

EXPECTATIONS OF JAERI ON INIS FROM A VIEWPOINT OF SOCIO-ECONOMIC EVALUATION

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Abstract. Because the taxpayers funded basic scientific researches in JAERI, a feedback of the results to the public is strongly requested by the Japanese government. By using the concept of socio-economic effect, that is, the stimulation and promotion of social interrelations through a formation of networking in basic research, the authors tried to show a kind of feedback. For this purpose, JAERI developed computer code SOCIOECO combined with INIS was used as a main tool and database. The case study was addressed to the Material Science (MS) field in JAERI. It is revealed from the study that a significant formation and development of socio-economic networking is occurring at the emphasized basic research fields (EBRF) of ion irradiation and actinides having a strong relation to nuclear. For actinides a total of 7,237 papers were written in basic research fields, where the share of JAERI over 25 years was 25%, while 52% by public sectors (PS, namely university (U) and governmental sectors (GS)) and 17% by private organizations (PO). Numbers of co-written papers defined as an index of socio-economic networking were increased with time. The growth rate, for example, between JAERI and PS was of order of 3-4% per 25 years, while 8% per recent 5 years. The socio-economic networking described here seems to be useful for showing the feedback occurring from basic research to the public.

1. Objectives

To show the formation of socio-economic networking in basic research in JAERI is a main objective of the present study. For the purpose of quantitative evaluation, JAERI developed computer code SOCIOECO combined with INIS was used as a main tool and database.

2. Concept for Evaluation

2.1 Form of socio-economic effect [1-2]

Taking into consideration of previous studies [3], socio-economic effects of publicly funded basic research are defined to observe in the following styles:

- ① Increase of useful intellectual stocks,
- ② Upbringing of highly skilled college graduates,
- ③ Construction of new scientific facilities and creation of methodologies,
- ④ Stimulation and promotion of social interrelations through formation of networking,
- ⑤ Increase of one's ability to solve scientific problems,
- ⑥ Establishment of venture business

Typical example of products of those are; numbers of papers published(□), numbers of trainee(□), constructed numbers of research facilities and patents (□) and numbers of venture companies established(□)[4].

2.2 EBRF

Hereafter, item □ is focused due to a direct relationship with the socio-economic effects that is, a resultant formation of networking. As shown in Fig. 1, the effect may significantly be large in proportion to the net width represented by numbers of co-writing papers. Enlargement of net width will occur with increase of socio-economic cooperation between JAERI and the

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other research bodies; PO and PS. Our study is addressed to clarify the emphasized basic research fields (EBRF) in MS and to show the socio-economic networking developed in the clarifies EBRF.

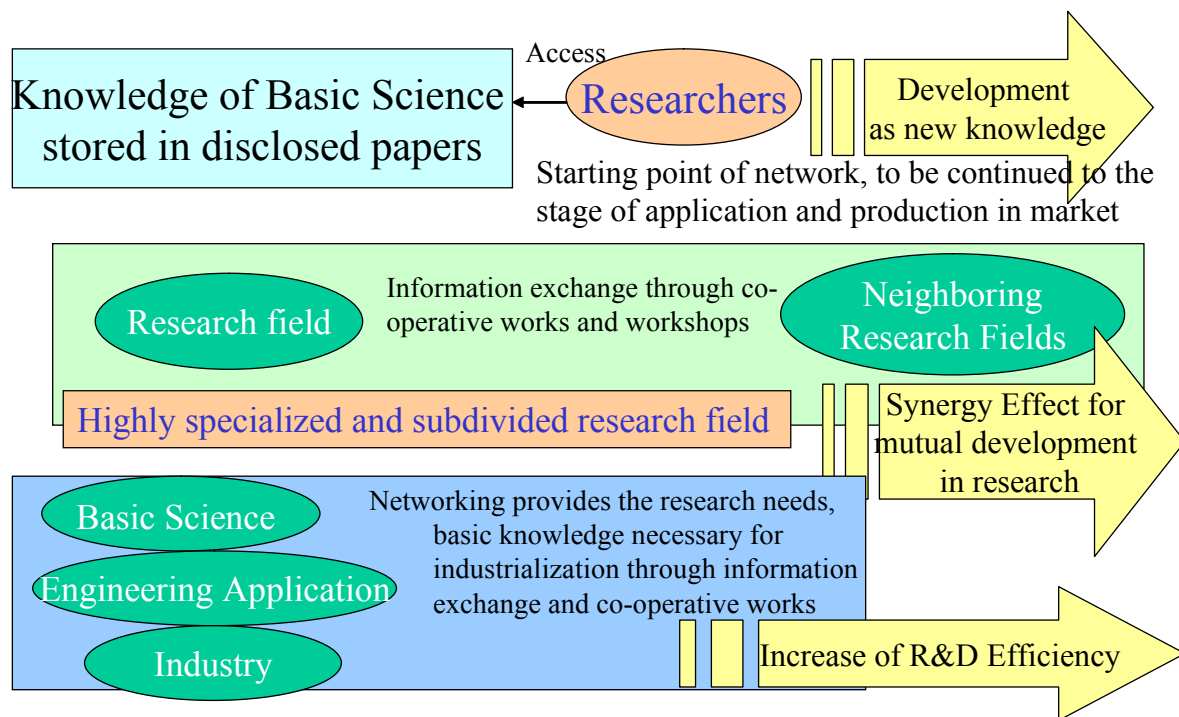


Fig. 1 Socio-economic networking with various stage of enlargement observed in basic science

3. Evaluation Method

3.1 Necessity for Networking

A paper written in MS includes a few keywords and can indicate explicit field of researcher's interest. To study a formation of networking, one is necessary to know 1) affiliations of authors such as JAERI, PO and PS, 2) numbers of papers submitted to journals, and 3) existence of co-written papers. The last term is a key factor because as mentioned previously the socio-economic effect is more significant in proportion to the increased numbers of co-written papers between two different organizations.

3.2 Working Steps

(1) Step1: Finding EBRF

By using MS papers written in JAERI, SOCIOECO run combined with both JOLIS and INIS database was made first to set up the keyword top {100}. The ranking is defined here as the conceptual envelope of EBRF. The procedure taken was shown in Fig. 2.

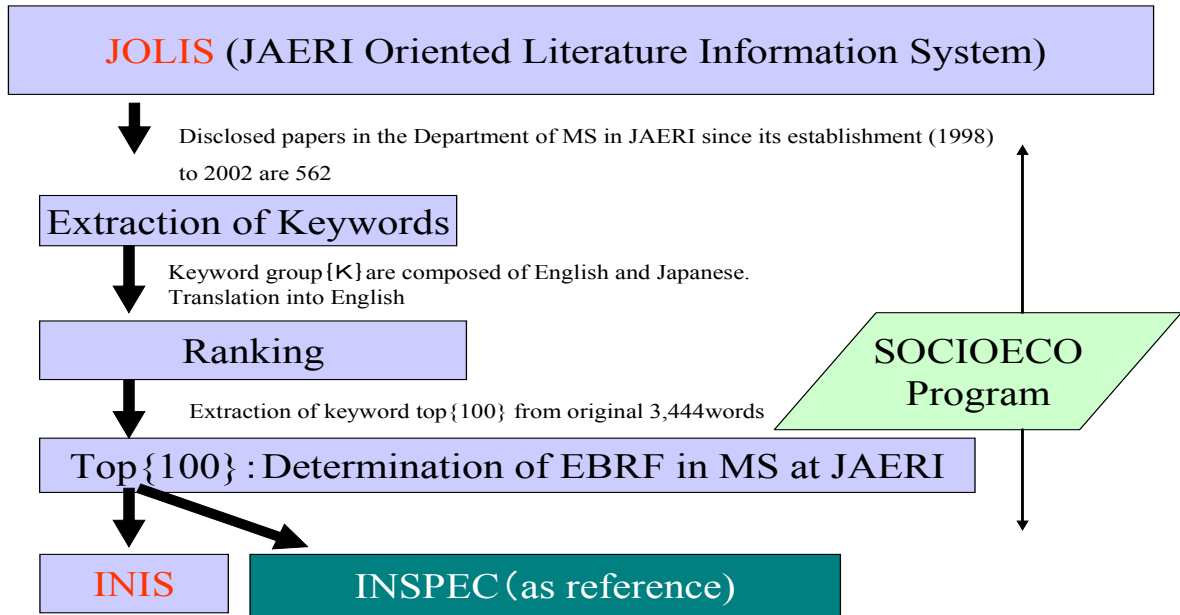
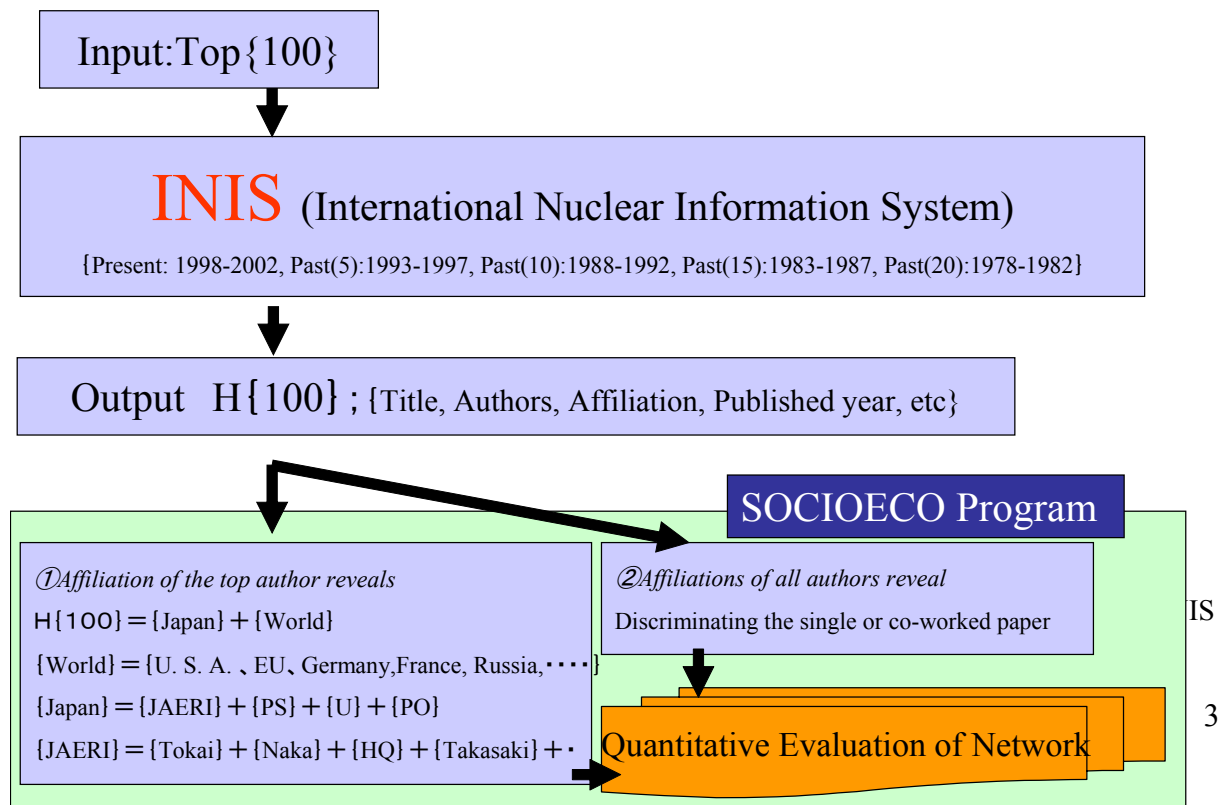


Fig. 2 Process for finding EBRF in form of keyword top{100}

JAERI has 7 MS-related departments, from which the department of MS (DMS) was selected for a case study. Using JOLIS (JAERI Oriented Literature Information System), all papers published by DMS covering the period from 1998 (a year of establishment of DMS) to 2002 were selected for logging into the JAERI-developed computer code SOCIOECO. The code run found that original papers were 562, having as-written keywords by 3,444. After putting Japanese keywords into English, another run for final ranking carried out. Note that the computer code SOCIOECO was developed by JAERI for the purpose of determining EBRF through keywords and socio-economic networking formation through magnitude of co-written papers. A part of its function is illustrated in Fig. 3.

(2) Step2: Socio-economic Networking

To make quantitative study of socio-economic networking, the subsequent steps are taken into act as shown in Fig. 3.



1) Use the INIS as main tool, where it was operated by IAEA since 1970 under the cooperation of 108 nuclear related countries. A time span was as long as 25 years, hence from 1978 to 2002. During study it was cut into 5 years such as Present: 1998-2002, Past (5): 1993-1997, Past (10) : 1988-1992, Past(15):1983-1987 and Past(20): 1978-1982.

2) When one input keyword group {K} into INIS, output may be {H}. According to options one may have database consisted of {title, authors, affiliation, and year of issue}. For socio-economic networking, database was automatically transferred to SOCIOECO installed into a large-scale computer machine. Code can distinguish the author's nationality by affiliation data. Hence, if one input the keyword {actinides}, outputs related to nationality may be given by {H}={Japan}+{other countries in the World}. The latter can be further discriminated as {other countries in the World}= {U.S.A.}+ {Germany}+ {France}+ {Russia}+{others}. Unfortunately as to the case of actinides, 9% of the total papers were unknown nationality including no Japanese authors.

3) For socio-economic networking, SOCIOECO facilitated to discriminate co-written papers. Namely all author's affiliation was discriminated automatically into the group of belongings; JAERI, PS, PO and the others. From the viewpoint of accuracy, it is desired to keep one-to-one correspondence between the author and his affiliation. Note that change of author's name and his affiliation during the stage of input work should be avoided. Unfortunately, it is found that there existed papers of unknown belonging covering the magnitude of order of 5 to 10% occurred by restructuring or renaming of organizations. In the present study, SOCIOECO omitted them from the output. This may be a fatal problem occurred at the stage of input work at every countries.

3.3 Database Used

1) Characteristic of INIS and INSPEC

INIS has been logged a total of 2.2 million scientific papers issued from about 4,000 journals related strongly to nuclear. In our country, JAERI is the supporting organization to INIS, having a high follow up rate of Japanese papers. Regarding all JAERI papers written by Japanese or by English, the follow up rate by INIS was 100% while that by INSPEC was 30%. Note that the latter was established by the Institute of Electric Engineers, England since 1969, where a total of 6.5 million papers issued from about 4,000 journals has been logged in the field of physics, electric engineering, computer sciences etc.

2) INIS Selection

For our evaluation, INIS was rather advanced than INSPEC in the following points. INSPEC data was adopted as reference not showing their typical results.

① The density of nuclear data in INIS was rather high in magnitude than that in INSPEC; the nuclear database with high density is preferred.

② For study of international networking, INSPEC may rather be suitable because of a worldwide large database. Our study is, however, focused on rather domestic or Japanese networking; therefore the high rate logging of Japanese data done by INIS is preferred. It is significant to say that regarding one-to-one correspondence between author's affiliation and his belonging, INSPEC only had the top author's affiliation but INIS could have all authors' affiliations. This is one of key factor for the formation of Japanese socio-economic networking.

③ Combined searches with INIS, INSPEC and CAlplus were planned at the beginning but not executed due to cost problems.

4 Results

4.1 EBRF

(1) Result of keyword ranking

The keyword top {100} determined by SOCIOECO is shown in **Table 1**. Due to alphabetical expression after statistical treatment, top {100} shown hereinafter included practically a total of 109 keywords instead of 100. Rank 1st obtained was ion irradiation (31 hit papers or 31 net points out of 562 sourcing), 2nd the actinides (27 papers) and so on. These are EBRF in MS occupying about 5% of original 3,444 words, where not only research fields but also research facilities or instruments (e.g., rank 3rd tandem accelerator) are come out inevitably.

Table 1 Keyword top {100}, hence EBRF of MS determined by SOCIOECO code

Rank	Keyword	Hit	Rank	Keyword	Hit
1	Ion Irradiation	31	98	Low Dosed Ferritic Steel	5
2	Actinides	27	99	Nondestructive Analysis	5
3	Tandem Accelerator	25	100	Plateau	5
4	Molten Salt	21	(Abbreviated)		
5	EXAFS	18	106	Surface	5
6	Neutron Irradiation	18	107	Thermal Diffusivity	5
7	Synchrotron Radiation	18	108	XANES	5
8	Lanthanide	17	109	Zirconium Carbide	5
9	Transmutation	14	Note:EXAFS=Extended X-ray Absorption Fine Structure XANES=X-Ray Absorption Near Edge Structure		
10	ECR Ion Source	13			

(Abbreviated)

(2) Characteristics of keywords top {100}

EBRF as the envelope of MS are ion irradiation, actinides, tandem accelerator, molten salt, EXAFS, neutron irradiation, synchrotron radiation, lanthanide, transmutation, and ECR ion source. These are all related to nuclear field with emphasis by JAERI. Result of SOCIOECO evaluation is shown in Fig. 4, where MS related papers were written not only in JAERI but also in other countries because of their importance. The magnitude is of order of EU, U. S. A., Japan, Russia and China. If we look into more details about Japan for the present 5 years as shown in Fig. 5, the share of Japan to the world is approximately 13%. Inside country, a share of JAERI was 21% implying that MS in JAERI played a big role for promotion of basic scientific study. It is worthy mentioning that practical numbers of organizations included in U, GS, PO and JAERI here are 209, 183, 414 and 1, respectively.

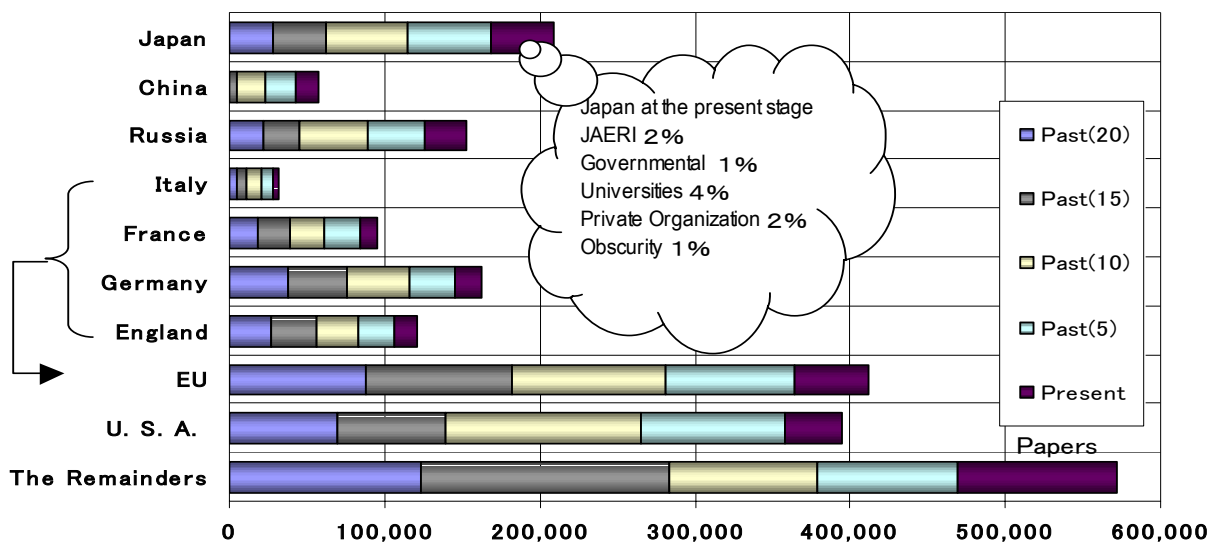


Fig. 4 Numbers of MS papers published in several countries participating to INIS; Top {100} keywords based on JAERI are used for SOCIOECO/INIS.

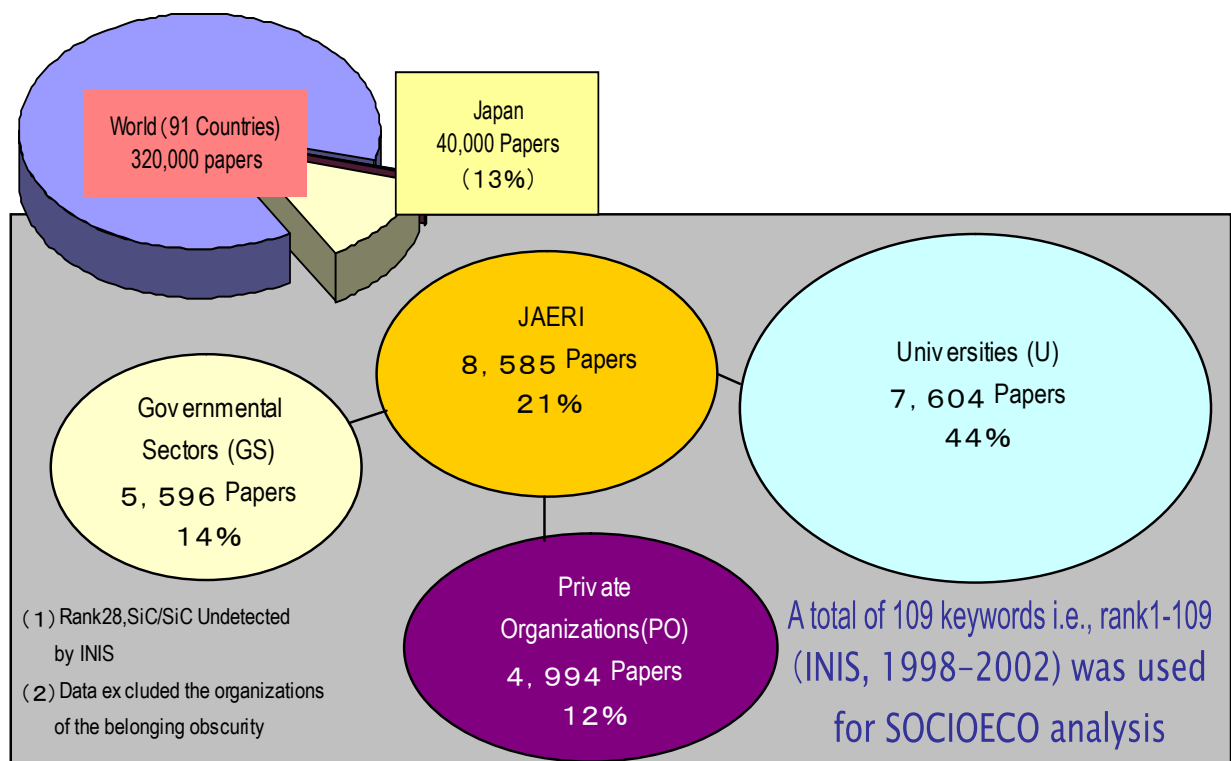


Fig.5 Numbers of MS papers published in the INIS participating countries covering the period from 1998 to 2002, where (top) share of Japan is 13% (bottom) discriminated publication of papers at JAERI (21%), PO (12%) and PS made of GS (14%) and U (44%).

4.2 Actual networking of EBRF in JAERI

Fig. 6 shows the resultant network of actinides obtained from SOCIOECO. A total number of papers issued as per 25 years were 7,237, where 52% was belonged to PS, 25% to JAERI and 17% to PO. Actinides seem to be important research theme studied commonly among organizations in Japan. Socio-economic networking developed between JAERI and PS was 4.3% in total average, while that between PS and PO was about 2%, and about 1% between PO and JAERI. A growth rate of socio-economic networking evaluated by co-written papers as per 5 years is shown in the bottom of Fig. 7, where total numbers of published papers is given in the figure top as a reference. It is clear that the socio-economic effect is prominent by the progress of year. It is particularly significant between JAERI and PS, thus a magnitude of socio-economic networking is increased to the magnitude by 3-4% per every 5 years. In particular, not only co-written papers (132) but also TR ones (10) are born though they did not appear at the past (20). Owing to our criteria it can be judged that socio-economic networking of actinides between them is developing.

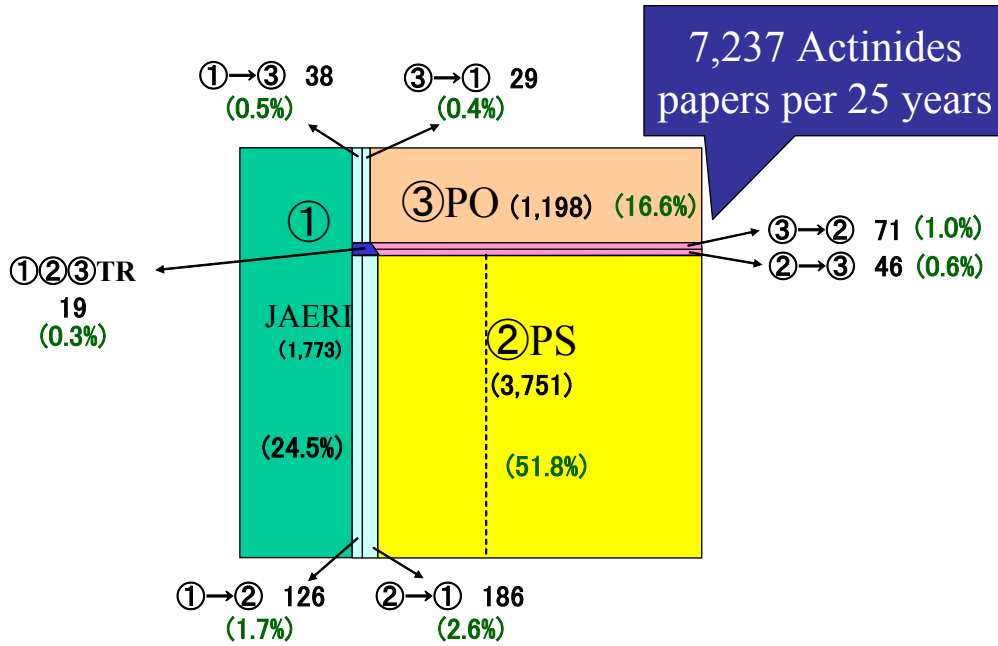


Fig. 6 Networking of actinides over 25 years

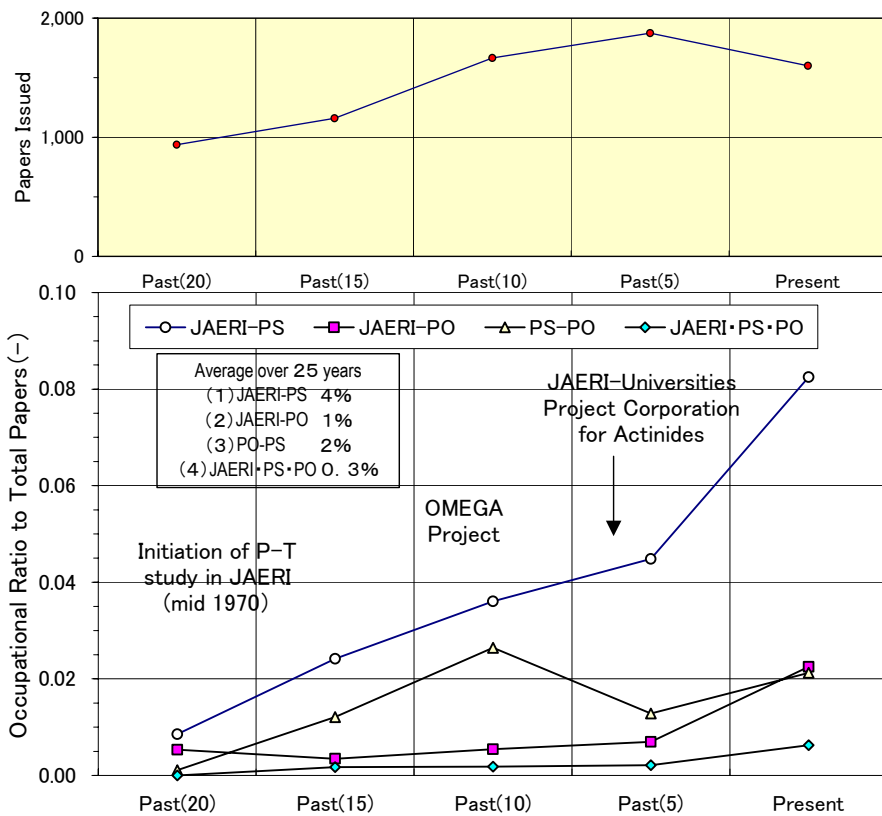


Fig. 7A growth rate of networking observed in actinides; (top) all actinides papers issued and (bottom) occupational ratio of co-written papers as per 5 years

5. Conclusions

From the viewpoint of socio-economic effect of basic scientific research funded by the public, the stimulation and promotion of social interrelations by networking was studied. As a case study, MS keywords in JAERI are provided for the JAERI-developed computer code SOCIOECO combined with INIS as an analytical tool and database. As an index showing the magnitude of socio-economic networking, co-written papers between JAERI and others (PO, PS) are prepared. Results are as follows;

(1) SOCIOECO revealed that original EBRF of MS in JAERI are; ion irradiation, actinides, tandem accelerator, molten salt, EXAFS, neutron irradiation, synchrotron radiation, lanthanide, transmutation, ECR ion source. Those are strongly related to nuclear.

(2) Actinides and ion irradiation are representative EBRF showing a large share of JAERI in magnitude. For actinides (7,237papers), the share of JAERI over 25 years was 25%, while 52% by PS and 17% by PO. The growth rate of socio-economic networking between JAERI and PS was of order of 3-4% per 25 years and 8% per recent 5 years. Lately, socio-economic effect in actinides spread sharply perhaps attributed to significant contribution by JAERI for enhancement.

(3) Taking into consideration of co-written papers, SOCIOECO analysis combined with INIS database can show a quantitative index of socio-economic networking formed and developed in basic scientific research.

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