Prospective Collaborative Mechanism Model: Strategic Thinking, Tactical Development, and Combat Skill Training

Authors: Gu Liping

Date: 2016-06-07T00:00:00+00:00

Abstract

Based on a comprehensive review of the strategic formulation approaches of national foresight mechanisms across various countries, this paper analyzes and applies the same principles to describe organizational units' foresight philosophy, tactical practices, and cultivation of tactical skill training. Accordingly, it proposes a three-layer collaborative model for foresight mechanisms and its implementation program.

Full Text

Preamble

Model of Foresight Collaborative Institution: Strategy Thought, Tactics Development, and Skills Training

Ku Liping
National Science Library, Chinese Academy of Sciences, Beijing 100190

Abstract: Based on a comprehensive investigation of strategy-making approaches in national foresight mechanisms worldwide, this paper analyzes how the same principles can be applied to describe foresight thinking within organizational units, operationalize foresight tactics, and cultivate foresight skills training. Accordingly, it proposes a three-tier collaborative model of foresight institutions along with its implementation guidelines.

Keywords: foresight activities; foresight process; foresight exercises; technology foresight; strategy foresight

1 Recent Global National Foresight Processes and Their Principles

Experience from the United States, United Kingdom, and Australia demonstrates that strategic foresight mechanisms help focus attention on identifying emerging issues and leverage broad information sources to make policies more durable and effective [1]. Foresight mechanisms serve three functions: correction, disruption, and innovation [2]. The correction function addresses systemic failures and chains of policy defects. The disruption function encourages focus on crisis management or emergencies to fundamentally transform the status quo. The creation function generates new external networks and internal structures, cultivating conditions for organizational development and growth.

Countries worldwide have conducted technology foresight studies for scientific and technological development [3-5]. Currently, national foresight processes consider not only technology but also other aspects of social, economic, cultural, and comprehensive national strength. These processes are summarized in Table 1 .

Table 1 Overview of National Foresight Processes Worldwide

Country	Institution	Process	Characteristics
Japan	National Institute of Science and Technology Policy (NISTEP)	"Technology Strategy Map"	Serves as important basis for national "Science and Technology Basic Plan" ; develops technology competitiveness comparisons based on global S&T development status
UK	Horizon Scanning	"National Scenario Modeling"	Conducts long-term (20-80 years) key issue research and short-term (10-15 years) S&T development planning; develops future S&T roadmap predictions based on global S&T development history
Korea	Ministry of Education, Science and Technology & National Science and Technology Commission	"Science and Technology Future Vision 2040"	Establishes national scenario modeling based on socio-economic demand analysis to serve as planning basis for S&T basic plans

Country	Institution	Process	Characteristics
Germany	Federal Ministry of Education and Research & Federal Ministry of Economics and Technology	"National R&D System and Program Evaluation Report," "National Scenario Modeling"	Transforms and plans S&T policy decision-making mechanisms; develops series of action plans to guide future R&D directions based on technology development trends
China	Ministry of Science and Technology	"Foresight Technology Report"	Provides reference for senior decision-makers to formulate national S&T development routes based on foreign S&T development
Finland	Academy of Finland & Finnish Funding Agency for Technology and Innovation	"FinnSight 2015"	Formulates policies for ten future S&T fields; develops selection options based on technology forecasting

Common characteristics of these national foresight processes include: (1) extensively collecting foreign intelligence as decision support content; (2) developing phased implementation plans oriented toward future development trends; (3) employing multiple foresight methods such as technology roadmapping and scenario analysis as decision support tools; and (4) formulating policy recommendations based on decision-maker needs, including various models like competitiveness comparisons, forward-leading strategies, resource allocation priorities, action programs, late-mover advantage strategies, and cross-domain integration.

Analyzing these global national foresight processes helps us understand how foresight mechanisms operate and identify shared characteristics. Based on these commonalities, organizations can directly or indirectly participate in national foresight processes and apply the same theoretical concepts and practical tools to enhance foresight capabilities at the industry or departmental level.

Drawing from the principles of national foresight processes, a three-tier collaborative model can be formed for industry organizations encompassing strategy, tactics, and skills. By analyzing foresight mechanisms in various regional governments and large enterprises and summarizing their implementation processes, we can outline the strategic thinking principles for organizational units, tactical operational practices, and the gradual cultivation of combat capabilities for policy departments in foresight mechanisms. This hierarchical relationship is shown in Table 2 .

Table 2 Three-Tier Collaborative Model of Foresight Mechanisms

Level	Resource Allocation	Deployment	Optimization
Strategy	Mobilize and arrange resources	Deploy and configure resources	Optimize resource utilization
Tactics			
Skills			

In any competitive arena—whether national, regional, corporate, departmental, or individual—strategy determines the overall situation. Flexible tactics can temporarily compensate for strategic deficiencies but cannot reverse the situation unless local tactical successes prompt overall strategic adjustment. Similarly, skills can only remedy tactical flaws but cannot change the direction set by tactics. Therefore, foresight mechanisms have certain conditional limitations, as shown in Table 3 .

Table 3 Implementation Conditions for Foresight Mechanisms

Sequence	Condition	Meaning
First	Proper positioning	Recognize hierarchy, understand authority, play effective role; avoid confusion
Second	Internal collaboration	Intelligence analysis, phased planning, advanced methods; unify objectives
Third	External influence	Build consensus, establish vision, advance gradually; consolidate strength

Foresight mechanisms are built upon three foundational elements. The first element requires personnel in each organizational unit to recognize hierarchy, understand authority, and play effective roles. Based on this, the second element involves internal collaboration, including intelligence analysis, phased planning, advanced methods, and potential policy recommendations. The third element concerns external influence, encompassing structured patterns such as building consensus, establishing vision, and advancing gradually. Through scientific policy analysis and democratic public discussion, policies can be gradually and reasonably constructed and implemented.

3 Asian Foresight Thinking Originates from Library and Information Science Work

The three-tier collaborative model of foresight mechanisms—strategy, tactics, and skills—originates from Asian national foresight processes and has evolved into a model applicable to various organizational levels.

Since 2004, Korea' s science and technology development has advanced rapidly for many reasons, one being its adaptation of Japan' s earlier technology foresight methods into the Korean national technology roadmap. This roadmap distinguishes four levels [6]: (1) vision formulation, (2) development direction, (3) product function description, and (4) key technology identification or development. As shown in Table 4 , a clear foresight collaborative mechanism architecture can save resources and expand benefits.

Viewed from bottom to top, a single technology can serve multiple product functions, avoiding redundant construction and R&D. For example, digital broadcasting technology can develop ubiquitous networks for pervasive communication, channels for innovative content services, and implementations for smart home spaces in ubiquitous intelligence.

Viewed from top to bottom, national platform planning can rapidly concentrate national efforts to breakthrough enterprise key technologies while ensuring market profitability continues to fund innovation.

Table 4 Korean S&T Foresight Collaborative Mechanism—From Strategy to Operations

Level	Description
Vision (Political)	Knowledge-based intelligent society
Direction (Strategic)	Ubiquitous communication, content service innovation, and ubiquitous intelligence
Product Description (Tactical)	Digital convergence, intelligent computing, ubiquitous networks, mobile vehicles
Key Technology (Skills)	Digital broadcasting technology, etc.

Additionally, in 2004—the same year UNESCO published its Foresight Methodology—China's Ministry of Science and Technology Development Planning Department funded the China Science and Technology Development Research Center to organize, for the first time, a technology foresight team and domain expert groups to conduct a "Technology Foresight" study on energy, resources, environment, and advanced manufacturing [7]. This study employed the Delphi method with rigorous processes and important reference value. Related research includes Xu Wenzhang' s 2006 analysis of foresight experiences from Japan, China, the UK, the US, Ireland, the Netherlands, and Finland, which systematically organized primary research methods [8]. In 2007, Sun Chengqian et al. [9] systematically reviewed various concepts of technology foresight and foreign applications,

introducing them into information science and integrating them with strategic intelligence research.

More recently, in 2009, Taiwan' s Industrial Technology Research Institute (ITRI) Industrial Economics and Knowledge Center (IEK) jointly with the Institute for Information Industry (III) Market Intelligence Center (MIC) continuously published "2015 Taiwan Industrial Development: Taiwan Industrial Foresight Research Methods and Process" [10] and "2015 Taiwan Key Industrial Technology Development Blueprint (III)" [11]. The former carefully analyzed previous foresight efforts in Japan and the UK to propose Taiwan's national foresight process methodology, while the latter formulated "action plan" planning content.

This action plan includes two-stage foresight processes: The first stage' s divergence and convergence process focuses on exploring potential development opportunities, with foresight intelligence work including in-depth interviews with domestic and foreign experts and literature review of global foresight plans and trend studies. The second stage' s divergence and convergence process analyzes the first stage' s conclusions through subjective and objective factors, including further implementation feasibility and comparative differences with other countries.

Finally, in Asia, Japan was the earliest to conduct Technology Foresight, the fastest to introduce Strategic Foresight, and the first to recognize the combination of both as "foresight exercises." In late 2012, Japan' s Ministry of Education, Culture, Sports, Science and Technology (MEXT) National Institute of Science and Technology Policy (NISTEP) published its "Science and Technology Innovation Policy Report" [12], stating that to revitalize national S&T, policy research aims to enhance international S&T competitiveness—and indirectly, national status—through rational policy guidance and effective resource allocation (funding, personnel, institutions, etc.).

Figure 1 [Figure 1: see original paper] Data Intelligence Framework for Deriving S&T Policy [12]

As shown in Figure 1, from bottom to top is a three-tier structure of resources, technology, and policy. The pyramid' s base comprises raw data integration on resource inputs, S&T outputs, and social demands. The middle tier consists of various technologies and methods for transforming data into intelligence. The pyramid' s apex involves policy formulation and evaluation.

For library and information institutions, familiarity lies with lower-level literature and patent data, middle-level scientometrics, and upper-level strategic intelligence. However, from these foundations, horizontal development is possible at each level. For instance, the data foundation should include talent and funding data on inputs, as well as national economic consumption data and enterprise innovation efficiency data on socioeconomic aspects. At the middle technical method level, network theory, cost-benefit analysis, and policy foresight methods should be developed. At the upper policy recommendation

level, multiple policy effectiveness evaluations can be incorporated. This enables broader research spaces and more comprehensive issue analysis.

For general institutions, national foresight process reports listing various emerging technologies and S&T policy implementation methods may or may not be relevant to industry development. The key lies in how they think about and reflect on policy work, and whether such policy research and practice methods can be borrowed for one' s own industry. The principles of national foresight processes can be applied to organizational foresight strategic thinking, foresight mechanism tactical development, and skills training through hierarchical scoping of the foresight mechanism model.

4 Strategic Thinking Principles of Foresight Mechanisms

The EU Horizon program is a large-scale comprehensive research initiative where EU countries propose national development plans and conduct resource allocation and mutual complementarity through the EU Research Council platform [13]. However, each country maintains independent operation principles with distinctive national foresight processes. Using Denmark, the UK, and the Netherlands as examples, these are summarized in Table 5 .

Table 5 National Foresight Processes Under the EU Horizon Program

Country	Process	Characteristics
Denmark	(1) Map research needs; (2) Define and identify themes; (3) Form final proposals	Dynamic scanning of S&T policy, expert team evaluation, and communication with various agencies and social groups to enhance social and public policy influence; policy working groups reorganize Horizon foresight report content with media promotion for policy dissemination

Country	Process	Characteristics
UK	(1) Research phase: collect and organize relevant review reports, categorize data, and build databases; (2) Data analysis phase: issue analysis and review, establish working groups and construct thematic scenario analyses; (3) Evaluation phase: external expert review and report revision; (4) Dissemination phase: website access, documents, and multimedia	Domain expert consultation plays important roles at all stages; systematic evaluation and opinion aggregation are frequently conducted in R&D and policy agendas

Country	Process	Characteristics
Netherlands	(1) Literature review, (2) Expert consultation, (3) Define problems and opportunities, (4) Indicator weighting and evaluation for problems and opportunities, (5) Categorize creative forum exchange opinions, (6) Normalize clustering and linking methods, (7) Describe, (8) Brief commentary, (9) Organize relevant knowledge and response strategies for each cluster, (10) Policy recommendations	Domain expert consultation plays important roles at all stages; systematic evaluation and opinion aggregation are frequently conducted in R&D and policy agendas

Further summarizing these foresight processes'commonalities forms the strategic thinking model of foresight mechanisms, including: (1) systematic intelligence collection, analysis, judgment, and organization as foundational work; (2) domain expert consultation roles; (3) emphasis on multiple presentation formats such as searchable websites, multimedia dynamic demonstrations, and downloadable reports; and (4) communication with various stakeholder groups or citizens for policy recommendation consideration.

5 Tactical Development Methods for Foresight Mechanisms

Organizational foresight mechanism tactics unfold within a dual-track policy cycle mechanism. The policy cycle has two layers, as shown in Figure 2 [Figure 2: see original paper] [14]. The first layer involves policy team work: goal setting, strategy building, outcome forecasting, policy selection, evidence clarification, intention communication, operational plan design, monitoring and evaluation, and problem and opportunity analysis. The second layer involves decision-making team work: policy formulation, budgeting, policy publication, legalization procedures, policy acceptance or rejection, project management, and

evaluation and adjustment. Between these two layers are communication methods, with institutional requirements to propose recommendations, revise policies and programs, and execute projects.

Figure 2 [Figure 2: see original paper] Policy Cycle [14]

Foresight scholars Calof J. and Smith J.E. propose accumulating experience in thinking about the future and using foresight methods [15]. As shown in Table 6 , once an organizational unit transforms into a foresight mechanism, its policies, organization, and personnel undergo substantial qualitative improvements.

Table 6 Three Dimensions of Organizational System Enhancement by Foresight Mechanisms

Dimension	Enhancement
Social Development	Because the primary goal is improving organizational and social interaction quality, foresight processes are characterized by cooperative networks. Foresight provides opportunities for complex systems to adjust for resilience and enhanced preparedness. Most foresight projects aim to provide decision-makers with greater certainty or reduce decision risks, even for inherently unpredictable future events.
Social Interaction	Facing social development changes, organizations must: (1) provide future-oriented policy content for institutional adoption, (2) develop consulting services for decision-makers and innovators, (3) clarify S&T innovation priorities in development directions, (4) create a practical system and context for future thinking, and (5) strengthen diversity, comprehensiveness, and multi-perspective approaches.

Dimension	Enhancement
Social Verification	Facing social interaction demands, organizations must: (1) support constructive discussions about the future, (2) break traditional thinking frameworks and challenge inherent mindsets, (3) build new networks and repositioned expert clusters, and (4) establish dissemination structures among innovators. Facing social verification challenges, organizations must perform bridging functions: (1) support institutions in creating their own futures, (2) create shared visions among different actors, (3) insight into complex interactions and emerging change drivers, (4) build trust and shared experience bases among institutions, (5) monitor and analyze weak signals that can foresee the future, (6) investigate potential disruptive changes, (7) provide advance intelligence on system and institutional changes, (8) develop new ways of thinking about challenges and opportunities, (9) promote collaborative learning through open information and experience exchange, (10) emphasize systemic approaches to policy-making and innovation, (11) simulate foresight movements inspired in other institutions, and (12) better understand their own strengths and capabilities.

Foresight practice has three characteristics [16]: Action, Reflection, and Knowledge Production. In fact, organizational foresight mechanism tactical application is inseparable from departmental foresight mechanism skills training, and the 12 social bridging functions for social verification challenges serve as appropriate criteria for selecting, cultivating, guiding, and examining departmental teams.

In summary, combining foresight mechanism strategic thinking and tactical application produces various impacts: (1) supporting policy decision-making, (2) enhancing policy implementation, (3) strengthening strategy formulation (better risk identification), (4) adopting future-proof strategies and deployments, (5) building evidence-based policies, and (6) increasing R&D investment outcomes.

6 Skills Training Approaches for Foresight Mechanisms

Beyond basic personnel requirements, policy department foresight mechanisms require deep recognition of constant environmental changes and necessitate that within organizations, policy teams serve as the most sensitive group observing change trends. Evolution encompasses concepts of environment, competition, elimination, and self-transformation. Within organizations, policy teams must first recognize gaps between external environmental changes and internal reality conditions, driving organizational transformation and industry change through self-transformation.

At the end of the last century, several scholars jointly proposed an analogy between natural evolution and technological development [17], as shown in Table 7 .

Table 7 Analogy Between Natural Evolution and Technological Development [17]

Natural Evolution Concept	Definition	Technological Development Analogy
Species	Members of ecological communities	Competencies
Population	Bundling of organizational resources and capabilities	Organizations
Ecosystem	Biological communities and their living environments as interactive systems	Knowledge ecosystem
Learning	Acquiring new knowledge	Knowledge ecosystem as complex adaptive system
Evolution	New carrying capacity	Knowledge cycles
Energy	Flow of energy in ecosystems	Informetrics

Natural Evolution Concept	Definition	Technological Development Analogy
Co-evolution of species	Additional requirements accompanying species evolution	System co-evolution
Mutation	Changes sufficient to alter daily operations	Innovation
Food chain	Interdependent relationships among species	Activity associations for creating or utilizing knowledge
Biogeochemical flows	Energy flow and resource circulation cycles	Dissemination flows
Predation	Organisms consuming organic food	Organizational agents utilizing knowledge
Habitat	Ecological niche of species in biological environment	Special collections of knowledge and products
Energy consumption	Efficiency of energy use	Input-output efficiency
Symbiosis	Interspecific relationships benefiting two or more related species	Collaborative alliances enhancing competitiveness

Natural Evolution Concept	Definition	Technological Development Analogy
Landscape	Topographic features and biogeo-chemical cycles	Shared platforms for invention, discovery, and development

This analogy becomes the theoretical foundation for self-starting personnel in foresight mechanisms to continuously observe environments and challenge themselves. It includes 19 core concepts forming a core competency for self-innovation and verification capabilities.

Foresight mechanism skills training also includes understanding organizational history and past accumulated achievements. Skillfully summarizing the past and identifying partners worthy of continued development and collaboration forms the most important foundation for providing future vision policy recommendations. For example, Japan' s National Diet Library 2006-2010 development map [18] reviewed past organizational achievements and accordingly revised future development strategies. The map' s top shows a 2006-2010 timeline, while the left side outlines six priority development directions: (1) policy and regulation revision, (2) digitalization projects, (3) long-term digital preservation, (4) S&T information collection, (5) socioeconomic services, and (6) major foreign peer developments. Such maps can concisely outline institutional development priorities, progress, and achievements.

Foresight mechanism skills training includes two orientations: individual self-driving (including concepts of rational competition and substitution) and group value setting (including reshaping organizational history and forming future event concepts).

7 Adaptive Foresight Collaborative Mechanisms

The three-tier collaborative model of foresight mechanisms—strategy, tactics, and skills—can be implemented using the method shown in Figure 3 [Figure 3: see original paper] [19]. When understanding an organization' s past achievements, current priorities, and future development strategies, three perspectives examine three critical organizational survival and development issues: internal development viewpoints, external environmental trends, and actual work outputs.

Figure 3 [Figure 3: see original paper] Dynamic Application Covering the Future [19]

The three-dimensional perspective of foresight mechanisms includes: (1) Viewpoint correctness: whether internal development viewpoints align with external

environmental trends; (2) Output correctness: whether external environmental trends align with actual work outputs; and (3) Internal stability: whether actual work outputs align with internal development viewpoints.

The fourth dimension is the timeline. Over time, this allows examination of changes in these three alignments. Under the traction of this fourth dimension, it serves as an important tool for developing foresight mechanisms, helping them correctly understand strategic directions, tactical application timing and contexts, and key skills training orientations.

8 Toward Self-Evolving Foresight Mechanisms

This paper proposes a three-tier collaborative model of foresight mechanisms—strategy, tactics, and skills—based on summarizing relevant research models of foresight mechanisms at home and abroad. After 梳理 ing the principles of national foresight processes worldwide, it separately describes how organizational units can establish adaptive foresight mechanisms at the strategic, tactical, and skills levels with self-examination capabilities. However, as previous research [20] stated, the priority is practical work, followed by methodological exploration, and then mechanism formation. This paper aims to serve as a modest spur to induce more valuable contributions.

Acknowledgments: Thanks to anonymous reviewers and editorial board for their suggestions.

[1] Leigh A.. Thinking Ahead: Strategic Foresight and Government[J]. Strategic Foresight 2003, 62(2):3-
[2] Georghiou L., Harper J.C.. From priority-setting to articulation of demand: Foresight for research and innovation policy and strategy[J]. Futures, 2011, 43:243-251.
[3] Konnola T., Scapolo F., Desruelle P., Mud R.. Foresight tackling societal challenges: Impacts and implications on policy-making[J]. Futures, 2011, 43:252-264.
[4] 杨荣斌、杨震华. 日本 2009 年战略技术路线图：投资于未来的战略技术 [J]. 科技发展研究, 2010, 243(13):1-8.
[5] 邱锦田. 擘画未来芬兰愿景的国家前瞻计划-FinnSight2015[J]. Sci-Tech Policy Review 2007, 03:82-85.
[6] Park B.. Technology Roadmapping as foresight instrument[EB/OL][2007-12-14] www.nistep.go.jp/IC/ic071119/pdf/3-2_Park.pdf
[7] 国家技术前瞻组. 中国技术前瞻报告 2004[M]. 北京：科学技术文献出版社, 2005：319-427.
[8] 徐文章. 前瞻方法论之比较研究 [M]. 台北：国家科学委员会, 2006：1-84.
[9] 孙成权, 曹霞, 黄彦敏, 王颖. 战略情报研究与技术预见 [M]. 上海：上海科学技术文献出版社, 2008：106-129.
[10] 2015 年台湾产业与科技整合研究计划小组. 2015 年台湾产业发展：台湾产业前瞻研究方法与流程 [M]. 台北：经济部技术处, 2009:20.
[11] 2015 年台湾产业与科技整合研究计划小组. 2015 年台湾重要产业技术发展蓝图 (III) [M]. 台北：经济部技术处, 2009：53-64,115-124.

[12] 文部科学省科学技術政策研究所. 科学技術イノベーション政策のための科学 [EB/OL][2012-11-04]http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/016/kaisai/1330696.htm
[13] van Rij V.. Joint horizon scanning: identifying common strategic choices and questions for knowledge[J]. Science and Public Policy, 2010, 37(1):7-18.
[14] Vaughan R. J., Buss T.E., 沈崇麟译. 科学决策方法 [M]. 重庆: 重庆大学出版社, 2006:71.
[15] Calof J., Smith J.E.. Critical success factors for government-led foresight[J]. Science and Public Policy, 2010, 37(1):31-40.
[16] Coates J., Durance P., Godet M.. Strategic Foresight Issue: Introduction[J]. Technological Forecasting and Social Change, 2010, 77:1423-1425.
[17] Bowonder B., Muralidharan B.. Forecasting technological change: insights from theories of evolution[J]. Interdisciplinary Science Reviews, 1999, 24(4):275-288.
[18] 科学技術関係資料整備審議会. 国立国会図書館における今後の科学技術情報整備の基本方針に関する提言 [EB/OL][2012-09-22]http://www.ndl.go.jp/jp/aboutus/pdf/teigen_2.pdf
[19] Cinzia Battistella C., de Toni A.F.. A methodology of technological foresight: A proposal and field study[J]. Technological Forecasting and Social Change, 2011, 78:1029-1048.
[20] 顾立平. 科技信息政策的前瞻研究 [J]. 科技信息政策的前瞻研究, 2013, 151(1):47-55.

Note: Figure translations are in progress. See original paper for figures.