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A Comparative Study on Governance Models of World-class Scientific and Technological Societies and Their Enlightenment to China

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Abstract: This study comparatively analyzes governance models of scientific and technological societies across Anglo-Saxon, Continental European, and Oriental Hybrid framework, synthesizing critical external conditions for their emergence, common elements and indicator framework, internal governance and the success logic behind their effectiveness, benchmark samples and the driving forces for their vigorous development of world-class scientific and technological societies, while proposing constructive ideas for the actionable pathways of building world-class scientific and technological societies in China.

Keywords: World-class; Scientific and technological societies; Governance model

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1. Introduction

"World-class" has become a common organizational aspiration and ideal pursuit in contemporary international competition. It represents a normalized developmental goal for scientific and technological societies striving for high positioning and high quality in the new era. The development of internationally active and highly influential scientific and technological societies holds significant reference value.

2. External conditions for the emergence of world-class scientific and technological societies

The scientific and technological societies face differing external conditions under different social organization governance models. Typical governance models include the Anglo-Saxon model, the Continental European model, and the Oriental hybrid model.

The Anglo-Saxon governance model is primarily found in English-speaking nations, with the United

States and the United Kingdom as the main representatives. These societies generally advocate for freedom and democracy, where social organizations operate autonomously, with minimal government intervention beyond tax regulation. Key features include high autonomy, self-funding, voluntary membership, and structural diversity. Governments do not grant administrative functions to these organizations. Under the U.S. laissez-faire model, social organizations can be freely established. However, registration with the government is required to access benefits such as tax exemptions. The provisions for tax-exempt applications and management for these organizations are highly detailed and well-defined. Furthermore, numerous laws and regulations address issues involving NGOs, including immigration and visas, campaign fundraising and lobbying, as well as terrorism financing and money laundering. Under the United Kingdom's unified regulatory model, social organizations are subject to management categorically, with strict norms governing the establishment of charitable institutions and their policy registration.

Countries under the Continental European governance model primarily include European nations, with France and Germany as the principal representatives. This model features stronger administrative influence compared to the Anglo-Saxon model, where the government grants certain administrative functions to social organizations, which operate under government leadership and supervision. Socially and culturally, the reverence for professions, technical expertise, and skilled specialists, coupled with enterprises' recognition of scientific learning and cultivation of innovation, establishes the fundamental cultural foundation for science and technology in societies' development. Governments provide support through funding, legislation, and policy safeguards, while implementing rigorous regulation and evaluation mechanisms. Competition and collaboration among these societies drive their development. Furthermore, Europe's unique and distinctive global standing in science and technology ensures funding, prestige, and status for its societies. This model facilitates cooperation between social organizations and the government while supporting independent organizational development.

The Oriental Hybrid governance model is predominant in many Asian countries. It is not fundamentally distinct but strategically integrates elements of the previous two models based on their specific national conditions and characteristics. Countries with stronger libertarian tendencies lean toward the Anglo-Saxon model, while those with stronger state influence tend to the Continental European model [1]. China's social organization management system exhibits strong hybrid characteristics. Therefore, the oriental hybrid governance model can well respond to the management system of social organizations in China and provide valuable references. External conditions under this model include robust legal and regulatory support, comprehensive and diversified policy assistance, relatively institutionalized governance, and an open, democratic social culture.

Despite differences, commonalities exist in the external conditions faced by scientific and technological societies across these models. Beyond the prevailing societal atmosphere of openness and democracy in these countries or regions, where citizens demonstrate strong willingness to civic association, enabling academic communities to thrive through free association, commonly fostering a robust culture of philanthropy and donation systems, with mature market economies providing an operational environment, these shared conditions are further prominently reflected in the following aspects: Comprehensive legal frameworks for social organization governance, refined policies for cultivating and supporting social organizations, integrated comprehensive regulatory systems that curb power divergence, minimal external intervention ensuring organizational self-organization, and market-oriented fundraising mechanisms [2].

3. Common elements and indicator framework for world-class scientific and technological societies

Through summarization and analysis of the common elements of world-class scientific and technological societies, it is found that the comprehensive evaluation framework for scientific and technological societies should encompass at least eight primary indicators:

A. Clear organizational value positioning and adherence: Manifested through a well-defined and explicit articulation of organizational mission, leadership identification at decision-making levels, staff-wide value identification, and public dissemination of core values [3]. B. Scientific and open organization and structure: Characterized by a high degree of autonomy, an open and democratic governance structure, adaptable and standardized regulations, outstanding strategic management and leadership capabilities, structural adaptability and operational efficiency, and strict regulation of branch activities [4]. C. Robust resource support system: Evidenced by quality human resources and effective cooperation mechanisms, fundraising capacity and sustainability via nonprofit revenue streams, and an ideal social network resource [5]. D. Foremost authoritative and representative academic and intellectual strength: Demonstrated through academic exchange and knowledge-sharing capabilities, science popularization and communication capacity, and scientific and technological evaluation capability, etc. E. Targeted member services and support: Measured by membership growth index, level of organizational support for members, level of transparency, innovative member service mechanisms, and member satisfaction/evaluation index. F. Strong social service and reputation: Reflected in brand awareness, public credibility, effective participation in social governance, and proactive fulfillment of social responsibility.

G. Serving national development goals and effective participation in government processes: Includes participation or influence in legislation and policymaking, statistical research, analysis, and forecasting of national S&T information, leading national economic, social, and S&T progress through S&T innovation, effectively undertaking functions transferred from the government, optimizing the national academic environment and promoting academic ethics, and playing an active role in major national events, [6]. H. Proactive participation in global governance: Encompasses engagement in international and regional affairs, initiating or organizing international academic activities, international provision of professional knowledge and other intellectual resources, and performance in global philanthropy and social service [7].

The above indicators serve as crucial benchmarks for evaluating the status of world-class scientific and technological societies [8–9].

Table 1. Governance capability evaluation indicator system for world-class scientific and technological societies

First-level Indicators	Secondary Indicators
Clear Organizational Value Positioning & Adherence (X_1)	well-defined and explicit articulation of organizational mission (X_{11})
	leadership identification at decision-making levels (X_{12})
	staff-wide value identification (X_{13})
	public dissemination of core values (X_{14})
Scientific and Open Organization & Structure (X_2)	high degree of autonomy (X_{21})
	open and democratic governance structure (X_{22})
	adaptable and standardized regulations (X_{23})
	outstanding strategic management and leadership capabilities (X_{24})
	structural adaptability and operational efficiency (X_{25})
	strict regulation of branch activities (X_{26})

Table 1 (Continued)

First-level Indicators	Secondary Indicators
Robust Resource Support System (X_3)	quality human resources and effective cooperation mechanisms (X_{31})
	fundraising capacity and sustainability via nonprofit revenue streams (X_{32})
	ideal social network resource (X_{33})
Foremost Authoritative and Representative Academic & Intellectual Strength (X_4)	academic exchange and knowledge-sharing capabilities (X_{41})
	science popularization and communication capacity (X_{42})
	scientific and technological evaluation capability (X_{43})
Targeted Member Services and Support (X_5)	membership growth index (X_{51})
	level of organizational support for members (X_{52})
	level of transparency (X_{53})
	innovative member service mechanisms (X_{54})
	member satisfaction/evaluation index (X_{55})
Strong Social Service and Reputation (X_6)	brand awareness (X_{61})
	public credibility (X_{62})
	effective participation in social governance (X_{63})
	proactive fulfillment of social responsibility (X_{64})
Serving National Development Goals and Effective Participation in Government Processes (X_7)	participation or influence in legislation and policymaking (X_{71})
	statistical research, analysis, and forecasting of national S&T information (X_{72})
	leading national economic, social, and S&T progress through S&T innovation (X_{73})
	effectively undertaking functions transferred from the government (X_{74})
	optimizing the national academic environment and promoting academic ethics (X_{75})
	playing an active role in major national events (X_{76})
Proactive Participation in Global Governance (X_8)	engagement in international and regional affairs (X_{81})
	initiating or organizing international academic activities (X_{82})
	international provision of professional knowledge and other intellectual resources (X_{83})
	performance in global philanthropy and social service (X_{84})

4. Internal governance of world-class scientific and technological societies and the underlying logic of their effectiveness

Examining the internal governance of world-class scientific and technological societies and the underlying logic of their effectiveness reveals distinct characteristics across governance models:

Anglo-Saxon model societies demonstrate prominent features including: a self-contained and practical charters and rules have been established; clearly articulated visions, missions, strategic objectives and plans have been formulated; an outstanding democratic election and decision-making system has been established; it has formed an independent multi-center and multi-branch setup; established a fully and truly information disclosure and public disclosure mechanism; and carried out activities centered on members and centered around them. The internal governance of scientific and technological societies under the continental governance model is characterized by achieving standardized governance, emphasizing characteristic governance, attaching importance to member services, conducting operational governance, realizing socialized governance, utilizing internet platforms and big data to achieve intelligent governance, and attaching importance to internal supervision. The

internal governance advantages of scientific and technological societies under the oriental hybrid governance model are manifested in their mature institutional design and comprehensive organizational charters, well-developed democratic decision-making mechanisms, sophisticated supervision and review system, and established information disclosure and transparency mechanism.

Synthesizing internal governance experiences among world-class scientific and technological societies reveals core characteristics: governance is founded on substantive democracy, featuring rigorous and ordered corporate governance structures, prioritizing to meet the needs of members as the criterion and attaching importance to member classification management as well as diversified development of members, establishing clear and standardized governance systems for internal departments and branches, exhibiting a high level of socialization and professionalization as well as engaging in business-oriented governance, and actively cultivating social capita within the society.

5. Benchmark samples and case studies of world-class scientific and technological societies

This study selected several internationally influential scientific and technological societies as samples for focused analysis and experience synthesis. It was found that scientific and technological societies under the Anglo-Saxon model are represented by societies such as The American Chemical Society (ACS), Institute of Electrical and Electronics Engineers (IEEE), Royal Society of Chemistry (RSC), The Canadian Medical Association (CMA), and The Institution of Engineers Australia (IEAust). The prominent features of science and technology societies under this governance model include autonomous governance, emphasis on institutional rules, and internal decentralized democratic governance.

Scientific and technological societies under the Continental European model are represented by Deutsche Physikalische Gesellschaft (DPG), Gesellschaft für Chemische Technik und Biotechnologie.e.V (DECHEMA), Verein Deutscher Ingenieure (VDI), Société des Ingénieurs et scientifiques de France (IESF), Société Française d'Énergie Nucléaire (SFEN), and Italian Association for the Development of Biotechnology (ASB). The prominent features of scientific and technological societies under this governance model are that although they possess a certain semi-official nature with strong support, from the government, and have some mandatory nature in membership admission, they remain social organizations independent of the government, operating as part of the third sector of society, with significant autonomy, and fulfill social functions t beyond the capacity of government and enterprises in modern society. By virtue of the standardization, characteristic, business-oriented operationalization, socialization, and intellectualization of internal governance, as well as attaching importance to member services and internal supervision, they operate independently and valuably. They promote knowledge flow, foster a sound innovative culture, maintain the rational utilization of science and technology, and drive government reform and functional transition. Consequently, they constitute vital components of the national innovation system.

Scientific and technological societies under the Oriental Hybrid governance model are represented by the Japanese Medical Association (JMA), the Physical Society of Taiwan Region (PST), the Hong Kong Medical Association (HKMA), and the Singapore Computer Society (SCS). The prominent characteristics of scientific and technological societies under this governance model include establishing a comprehensive internal governance system and strict compliance with institutional rules, building a robust member service mechanism to enhance

members dependence and belonging, maintaining transparent and open financial systems to earn the trust from members and the public, being significant participants in shaping macro-policies through actively involving in the formulation of national policies and laws, ensuring timely information update and maintenance to strengthen the adhesion of members and the public to the society, expanding the organizational popularity and visibility through diverse public relations activities, and carrying out extensive and close international exchanges to enhance the organization's international reputation and professional standing.

In general, the driving forces for the growth and vigorous development of world-class scientific and technological societies are as follows: societies rely fundamentally on members and provide in-depth support for them; their administrative offices exhibit a high degree of professionalization, professionalism, and socialization; they have obtained substantial economic strength through market-oriented operation and business-oriented governance; they innovate and develop service projects and implement brand-oriented operation; they strictly abide by institutional rules to mitigate governance risks, etc.

6. Implementation pathways for developing world-class scientific and technological societies in China

To achieve world-class status, China's scientific and technological societies urgently need to strategically adapt globally proven models through the following implementation pathways:

A. Government-led construction of an external support system: It is necessary to strengthen legal and institutional provisions favorable to scientific and technological societies, reduce governmental intervention intensity to ensure societies transcend being mere outcomes of government selection, implement more confident and relaxed entry registration to diminish bureaucratic constraints, utilize tax exemptions or reductions as economic incentives to normatively guide social organization development, Leverage the China Association for Science and Technology (CAST) as the pivotal organizational framework for scientific and technological societies governance.

B. Organizational mission-driven and self-motivated based on value identification [10]: Scientific and technological societies should embed their core ideas and missions as organizational DNA; formulate distinctive visions, missions, strategic goals and plans embodying fundamental values and missions as well as unique characteristics; cultivate organizational culture identification as vital internal social capital for self-driven motivation; and systematically cultivate organizational values and culture in aspects such as spiritual culture, institutional culture, behavioral culture, material culture and image culture, etc.

C. Establishing democratic governance frameworks and an efficient organizational management system: It is necessary for scientific and technological societies to enhance intrinsic motivation to achieve autonomous operation, construct open and democratic corporate governance structures, prevent power diffusion through comprehensive institutional systems, elevate strategic management capabilities and leadership effectiveness, achieve structural adaptability and operational efficiency, and strictly standardize branch activities [11].

D. Building a multi-dimensional resource support system: Scientific and technological societies should develop quality human resources and cooperative mechanisms through socialization and professionalization of secretariats as well as maximizing member and volunteer resource utilization, raising sufficient and stable funding through non-profit means, accumulating robust social network resources, etc. [12].

E. Developing foremost authoritative academic and intellectual strength: It is necessary for scientific and

technological societies to improve academic exchange and knowledge-sharing capabilities, proactively conduct science popularization and dissemination, and enhance scientific and technological evaluation methodologies.

F. Member-centered and integrates its members into organizational operation: It is suggested scientific and technological societies to expand paid membership scale and proportion, provide substantial member support to enhance attraction and retention, ensure operational transparency and clear accountability mechanisms, innovate member service models, increase member satisfaction and non-member aspirational appeal, implement precision membership categorization and deliver tiered value-added services as well as refined member management, and implement transparent accountability mechanisms [13].

G. Provide excellent social services and build up social reputation: The specific approaches include optimizing and strengthening brand projects to expand their influence, strengthening public credibility, effectively participating in social governance, and actively fulfilling social responsibilities.

H. Serving national goals and participating in government processes: It is suggested scientific and technological societies to function as think tanks by participating in legislation and policy formulation, conduct national scientific and technological statistical research and forecasting, support innovation to serve as an important pillars for the national scientific and technological strategy, undertake transferred government functions to alleviate burdens on the government or to fill the gap for the government service, establish academic research norms and ethical self-discipline guidelines, and play active roles in major national events.

I. Engaging proactively in global governance and striving for international discourse power in science and technology: It is suggested to participate substantively in international or regional affairs and rule-making, initiate and organize transnational academic programs, supply professional knowledge and intellectual resources globally, engage in international philanthropy and social services, as well as conduct globalization recalibration based on domesticized resources.

7. Conclusion

In conclusion, Chinese scientific and technological societies that pursue “world-class” status as their developmental goal and self-imposed requirement should focus their efforts on the aforementioned objectives. This is not only a constructive approach for the development of scientific and technological societies but also the highest rationalization standard that they should strive to reach. All these elements are indispensable. As academic communities, scientific and technological societies need to observe the above high standards in their organizational practices during the orderly development process and continuously drive the improvement of their capabilities.

Disclosure statement

The author declares no conflict of interest.

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