

A Strategic Blueprint for Thailand's High-End Semiconductor Talent Ecosystem: Architectural Governance, Competency Frameworks, and a Multi-Year Implementation Roadmap

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I. Introduction and Policy Context

The global semiconductor value chain is undergoing a profound structural realignment driven by geopolitical imperatives, regional diversification, and the exponential rise of artificial intelligence (AI) and advanced microelectronics. Thailand, historically anchored as a regional hub for back-end Assembly, Testing, and Packaging (ATP), has articulated an audacious national ambition: the "Made-in-Thailand Chips" roadmap. This strategic framework targets the comprehensive positioning of the Kingdom as a global manufacturing and design hub for high-end, high-value semiconductors by 2050, aiming to mobilize over 2.5 trillion baht in fixed capital investment and cultivate a specialized workforce exceeding 230,000 highly skilled personnel.

To move up the global value chain into front-end fabrication, advanced packaging, and chip design, Thailand must transition from a reactive workforce model to a proactive, industry-led talent ecosystem.

Currently, Thailand's electrical and electronics (E&E) sector employs between 750,000 and 800,000 workers, with approximately 55% dedicated to the electronics sub-sector. However, out of this vast workforce, only 50,000 to 60,000 individuals function as high-skilled engineers and specialized technicians in advanced electronics, such as integrated circuits (ICs), high-density interconnect PCBs, and wafer processing. Furthermore, within the burgeoning Printed Circuit Board (PCB) supply chain, high-skilled foreign experts comprise 12% of the workforce, underscoring a persistent structural reliance on external technical talent.

To move up the global value chain into front-end fabrication, advanced packaging, and chip design, Thailand must transition from a reactive workforce model to a proactive, industry-led talent ecosystem. Capital incentives alone are no longer sufficient; talent availability has become the primary driver for Foreign Direct Investment (FDI). This paper provides a strategic framework to bridge Thailand's acute talent shortage through a centralized governance model, dedicated competency frameworks, and an actionable roadmap leading up to 2030.

II. Institutional Governance: The Thailand Semiconductor Talent Agency (TSTA)

To overcome the institutional fragmentation currently characterizing Thailand's human capital development—where responsibilities are scattered across multiple ministries—the state must establish a centralized, autonomous body: the **Thailand Semiconductor Talent Agency (TSTA)**.

Mode of Establishment

TSTA should be established via a Royal Decree under the Office of the Prime Minister, granting it the statutory authority to bypass bureaucratic silos and mandate inter-ministerial cooperation. It must operate as a public-private partnership (PPP) agency, mirroring successful international benchmarks like Malaysia's TalentCorp, ensuring that private sector dynamics dictate national educational and migration strategies.

To overcome the institutional fragmentation currently characterizing Thailand's human capital development, an autonomous body: "The Thailand Semiconductor Talent Agency (TSTA)" must be established.

Organizational Structure

The agency will be governed by a Board of Directors with participation of private industry leaders and public officials:

- **Chairperson:** A highly respected industry veteran from the semiconductor or advanced technology sector (list of potential candidates available)
- **Ex-Officio Board Members:** Secretary-Generals of the National Economic and Social Development Council (NESDC), Board of Investment (BOI) and the Eastern Economic Corridor (EEC) Office; Permanent Secretaries of the Ministry of Higher Education, Science, Research and Innovation (MHESI), the Ministry of Labor (MOL), the Ministry of Digital Economy and Society (MDES) and the Ministry of Industry (MOI).
- **Private Sector Board Members:** Representatives from the Thailand Printed Circuit Association, the Electrical and Electronics Institute (EEI), Thai

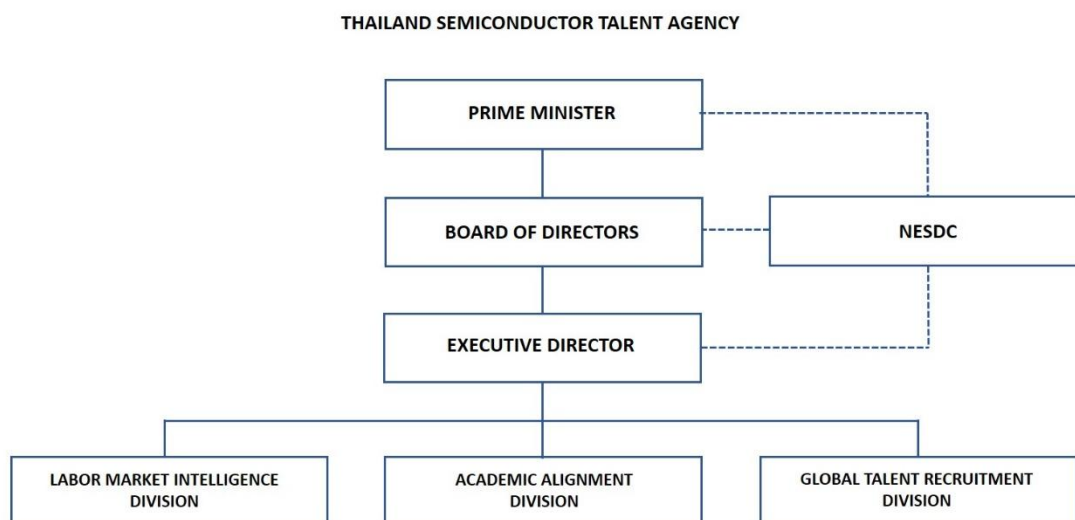
Semiconductor Association, photonics and managing directors of multinational Integrated Device Manufacturers (IDMs) operating in Thailand.

Internal Functional Divisions

1. **Labor Market Intelligence Division:** Tasked with developing and updating the annual *Thailand Skilled Occupations List (T-SOL)* to isolate real-time skill deficiencies using predictive data analytics.
2. **Academic Alignment Division:** Charged with co-designing undergraduate, postgraduate, and Technical and Vocational Education and Training (TVET) curricula directly with global chipmakers.
3. **Global Talent Recruitment Division:** Tasked with running global repatriation campaigns for Thai professionals abroad and administering fast-tracked visa regimes for foreign experts.

Ideal Structure and Reporting Line

To ensure maximum political leverage and swift execution, the TSTA Executive Director will report directly to the **Prime Minister of Thailand** via the National Economic and Social Development Council (NESDC). This direct line ensures that talent development strategies are legally and financially bound to the country's macroeconomic planning and industrial policy.



III. Comprehensive Talent Breakdown and Competency Matrix

To service front-end engineering, advanced back-end processes, and the integration of AI in microelectronics, human capital must be developed across four primary domains.

1. Information Technology (IT) & Software Engineering

- **Required Talents:** Electronic Design Automation (EDA) Software Engineers, Embedded Systems Developers, Cloud Infrastructure Architects, and Cyber-Physical Systems Engineers.
- **Core Competencies:** Proficiency in hardware description languages (VHDL, Verilog), compiler design, real-time operating systems (RTOS), and secure DevOps for distributed semiconductor manufacturing environments.

2. Artificial Intelligence (AI) & Advanced Computing

- **Required Talents:** AI Silicon Architects, Machine Learning (ML) Ops Engineers, Neuromorphic Computing Researchers, Computer Vision Specialists for Automated Optical Inspection (AOI), and silicon photonics engineers.
- **Core Competencies:** Designing specialized AI accelerators (NPUs, TPUs), deep learning framework optimization (TensorFlow, PyTorch), edge-AI deployment, predictive maintenance algorithms for cleanroom robotics, and silicon photonic integrated circuit design.

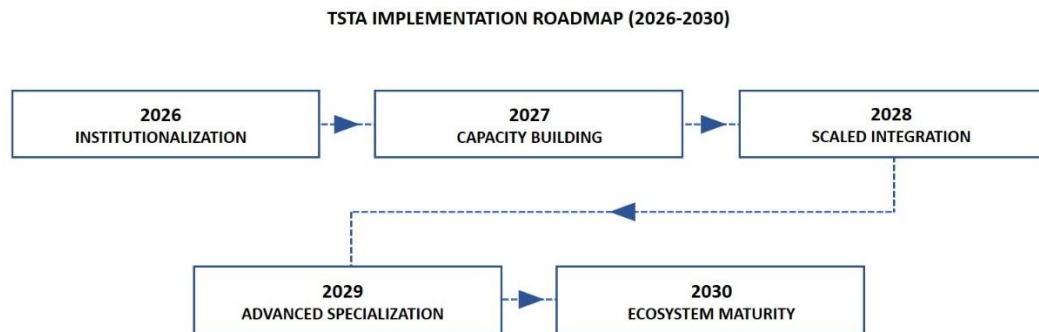
3. Electronics & Semiconductor Engineering

- **Required Talents:** Analog/Digital IC Design Engineers, Radio Frequency (RF) Design Engineers, Wafer Fabrication Process Engineers (Lithography, Etching, Thin-Film Deposition), Advanced Packaging/Substrate Engineers (Silicon Interposers, 3D ICs), and Failure Analysis (FA) Engineers.
- **Core Competencies:** Sub-nanometer CMOS technology nodes, Silicon Carbide (SiC) and Gallium Nitride (GaN) wide-bandgap semiconductor manufacturing, thermodynamic modeling of high-density substrates, and cleanroom protocols.

4. Strategic & Technology Management

- **Required Talents:** Semiconductor Fab Operations Managers, Global Supply Chain Architects, Technology Transfer Directors, and Intellectual Property (IP) Strategists.
- **Core Competencies:** Lean Six Sigma black-belt manufacturing execution, international trade compliance, patent landscaping, agile project management, and high-tech capital expenditure (Capex) optimization.

IV. Multi-Year Implementation Roadmap: Countdown to 2030



Year 1 (2026): Institutional Foundation and Data Architecture

- **Action 1:** Promulgate the Royal Decree establishing the TSTA and formalize the inter-ministerial board structure under the Prime Minister's Office.
- **Action 2:** Launch the inaugural *Thailand Skilled Occupations List (T-SOL)* focusing specifically on advanced electronics, chip design, and PCB manufacturing to map precise talent bottlenecks.
- **Action 3:** Launch the "Thai Semiconductor Diaspora Network" to trace and catalog high-skilled Thai engineers working in global semiconductor clusters like Taiwan, Silicon Valley, and Singapore.

Year 2 (2027): Institutional Co-Design and Infrastructure Launch

- **Action 1:** Establish the first two *Thailand Skills Development Centres (TSDCs)* within the Eastern Economic Corridor (EEC), modeled after the Penang Skills Development Centre (PSDC), where private anchor firms co-fund equipment and define training curricula.
- **Action 2:** Roll out the "Semiconductor Fast-Track Visa" program, managed by TSTA and BOI, lowering immigration barriers and offering tax incentives for specialized foreign engineers.
- **Action 3:** Overhaul the curriculum for the top 15% of STEM students across Thai universities, introducing mandatory courses in EDA tools, cleanroom operations, and AI chip architecture.

Year 3 (2028): Scaled Implementation and Industrial Integration

- **Action 1:** Initiate large-scale cooperative education programs (work-integrated learning), placing at least 10,000 university and advanced TVET students annually into co-op roles at operating IDMs and OSAT facilities.

- **Action 2:** Activate the "Returning Expert Incentive Package," providing competitive personal income tax caps and research grants to attract overseas Thai semiconductor experts back to domestic institutions.
- **Action 3:** Deploy TSDC-certified upskilling modules for the existing domestic engineering pool, transitioning 15,000 traditional E&E assembly workers into automation maintenance and testing roles.

Year 4 (2029): Advanced Specialization and R&D Clustering

- **Action 1:** Establish dedicated Research and Development clusters focused on Wide-Bandgap Semiconductors (SiC/GaN) and AI-driven IC design, funded jointly by the BOI and international tech companies.
- **Action 2:** Achieve full curriculum alignment across all national technical universities with the T-SOL framework, ending historical, supply-driven enrollment models.
- **Action 3:** Expand the TSDC network to include specialized pilot lines for advanced packaging and high-density PCB substrate fabrication.

Year 5 (2030): Ecosystem Maturity and Self-Sustenance

- **Action 1:** Conduct an independent, comprehensive audit of the "Made-in-Thailand Chips" roadmap, evaluating the integration of the target high-skilled workforce into high-value design and fabrication operations.
- **Action 2:** Transition the TSTA financing model to a self-sustaining structure funded partially by private industry levies, corporate training fees, and technology commercialization revenues.
- **Action 3:** Position Thailand as a primary net exporter of advanced microelectronics talent within the ASEAN region, solidifying its status as a high-value semiconductor hub.

V. Conclusion

Thailand's transition from a legacy, back-end assembly, testing, and packaging hub into a premier global center for high-end, high-value semiconductors hinges on a fundamental shift from capital-driven incentives to human-centric capability building. By consolidating the historically fragmented technical and educational architectures under the singular governance of the Thailand Semiconductor Talent Agency (TSTA), the Kingdom can successfully align its workforce cultivation with real-world macro-industrial goals. The implementation of the *Thailand Skilled Occupations List (T-SOL)*, paired with public-private training facilities like the Thailand Skills Development Centres (TSDCs), ensures that educational and technical pipelines actively adapt to the rapidly evolving standards dictated by

leading global Integrated Device Manufacturers (IDMs) and advanced electronics producers.

Ultimately, the successful execution of the proposed five-year roadmap up to 2030 will determine Thailand's capacity to absorb advanced foreign direct investment and move up the global semiconductor value chain. Through targeted initiatives in IT, AI software engineering, wafer processing, and technology management, the nation can effectively mitigate its structural talent shortages and transform its domestic labor supply. Capitalizing on international technology transfers, repatriating the skilled Thai diaspora, and integrating automated computing into manufacturing lines will allow the country to meet its objective. In doing so, Thailand will secure its position as a highly competitive, self-sustaining microelectronics leader, effectively realizing the vision of the "Made-in-Thailand Chips" national roadmap. ■

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