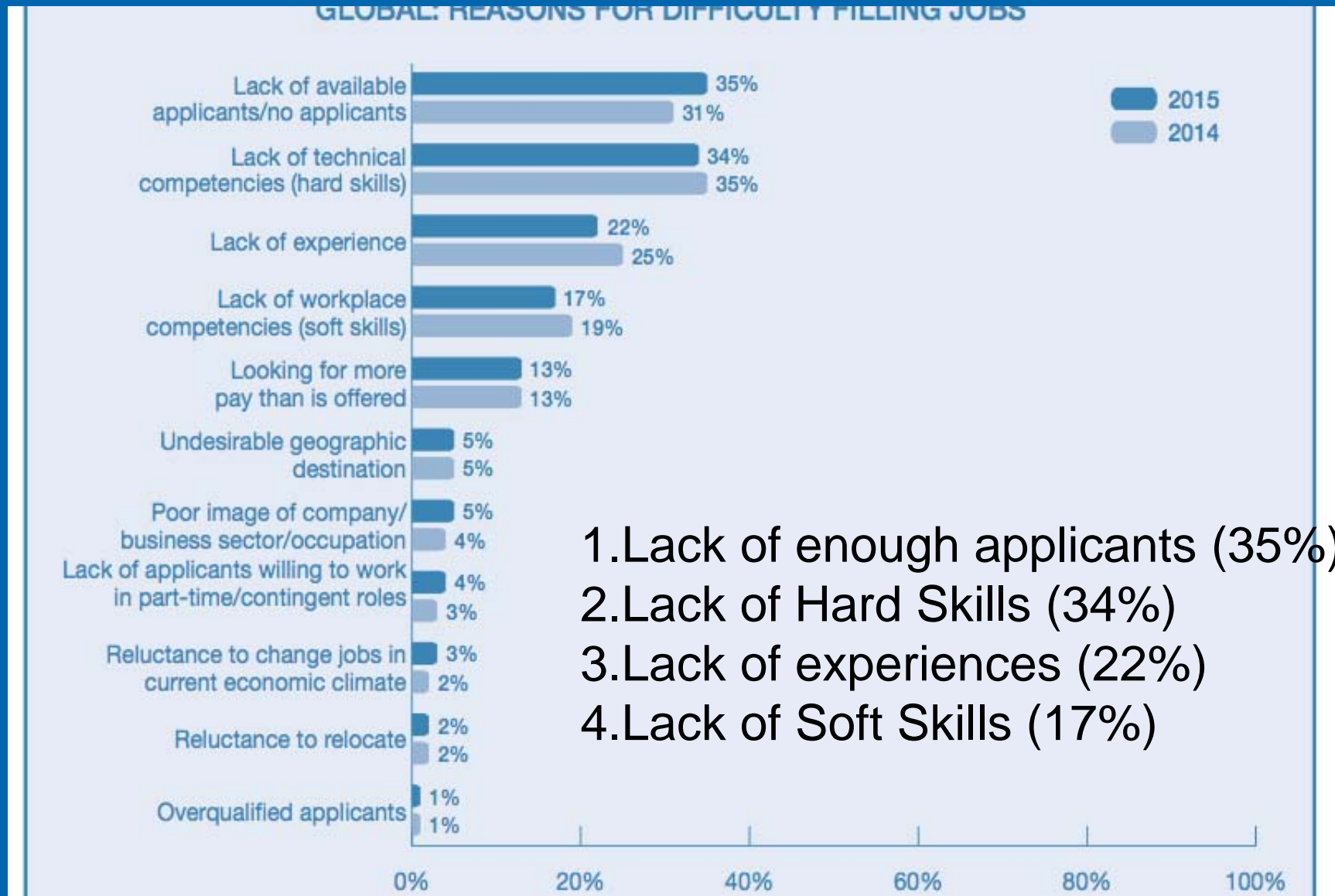
Reasons for Difficulty Filling Jobs



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How to satisfy the key stakeholders' needs ?

- Graduates find jobs
- Companies recruit talents
- State builds for Human Resource

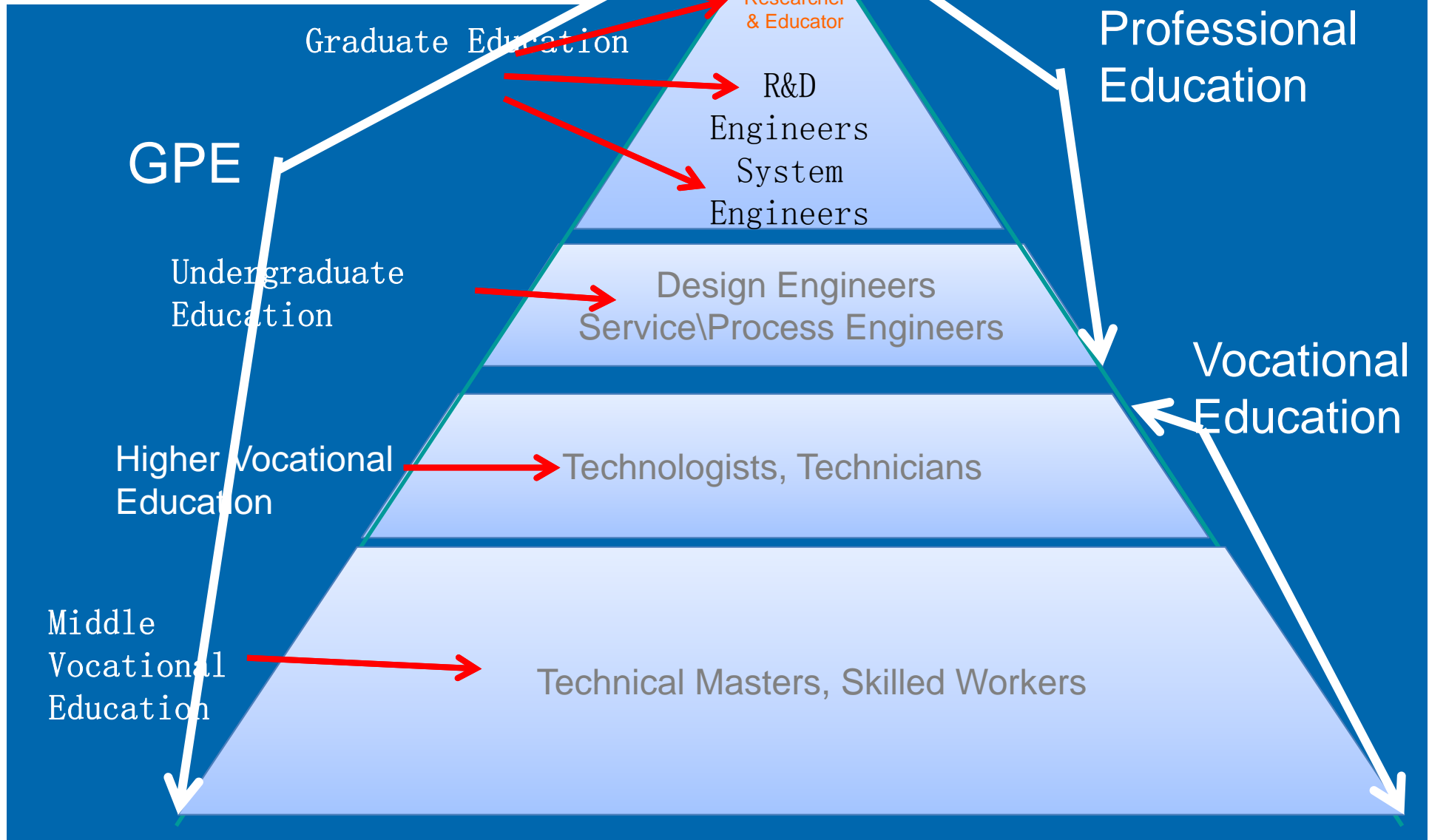


**Job market with
Requirements of
professional
career !**

Professional career-oriented professional
education must be promoted!

Generalized Professional Education

Academic Talents : 1% of 7.5 m
80% of MIT graduates from Underg.
Study become Engineers



Desired engineers for 21st century

source: Greta Tryggvason and Diran Apelian , JOM Oct.2006, translated into Chinese by Cha



➤ **19th Century and First Half of the 20th Century: The Professional Engineer**

- ◆ As distinct profession early engineering programs focused on considerable hands-on training
- ◆ Role of science and mathematical modeling slowly increased and gained acceptance.

➤ **Second Half of the 20th Century: The Scientific Engineer**

- ◆ By 1950's, technological progress, such as nuclear energy, geopolitical realities by Sputnik stimulated needs for engineers to be well-versed in science and mathematics
- ◆ This continued until 2000, although design content increased slowly. In early 1990s it was clear that more than science was needed to emphasize non-technical professional skills such as teamwork and communications.

Desired engineers for 21st century

source: Greta Tryggvason and Diran Apelian , JOM Oct.2006, translated into Chinese by Cha



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- **The 21st Century: The Entrepreneurial/ Enterprising Engineer**
- ◆ Knows everything—can find information about anything quickly and knows how to evaluate and use the information.
- ◆ Can do anything—understands the engineering basics to the degree so they can quickly assess what needs to be done, can acquire the tools needed, and can use these tools proficiently.
- ◆ Works with anybody anywhere— communication skills, team skills, and understanding of global and current issues necessary to work effectively with other people.
- ◆ Imagines and can make the imagination a reality—has the entrepreneurial spirit, the imagination, and the managerial skills to identify needs, come up with new solutions, and see them through.

Desired attributes of an engineer

source: Boeing Management Company



- A good understanding of engineering science fundamentals
- A good understanding of design and manufacturing process
- A multi-disciplinary, systems perspective
- A basic understanding of the context in which engineering is practical (market, business, economy, services,
- Good communication skills
- High ethical standards
- Ability to think both critically and creatively-independently and cooperatively
- Flexibility: the ability and self-confidence to adapt to rapid or major changes
- Curiosity and desire to learn for life
- A profound understanding of importance of team work

Huge Gap between Cultural Context of Professional Career and Professional Education



1. Customer-oriented vs. Self-entertainment-oriented
2. Complete products and life-long services for customers vs. Ending service as soon as graduation
3. Continuous improvement and innovation vs. Rigid structure for decades
4. Team work and effective communication vs. Isolated students
5. Problem-based working strategy vs. Discipline-oriented with gap between disciplines
6. Meet social needs for better products and services with resources currently available vs. Waiting for change of conditions

Paradigm for GPE



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General Goals for all
Education



- Four Pillars
- Learning to know
- Learning to do
- Learning to live together
- Learning to be

Goals for
Engineering
Education

5E Model



Reform
Strategies

Internationali-
zation

Learning By
Doing

University-
Industry
Cooperation

Implementation
Models

Washington
Accord



12 Standards

Co-Op
Education

Learning
Process

Student-centered, project-based active learning by making use of
advance education technology and ICT tools

5E Outcomes-based Engineering Education by Group T of Leuven University



- Engineering: Innovation — design and make
- Enterprising: Entrepreneurship — vision, mission, deliver to market, cost effective, efficiency, team work
- Educating: Developing ones- Life-long learning and to communicate with others
- Environmenting: Consciousness-adapting to multi-cultural and protect natural environment/resource
- Ensembling: Responsibility-to be harmonic with society and nature, social and professional ethics

Roles of ICT in Future Professional Education From Macro to Micro

- To identify real needs in society and industries
- Recruitments of students and faculty
- Management of pedagogic process
- Management of student-centered project-based active learning process
- Education resources for everyone at anywhere and anytime - OER, MOOC....
- Assessment on learning outcomes- not only for theoretical work but also for practice

Personalized Mass Edu. vs. Customized Mass Production

**Changes of learning Paradigm create great needs
for ICT**

Tsunami Impact of ICT on professional education-how long it will be last ?



Students

Teachers' interaction

Internship in job market

Labs → Professional training Center → Maker's Space → Platform for student-centered active learning + Professional Experts

(Teacher+Engineer, Physician, Accountant, Lawyer....)



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“If we teach today as we taught yesterday,
we rob our children of tomorrow

— John Dewey

**We must continuously improve
professional education!**



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Thank you for your
attention!

Q&A