Status Analysis of Chinese Academy of Sciences among National Research Institutes in the World ——Academic Impact Evaluation of NRIs

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Outlines

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Motivation

- CAS, the leading independent national research institution in China , has almost 100 research institutes involving all the disciplines of natural sciences, with about 60,000 staff working for CAS, among which about 30,000 are permanent research staff.

- Since its foundation in 1949, CAS has achieved great progress in scientific research, but as we can see, compared with some world-class national research institutions, there's still a distance.

- In order to recognize the strengths and shortcoming of CAS, this comparison study was carried out.

Introduction (1)

- During the First Technological Revolution between the middle of 16th century and end of 17th century, various kinds of national research institutes (NRIs) with highly organized systems have been established gradually.

- They mainly include scientific research institutes either directly set up by the state, or affiliated with a central government department.

- NRIs undertake the work of scientific and technological innovation for national economic and social development, national security, and scientific frontier exploration etc.

- NRIs, together with universities & colleges and enterprises, constitute an important part of the national innovation system.

Introduction（2）

- S&T Evaluation has been received more and more extensive attention by the scientific research organizations around the world, and has been an important basis for S&T strategic management.

- There are more and more S&T evaluation practices, including Innovation capacities evaluation, S&T competitiveness evaluation, universities ranking and nation competitiveness ranking and etc.

- The academic impact of NRIs involves many factors such as research capacities, competitive strength, and impact on science and society, on which the NRIs relies to fulfill their missions.

- The comparative analysis on academic impact of NRIs is aimed to: 1) help the institutes better understand their development status, so as to recognize own strengths and weakness; 2) promote effective communication and cooperation between each other on the basis of mutual understanding; and 3) increase public attention and supervision on their development.

Key research topics

- The academic impact evaluation of NRIs is different from other related evaluation, such as universities ranking, regional S&T competitiveness evaluation because the orientation, mission and organization structure of NRIs and other scientific research organizations are diversified.

- So, how to design the evaluation model for NRIs' academic impact and the relevant indicator system to meet the specialties of NRIs is a key topic needed to be investigated and discussed in this research.

Evaluation Model (1)

- The evaluation model is designed based on 3E theory in this research.
  - Efficacy
    - Outputs of a system
  - Efficiency
    - Outputs/resources
  - Effectiveness
    - Desirable impact of Efficacy
- So, the evaluation model is framed from three aspects: Efficacy of NRIs, Efficiency of NRIs and Effectiveness of NRIs
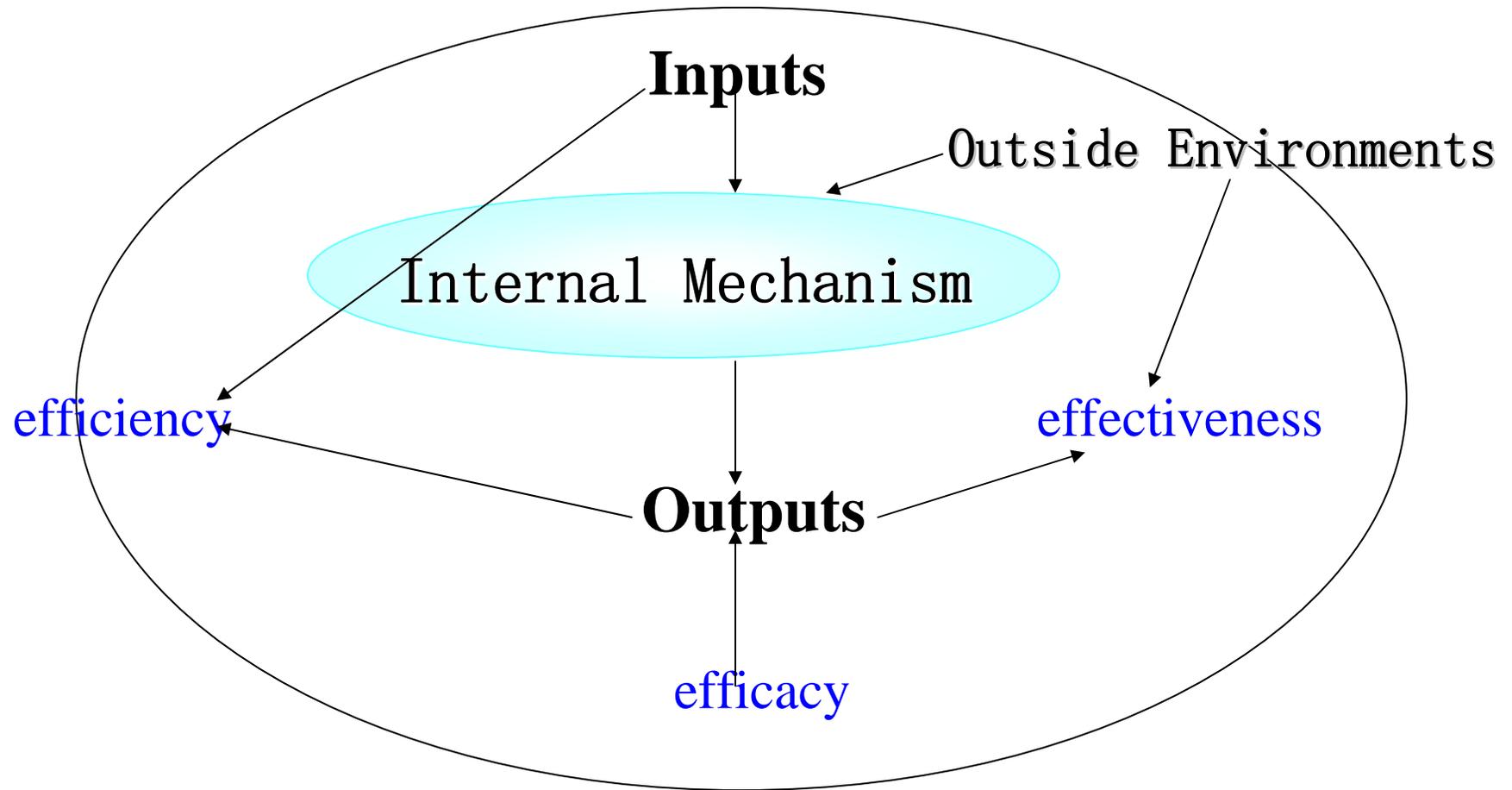
The Ladder Theory

- In this research, the indicator structure is designed according to "the Ladder Theory" in order to map the NRIs' development status.

- For instance, "high-quality paper" is served as level-I indicator, while TOP10% paper, TOP1% paper, and TOP0.1% paper constitute three independent level-II indicators going up in a ladder-like manner.

- Not only the importance of scientific research quality can be well represented, but also the various research levels can be reflected, so as to balance the data randomness of different ladder indicators.

Indicator System（1）

- The evaluation model is designed based on 3E theory and the ladder theory, including indicators and weights.

- Discipline Category: 21 disciplines (multidisciplinary excluded) from ESI database.

Indicator System（2）

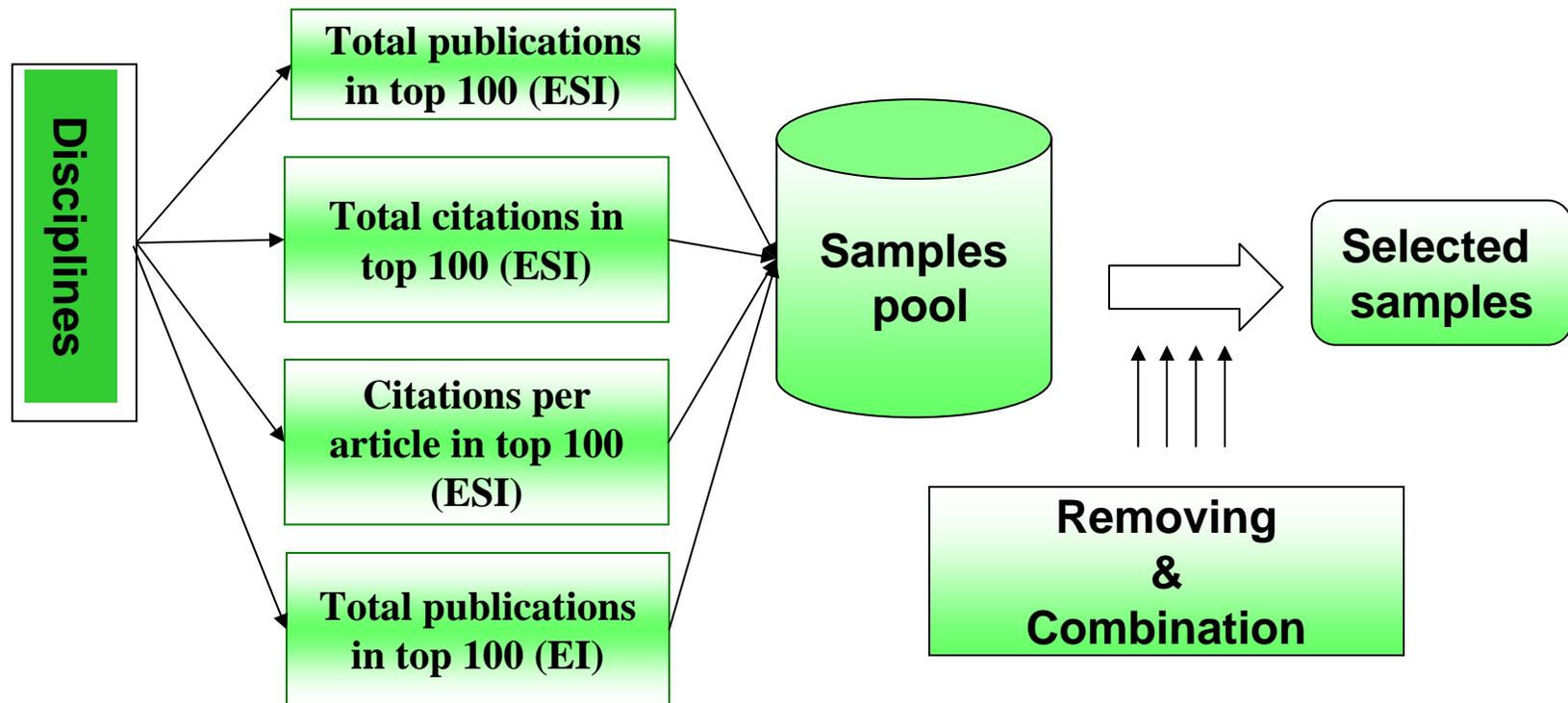|		
18 disciplines of natural science, 2 disciplines of social science	**Efficacy: E1**	1 Sum of SCI (SSCI) papers 2 High-quality paper
	Efficiency:E2	3 1/staff 4 2 /staff
	Effectiveness: E3	5 Citations 6 Important academic positions 7 International important awards
Engineering	**Efficacy: E1**	1 Sum of total papers of Engineering 2 High-quality paper 3 Sum of patents (including patent applications and patents authorized)
	Efficiency: E2	4 1/staff 5 2 /staff 6 Patens /staff
	Effectiveness: E3	7 Citations 8 patents' citations 9 Important academic positions 10 International important awards

Methods of Calculation

- Discipline Ranking：The discipline rankings of NRI involve the indicators of Efficacy (E1) , Effectiveness (E3) and the comprehensive scores calculated from all level- I indicators of E1 and E3. The comprehensive scores are used for discipline rankings.

- Comprehensive Ranking：Based on the discipline rankings, the summation of E1, E2 and E3 for each discipline results of the institute as a whole, the summation of both results in the comprehensive score of the institute are calculated and based on that score the institute is ranked.

- Data reliabilities analysis: Random disturbing method and the maximum interval method.

Empirical Research Results

- For each of 22 subjects, determined by ESI database, the top 100 institutes were chosen for further consideration based on the rule of the total SCI (SSCI) publications, or the total citation counts, or the average citation counts per paper. Finally 86 NRIs from 26 countries were picked out for analysis and ranking.

- United States takes the lead with 12 institutes on the list. Institutes from United States, Japan, Germany, Canada and France have accounted for 50% of the total sample institutes.

- Most of 86 sample institutes have covered 21 subjects (multidisciplinary excluded) more or less. So, there is comparability to some extent among these NRIs.

- Taking E1 indicators of Agricultural Science as an example, USDA, INRA, CSIC, AAFC rank in the top, which shows that E1 indicators are reasonable.

Sample Institutes Selection Process

Disciplines

Total publications in top 100 (ESI)

Total citations in top 100 (ESI)

Citations per article in top 100 (ESI)

Total publications in top 100 (EI)

Samples pool

Selected samples

Removing & Combination

Based on ESI（Essential Science Indicators), 22 disciplines and EI database

Conclusions

- In this research, 3 aspects for evaluating NRIs' academic impact were proposed: Efficacy, Efficiency, Effectiveness.

- Secondly, the indicator structure according to "the Ladder Theory" is designed to show the research quality of different levels, and to balance the data randomness of indicators of different ladders.

- Based on the systematic analysis of NRIs' academic impact, the indicator system used to evaluate NRIs academic impact was proposed in this research. This indicator system is based on discipline. The comprehensive ranking of NRIs as a whole is based on discipline ranking.

Discussion

- Evaluation Assumptions: The NRIs' academic impact evaluation is based on discipline ranking and we assumed that each discipline has the same weight. So, the comprehensive institutes will dominate.

- Sample difference: There are two types of NRIs: one is the institutions with industry and ministries characteristic, which is represented by USDA. The other is comprehensive institutions, such as CNRS, MPG, CAS.

- Data integrality: Although we use authoritative data, such as ISI, DII and etc. But there are still some data obtained from website. And some data, such as research funding of some institutes, is not available. Besides, due to the differences in statistics methods of different countries, some data may not be totally comparable, take the human resource data for example, some institute use FTE data, but some don't.

The report will be released soon, suggestions and comments are welcome. Contact me at glyang@casipm.ac.cn.

Thanks&questions?