2.3 Governance of inter-actor relationships in STI policy implementation

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Abstract

Among the types of policy for science, technology, and innovation—a type of science, technology and innovation policy—industry, ministries and agencies, independent agencies, and universities are mainly involved in the implementation of policies aimed at realizing innovation originating from science and technology. Each actor has its own philosophy, goals, and code of conduct. It is not easy for different actors to cooperate with one another. How should authority be distributed among them (i.e., governance), and how should we create a system and code of conduct for the effective use of resources (i.e., management)?

Keywords

Governance of industry-government-academia collaboration, management of industry-government-academia collaboration, risk management in industry-government-academia collaboration, triple-helix, emergence

1 The state of governance in industry, government, and academia: Who should take the lead?

Within science, technology, and innovation policy, one of the core elements of policy for science, technology, and innovation (see 2.1.1) is the realization of innovation originating from science and

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technology. Analyses of many examples of innovation in the United States have confirmed that the interaction between industry, government, and academia is essential for innovation originating from science and technology. This raises the question of how we can design institutions and coordination mechanisms to generate this interaction. In other words, the point in question is "governance" in the sense of who should lead the system. Proposed by Professor Henry Etzkowitz of Stanford University in 1993, the "triple helix" theory has had a significant impact in the context of science- and technology-based innovation since the early 1990s (Etzkowitz and Chunyan, 2017).

The conventional understanding of the relationship between industry and academia is that universities conduct basic research, the results of which are conveyed to industry through some kind of channel, while applied research moves forward and leads to practical applications. However, in reality, there are "entrepreneurial universities"[2] that actively seek ways to put the results of research into practical use—sometimes by licensing them, and sometimes by actively creating university-launched startups. Indeed, a number of scientific and technological innovations have been born from such universities. Industry is not merely a recipient of knowledge transfer, it is also actively involved in knowledge creation, and works with universities to strengthen human resources in R&D. Governments have supported this movement by providing public research funds, playing a role in searching for and cultivating nascent science and technology constituting the seeds of innovation, and by acting as a venture capitalist by providing funding for results in the early stages of commercialization. The triple helix theory is based on the fact that the three actors of industry, government, and academia are intertwined and move toward innovation, and compares this structure to the triple helix structure of a gene.

One example of the three actors interacting with each another is government-led policy to support the promotion of budding research or research that requires a large amount of research funding through industry-academia collaboration. Such policies have a long history. Many such initiatives can be observed in space and military technology in particular. One of the most famous examples is the Apollo program, which was run by the National Aeronautics and Space Administration (NASA) for eleven years from 1961, with the goal of exploring the moon by manned space flight. This program, in which about 20,000 organizations from industry and academia participated, has had a significant impact on the development of space technology and related industries. A more direct example of an industrial policy that has drawn considerable attention is the VLSI Cooperative Laboratories, launched in Japan in 1976. Under the leadership of the Ministry of International Trade and Industry (now the Ministry of Economy, Trade and Industry), the Agency of Industrial Science and Technology (now the National Institute of Advanced Industrial Science and Technology), Toshiba, NEC, Hitachi, Fujitsu, and Mitsubishi Electric jointly developed VLSI manufacturing equipment with the aim of producing integrated circuits for large computers domestically. This achievement has been credited with the development of the Japanese semiconductor industry in the 1980s. This kind of joint effort by competing companies to develop technology was difficult to implement in the United States at the time because it risked violating antitrust laws (Tatsumoto Hirofumi,

2 In this context, "entrepreneurial" refers to the act of starting a new business, regardless of whether or not a new company is started.

2017). Certainly, this form of governance, in which the government takes the lead in setting goals and consolidating the capabilities of actors in industry and academia, including competing companies, was an effective method of technological catch-up.

However, this approach is not necessarily the best solution for innovation. For example, studies in business history have shown that the Sunshine Project, which triggered the industrialization of solar power generation, did not go according to the government's plan, but instead succeeded in an unplanned way due to action from the industry side and the ensuing interaction with the government (Shimamoto Minoru, 2014). As the triple helix theory suggests, for initiatives with highly uncertain goals such as innovation, a form of governance that allows the three actors to establish an emergent relationship will help capture market trends in an agile manner and quickly secure the resources necessary to achieve the innovation.

Table 1 presents specific examples of policy implementation instruments adopted in Japan by governance type. Those that are government-led can be expected to be implemented reliably. In contrast, the hybrid form can be expected to generate emergence among industry, government, and academia. Academic knowledge on what kind of governance is effective under what conditions is scarce, and remains a topic for future inquiry.

Table 1. Examples of policy implementation instruments for science, technology, and innovation by type of governance

Governance Structure	Example of policy implementation instruments
Government leadership	Direct supply of specific science and technology (Created by National R&D Corporation) Regulation of specific science and technology Commissioned research and development projects related to specific science, technology and industry
Eclectic structure	Tax incentives for research, development, and utilization of specific science, technology and innovation Proposal-based research and development assistance program Matching fund-based R&D grant program Procurement of the outcome/deliverable of specific science and technology

Note. R&D includes not only basic R&D, but applied technology development and empirical research for the social implementation of the results of research.
Source: Created by the author based on Eugene Bardach, translated by Shiraishi Kenji, Nabeshima Manabu and Minamizu Kazuhiro (2012) and Akiyoshi Takao et al. (2015).

2 Management among actors in industry-government-academia collaboration: How to make effective use of resources

While collaboration between industry, government, and academia can make a significant contribution to the achievement of science- and technology-driven innovation, such collaboration is not always easy. Indeed, each actor is working with different goals and behavioral principles. Although profit is the main goal of the production side, many organizations also have long-term organizational survival and social contribution as their goals.[3] The government side acts with the goal of social stability and development. On the university side, the goal is to provide education, research, and the results of these initiatives to society (Article 83 of the School Basic Law). Among public research institutions, the goal is to test, research, and develop science

3 Companies with a strong profit motive include listed companies, and even unlisted companies with a shareholder structure that is susceptible to pressure from shareholders seeking short- to medium-term profits.

and technology from a medium- to long-term perspective (see Article 2, Paragraph 3 of the Act on General Rules for Incorporated Administrative Agencies).

In addition to differences in organizational goals and behavioral principles, the differences in the goals and behavioral principles of organization members also constitute barriers. For example, on the industrial side, even if an organization claims a noble philosophy of contributing to society, if its employees in the field lack incentives to contribute to society, it will not be easy to implement activities that contribute to society. On the production side, the design of incentives for members is diverse, with incentives are formed through various means such as salary systems, personnel evaluation systems, and organizational culture. Their structures may also differ within a given organization. On the government side, both in Japan and abroad, maintaining the organization (Toya Tetsuro, 2003) and expanding the organization's authority (Kato Junko, 1997) feature among the behavioral principles of its members. Business routines, including data-gathering channels and policy creation processes, differ by ministry (Shiroyama Hideaki et al., 1999; Shiroyama Hideaki and Sukehiro Hosono, 2002). It is possible that differences in behavioral principles are likely to manifest in each ministry. On the academic side, there tend to be strong incentives to produce academic research results, especially for young researchers who are not in tenured positions, that is, they are often in fixed-term employment. This tendency is known to be shared among the major countries, and those who are most likely to be involved in industry-academia collaboration tend to be exclusively those who have obtained tenured positions (this has been demonstrated by Abreu and Grinevich (2013), for instance, based on analysis using large-scale data from the United Kingdom). In other words, academics tend to exhibit a variety of behavioral principles depending on the individual.

Table 2. Goals and behavioral principles by actor

Actor	Main goals at the organizational level	Typical principles of action at the Member Level	Typical principles of action at the R&D projects
Industry	Profit-making, organizational sustainability, social contribution, etc. Goals are diverse as long as the sustainability of the organization is ensured. In the case of publicly traded companies, there tends to be a strong demand for profit.	Achievement of organizationally defined goals such as sales and profit targets	Improvement of existing products and services, development of new products and services
Government	Stability and development of society and fulfillment of the organization's mission	Execution of defined tasks within the organization, survival of the organization	Solving social problems and achieving public benefit
Academia	Conducting higher education, implementing academic research, and returning fruit to society	Research, ~~P~~publication and dissemination of papers and other results, and nurture of excellent students	Academic novelty and originality

Source: Created by the author.

Therefore, when implementing R&D through collaboration between industry, government, and academia, there is a strong need to coordinate different goals and behavioral principles. The first issue that is particularly problematic is the setting of goals. The industry side seeks relevance to products and services, while the academic side prefers originality and novelty in academic research (Nelson, 2004). The second issue pertains to the handling of the release of results. In this respect, the industrial side aims to keep the results secret in order to monopolize profits, while the academic side seeks to publish the results and disseminate them widely, thereby increasing the prestige of the researcher or institution. Indeed, where graduate students are involved, there is a particularly strong tendency to demand that the results be published in the form of a thesis as soon as possible so as to obtain a degree. However, when the results are made public, the industries involved lose the opportunity to monopolize the use of the results. In order to reconcile the interests of both parties, it is necessary to conduct research and development in such a way as to ensure the opportunity to apply for a patent before the publication of the results, which is mutually beneficial to both parties. The third issue concerns the handling of intellectual property rights. It has long been pointed out that it is difficult to reach a consensus on the criteria for cost and profit sharing. As the university side in particular has no way to implement the patent, it is common practice with joint patent applications to ask the industry side to compensate for non-implementation; however, this has been one of the points of contention between the two sides.

These practical issues are discussed in detail in Nagahira Akio and Nishio Koji (2006), while Perkmann et al. (2013) summarize the management issues that have been studied in academia to date and their findings. Nonetheless, the search for the best management methods remains ongoing. In Japan, it is recognized that we have yet to develop an adequate system of cooperation. In this context, in 2016, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Economy, Trade and Industry (METI) collaborated in publishing, "Guidelines for Strengthening Collaborative Research through Industry-Academia-Government Collaboration," which presents management issues and suggests how they might be addressed.

This collaboration between industry, academia, and government is also important in the context of open innovation. Open innovation refers to the use of technologies, human resources, supply chains, and so on outside the organization in order to bring about innovation, or the use of ideas and technologies outside the organization to bring about innovation that would be difficult to achieve within the organization itself due to various constraints. This trend has arisen due to the (1) increased mobility of human resources, (2) rise of venture capital, and (3) increasing role of each player in the supply chain in terms of innovation creation, making it less likely that a single organization will generate an innovation alone (Chesbrough, 2003). Within this trend, universities are positioned as important partners in open innovation.

3 Management of industry-government-academia collaboration: Focusing on social relations

In industry, government, and academia collaboration, it is insufficient to coordinate only the actors directly involved in collaboration (see "Guidelines for Strengthening Collaborative Research through Industry-Academia-Government Collaboration"). An important management issue is the management of conflicts of interest. By collaborating with industry, it is possible that society will perceive academic activities as no longer impartial but biased, and such bias may actually manifest. This has become a major issue, especially in the medical and drug discovery fields (e.g., Krimsky, 2003). Management of this issue can also be positioned as the management of the relationship with society.

Similarly, the management of relationships with society includes the handling of personal information, security export control, and the dissemination of results (i.e., public relations). These differences in management systems and management methods can be an obstacle to collaboration. Unfortunately, the management of these risks is specific to each case, and management tends to be fragmented (University of Tokyo STIG, 2017). One solution may be to assign research administrators who are fully engaged with the project and possess a high level of expertise. However, there remain issues to be addressed, such as the need to make allowances for overhead costs.

Appropriate communication with the public on scientific and technological research is also required, particularly insofar as much of it is supported by taxes and its results can affect the lives of citizens (see 3.2 for details). The movement toward open science has also gained momentum in recent years. As part of this movement, scientific and technological research involving citizens outside the traditional scientific and technological community is expanding. One of the simplest examples is the raising of research funds through crowdfunding and providing feedback on the results. Through these efforts, the public will have easier access to information about the significance of research, how research funds are used, and the results of research. Other scientific and technological research that seeks ideas from the general public is also emerging.

4 Summary

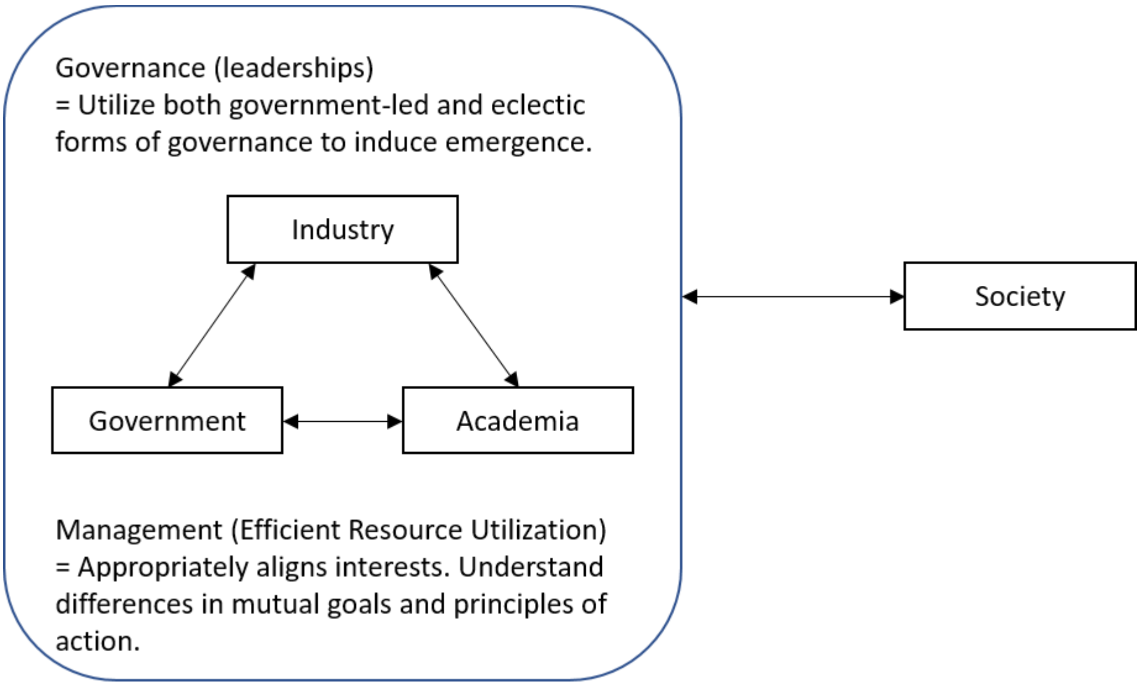

Figure 1. Governance of inter-actor relationships in STI policy implementation.
Source: Created by the author.

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