On the Evaluation of Development of International Engineering Education and Rethinking for Its Implementation in China

Yu Shouwen

Tsinghua University , Beijing , China

--2014-November,18th,Hanzhou,China, Zhejian University--

Outline

- 1--On Evaluation
- A--Goal and Criteria of Evaluation
- B--Evaluation of International EE
- C--Contrast and Balance
- D--Evaluation and Accreditation of EE
- 2--The Strategies of development and evaluation:
- A—Development: Road and the diversity needs
- B– Classification and Stratification
- 3--How to implement in China
- 4--Rethinking on the Concept

1--On the Evaluation

- **A--Goal and Criteria of Evaluation**
- **B--Evaluation of International EE**
- **C--Contrast and Balance**
- **D--Evaluation and Accreditation of EE**

A--Goal and Criteria of Evaluation

- To improve the quality of Engineering Education

or:

a—Academic rating and ranking;

b—Management and controlling;

c– Providing information for stakeholders;

d--Others

The comparing different categories of Evaluation

(1) **Recognition Evaluation**—
Government Accountability; Positivism

(2) **Certification Evaluation**—
Pass or not;

(3) **Social evaluation**---
Social Accountability; Constructivism

----Graduy Bogue, 2003; Zhou GL,Mo JF,2014

Different goal -- different criteria and weigh factor of Evaluation

- **(a)For quality assurance** of EE—
Focus on --learning outcome, Also for CQI

(b)For Academic research—
Focus on – paper; citation; funding ; Awards ; Faculties,…..;

(c) For management---Must keeping balance between R (research) and E (education)

Input---Outcome

- (1) **Input**—-- Outlook of resources
- (2) **Outcome**—Concept of Incremental value
- (3) **Comprehensive approach**– Balance of both but oriented one. To excite input or satisfy the need of stakeholders

It can be approximately expressed as formula considering—goal; needs ; historical evolution

--Data collection ;evidence based; justification

Input---Outcome

To determine– criteria; index ; weigh factor ,
Important **the " baton"** of Symphony orchestra

qualitatively or quantitatively

$$U = \sum_{i=1}^{N} U_i = \sum_{i=1}^{N} \lambda_i u_i$$

B--Evaluation of International EE

- **Some examples** in international evaluation for the rating and ranking for the disciplines and Universities
- Comparing three examples:

(1) US News—From Thomson Ruters-"in Cites"

(2) Times –http:/www.indexedu.com/learn/edu/14308.html

(3) QS (Quacquarelli Symonds)

……

US-news

- **Raputation-25%**--global 12.5%;region 12.5%
- **Paper----------65%**

Total number---------- 12.5%
normalized impact factor -----10%
Total citation number A--------10%
higher citation number B-----12.5%
B/A----------10%
International collaboration—10%
Confered Dr. Degree number—10%

Times

- **Education**—----------**30%**

Reputation----------15%;
Ratio Faculties/Students---------- 4.5%;
Average degree of Dr. /Bachelor -----2.25%;
Disciplines number----------6%;
Income of University/faculty ----------6%

Research----------**30%**
Citation of paper----------**30%**
Internationalization----------8%
Income from enterprises---------- ----------2%

QS

- Assessment from **academic peer--------40%**
- **Global employee** evaluation----------**10%**
- **Ratio of number of faculties/students—20%**
- Average paper citation/ faculties----------20%
- Ratio of international students----------5%
- Ratio of international teacher----------5%

Then we can find different ranking results corresponding to different purpose

C--Contrast and Balance

- Education <->Research (Big R and small E ???)
- Input <-->Outcome (Outcome based)
- Quality assurance <--> Ranking and rating . Hand the " Baton"
- Undergraduate—Graduate students
- Evaluation criteria of EE—for Programs/Disciplines/University and instructions

D—Evaluation and Accreditation

- Several Case study in China:
  --Evaluation of higher engineering education
  --Evaluation on disciplines
  --Accreditation of undergraduate programs
  --On Evaluation system
- **See Part 4**

2--The Strategies of Development and Evaluation:

- A-- The road of Development of EE
- B---DIVERSITY-in the globalization of EE

A---DEVELOPMENT STRATEGY

--The development trend of international engineering education showed the following characteristics throughout

the engineering education **strategy a/b/c**

a---some developed country used was to "occupy" the innovative persons training in the **high-end;**

b--The manufacture and the engineering need large labor input were transformed or **"outsourcing"** to other countries

- ; **C--**We **must "walking on two legs",** not only possess innovative engineering but also served to manufacture engineering which need large number of labors but will combined with IT ;
- **Third**, projects are developing towards two ends: part of it developed to **cutting-edge and fine, the other part developed to systematic, complex and large**

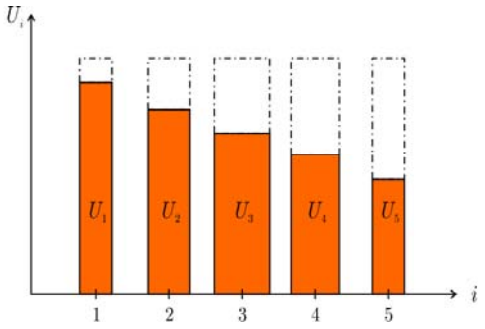
If there is **N grades** of such young peoples,

$$U_i = \lambda_i u_i \qquad 0 \le \lambda_i \le 1$$

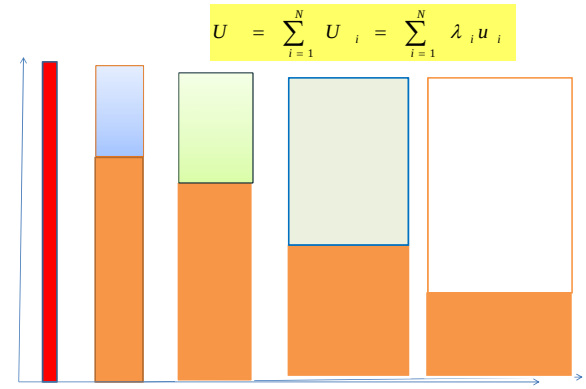
- the total energy of the human resource of young peoples in the whole society could be calculated by the formula ; (**N→~31 Million**)

$$U = \sum_{i=1}^{N} U_i = \sum_{i=1}^{N} \lambda_i u_i$$

The Principle of Max. release of Energy
N-→31 Million !



- When λ_i approach to **one**



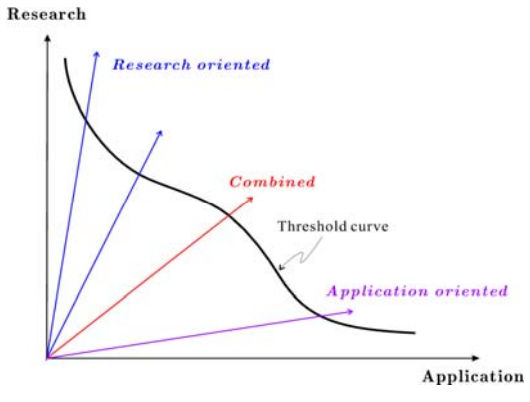
- It was the only fear to **divide them into different grades** when they are seventeen or eighteen years old. (see **national wide entrance examination** every summer)
- **which** will become the **moat and sea** that divided the grades of their **whole life**,
- this original condition may be changed when you are examined to be a graduate student, that's why the society, public opinion, family and parents have such authorization.
- Thereupon, the **total energy** contained in the society will be restrained and **underestimated**.

λ_i approach to **one**.

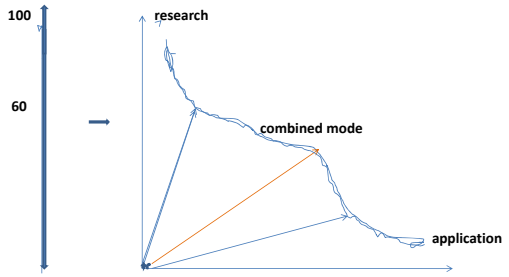
- The advantage of China as a powerful nation of human resource will emerge.
- This was the **most important "mine"** of china in the international.
- Then, the undoubted human resource was assured for the purpose of achieving the goal of a strong country

- **B---DIVERSITY-in the globalization of EE**

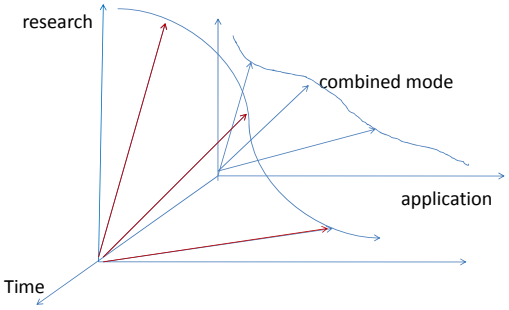
- We can use the **two dimensional map**
- The emission lines started from the origin represent the tropism of different schools or degrees.
- The **threshold** curve represents the **lowest standard for its degree.**
- The **multiple tropism choice** of talent with different degree and the multiple development path after reached the threshold of the engineering education in a nation are expressed in this two dimensional plane.



1 D **2 D** **(Evaluation Model)**



3 D **(Time evolution evaluation model)**



- Only when the talent market exhibits this **multiple requirement**, the **society accepted the multiple training approach of talent**,
- **government promoted the implementation of multiple talents** foster foresightedly, restrict the minimum threshold of their entry criteria for different cultivation approach and ensured on the system and mechanism,
- the whole engineering education will be able to exuberant, Great talents appear :successively, **developed harmoniously and matched with proper complexion**.
- "One may distinguish himself in any trade"

Diversity of the needs of human resource

- **--Balance between globalization and localization**
- **--Quality assurance of higher engineering education—The needs of human resources :**
- **According to the needs for international level and local economic region**

3--The Strategies of Evaluation:

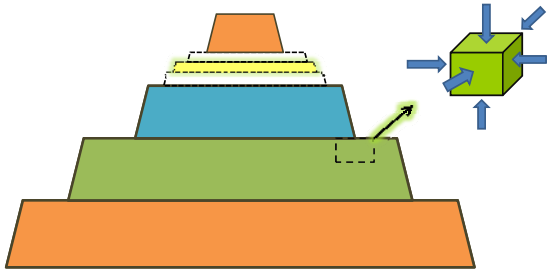
- **Three strategies**

1--—Stratification—Strategy I—Evaluation for Excellent education in University ; Ranking of disciplines

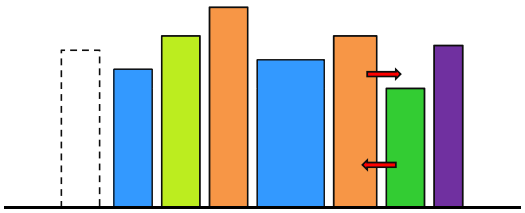
2--—Classification—strategy II--Programs Accreditation, Qualified disciplines

3-—Strategy III—Stratification based on classification

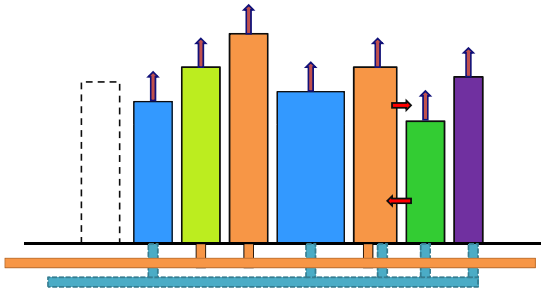
1—Stratification—Strategy I----"pyramid" mode



2—Total Classification—strategy II



3—Strategy III—Stratification based on classification

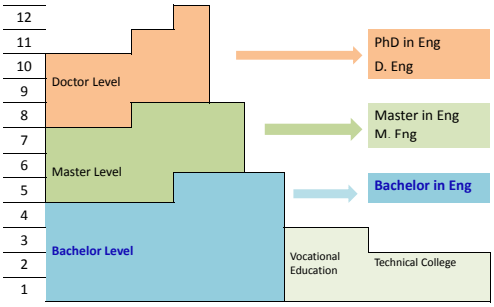


4—How to implement in China

- **A**--Recent status of EE in China—a **brief introduction**
- **B**- The change of **disciplines evaluation**
- **C- New evaluation system** for undergraduate education
- **D-** Engineering education **accreditation**

A--Recent status of EE in China-a brief introduction

Chinese Engineering Education System



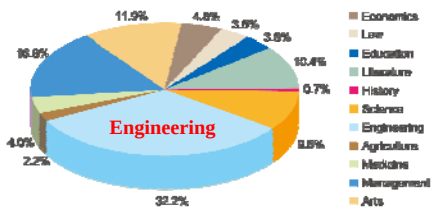
Levels, types & scale of engineering education

➢ **In the year of 2013**

- **1,170** HEIs provided bachelor's degree nationwide, among which **1,077** HEIs provided engineering programs.
- 48,922 undergraduate programs were available nationwide, among which **15,733 were engineering programs.**

Levels, types & scale of engineering education

Engineering programs took about **1/3 of all the undergraduate programs in 2013.**



Scale of engineering education

In undergraduate programs of 2013

- The number of enrollment of engineering students reached **4,953,334**, taking **33.1%** of the total number.
- The number of engineering faculty in HEIs is **402,946**.

Global competencies with China characteristics

- **(1)--Master of Engineering**
- **(2)--Engineering Education Accreditation**
- **(3)--Outstanding Engineers Training Project**
- **(4)—CDIO Education Program**
- **……**

B- The change of disciplines evaluation

- From the **Key disciplines evaluation** (Ranking and rating 1985~2012), to -→**Self evaluation** and **qualified evaluation of graduate education**(2014---);

C- New evaluation system for undergraduate education

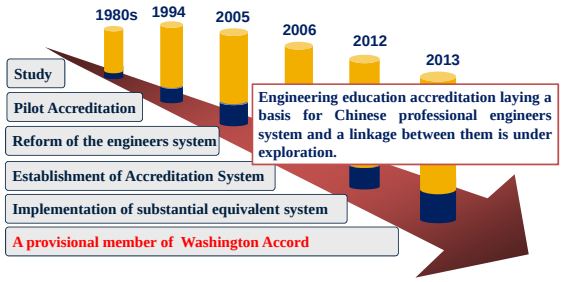
- University's Evaluation (**Level evaluation** ,2003-2008) to **New evaluation system** for undergraduate education (2010→)

- **Five categories of evaluation—Comprehensive Evaluation system for undergraduate education 2010→**
- 1--自我评估 **Self-Evaluation**
- 2--院校**评估 University's evaluation**
  a-- **Qualified evaluation**; b-、**Checking evaluation**
- 3--专业认证及评估(鉴定） **Program's accreditation**
- 4--国际评估 **International evaluation**
- 5--教学基本状态数据常态监测Monitoring and measurement of **fundamental data** of education state

D– Engineering education accreditation

- **Objective**:
- Forming **a quality assurance** system for engineering education;
- Establishing an engineering education accreditation system **linking up with professional engineer system**;
- Promoting the **cooperation** between engineering education and industry;
- Promoting the **international mutual recognition** of Chinese engineering education and enhancing communications with international counterparts.

History of engineering education accreditation in China



Accreditation program areas

Total 31 program areas in engineering directory

17 already accredited areas

- Mechanical Engineering
- Chemical & Pharmaceutical Engineering
- Electronic information
- Electrical Engineering
- Hydraulic Engineering
- Transportation Engineering
- Civil Engineering
- Food Engineering
- Mineral Engineering
- Safety Engineering
- Materials Engineering
- Environmental Engineering
- Surveying Engineering
- Instrument Engineering
- Geographic Engineering
- Computer Engineering

11 to be accredited areas

- Energy and Power
- Textile Engineering
- Light Industry
- Forestry Engineering
- Agricultural Engineering
- Nuclear Engineering
- Aerospace Engineering
- Biological Engineering
- Biological Medicine
- Ocean Engineering
- Eng.Mechanics

3 areas not included

- Public Security Technology
- Weapon
- Architecture

Accreditation organization system

- Established in 2012
- Under the oversight of CAST
- Non-profit, NGO
- Authorized by MOE, independent of MOE
- 33 associations involved

CAST

CEEAA

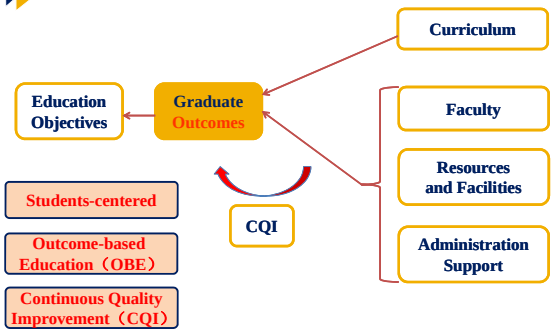
- CAST represents China to apply for the provisional status of Washington Accord.
- CAST conduct engineering education accreditation in China through its member organization, CEEAA

Council

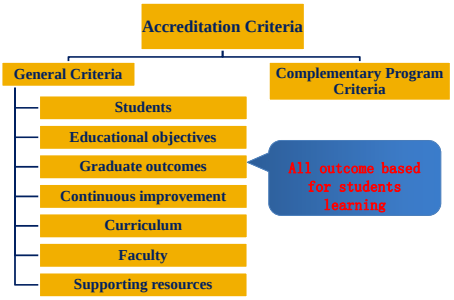
Board of Supervisors

Secretariat | Academic Committee | Decision Advisory Committee | Sub-Committee | Sub-Committee | Sub-Committee

Philosophies of Criteria



Criteria



Outcomes are substantial equivalent to WA graduate attributes

CEEAA graduate outcomes

I. Ethics
II. Basic Knowledge
III. Engineering Knowledge
IV. Experiment Design/Investigation
V. Innovation and Project Management
VI. Modern Tool Usage
VII. Environment and Sustainability, Engineer and Society
VIII. Team work
IX. Lifelong learning
X. Communication

5--Rethinking on the Concept— University

- **What is a "university"** ?
- The former president of Tsinghua university Mr. **Mei Yiqi** said that: "**The so-called university is not because of the big buildings but great masters**." (1931,TH News,N0:341)
- " Not only the intelligence of us depend on the teach of teachers but **also the spiritual cultivation**. "
- The inaugural speech of Mr. Mei Yiqi, the president of Tsinghua University, the school publication of Tsinghua university, No. 341, 12/14/1931

- We fulfill the sentence above as:

"The so-called university is not because of the big buildings but the place where great masters educate talents."

- This renew at first emphasize the resource of masters and second require the **masters to teach talents , and students learning, implement the education.**
- But the **most important aspect for university is the "output", the production of talents cultivation**. But it is difficulties to indentify in a short term evaluation!
- The common mission of teachers and masters is **talents cultivation.**

5—Concluding remarks

- E E **Evaluation system**

  Object-Criteria-Hand the "Baton"
- **EVALUATION—Diversity; Strategy**

  Rethinking on the fundamental concept of **education**

To answer—What is the main task of University?

- **Any discrepancy of the main task of university and the purpose of evaluation, It may induced the evaluation to incorrect direction!**

Thank you for your attention!

For questions and discussion