International Journal of u- and e- Service, Science and Technology
Vol.9, No. 3 (2016), pp.89-96
http://dx.doi.org/10.14257/ijunesst.2016.9.3.10

Relational Network Analysis for Advanced National R&D Outcomes Management

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Abstract

Through national R&D project, various research outcomes, such as papers and patents, are generated in every year. In particular, some outcomes are come from joint researches, and they represent social relationships. This paper proposes the relational network analysis for advanced national R&D management approaches for dealing the complex relationship between R&D outcomes in convergence researches. We analyze the relationship between national R&D project and followed outcomes with status of collaborative researches.

Keywords: *Social Network Analysis, National R&D Outcomes Management, Web 2.0*

1. Introduction

Each year, various R&D outcomes, papers, patents, research reports as the results of national R&D projects are created. There has been amount of interest because they received the governmental investment for researches[1]. Furthermore, the creation, distribution and application of knowledge in the area of science and technology has become a major issue. The results of each project are collected by each ministries or followed project management organizations, so that efficient management of achievements is not easy. Outcome management agencies are dealing with each R&D outcomes of each project. Furthermore, NTIS(National Science and Technology Information Service) manages entire R&D Project and followed outcomes. They causes the growth of utilizations of national R&D outcomes information. However, R&D information from cooperation and convergence researches are still difficult to manage.

Meanwhile, a social network is a concept of graphical representation of the connections between mutually interdependent objects (Figure 1) [2]. The social network consists of relationships in terms of network theory with nodes and links [3]. Since links can be applied in many different ways, social networks are useful to analysis various, complex relationships in data management. Moreover, transforming and inferring the quantitative information is relatively simple in social networks that are mathematical structures (*i.e.*, network theory). Thus, social networks have become a popular research issue, and various applications with social networks have emerged, nowdays [4].

We proposes the relational network analysis methodologies for advanced national R&D outcomes management. The relational networks are composed of the characteristics of R&D project and followed outcomes. In this paper, Section 2 presents related works and background information. Section 3 describes the proposed data management approach with social network analysis. In Section 4, experimental analysis and concluding remarks in Section 5.

ISSN: 2005-4246 IJUNESST

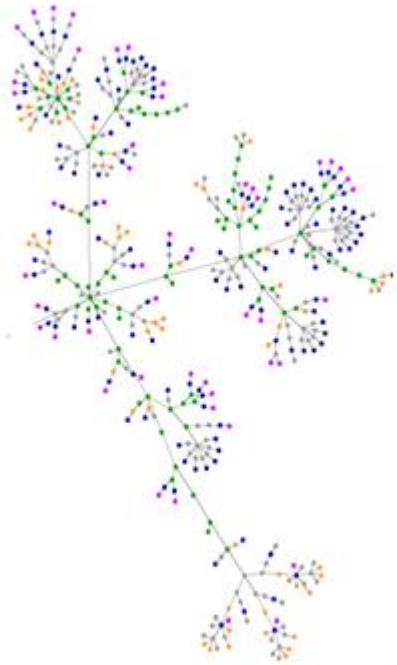

Figure 1. The complex Structure of Social Networks

2. Related Work

Amount of social network researches are focused on analyzing networks between web data. Moreover, there have been many studies that attempted to specify the degrees of relationships by defining social trust models. Trust is an essential component of building any relationship between individuals or organizations [9]. Trust exert their influence on every activity and technology involving interactions between people, and serve as a barometer to estimate the degree of trustworthiness of the potential counterparts [10]. Lately, there has been increasing research on formalizing trust via computational models. Marsh proposed a computational model for trust that is applicable to the domain of Distributed Artificial Intelligence (DAI) [8]. The model is describe problems at the extreme values, and it has trouble dealing with negative trust values. This work dealt detailed exploration of the possibilities for formalizing trust as a computational concept. [10] proposed a mathematical model to calculate agents' trust based on probabilistic. In addition, they provide a mechanism that infers trust of the trustor toward the trustee from the reputation data about the trustee. [11-12] presented an inference algorithm of social trust models. In this works, they inferred indirect trust with intermediate nodes. [5-7] are focused on analyzing graphs expressed as relational networks in data management and mining.

Meanwhile, using graph analysis and trust models, many studies have been conducted on visualization [13] and relation maintenance [14-15] and link predictions [16-17] *etc.*, in social networks. In addition, studies intended to apply social networks to diverse areas such as e-mail spam detection [18] and recommendation systems [6-7] have been actively conducted.

3. Advnced R&D Outcomes Management Methodology

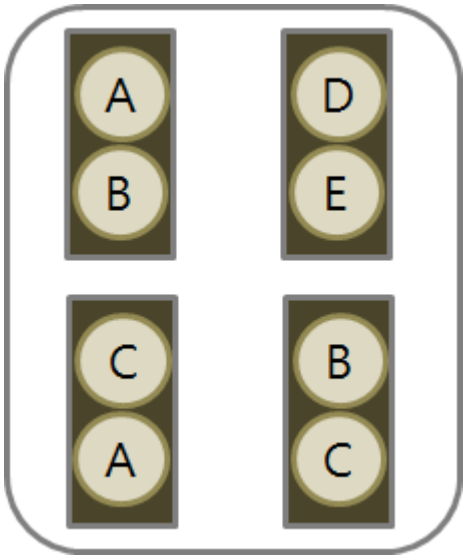

Figure 2. Projects and Outcomes Produced by R&D Projects

This section should describe the efficient R&D outcomes management approach. The proposed approach is based on social network analysis with the relationship between papers and project property. Amount of outcomes are produced by the achievements of national R&D project. Furthermore, some outcomes are related to R&D multiple projects. Figure 1 shows four R&D projects(P_{rj}) and followed five outcomes(P_i). As you see, Outcome A is produced by Project 1(Pr_1) and Project 3(Pr_3). So, they make eight kinds of pairs which is consist of project, outcome(Eq. 1).

$$Oi = \{Pr_j, P_i\} \quad (1)$$

The combination of project-outcome pairs could be easily managing the various collaborative researches and the convergence technologies. However, extraction of relationship between them are difficult. Because outcomes are identified by each separated project, and the critical identifications, such as title of papers and journal, are confused by the different sources of information.

On the other hand, the achievements of national R&D projects(*i.e.* papers, patents) are collected with verification process. In this case, there are issued the verification key if outcomes are verified successfully.(Verification keys are used to determine whether the validity of artifacts, which are issued unique. However, this paper does not deal with verification process).

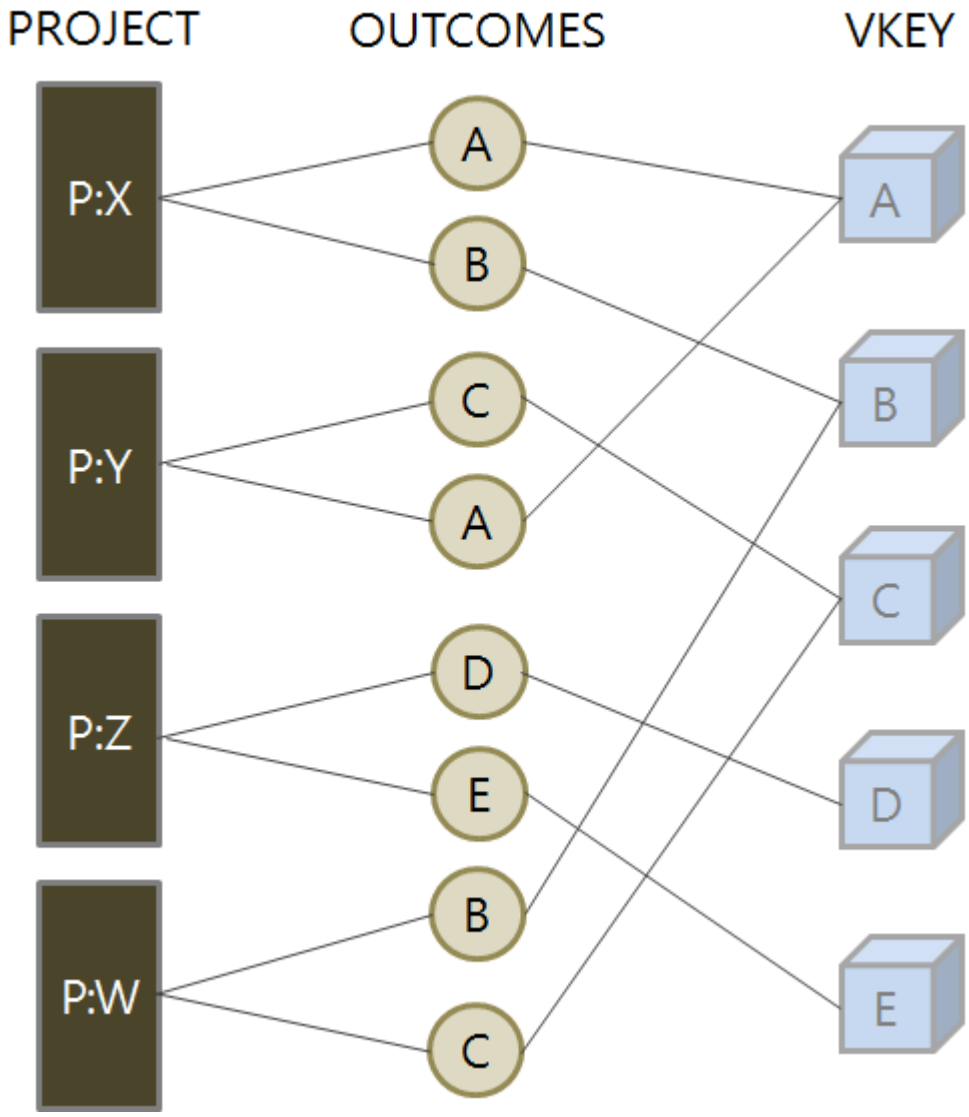

Figure 3. The Simple Relation Map Between (Project and Outcomes) with Verification Key

Figure 3 displays the relationship between some project-outcomes(already explained Figure 1) with verification key. The pairs of (project, paper) are nodes and the verification keys are generating the link between these pairs. Because the same verification key means the same papers. For example, project X and project Y have the relationship with outcome A, and project X and project W have a relationship through outcome B. Moreover, project Y and project W also have a link with outcome C. In this case, project X, project Y, and project W represent the triangle structure it means that three projects are likely have similar scientific properties. Different outcomes A and C can have similar personalities.

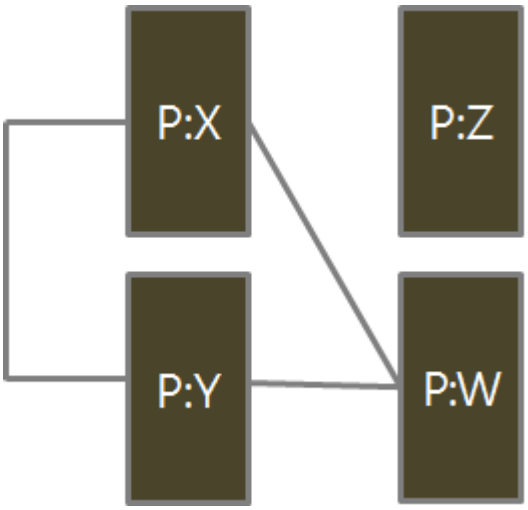

Figure 4. The Relationship Between Projects with Link of Collaborative R&D Outcomes

4. Experiment and Analysis

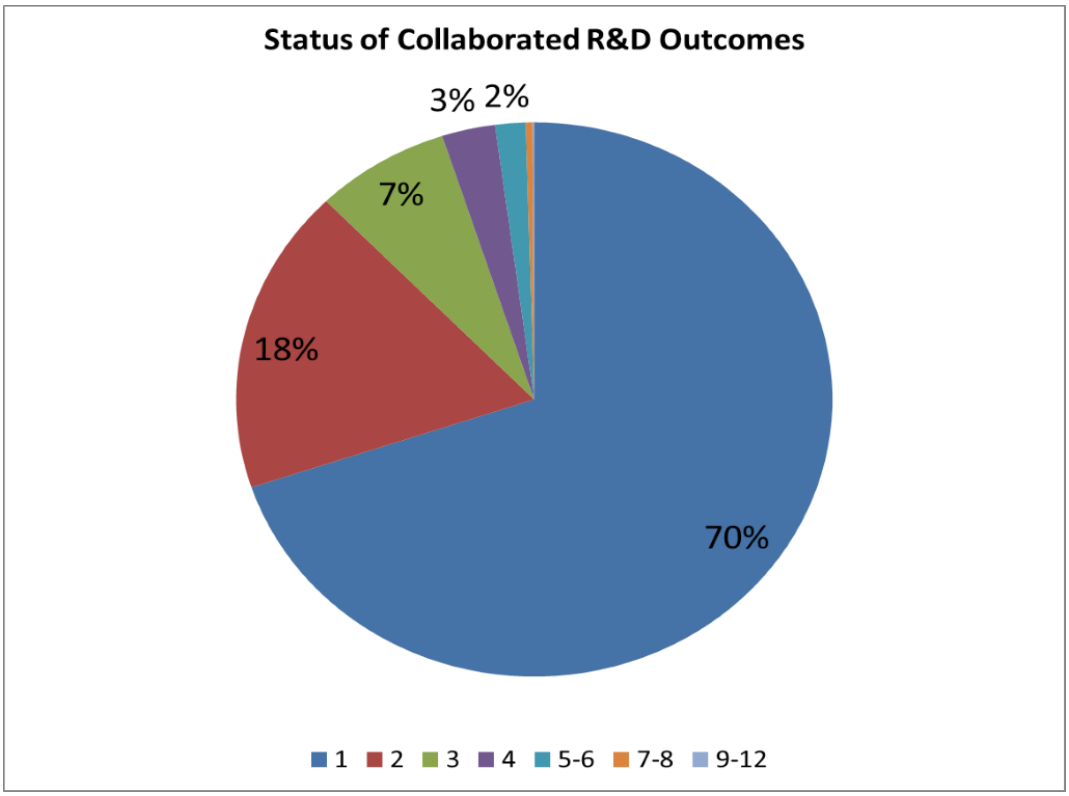

Figure 5. Status of Collaborative Researches

This section analysis the status of the collaborative research papers which are published in sci-indexed journal, in 2011(Figure 5) (Table 1). Most of them(about 70%) are produced by exclusive R&D projects. However 28% of papers are occurred by collaboration of 2-4 projects. In addition, about 2% of papers are produced by collaboration of 7-12 projects. It means that various relationship between R&D outcomes and projects are important to identify and analyze the entire national R&D projects and followed achievements.

Table 1. Status of Collaborative Research Papers

# of collaborations	# of Outcomes
1	21431
2	5472
3	2239
4	890
5-6	506
7-8	112
9-12	25
ToTal	30675

5. Conclusions

In recent, the creation, distribution and application of knowledge in the area of science and technology has become a major issue. Through R&D research project, many scientists should produce achievements such as papers, patents, and research reports. For efficient R&D outcomes management, collaboration achievements by multiple research projects are important. We proposed the social network analysis based national R&D outcomes management methodology. We defined the pair key which is consisted of project and outcomes for efficient management. Furthermore, we generated the link between pairs with verification key of R&D outcomes. It should be important to analyze not only the collaborative researches and convergence technology, but also the state of entire national R&D projects and followed achievements.

Acknowledgments

This research was supported by the Sharing and Diffusion of National R&D Outcome Program of the Korea Institute of Science and Technology Information (KISTI) (K-14-L02-C02-S02).

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