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What Do Megaprojects Leave Behind? Resource Wealth, State Orchestration, and Enduring National Capabilities

Rozali Indra Saputra
Universitas Indonesia, Indonesia
Email: indrascore@gmail.com

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Abstract

Resource-rich states can finance extraordinary projects without necessarily developing the capabilities required to achieve prosperity beyond resource extraction. The critical challenge lies not merely in expenditure but in the institutional capacity to convert temporary resource revenues into widely distributed, reproducible, and renewable capabilities. This article examines the conditions under which state orchestration transforms resource wealth into enduring national capabilities through transformational megaprojects while remaining within social and ecological limits. A purposive integrative literature review synthesizes perspectives on resource revenue management, technological learning, absorptive capacity, innovation systems, public investment, and mission-oriented governance. The study develops a six-stage resource-to-capability conversion framework encompassing resource revenue generation, mission-based allocation, learning and capability formation, diffusion across national networks, maintenance and renewal, and the development of enduring capabilities. Eight theoretical propositions explain why financially supported assets may fail to generate operational capabilities, why localized learning may remain geographically concentrated, and why capabilities may deteriorate following successful project commissioning. The Transformational Orchestration for Nexus Endurance (TONE) framework provides an integrated governance architecture, with credible revisability serving as an enabling condition rather than the study's primary theoretical contribution. A prospective application to Nusantara, Indonesia's planned new capital, illustrates decision gates, alternative mission configurations, dependency assessments, and lifecycle responsibilities without asserting empirically verified implementation outcomes. The study contributes a multilevel conceptual framework for understanding resource-to-capability conversion by distinguishing financial accumulation, infrastructure delivery, organizational learning, nationwide capability diffusion, and long-term renewal. The findings suggest that transformational megaprojects should be evaluated according to their additional contributions to national capabilities, credible mechanisms for knowledge diffusion, sustainable operational performance, and acceptable social and ecological consequences rather than their financial scale, symbolic significance, or access to resource revenues.

INTRODUCTION

Once a natural resource has been extracted, a country may retain financial revenues, infrastructure, technical expertise, liabilities, or an uneven combination of these

outcomes. These represent distinct forms of developmental inheritance. A completed research campus cannot substitute for qualified researchers capable of utilizing its facilities; a digital platform cannot replace public institutions equipped to govern, maintain, and improve it; and a newly established urban center cannot demonstrate national transformation merely through the concentration of advanced infrastructure and assets. The fundamental strategic question concerns what individuals and institutions become capable of accomplishing, how extensively these capabilities diffuse across society, and whether they can be sustained and renewed after the initial financing opportunities diminish.

Resource economics has long challenged the assumption that abundant natural resource wealth necessarily generates sustained economic development (Auty, 2000; Barbier, 2002). Competing explanations emphasize macroeconomic pressures, institutional quality, incentive structures, and the governance of resource revenues (Sachs & Warner, 2001; Mehlum et al., 2006; van der Ploeg, 2011). Theories of intergenerational investment and comprehensive wealth accounting further distinguish the utilization of current resource revenues from the preservation of future productive capacity (Hartwick, 1977; World Bank, 2024). Consequently, the challenge of converting exhaustible natural resource wealth into alternative forms of productive capital has been well established in the literature. Advancing this discussion requires explaining the specific mechanisms through which such conversion occurs rather than merely asserting that resource wealth should contribute to future development.

This article examines the organizational and interorganizational processes through which resource-financed investments contribute to the formation of enduring national capabilities. Research on public investment demonstrates why government expenditure cannot automatically be equated with the accumulation of productive capital (Pritchett, 2000; Rajaram et al., 2014). Studies of technological capabilities distinguish the acquisition of productive facilities from the development of organizational competencies required to operate, adapt, and continuously improve them (Lall, 1992; Bell & Pavitt, 1993). Innovation systems research further emphasizes that technological learning emerges through interactions among firms, universities, public institutions, and users (Lundvall, 1992; Nelson, 1993). Collectively, these theoretical perspectives reveal a complex conversion challenge in which asset financing, knowledge acquisition, capability diffusion, and long-term renewal involve distinct institutional actors and processes that do not necessarily emerge automatically or sequentially.

Transformational megaprojects make this conversion challenge particularly significant. Such projects can mobilize investment demand, infrastructure development, institutional coordination, and political commitment around long-term national development missions. However, they may also consume scarce resources, generate institutional and technological dependencies, and prioritize construction milestones over sustainable capability development. Research on megaproject performance, governance, and value distribution highlights these potential risks (Flyvbjerg, 2014; Denicol et al., 2020; Gil & Fu, 2022). Therefore, the central question is not whether megaprojects are inherently transformative but under what institutional, organizational, and economic conditions they can function as effective instruments within a broader national capability development portfolio.

Nusantara, Indonesia's planned new capital, provides a relevant context for the prospective application of this framework. Its development ambitions raise important questions concerning administrative effectiveness, research and educational capacity,

technological learning, and social and ecological resilience. Nevertheless, these ambitions do not necessarily demonstrate that concentrating investment in Nusantara would generate greater developmental benefits than strengthening existing institutions or geographically distributed innovation networks. Instead, they underscore the importance of systematically evaluating additionality, institutional connectivity, operational sustainability, and opportunity costs. Accordingly, this article investigates how resource-financed investment portfolios, using Nusantara as a prospective application, can transform resource revenues into enduring national capabilities, identifies the conditions required for successful conversion, and examines how these processes can be evaluated before implementation. The study seeks to develop a conditional explanatory framework and a prospective application architecture rather than estimate causal effects or claim that the proposed governance arrangements have already been implemented. Its principal contribution is a multilevel framework for capability formation that integrates fiscal stewardship, mission-oriented resource allocation, organizational learning, capability diffusion, lifecycle commitments, and selective portfolio management within a unified appraisal approach. The framework is intended to provide policymakers and institutional decision-makers with a more rigorous basis for determining whether transformational megaprojects can generate additional public capabilities, facilitate broader knowledge diffusion, support sustainable operations, and enable long-term institutional renewal before substantial resources are committed.

METHOD

Integrative review and mechanism-oriented theory synthesis

This study employed a conceptual research design based on a purposive integrative literature review and theoretical synthesis to develop a conditional explanatory framework and a prospective application architecture. The methodological approach emphasized the alignment of the research problem, theoretical foundations, and analytical contributions while maintaining consistency between the review procedures and the scope of its claims (Jaakkola, 2020; Snyder, 2019). The study did not seek to estimate empirical effects or provide exhaustive systematic coverage of the literature.

Relevant sources were identified through the supplied manuscripts and their foundational references, followed by targeted verification and additional literature searches covering resource economics, public investment, technological learning, knowledge transfer, and innovation systems. The review incorporated 52 references, comprising 51 published external sources and one related unpublished manuscript. Sources were selected based on their theoretical relevance, conceptual contributions, comparative insights, and alternative interpretations. The unpublished manuscript provided the foundational Transformational Orchestration for Nexus Endurance (TONE) architecture but was not treated as independent empirical evidence supporting the study's theoretical propositions.

Bibliographic information was verified using publisher databases, institutional repositories, research reports, and available scholarly publications. Source accessibility varied, with some publications available in full text and others accessible only through abstracts or institutional summaries. Accordingly, the study did not undertake uniform full-text coding, systematic screening with documented selection counts, or a formal risk-of-bias assessment. The descriptive reference chart was limited to the selected bibliography and was not presented as evidence of comprehensive literature coverage.

Analytical operations

Four operations organize the synthesis. First, the focal outcome was decomposed into usable organizational ability, connection across organizations, access, and renewal. Second, each literature was assigned an explanatory role in the conversion chain, with special attention to claims already established. Third, the interfaces between financing, allocation, learning, diffusion, and renewal were examined for missing actors, resources, incentives, and responsibilities. Fourth, conditional propositions and rival explanations were developed, then translated into a prospective Nusantara appraisal architecture.

Configurational reasoning helps distinguish a collection of desirable attributes from an explanation based on their conjunction (Furnari et al., 2021). We use that reasoning to propose complementarity among conversion tasks, not to claim that qualitative comparative analysis was performed. The subsequent symbolic illustration clarifies the logic of bottlenecks; it is neither an estimated production function nor evidence that every conversion process follows the same mathematical form.

The analysis also treats the megaproject as a candidate instrument within a broader portfolio. Comparators include distributed investment, strengthening existing institutions, alternative technologies, staging, financial saving, and deferral. This counterfactual discipline prevents the framework from turning the availability of resource revenues into a presumption that the flagship should receive them.

Reference architecture and research-question alignment

Table 1. Primary analytical roles of the selected bibliography

Primary analytical category	Number of selected works
Resource wealth and investment	12
Learning and capabilities	11
State orchestration and missions	9
Places and documentary context	8
Networks and innovation systems	5
Research design	4
Social and ecological foundations	2
Related conceptual manuscript	1
Total	52

Each of the 52 works is assigned one primary category for display. These are selection counts, not systematic-search yields, citation frequencies, quality scores, or evidence-strength measures.

Table 2. Questions, analytical operations, and theoretical outputs

Research question	Operation	Output
RQ1: Mission allocation	Compare fiscal stewardship and public-investment selection.	Allocation conditions and P1.
RQ2: Learning and ability	Connect asset delivery to absorption and demonstrated use.	Learning conditions and P2.
RQ3: National diffusion	Trace recipient capacity and knowledge boundaries.	Network conditions and P3, P7.
RQ4: Maintenance and renewal	Distinguish continuing operation, exploration, and fiscal buffers.	Endurance conditions and P4–P5.
RQ5: Constraints and dependencies	Identify coupled inputs, admissibility, and portfolio limits.	Configuration conditions and P6, P8.

The analytical outputs are construct distinctions, conditional propositions, an integrated model, and a prospective decision architecture. Their value depends on explanatory usefulness and subsequent testing, not the number or prestige of the selected references.

Units, evidence roles, and observable outcomes

The primary unit is a resource-to-capability conversion process within a mission portfolio. A process may contain multiple investment and learning episodes across several organizations. Individual projects and facilities are nested instruments; national capability is a higher-level outcome that requires evidence of useful connections beyond a focal site. A successful research team cannot alone establish a national effect, while a national outcome cannot automatically be attributed to one megaproject.

Table 3. Distinguishing stocks, abilities, and system-level outcomes

Construct	Definition	Indicative observation
Resource receipts	Lawfully captured fiscal inflows associated with resource activity.	Verified revenue classification, timing, volatility, and existing claims.
Mission allocation	Assignment of investible resources to appraised public outcomes and alternatives.	Selection records, additionality, staged budgets, and lifecycle commitments.
Organizational capability	A reproducible ability to perform or improve a specified activity.	Independent task performance, adaptation, retention, and repeatable routines.
National diffusion	Practical uptake and connected use across a wider institutional network.	Recipient adoption, joint problem solving, access, and demonstrable use.
Capability endurance	Continued use and renewal through financing, personnel, and technological change.	Service or research continuity, maintenance, replacement, and renewed competence.

Nusantara is used as a prospective design application rather than an empirical case test. The official smart-city blueprint supplies a documented statement of direction (Otorita Ibu Kota Nusantara [OIKN], 2023). Contextual and critical scholarship supplies competing interpretations and historically situated concerns (Negara & Neo, 2024; Al Faruq, 2025). No new interviews, contract audit, project dataset, fiscal forecast, or environmental assessment was conducted.

Three evidentiary roles remain separate. Existing literature supports component concepts and established arguments. Documentary sources establish stated intentions or reported conditions within their dates and scope. The present analysis produces new theoretical propositions and illustrative design choices. None of these roles permits the inference that TONE has already improved Nusantara's performance. Where a numerical or contextual assertion exceeds available support, the required designation is: "Additional evidence or literature support required."

RESULTS AND DISCUSSION

The integrated architecture



Figure 1. Six conversion tasks between resource receipts and enduring capabilities.

The arrows specify proposed relationships and feedback opportunities, not measured effects. Social–ecological admissibility and opportunity cost apply throughout. Tasks overlap in time and require reassessment.

The model distinguishes financing an opportunity from realizing a capability. Receipts supply potential purchasing power. Mission allocation determines the problems and alternatives to which that power is directed. Learning forms usable abilities within organizations. Diffusion connects those abilities to wider recipients and institutions. Maintenance and renewal preserve their productive use under change. Endurance is the conditional outcome of these interacting tasks.

State orchestration operates across interfaces rather than replacing the specialist work performed within them. A fiscal authority cannot supply researchers' competence; a university cannot independently secure a utility's lifecycle finance. Their decisions can nevertheless make each other's investments usable or stranded. Orchestration matters when it aligns those decisions without allowing coordination to conceal capture, unfunded commitments, or excluded interests.

The architecture distinguishes productive concentration from enclosure. A flagship may accelerate learning through proximity and shared infrastructure, while national contribution depends on usable connections beyond it. It also distinguishes continuity from renewal. Keeping an aging facility open is different from retaining the ability to perform its function. These distinctions define outcomes against which the following propositions can be assessed.

Resource capture and the boundary of the investible pool

The chain begins with a classification problem. Resource wealth, corporate profit, tax receipts, royalties, environmental liabilities, and investible public funds are not interchangeable. A large extractive sector does not show that its gross revenues are available for public allocation. Nor does a proposal for national investment establish a lawful claim on a particular firm. The relevant starting point is verified public receipts and legally authorized contribution mechanisms, after recognizing existing obligations and competing fiscal claims.

A useful design separates four accounts. The first records lawful receipts. The second records restoration, compensation, or other liabilities associated with demonstrated harms. The third manages stabilization and intergenerational financial choices. The fourth funds appraised capability investments. These accounts may interact within the public budget, but distinguishing their purposes prevents a contribution to a

flagship from being treated as a substitute for environmental duties or as evidence that all extractive activity has become socially beneficial.

Non-renewable minerals and renewable biological resources also require different treatment. Mineral depletion raises an exhaustibility problem. Palm oil and production forestry involve land, ecosystems, labor, and potentially renewable output, but regeneration and sustainable management cannot be presumed. The framework does not classify every resource-related receipt as compensation for irreversible depletion. It requires a transparent account of the specific economic and ecological conditions.

Stabilization is not an administrative interruption of transformation. It can protect a learning trajectory from commodity-price shocks and abrupt budget reversals. Conversely, excessive ring-fencing can insulate an ineffective project from comparison with more valuable uses. Resource-finance design therefore needs an explicit connection between fiscal stewardship and selection, with the authority to retain liquidity, stage commitments, and reconsider instruments (Collier et al., 2010; Basdevant et al., 2021).

For Indonesia, a proposed contribution from mining, mineral, palm-oil, or production-forest businesses would require separate analysis of existing taxes, royalties, proven liabilities, and any new obligation. Sector-wide claims that all firms cause fires, haze, landslides, or other disasters would exceed this evidence base. Additional evidence or literature support required for firm-level culpability, revenue availability, allocation percentages, and the legal feasibility of a proposed mechanism.

The conversion argument thus begins before a project receives funds. It asks whether the proposed pool is real, available, ethically and legally admissible, and better used for the candidate investment than for its alternatives. Without that discipline, national-future language can conceal a transfer whose public value remains unexamined.

Mission-based allocation must select functions and alternatives

Mission allocation converts a financing opportunity into a portfolio of commitments. The critical decision is not whether a project can absorb expenditure, but whether an instrument can make an additional contribution to a specified public outcome. A mission such as stronger public technological problem solving admits several instruments: a central facility, distributed laboratories, university networks, procurement reform, scholarships linked to research roles, or shared access to existing infrastructure. Selecting the flagship first and defining its mission afterward reverses the appraisal logic.

Additionality has several dimensions. Financial additionality asks whether new resources supplement rather than relabel existing commitments. Capability additionality asks what people and institutions become able to do beyond the counterfactual. Network additionality asks whether new relationships make existing abilities more usable. None can be established by an increase in a project budget alone. Their assessment requires a baseline and plausible alternatives, with uncertainty made explicit.

Proposition 1. Holding investible resources and implementation quality comparable, mission allocation that compares alternative configurations and requires demonstrable capability additionality produces stronger capability formation than allocation organized primarily around expenditure absorption or flagship asset completion.

P1 extends the investment-management argument from asset selection to the capability requirements of the selected configuration. It does not imply that outcome-based appraisal is sufficient or that physical milestones are dispensable. Construction, procurement, and technical reliability remain necessary. The causal claim is that selection

changes the incentives and commitments through which learning, use, and diffusion are designed into an investment rather than left as hoped-for consequences.

A disconfirming pattern would be comparable capability outcomes under asset-driven selection after accounting for prior skills, operating finance, and implementation. Another would be mission appraisal that changes language without changing portfolio choice, recipient responsibility, or budgets. Such observations would suggest that formal mission orientation is ceremonial or that other factors dominate.

The role of a public orchestrator is consequently bounded. It should make alternatives comparable, allocate decision responsibility, and ensure that capability claims survive scrutiny. It should not predetermine that every national concern belongs in the same project. Mission-oriented investment remains subject to opportunity cost, political authorization, and the risk that a designated mission becomes a protected claim on public resources (Mazzucato, 2018; Larrue, 2021).

Learning must be organized into delivery and use

Asset delivery can create opportunities for learning when recipient organizations participate in design, commissioning, operation, troubleshooting, and improvement. Those opportunities remain conditional. A team with insufficient prior knowledge may be unable to assimilate complex instruction; a well-trained team without access to source documentation or operating decisions may be unable to apply it. The conversion task is to connect access, prior competence, incentives, and actual responsibility.

Theoretical support comes from technological capability, absorptive-capacity, and knowledge-boundary research (Lall, 1992; Zahra & George, 2002; Carlile, 2004). The present extension concerns how a public mission makes these conditions part of investment design. Procurement can require bounded knowledge rights, joint problem solving, recipient roles, and demonstrations of independent performance, while recognizing legitimate intellectual-property constraints. The appropriate design depends on what capability is sought and what transfer is feasible.

Proposition 2. For comparable delivered assets, arrangements that combine recipient readiness with consequential participation, usable knowledge access, and repeated performance responsibility generate stronger organizational capability than delivery accompanied by training or transfer clauses alone.

The mechanism involves practice that exposes knowledge gaps, gives recipients a reason and opportunity to resolve them, and embeds the resulting ability in routines that survive individual participation. A demonstration should test a specified task: maintaining a subsystem, adapting an application, reproducing a research procedure, or diagnosing an operational problem. Course attendance, certificates, and training expenditure are inputs. They do not independently establish the ability.

This proposition does not require complete technological self-sufficiency. External specialization can be efficient and productive. The relevant distinction is between a consciously chosen interdependence with workable access and an unexamined dependence that undermines a mission's function. A public organization may rationally outsource a task while retaining the competence to specify, evaluate, integrate, and replace the service.

P2 would be weakened if independently tested ability did not vary with these arrangements once prior competence and task difficulty were accounted for. It would also be challenged if temporary vendor support generated durable recipient performance without the proposed learning channels. Longitudinal observation is needed because early

participation can appear successful while knowledge remains concentrated in individuals who subsequently leave.

National diffusion requires capable recipients and useful relationships

Diffusion converts an organizational achievement into an available national capability. The relevant outcome is uptake in another setting, not simply outward communication. A municipal agency may need to adapt a public-service system; a regional university may need access to research facilities and joint supervision; a domestic supplier may need a qualification pathway and a problem worth solving. These recipients face different constraints, making a uniform dissemination program unlikely to suffice.

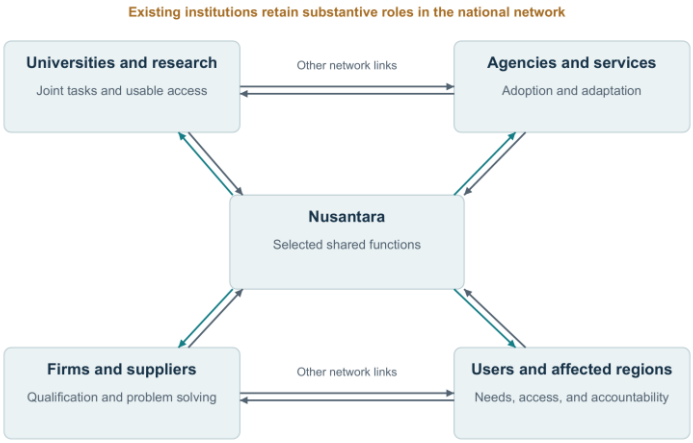


Figure 2. A flagship contributes through reciprocal national learning networks.

Nusantara is depicted as one possible node among existing institutions. Connections indicate proposed task relationships, not observed partnerships, geographic locations, or quantified flows.

Proposition 3. Capabilities formed in a flagship location produce wider national uptake when reciprocal problem-solving relationships are combined with recipient absorptive resources and practical access; partnership counts or one-way dissemination alone have weaker effects.

The proposition follows from knowledge transfer and innovation-system reasoning (Argote & Ingram, 2000; Lundvall, 1992). Its additional claim is that resource-funded flagship appraisal should include the receiving side of diffusion as a funded responsibility. Without recipient time, adaptation resources, and authority to use the knowledge, an impressive network diagram can remain a collection of institutional logos.

A test must examine adoption and use beyond the hub, distinguish genuine additional uptake from pre-existing relationships, and record transfer costs. Some highly specialized activities may reasonably remain concentrated. The question is whether their outputs become usable through services, access, training, suppliers, or complementary research, not whether every locality duplicates the same facility.

Maintenance and renewal preserve abilities, not only equipment

Capability endurance depends on recurring input flows. Skilled people need career paths and continued practice; equipment needs servicing and replacement; data infrastructure needs stewardship and security; institutional routines need adaptation when tasks change. A capital budget can create a facility without creating these continuing commitments. The project may then survive physically while the capability decays.

Maintenance protects dependable operation. Renewal changes the ability to meet altered requirements. Treating them separately prevents a common conceptual shortcut: classifying every repair as adaptation or every new technology purchase as renewal. A facility can modernize equipment while neglecting the competence to use it, just as an organization can retain valuable knowledge while its physical infrastructure becomes unreliable.

Proposition 4. Initial capabilities are more likely to endure when recurrent finance, personnel retention, maintenance, and periodic renewal are assigned to accountable organizations before asset commissioning, compared with arrangements that fund construction while leaving those obligations unresolved.

The mechanism is continuity of productive use and the preservation of opportunities for learning. Unfunded maintenance can interrupt use; interrupted use can erode competence; the resulting dependence on external repair can further reduce learning. Conversely, planned renewal can expose new problems that sustain the ability to adapt. This reasoning combines investment lifecycle discipline with capability and learning arguments (Rajaram et al., 2014; Winter, 2003; March, 1991).

A rival explanation is that facilities with high demand naturally attract later operating funds and skilled people, regardless of prior commitments. P4 therefore requires comparisons holding expected demand and technical quality reasonably comparable. Preassigned budgets and duties would not support the proposition if they were routinely abandoned without affecting capability. Formal promises should be separated from funded and implemented obligations.

For a Nusantara-linked research program, a lifecycle account would identify the institution that employs researchers, the authority that governs access, the payer for connectivity and energy, the owner of data and equipment, and the source of replacement finance. These responsibilities need not reside in one institution. They need to form an implementable arrangement whose costs remain visible after construction ceases to dominate political attention.

Endurance can also involve replacing an instrument. A learning network may continue using another facility if relocation is more viable; an obsolete system may be retired while its skills and knowledge migrate. Credible revisability supports such choices as an enabling governance condition (Saputra, 2026). The present explanation concerns whether the capabilities remain usable through that transition.

Fiscal volatility can interrupt the learning trajectory

The timing of finance matters because capabilities accumulate through repeated activity. A revenue windfall can finance rapid acquisition followed by operating retrenchment. The resulting discontinuity may reduce both service reliability and the ability to learn, even when cumulative expenditure remains high. Fiscal volatility thus enters the conversion mechanism through organizational continuity, not only aggregate demand.

Proposition 5. Holding expected resource revenues and portfolio quality comparable, stabilization arrangements and staged commitments that protect essential learning and lifecycle obligations reduce capability interruption relative to expenditure paths mechanically linked to current resource receipts.

The proposition does not prescribe a particular sovereign fund, budget rule, or allocation rate. Its mechanism is the protection of a justified operating and learning trajectory against shocks, while retaining the ability to stop unsuitable investments. A buffer should not become a guarantee that every program survives. The fiscal anchor must

remain compatible with appraisal, review, and competing public obligations (Basdevant et al., 2021).

A practical distinction is between committed recurrent costs and discretionary expansion. A research program may need a predictable minimum to preserve a cohort and an operating platform, while new buildings or equipment remain conditional on demonstrated use. This distinction can reduce the temptation to announce an expansive portfolio during a boom and withdraw the inputs that make it productive during a downturn.

The choice between domestic investment and financial saving remains conditional. Capital scarcity and learning opportunities can justify domestic investment, but institutional bottlenecks and overload can reduce its value (Collier et al., 2010). The model therefore rejects both automatic immediate spending and automatic earmarking for a flagship. It asks what sequence of investment and saving best supports admissible capabilities under the constraints actually present.

P5 can be investigated through the timing of resource receipts, budget releases, interrupted activity, staff exits, and capability performance. A useful comparison would distinguish the effect of volatile financing from poor demand, managerial failure, and technological obsolescence. If protected learning budgets fail to sustain use because a capability is unwanted or ineffective, the failure concerns portfolio choice or implementation rather than a need for stronger financial insulation.

Additional evidence or literature support required for the size of a suitable buffer, a legally available earmark, projected commodity receipts, and the affordability of a specific Nusantara operating commitment. The analytical contribution is the transmission channel from fiscal timing to capability continuity, not an uncalibrated fiscal rule.

Conversion tasks can be complementary without being universally indivisible

The six-stage architecture does not imply that every weak interface causes total failure. Capabilities vary in substitutability. A training program may compensate for some initial readiness constraints; shared infrastructure may substitute for a dedicated facility; external maintenance may preserve operation while local competence develops. The important theoretical issue is when such substitutions remain feasible and when a missing complement sharply reduces the value of another investment.

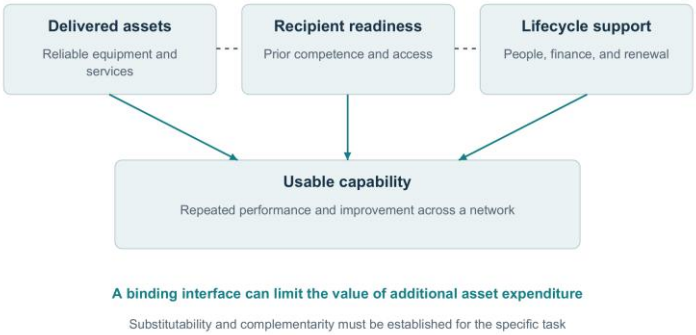


Figure 3. Complementarity and bottlenecks in capability conversion.

This is a qualitative causal architecture. No numerical weights, efficiency scores, production-function estimates, or threshold values are assigned.

Proposition 6. Where learning, recipient uptake, and lifecycle support are materially complementary, increasing asset investment without strengthening a binding conversion interface yields smaller capability gains than a portfolio that addresses that interface.

The mechanism is the dependence of one task's usefulness on another. A computing facility without qualified users has limited mission value; skilled users without reliable access cannot apply their abilities. The proposition draws on accumulation and interdependence arguments (Dierickx & Cool, 1989; Jacobides et al., 2018), but its focus is the design of resource-financed capability portfolios.

P6 predicts targeted reallocation rather than uniformly larger budgets. A small recipient-support program or maintenance intervention may have greater capability value than expanding the visible asset, conditional on the actual bottleneck. It would be challenged where tasks are sufficiently substitutable that additional asset investment reliably compensates for the suspected constraint. Diagnosis must therefore precede the label bottleneck.

Territorial access and accountability condition national contribution

A capability can be nationally located yet socially or territorially enclosed. This may occur through pricing, admission, infrastructure access, research priorities, intellectual-property arrangements, or the concentration of decision power. Physical connectivity is insufficient if prospective users cannot influence the tasks a facility undertakes or afford the complementary resources required for uptake.

The distinction between technical diffusion and distribution is important. A recipient organization may be capable of using knowledge but excluded from access. Conversely, an inclusive access rule may offer little value to an organization without the people or resources to participate. P3 addresses the capacity and relationship conditions of uptake. The present proposition concerns how priority setting and accountability affect whose problems enter the network.

Proposition 7. In geographically concentrated transformation portfolios, recipient participation in mission priorities and answerability for realized access increase the breadth of national capability use, conditional on recipient capacity and a workable division of specialist authority.

Participation is not a substitute for technical judgment, nor does it require every actor to hold a veto. It concerns practical routes through which users, regions, universities, and affected communities can shape relevant priorities and challenge exclusion. A program measured only by research prestige or investment attracted may rationally favor activities that do not address wider domestic needs. Accountability for use and distribution changes that incentive.

The proposition connects public value distribution to the geography of missions (Gil & Fu, 2022; Uyarra et al., 2025). It also recognizes a failure mode: a nominally representative body can be captured by organized interests, while diffuse or future beneficiaries remain weakly represented. Measures must examine agenda influence and actual access rather than committee membership alone.

Social and ecological limits remain admissibility conditions beyond any prediction about cooperation. A capability's productivity cannot justify an unlawful loss of rights or imply unlimited substitution for ecological functions. Sen (1999) and Raworth (2017) support evaluating development through substantive opportunity and limits, while project-specific thresholds require independent evidence. Additional evidence or literature support required for claims about local consent, rights protection, cumulative ecological effects, or the adequacy of compensation.

For Nusantara, national contribution would therefore require evidence about users and institutions beyond the city, including producing regions and communities bearing resource or infrastructure burdens. The framework does not assume that such groups

should receive identical benefits. It requires the distribution and its justification to be visible in appraisal and subsequent evaluation.

Portfolio selectivity and the role of TONE

An ambitious transformation can accumulate missions faster than it develops the competence to deliver them. Administrative modernization, AI, higher education, food resilience, and climate adaptation can all be important while requiring different organizations, operating models, and spatial configurations. Adding them to one place-based portfolio does not create the complementarities needed to make them work.

Proposition 8. When orchestration and operating capacity are constrained, a mission portfolio that stages entry according to demonstrated conversion readiness produces stronger capability formation than simultaneous expansion across missions without matching learning, diffusion, and lifecycle commitments.

The mechanism is organizational attention and the scarcity of complementary inputs. Overextension can fragment managerial effort, compete for the same talent, and create recurrent obligations that exceed the funding base. Selectivity does not mean permanent narrowness. A portfolio can expand when learning, operating resources, and network connections demonstrate readiness. Options reasoning supports staging under uncertainty without determining which capability should be selected (Trigeorgis & Reuer, 2017).

TONE supplies a coherent set of responsibilities; it is not a universal project-selection algorithm. Its prior credible-revisability logic helps a sponsor amend or withdraw an unsuitable instrument (Saputra, 2026). The present article's contribution is to specify what the portfolio must accomplish before and after such amendment: additional ability, wider uptake, sustainable use, and renewal. A project may remain revisable and still be a poor vehicle for those outcomes.

Prospective Application to Nusantara

A node in a national portfolio

The application asks how Nusantara could contribute to national capability formation under explicit appraisal conditions. It does not infer a current capability deficit from the absence of detail in one document. The official smart-city blueprint provides an articulated direction (OIKN, 2023), while contextual and critical scholarship raises questions about sequencing, power, and territorial effects (Negara & Neo, 2024; Al Faruq, 2025). These sources justify scrutiny and comparison; they do not establish the performance of the proposed design. New-city scholarship also foregrounds power, profit, and prestige, reinforcing the need to scrutinize whose priorities a flagship serves (Moser & Côté-Roy, 2021).

These missions are candidates, not established comparative advantages. A stronger government platform requires interoperable processes and authorized users. A research facility requires researchers, governance, access, and a diffusion pathway. Education programs require quality and practical learning opportunities. Resilience interventions require evidence about beneficiaries, resource use, and environmental consequences. Each mission must pass its own conversion test.

The strategic role of Nusantara should be chosen against national opportunity cost. Co-location may improve coordination for some functions; a distributed network may better support others. The framework permits a mixed configuration in which Nusantara hosts selected activities while universities, firms, agencies, and communities elsewhere undertake complementary roles. Physical concentration is assessed as a design choice rather than a measure of ambition.

The same principle applies to food security, geopolitical resilience, and civic belonging. These are consequential national concerns, but attaching their labels to a city does not demonstrate a mechanism. A justified contribution would identify the specific ability sought, the responsible institutions, the intended users, and the feasible alternative. Additional evidence or literature support required for claims of economic superiority, national cohesion effects, or an appropriate scale of mission expansion.

An AI and research mission as an appraisal example

A proposed AI-related mission provides a concrete test because its enabling inputs and operating obligations are consequential. The appropriate objective would be a specified public or productive ability, such as improving a defined service or supporting a demonstrable research task. An AI hub label is not an outcome. Nor does this article establish that a new dedicated facility in Nusantara is preferable to shared computing access or stronger existing research institutions.

Learning requirements could include joint operating teams, documented interfaces, bounded knowledge rights, and demonstrations that recipient organizations can reproduce or adapt a specified task. National-network design could include shared access, joint supervision, co-developed public applications, and support for recipient implementation. These are alternative arrangements for appraisal, not descriptions of existing Nusantara programs.

This example does not provide electricity or water forecasts, employment estimates, productivity gains, or a recommended investment amount. Additional evidence or literature support required for those quantities and for legal, security, and environmental feasibility. Its concrete contribution is to identify decisions and evidence needed before authorizing a mission, and to make continued funding conditional on demonstrated conversion rather than the persistence of a fashionable technology label.

Nexus diagnosis connects the mission to enabling systems

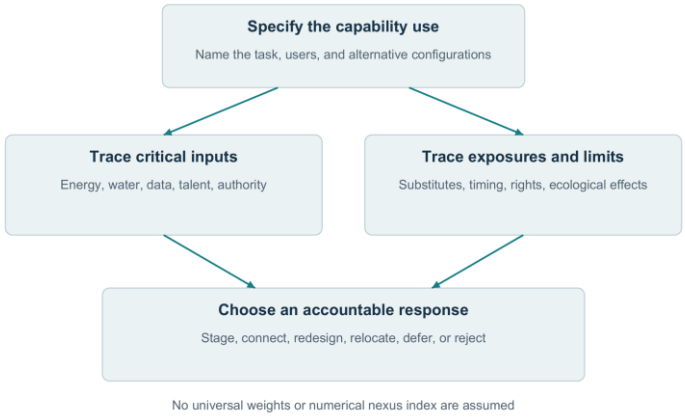


Figure 4. Dependency diagnosis for a candidate capability mission.
The diagnostic connects mission use, critical inputs, affected actors, and feasible responses. It is not a calibrated index or an empirical map of Nusantara.

Nexus analysis begins with a bounded use, not a list of sectors. For each proposed activity, the appraisal records inputs, responsible actors, foreseeable exposures, substitutes, and the time needed for adjustment. Six dimensions are relevant: consequence of interruption, substitutability, cross-boundary spillovers, response time, fragmented authority, and social–ecological incidence. An aggregate score is unnecessary unless its measurement and weighting are independently justified.

A tightly coupled interface with few substitutes may require staged investment, shared contingency arrangements, or a different location. A reversible experiment may warrant delegated authority and a short learning cycle. A rights or ecological conflict may require redesign or rejection even when the financial case is attractive. These are different decision problems; combining them into one risk number can conceal an inadmissible trade-off.

For an AI-related mission, energy or water exposure could constrain a particular technical configuration without invalidating all knowledge investment. For an administrative mission, legal authority and interagency interoperability could be more consequential than new hardware. For an education mission, faculty availability and recipient access could bind before physical capacity does. The framework requires evidence that a dependency is material before prescribing orchestration around it.

The relevant response is a named action by an authorized organization with resources and a deadline. Monitoring alone does not meet that requirement. However, the present article does not derive a new theory of correction from this observation; it uses the prior TONE architecture to connect dependencies to decisions (Saputra, 2026). Additional evidence or literature support required for numerical thresholds, site-specific constraints, or claims that a particular dependency currently limits Nusantara.

Responsibilities and decision records

The proposed roles need not imply new agencies. Existing institutions may perform them if mandates and resources are aligned. Creating an additional coordinating body without changing the allocation of decisions can increase reporting while leaving conversion gaps intact. The purpose of the architecture is to expose who can make a consequential decision and who must answer for its effects.

Shared outcomes should be paired with specific responsibilities. A ministry could contribute to the same mission as a university or utility while remaining accountable for a different interface. Agency targets should record demonstrable contribution to learning, use, or renewal, alongside delivery and compliance. Broad exhortations to avoid silos cannot substitute for those assignments.

A public decision record should identify the function, chosen instrument, alternatives, financing source, learning requirements, recipients, lifecycle obligations, dependencies, and review conditions. It should also state which uncertainties remain unresolved. A resource-funded mission thereby becomes reviewable without presenting every forecast as a promise. This is an institutional design implication, not evidence that such records already exist or will be effective in a particular setting.

A suitable first implementation would be one bounded mission with identifiable users and a feasible learning cycle. Expansion would follow demonstrated conversion readiness. The decision to pilot, delay, redesign, or reject must remain available; otherwise the architecture risks becoming a more elaborate justification for predetermined expansion.

Scenarios expose where the conversion chain can break

The scenarios are original analytical illustrations, not observed classifications of Nusantara. Their purpose is to make different failure mechanisms lead to different actions. Increasing finance is appropriate only when a financial constraint is actually binding. Stronger central coordination is appropriate only when it resolves a relevant interface without creating greater costs or excluding necessary knowledge.

They also make continuation and withdrawal assessable. A program that stops after an unfavorable comparison may preserve public resources and useful learning. A program

that continues may be justified when it retains additional value and workable lifecycle commitments. The relevant object is the portfolio's contribution to capabilities, including transition costs and obligations, rather than the reputation of a particular instrument.

This prospective application complements the prior article. Credible revisability explains how change can remain governable. The conversion architecture explains which contributions and dependencies that change should be evaluated against. Neither framework can establish project desirability without the relevant fiscal, technical, institutional, social, and ecological evidence.

Strategic management: capabilities are built through connected conversion tasks

The central strategic contribution is a multilevel account of capability formation through a public investment portfolio. Resource wealth creates a financing opportunity; assets create a platform for activity; learning creates an ability; networks extend its use; and renewal preserves its relevance. These relationships are connected but conceptually distinct. Treating their proxies as interchangeable obscures both why transformation fails and where intervention might improve it.

Strategic management has established that capabilities and strategic assets accumulate through processes that involve time, complementarities, and organizational routines (Dierickx & Cool, 1989; Winter, 2003). The present article extends that reasoning to a setting in which fiscal authorities, operators, learning institutions, and recipients control different conversion tasks. The national outcome cannot be attributed to an orchestrator's internal capability alone. It emerges, if at all, through coordinated contributions and workable access across the portfolio.

This argument qualifies the strategic meaning of scale. A larger asset can expand potential throughput without increasing the ability to solve a problem. A smaller intervention at a binding interface can make existing assets more productive. The resulting prediction is conditional: additional spending has different capability effects depending on the configuration of learning, recipient uptake, and lifecycle support. This can be tested without assuming that megaprojects generally fail or that distributed investment is always superior.

Innovation policy: place-based ambition needs a receiving system

Mission-oriented policy connects directionality to experimentation and institutional capability (Mazzucato, 2018; Kattel & Mazzucato, 2018). Innovation systems and knowledge-transfer research show why the receiving environment matters (Nelson, 1993; Argote & Ingram, 2000). Our contribution is to bring recipient-side conversion into the appraisal and financing of a flagship mission. A diffusion ambition becomes a commitment to fund and organize usable uptake rather than a promise that benefits will eventually spill over.

This implies a different interpretation of a national hub. It can be valuable because it hosts shared infrastructure, coordinates difficult tasks, or provides a platform for joint learning. Its national contribution depends on how those functions connect to existing organizations. A hub should not absorb the label national merely because a ministry finances it. Nor should local specialization be criticized simply because every region cannot reproduce it.

Research should therefore follow the path from a flagship output to its recipient use. It should ask which boundaries require transfer, translation, or transformation; what resources recipients need; and who receives benefits or bears adaptation costs (Carlile, 2004). These observations can distinguish genuine diffusion from ceremonial partnership

and identify whether geographical concentration strengthens or weakens wider capabilities.

Political economy: who retains the future value of resource wealth?

The political economy of conversion concerns control as well as competence. A portfolio can mobilize finance, deliver assets, and generate specialized knowledge while concentrating appropriation among a narrow set of actors. Institutional incentives influence how resource opportunities are used (Mehlum et al., 2006), and public risk protection can support financial claims without producing commensurate public capabilities (Gabor, 2021). The framework therefore keeps ownership, access, obligations, and distribution visible throughout the chain.

It also rejects the inference that natural wealth creates a privileged entitlement for a flagship project. Producing regions may bear extraction and infrastructure burdens while resources are allocated elsewhere. Public investment can be nationally valuable despite uneven location, but the distribution requires a defensible account. The relevant questions concern additional capability, accessible benefits, lawful obligations, and fair treatment of burdens. A narrative of national progress cannot resolve them on its own.

Environmental responsibility remains separate from developmental contribution. Financing education or research does not purchase permission for inadmissible harm, and a restoration payment does not automatically create a capability investment. Raworth's (2017) social–ecological framing and Sen's (1999) concern with substantive opportunities help define the evaluative perimeter. Site-specific decisions still require evidence, legitimate procedures, and enforceable duties.

Megaproject governance and public investment

The framework extends evaluation beyond commissioning while retaining delivery discipline. Cost, schedule, and technical quality remain important because a delayed or unusable asset can frustrate learning and uptake. Yet project performance must also be connected to value creation and distribution (Gil & Fu, 2022). The proposed conversion tests add a structured account of what should happen after resources become assets and before those assets are described as national transformation.

Hirschman (1967) directs attention to learning and problem solving during development, while megaproject reviews demonstrate the need to address recurrent governance and implementation difficulties (Denicol et al., 2020). These insights should be held together. Learning cannot excuse every preventable loss; delivery discipline cannot imply that every valuable capability was fully specified before implementation.

For infrastructure authorities and investors, the implication is practical. Appraise the complete capability arrangement, including who will use it and how it will remain productive. For development agencies and multilateral institutions, support recipient and implementation capacity alongside finance. For sovereign wealth funds and fiscal authorities, distinguish financial preservation, productive investment, and continuing obligations. The appropriate instrument depends on the problem rather than a preferred institutional label.

An empirical agenda that can distinguish rival explanations

The propositions invite longitudinal studies of conversion processes rather than retrospective inventories of successful assets. A first design could trace one bounded mission from allocation through commissioning, learning, recipient uptake, and renewal. Evidence would include appraisal alternatives, budgets, contracts where accessible, task-performance records, recipient accounts, and lifecycle decisions. This would test whether the proposed interfaces actually transmit effects or merely describe stages after the fact.

A second design could compare similar facilities or programs with different learning and diffusion arrangements. The design should account for prior competence, demand, institutional quality, task complexity, and operating resources. Useful outcomes include independent performance, adaptation, retention, recipient use, and continuity. Partnership announcements, training counts, or construction completion would serve as inputs or intermediate indicators rather than decisive outcomes.

A third design could exploit the timing of resource-revenue shocks and budget releases to investigate capability interruption. Researchers would need to separate financing discontinuity from demand changes, political selection, technological obsolescence, and implementation quality. P5 does not imply that every program deserves protection from a downturn; an appropriate response may be termination when an alternative becomes more valuable.

Comparative research could also examine configurations across countries, sectors, and mission types. Scope conditions include resource dependence, revenue volatility, recipient absorptive capacity, technological specificity, geographical concentration, and the accessibility of public institutions. Cross-country learning should investigate these conditions rather than infer transferable effectiveness from a country's reputation for consistency. No claim about the successful transplantation of another state's orchestration model is made here.

CONCLUSION

Resource wealth can finance national transformation without guaranteeing the long-term sustainability of the capabilities generated. The central strategic challenge lies in converting investable resource revenues into additional public capabilities and ensuring their widespread utilization and continuous renewal. This article developed a six-stage framework encompassing resource revenue generation, mission-based allocation, organizational learning, capability diffusion, maintenance and renewal, and the formation of enduring national capabilities. Eight theoretical propositions identified allocation quality, learning mechanisms, recipient absorptive capacity, lifecycle commitments, fiscal stability, complementary activities, territorial accountability, and portfolio selectivity as critical conditions influencing this conversion process. The study's contribution was distinct from the concept of credible revisability, as the Transformational Orchestration for Nexus Endurance (TONE) framework provided a complementary governance architecture for coordinating missions, institutional responsibilities, interdependencies, and long-term sustainability. In contrast, the proposed framework focused on the conversion mechanisms necessary for capability development regardless of whether specific policy instruments were maintained or modified. A project could therefore demonstrate credible revisability without generating substantial national capabilities, while technically successful projects could remain geographically concentrated or experience declining productive utilization. The prospective application to Nusantara illustrated the framework through proposed development missions, alternative investment configurations, artificial intelligence (AI)-related appraisal criteria, dependency assessments, institutional responsibilities, and potential failure scenarios. However, the analysis did not establish that these arrangements had been implemented or demonstrated superior performance compared with alternative approaches. Accordingly, Nusantara's potential contribution to national transformation should be evaluated through evidence of additional capability formation, nationwide diffusion, sustainable operations, and acceptable social and ecological consequences

rather than investment scale or symbolic national significance. Future research should longitudinally examine specific development missions from resource allocation through project commissioning, organizational learning, capability adoption, and renewal; compare projects with different learning and diffusion mechanisms; and investigate how resource revenue fluctuations and budget disbursement schedules affect capability sustainability. Policymakers should initially prioritize clearly defined development missions and expand investment portfolios only after demonstrating sufficient institutional readiness, capability formation, and diffusion potential.

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CONFLICT OF INTEREST

The author states that there are no conflicts of interest, whether personal, commercial, or financial, that can affect the implementation and results of this study.

AUTHOR'S CONTRIBUTION

Rozali Indra Saputra contributes to research design, data collection and processing, system development, result analysis, and article manuscript preparation.

GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

In the process of compiling this article, the author uses generative artificial intelligence (AI) as a tool in language refinement, writing structure, and grammar improvement. The use of AI is carried out on a limited basis and remains under the supervision of the author. All data, analysis, interpretation, and scientific substance in this article have been checked and verified by the author. The author is solely responsible for the accuracy, authenticity, and final content of the manuscript.

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