ITRI

Learning what Taiwan can make: laboratories, industrial intelligence, and the work of building productive capability

The Industrial Technology Research Institute, usually called ITRI or 工研院, is Taiwan's large applied-research institution, headquartered in Zhudong, Hsinchu County. Established in 1973 as a foundation under public supervision, it develops technologies, helps firms use them, trains people, and produces intelligence about industries and their possible futures. Its work extends well beyond the semiconductor companies it helped establish: materials, machines, communications, energy, medicine, and the practical difficulties of making a promising invention work outside a laboratory.[1]

One revealing entrance is a map rather than a microchip. In an August 2026 research presentation, ITRI's industrial-strategy team described its third year of work on industrial spatial planning for Taoyuan. The sequence ran from measuring the local concentration of industries to mapping clusters, locating representative firms within supply chains, interviewing companies, identifying possible future sectors, and proposing where development could happen. The final task was to translate the proposal into language an administrative review committee could accept.[2]

A national ambition had to find a place to stand. A forecast about technological growth was insufficient; so was a map of available land. The researchers had to connect what firms were doing, what they might become capable of doing, and what a government could actually authorize. These are different kinds of knowledge, held by different people.

This is a useful way to approach the question that surrounds ITRI: **what is industrial strategy?** At its most concrete, it is an attempt to change the kinds of production an economy can sustain, and the position its producers occupy within them. It might mean acquiring the ability to manufacture a component, making an existing process less wasteful, helping suppliers reach a new market, or coordinating skills, infrastructure and demand so a new activity becomes viable. A subsidy can be an instrument. A testing facility, a training program, a procurement commitment or an organized exchange between firms and government can be one too.[3]

A strategy therefore needs more than a list of fashionable sectors. It needs a judgment about the missing capability, an account of who can build it, resources that reach those people, and a way to discover whether the intervention is working. The difficulty is that some of the necessary information does not exist until somebody attempts the work.

ITRI occupies that difficulty. It is both a producer of knowledge about industry and a place where industrial possibilities are tested into existence. The distinction between those functions is essential. A report can recommend a direction. A process engineer can establish that something is manufacturable. Neither fact, by itself, decides what the country ought to pursue.

A laboratory designed to let things leave

ITRI's institutional form was a deliberate answer to a practical problem. Its founding combined three existing organizations, concerned with industrial, mining and metal research, into a foundation rather than another ordinary government department. The institute's anniversary history presents this arrangement as a way around restrictions on public-sector recruitment, salaries and procurement. The political sponsor was economic minister Sun Yun-suan, working at a moment when Taiwan was seeking more technologically demanding forms of production.[4]

The legal design did not sever the state connection. The founding statute makes ITRI a foundation supervised by the Ministry of Economic Affairs. The premier appoints directors drawn from government, science and technology, and business, as well as the president. The board directs and supervises the president; annual plans, budgets, accounts and reports travel through the ministry and Executive Yuan to the legislature. Its operational flexibility sits within a chain of public appointments, supervision and reporting. Calling it either a government department or an independent private institute would miss part of the arrangement.[5]

The distinction becomes material in its income. ITRI's 2024 sustainability report gives a revenue breakdown of approximately NT$31.5 billion: 49 percent government scientific-research income, 23 percent government services and 28 percent enterprise cooperation. The chart excludes a further NT$2.563 billion associated with the Chip-based Industrial Innovation Program. Even within its stated scope, "roughly half government-funded" would miss another substantial public stream. These are dated revenue categories, not a measurement of economic benefit.[6]

Each relationship asks something different of research. A public research program can justify developing capabilities for which no customer yet exists. A company needs an answer that fits its process, cost and timetable. A government service contract may require a usable administrative result. A promising technology may survive a demonstration and still lack the equipment, financing, customer or regulatory route that would make it useful.

ITRI's published services give these gaps recognizable names: commissioned development, small-scale pilot production, process improvement, calibration, measurement, technology transfer and intellectual-property services. This is not simply a conveyor belt carrying university discoveries toward grateful firms. Different kinds of work enter at different points, including a manufacturer's existing problem.[7]

The organization needed to perform them is correspondingly untidy. Its current structure includes research institutes for electronics and optoelectronics, information and communications, mechanical systems, materials and chemicals, green energy and environment, biomedicine and devices, and unmanned technologies. Alongside them are strategy and service units, regional operations, and functions for finance, law, personnel, planning and commercialization.[8]

It is tempting to call these supporting functions overhead. But a technique cannot leave the laboratory merely because its inventor wants it to. Someone must specify what is being transferred, identify the recipient, determine responsibilities, negotiate rights and make the new arrangement durable. The institution's distinctive output is often not an object at all. It is a capability that another organization can take over.

What the semiconductor story actually proves

The familiar history contains a useful surprise: Taiwan did not begin by possessing a superior technology. It began by organizing the work of learning one.

In 1976, ITRI signed a technology-transfer and licensing agreement with RCA. Its first group of nineteen trainees was divided among design, manufacturing, verification and equipment work at different American locations. The demonstration plant completed in 1977 was where those separate forms of knowledge had to become a functioning production system. The resulting achievement was not reducible to a patent or a packet of instructions. It required people who could operate, diagnose and reproduce a process together.[9]

The next institutional move was equally important. In 1980, ITRI transferred four-inch wafer technology and a research team to the newly established United Microelectronics Corporation. In 1987, Taiwan Semiconductor Manufacturing Company received fabs, equipment, technology and ninety-eight professionals from ITRI. Philips participated in the formation of TSMC alongside Taiwan's government and private investors. These were transfers of organized productive capacity, not just licenses issued to firms that already knew what to do.[10]

The two companies should not be made into one retrospective formula. UMC initially combined design and manufacturing; its own history dates the transition to a pure-play foundry to 1995. TSMC's dedicated foundry model, by contrast, offered manufacturing to customers without competing with their chip designs. The institutional arrangement mattered because it changed who could enter the industry and what they needed to own.[11]

Morris Chang's 2007 oral history makes the sequence much less inevitable than the anniversary version. He recalled finding an inherited technology behind the leading manufacturers, and a research institute without the commercial scale needed to maintain the pace of an industry. Manufacturing capability offered a relative strength; design, intellectual property and marketing were weaker. The foundry model was a response to those conditions, not the execution of an already complete national blueprint. Chang also acknowledged that the future growth of fabless customers was initially a hope rather than an established market.[12]

That is a different kind of strategic intelligence from predicting which technology will win. It is the ability to distinguish what an organization already knows how to do from the business that might be built around that knowledge. Sometimes the important decision is not a more advanced technical target but a different division of labor.

Nor was the knowledge contained within Taiwan. AnnaLee Saxenian and Jinn-yuh Hsu's study of the Silicon Valley–Hsinchu connection emphasizes technical communities moving ideas, people and opportunities across the Pacific. The relevant unit was not an isolated national system receiving a single foreign transfer. It was a set of relationships that continued to change what firms and institutions on both sides could do.[13]

The semiconductor story establishes ITRI's capacity to assemble and release capabilities under particular circumstances. It does not establish a universal recipe. Chen-Dong Tso's comparison of semiconductor and wireless-communications policymaking argues that the coherence of Taiwan's state–technologist relationship varied across sectors and over time. The celebrated developmental state was itself an arrangement that had to be made, not an administrative talent that automatically worked wherever it was applied.[14]

Five kilograms, three hundred kilograms

A less monumental object brings the same problem closer to everyday work: a piece of glass with an enormous internal surface.

NaPoGlass, developed at ITRI, uses nanoporous material made from waste display glass to capture metal ions. The materials researcher Hung Huan-yi (洪煥毅) describes a long gestation: an earlier discovery of a porous structure eventually met the needs of a separate water-technology team. Making useful material at scale was the hard part. Conditions that worked in small laboratory batches did not carry over unchanged. The team had to find new formulation and process parameters; in ITRI's April 2025 account, production had risen from five kilograms a day to three hundred.[15]

The numbers matter less as a claim of triumph than as a description of the intellectual obstacle. "It works" is not one condition. It can mean that a material has the desired property in a small batch; that repeated batches behave consistently; that it can be made at a viable cost; or that a system using it can function in somebody else's plant. Knowledge at one scale does not automatically answer the question at the next.

An earlier episode in the same team's display-recycling work exposes a barrier that a laboratory cannot solve alone. In a 2018 interview with *CommonWealth*, Hung recalled having patents and a process for recovering liquid crystal, but no panel manufacturer willing to try it. Validation meant interrupting a valuable production line and accepting a risk to product quality. The researchers used industry contacts to seek a trial; the wait for the first factory test lasted a year. This was liquid-crystal recovery, not the glass adsorbent, but the industrial problem was closely related: the team needed access to somebody else's operating process before its technology could become credible.[16]

ITRI's application report identifies sixteen wastewater-recycling systems deployed at Taiwanese companies, including electroplating businesses 吉祥電鍍 and 偉順電鍍 and the company 祐輝實業. The arrangement connects waste display glass, metal-bearing wastewater, recovered resources and further uses for the material. These are institutional reports of deployment, not an independently audited comparison of lifetime cost or environmental performance. They nevertheless establish something more specific than an award: named places where the material has been incorporated into industrial work.[17]

This case also changes the picture of whom an industrial institute serves. A research project can concern the unglamorous remainder of a manufacturing process. The relevant customer may need a manageable treatment system rather than a frontier technology. Knowing that problem requires a different proximity to industry from tracking the most valuable semiconductor companies.

There is another, quieter kind of knowledge beneath such transactions. Taiwan's National Measurement Laboratory is operated by ITRI's Center for Measurement Standards under the Bureau of Standards, Metrology and Inspection. Its work maintains and transmits measurement standards. In 2022, the bureau announced additional calibration capabilities covering matters as different as electrical resistance, thermometers, angle gauges, microphones and isotope ratios.[18]

Measurement does not become strategically important only when it produces a newsworthy invention. A supplier and a customer need grounds for agreeing that a component meets a specification. A calibration chain makes a result traceable beyond the person or machine that produced it. This is industrial knowledge as maintained infrastructure: repeated, documented work that lets other organizations trust their own work.

The contrast with the semiconductor origin story is instructive. Some of ITRI's value appears when people and technology leave to create a new business. Some appears when a capability stays available, allowing many businesses to do things they could not reliably do alone.

An intelligence service for production

If the laboratory knows by making, another part of ITRI knows by comparing, visiting, calculating and connecting.

The Industry, Science and Technology International Strategy Center is usually abbreviated ISTI; its public research and consulting services retain the familiar IEK name. In 2018, ITRI combined its Industrial Economics and Knowledge Center with its international organization. Stephen Su's (蘇孟宗) account describes the resulting combination: industrial research, technology scouting, international partnerships and capability development. Intelligence was to connect with relationships through which it could be used.[19]

The resulting knowledge is not one disciplinary product. IEK's consulting materials describe production and sales analysis, technology and application trends, competitors' strategies, regional markets and supply chains. Its directory shows the specialization beneath those headings: batteries and energy systems, medical devices, automotive electronics, semiconductor processes, and

technology policy. The analyst is not expected merely to know that an industry is growing. The difficult question is where a Taiwanese organization might participate, what it would need, and what could make the apparent opportunity disappear.[20]

A market forecast, a technical comparison and a map of suppliers are therefore different instruments. A forecast places a scale and timing on demand. A technical comparison asks whether competing approaches meet the relevant requirements. A supply-chain account identifies the organizations whose cooperation, investment or permission is necessary. The strategic judgment begins when these accounts fail to line up: demand may be large while a vital input is inaccessible, or a technically elegant product may have no buyer at its achievable price.

Silicon Shih (石立康), an ISTI research manager, illustrates the mixture of competences. Trained first in mechanical engineering and then in business, he worked as a capital analyst in Intel's assembly-and-test operations. His ITRI biography connects market research with work on enterprise AI needs and the AIdea co-creation platform. The expertise is neither pure economics nor pure engineering. It includes recognizing a company's problem well enough to make it a researchable technical problem.[21]

A public institution must also decide which questions deserve sustained attention before anyone will pay for a definite answer. IEKTopics, a series begun in 2013, was described by Su as using the institute's own funds for exploratory thematic work. Subjects included manufacturing, circular economies and services. Su traces its service-based digital-transformation argument into the March 2020 雲世代產業數位轉型 program, designed to support industry's digital transition. That is the institution's account of influence, not a measurement of its exclusive contribution.[22]

The publication is only one stage. A research idea must acquire a sponsor, a budget, a partner and an administrative form. The Taoyuan example at the beginning of this study makes that translation unusually visible. The map and the interview do not speak for themselves; somebody has to decide what their combination warrants, then explain the decision to people with other responsibilities.

There is no reason to assume all participants want the same thing. A firm may want help with a proprietary bottleneck. A ministry may want a capability that many firms could use. A local government may want investment within its jurisdiction. An analyst can improve the evidence available to each without eliminating their conflict. Industrial intelligence is not an oracle standing outside those relationships. Its usefulness depends on moving through them without treating the loudest or best-connected participant as the whole industry.

The people between the disciplines

The careers inside such an institution do not all run from engineering school to laboratory to startup.

Wang Yun-chu (王韻筑) studied business, worked between a bank and an information-system supplier, joined a small technology company, then entered IEK's industrial-analysis work. She later moved into ITRI's information-and-communications institute, turning customers' requests into specifications for researchers. Institute-wide planning followed: coordinating research units around

technology roadmaps for 2030 and 2035. Wang Hsin-wen (王欣雯) took a different route: a Chinese-literature degree, an MBA, and more than a decade in IC-substrate planning and commercial work. She moved into commercialization at ITRI because she wanted to understand the packaging technology missing from her view of the industry. Their accounts appeared in the institute's 2024 career publicity. They document particular trajectories, not a promise that every department welcomes every background.[23]

Their work nevertheless identifies an important kind of competence. Translation here does not mean substituting an accessible word for a technical one. It means deciding what the other person's request entails: which requirements are indispensable, which assumptions are incompatible, what can be specified, and who needs to answer the next question. Good prose is useful, but so are an understanding of costs, an ability to inspect a process, and the patience to discover that the first description of the problem was wrong.

Other researchers enter with more explicitly quantitative training. Kuo-Che Hung's (洪國哲) published ISTI biography describes a finance doctorate and work using econometrics, time series, panel data and qualitative comparative analysis in research on financial technology, digital innovation and related topics.[24] The presence of these methods matters, but it does not make a model the institution's single language. It sits beside engineering tests, company interviews, contractual terms and the administrative categories through which public money is allocated.

The collective work becomes more visible when the professions disagree. In a 2022 interview republished by ITRI, chief operating officer Yu Hsiao-hsien (余孝先) described an engineering culture in which technically successful managers could assume they also knew best about personnel or organizational management. He argued for respecting the expertise of service departments. His concrete example concerned startup investments: decisions about when to dispose of equity, previously made by research teams, had been moved to ITRI's venture-investment subsidiary, ITIC.[25]

The point is not that a financial specialist invariably knows better than an engineer. It is that success in producing a technology does not settle every subsequent decision about it. A foundation trying to circulate knowledge needs legal and commercial judgment, organizational continuity and institutions capable of disagreeing with the inventor.

This is also what makes ITRI a distinctive vocational world. The satisfaction is not necessarily the authority of an individual byline or the ownership of a finished product. It can lie in making another organization more capable: a requirement clarified, a process stabilized, a suitable partner found, a project redirected before it consumes more money. Such contributions are harder to turn into a heroic career story. They are easier to recognize once one follows the handoffs.

The experiments that do not become industries

The danger of an institute famous for TSMC is that every later project can be read as a smaller version of the same success waiting to happen.

Gregory Noble's study of Taiwan's hard-disk-drive effort provides a useful interruption. Drawing on contemporary interviews and industrial records, he examined a sector in which sustained public assistance did not produce a viable domestic drive-manufacturing industry. The problem was not simply insufficient technical effort. Capital requirements, commercial scale, firm strategies and a moving technological target limited what the participating companies could achieve. Some people and capabilities subsequently moved into optical recording. Noble's account neither makes the original failure disappear nor treats it as evidence that the institution learned nothing.[26]

That distinction is difficult to preserve in management. If every unsuccessful project is defended as useful learning, failure becomes impossible to recognize. If only immediate commercial returns count, the institute is rewarded for work that a sufficiently well-resourced company might have purchased anyway. The public question is not just whether a project produced income. It is whether the intervention created a worthwhile capability, whether that capability would otherwise have emerged, and whether the institution responded intelligently when its assumptions failed.

Current oversight reveals the pressure to make those questions countable. An April 2026 Legislative Yuan budget-assessment summary reported that ITRI's investment-promotion effect had declined in most fields in 2025 compared with 2024, and that the proportions of valid patents unused for more than five and ten years were at five-year highs. The accessible summary does not supply the underlying tables, so it supports the direction of those findings, not a reconstructed patent-utilization rate.[27]

An unused patent is not automatically worthless: it may protect a research position or await complementary work. Nor does its existence demonstrate value. The more useful question is what the portfolio reveals about selection, maintenance, transfer and the willingness to discontinue a line of work. Counting patents can make activity legible while leaving the central question of use unresolved.

A separate, detailed legislative assessment of Ministry of Economic Affairs research programs supplies another revealing metric. For 2020–24, it reported a five-year average research-results-income-to-research-spending ratio of 14.69 percent for ITRI, against 15.20 percent across the institutes in the comparison. This is not a social rate of return; the revenue measure can include payments associated with earlier contracts. Its value here is to show the administrative test being applied, and how easily an income ratio could be mistaken for a verdict on public purpose.[28]

ITRI's leadership is not unaware of that tension. In a September 2026 interview, president Chang Pei-zen (張培仁) argued for longer-horizon research and against judging contributions to smaller firms solely through immediate income or surplus. He also described a very concrete discipline: asking service-robotics teams to visit at least ten prospective end customers and establish what they needed and would pay. One team, he said, replaced an expensive FPGA-based approach with a mass-produced domestic mobile-phone chip and software to reduce cost. These are the president's stated direction and reported example, not proof that the whole organization already operates accordingly.[29]

The intellectual move is consequential. Cost is not an embarrassing compromise imposed after the real research. For an institution charged with making technology usable, an affordable architecture is itself part of the research problem.

What a country can learn, and who gets to decide

ITRI's work is often described through the language of national technological strength. Yet its history makes national self-sufficiency a poor description of how that strength was acquired. Foreign equipment, licenses, companies, customers and mobile specialists were constitutive, not incidental. The strategic problem is often to change the terms of dependence: to become capable enough to negotiate, to supply something difficult to replace, or to sustain alternatives when a relationship breaks.

This is not merely historical. The institute's current remit links industrial research with resilience, energy, health and advanced manufacturing. Those categories reach beyond the production of more valuable exports. They involve choices about which needs deserve technical attention, which risks should be reduced, and whose work will be reorganized.[30]

Technical institutions can make such choices better informed; they cannot make them apolitical. A project that saves a manufacturer labor can change workers' prospects. A new industrial cluster can alter land use and infrastructure demands. A capability important for national resilience may not have the highest immediate financial return. None of these conflicts can be resolved by a laboratory test alone.

The industrial-policy literature increasingly treats these political and administrative capacities as part of the explanation rather than as inconvenient details outside the model. Réka Juhász and Nathan Lane emphasize that interventions redistribute opportunities and costs, depend on institutions capable of implementation, and must be understood within the political arrangements that support them.[31] That perspective is especially useful for reading an organization whose strength comes from proximity to firms and government. Proximity can provide indispensable knowledge. It also makes independence of judgment an achievement that must be maintained.

The Taoyuan map returns us to the scale at which this becomes work. The researcher must move between an industrial trend, a particular producer, a tract of land and a committee empowered to accept or reject a proposal. The materials engineer must move between a useful property, a repeatable process and a plant that can live with it. The commercialization specialist must turn a technical possibility into terms another organization can assume responsibility for.

What joins these vocations is not a single theory of the economy. It is the effort to make a possible future specific enough to be tested, organized and contested. The institution is built to repeat that effort across people and generations. Its continuing test is whether it can also recognize when the proposed future is the wrong one.

Ways into the institution

For readers who want to encounter the work rather than only its reputation, three routes are especially revealing:

- **Follow an object.** Read the NaPoGlass account alongside its deployment report. Separate the material property, the scale-up problem, the installed system and the claimed benefits. They are different achievements with different standards of evidence.[32, 33]
- **Follow a working argument.** IEK's public articles, expert directories and IEKTopics show how research questions are framed. Much of the detailed IEKNet material is subscription-based; public summaries should not be mistaken for access to the full analysis. Compare a proposal with the later program or procurement it is said to have influenced.[34, 35]
- **Read a success against a failure.** Put Chang's account of TSMC's formation next to Noble's hard-disk-drive study. Both concern technological development, but the commercial and organizational problems are different. The comparison is more instructive than extracting a universal "Taiwan model."[36, 37]

Research note: This study uses public institutional documents, participant interviews, company histories, scholarly research and legislative scrutiny. It does not reconstruct an observed day on campus. Institutional accounts of benefits and workplace culture are identified as such; no confidential client research, unreleased internal deliberations or private personnel material was used.

Notes and sources

1. ITRI, "ITRI Overview", current institutional description, accessed 4 November 2026. Portfolio and stated mission, not an independent evaluation. Headquarters location: ITRI, Taiwan office locations.↩
2. ISTI/IEK, IEK360 collection, "產業趨勢落實於空間布局：地方產業規劃手法與挑戰," 5 August 2026. The public presentation abstract describes methods; it is not the complete Taoyuan report or evidence of final planning approval.↩
3. Réka Juhász, Nathan Lane and Dani Rodrik, "The New Economics of Industrial Policy", *Annual Review of Economics* 16 (2024), 213–242; open working-paper version, 2023. The definition and range of instruments inform this explanation; the synthesis is not a claim that ITRI controls every instrument.↩
4. ITRI, "臺灣產業發展的推手：工研院的誕生", fiftieth-anniversary institutional history, 2023.↩
5. Ministry of Justice Laws and Regulations Database, Industrial Technology Research Institute establishment statute, 工業技術研究院設置條例, especially articles 2–10; amended 20 May 1981, current text accessed 4 November 2026.↩
6. ITRI, *2024 Sustainability Report*, introductory section, printed p.18, "財務績效." The revenue chart states that it excludes NT$2.563 billion associated with the Chip-based Industrial Innovation Program; figures here retain the report's stated reporting scope rather than constructing a broader consolidated total.↩

7. ITRI, “Industrial Development”, 17 December 2025. Public description of collaboration and service mechanisms.↩

8. ITRI, “組織架構”, current organization description, accessed 4 November 2026.↩

9. ITRI, “Adopting Technical Knowledge from RCA to Develop Taiwan’s IC Capabilities”, 2023. Nineteen refers to the first training group, not every person ever trained through the project. The 1976 date is the institute’s dated contract account.↩

10. ITRI, “Developing Semiconductors From Scratch”, 2023; TSMC, 2002 SEC filing, company history, printed p.50. ITRI’s anniversary page gives inconsistent start dates for the VLSI project; no precise start date is relied upon here.↩

11. UMC, corporate overview, including its 1980 establishment and 1995 business-model transition; TSMC formation source in note 10.↩

12. SEMI, “Oral History Interview: Morris Chang”, interview conducted 24 August 2007 for SEMI and the Computer History Museum. A participant’s retrospective judgments, not a neutral contemporary performance audit.↩

13. AnnaLee Saxenian and Jinn-yuh Hsu, “The Silicon Valley–Hsinchu Connection: Technical Communities and Industrial Upgrading”, *Industrial and Corporate Change* 10(4) (2001), 893–920. The argument summarized here is stated in the publicly accessible abstract; no claim rests on inaccessible full text.↩

14. Chen-Dong Tso, “State-Technologist Nexus in Taiwan’s High-Tech Policymaking: Semiconductor and Wireless Communications Industries”, *Journal of East Asian Studies* 4(2) (2004), 301–328. Public publisher extract; the comparison is attributed to the author.↩

15. ITRI, “金屬離子捕捉材NaPoGlass：廢玻璃變黃金，革新金屬廢水處理”, 17 April 2025, institutional interview with materials-and-chemicals researcher 洪煥毅. Scale-up figures are the institute’s report, not independent testing.↩

16. 康育萍, “舊手機、電腦螢幕都能回收再生？這10人做出德國大廠嚇一跳的科技”, *CommonWealth*, 1 October 2018. Named interviews with ITRI researchers and industry participants; the factory-trial account concerns liquid-crystal recovery, a different part of display recycling from NaPoGlass.↩

17. ITRI, “產業應用亮點”, NaPoGlass section, public sustainability site accessed 4 November 2026. The page is updated across projects; its displayed date should not be treated as the date of every later addition.↩

18. National Measurement Laboratory, ITRI Center for Measurement Standards listing; Bureau of Standards, Metrology and Inspection, “國家度量衡標準實驗室校正服務再升級”, 16 March 2022. The listed laboratory is distinct from Taiwan’s separate national time-and-frequency laboratory.↩

19. Stephen Su, “IEKTopics 2020 紀念合輯：為下個世代打造美好的明天”, 2020. Organizational history, self-funded thematic research and the institute’s retrospective account of policy influence.↩

20. IEK, consulting-service description and expert directory, accessed 4 November 2026. Staff totals differ among dated promotional materials and are not treated here as a stable headcount.↩

21. ISTI, Silicon Shih / 石立康, expert biography, accessed 4 November 2026.↩

22. Stephen Su, "IEKTopics 2020 紀念合輯：為下個世代打造美好的明天", 2020. Organizational history, self-funded thematic research and the institute's retrospective account of policy influence.↩

23. ITRI, "職涯點線面，我從產業的點，在ITRI看到全貌", published August 2024, updated October 2024. Named career accounts in employer publicity.↩

24. ISTI, Kuo-Che Hung / 洪國哲, expert biography, accessed 4 November 2026.↩

25. "工研院疫後轉型，網羅異地人才，研發合作成績逆勢躍進", interview dated 22 September 2022, republished by i創科技 in 2023; account of chief operating officer 余孝先. The cultural diagnosis is his, not a finding from an independent staff survey.↩

26. Gregory W. Noble, *Conspicuous Failures and Hidden Strengths of the ITRI Model: Taiwan's Technology Policy Toward Hard Disk Drives and CD-ROMs*, Information Storage Industry Center, University of California, San Diego, Report 2000-02, March 2000, especially the conclusion. Historical assessment, not a description of today's storage market.↩

27. 黃芝穎, Legislative Yuan Budget Center, 財團法人工業技術研究院*115*年度預算評估報告, April 2026, report 115072, public section summaries. Detailed underlying tables were not accessible through the published index.↩

28. 施岑佩 and 黃芝穎, Legislative Yuan Budget Center, MOEA 2026 budget assessment, section on technology projects, October 2025, table 4 and its notes. The income/spending measure concerns technology projects and is not ITRI's overall revenue ratio or a causal social-benefit estimate.↩

29. 李珣瑛, "工研院院長張培仁專訪 / 三招 助產業躍 A 段班", *Economic Daily News*, 21 September 2026. Attributed interview with ITRI's president; no claim of independent verification of the unnamed team's cost reduction.↩

30. ITRI, "ITRI Overview", current institutional description, accessed 4 November 2026. Portfolio and stated mission, not an independent evaluation. Headquarters location: ITRI, Taiwan office locations.↩

31. Réka Juhász and Nathan Lane, "A New Economics of Industrial Policy", *Finance & Development*, June 2024. An argument about political economy and implementation capacity, not an ITRI-specific impact evaluation.↩

32. ITRI, "金屬離子捕捉材NaPoGlass：廢玻璃變黃金，革新金屬廢水處理", 17 April 2025, institutional interview with materials-and-chemicals researcher 洪煥毅. Scale-up figures are the institute's report, not independent testing.↩

33. ITRI, "產業應用亮點", NaPoGlass section, public sustainability site accessed 4 November 2026. The page is updated across projects; its displayed date should not be treated as the date of every later addition.↩

34. Stephen Su, "IEKTopics 2020 紀念合輯：為下個世代打造美好的明天", 2020. Organizational history, self-funded thematic research and the institute's retrospective account of policy influence.↩

35. IEK, consulting-service description and expert directory, accessed 4 November 2026. Staff totals differ among dated promotional materials and are not treated here as a stable headcount.↩

36. SEMI, "Oral History Interview: Morris Chang", interview conducted 24 August 2007 for SEMI and the Computer History Museum. A participant's retrospective judgments, not a neutral contemporary performance audit.↩

37. Gregory W. Noble, *Conspicuous Failures and Hidden Strengths of the ITRI Model: Taiwan's Technology Policy Toward Hard Disk Drives and CD-ROMs*, Information Storage Industry Center, University of California, San Diego, Report 2000-02, March 2000, especially the conclusion. Historical assessment, not a description of today's storage market.↩