

From Invention to Shared Prosperity

Innovation models for developing countries in the age of open innovation and artificial intelligence

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I Author's note on the origins of this article

This article revisits ideas I began developing twenty-four years ago and subsequently used in teaching since 2023. The supplied version of my lecture notes, The Changing Face of Innovation, is dated 25 January 2024. It is an updated version of a paper I wrote in 2002- "Innovation in Africa-Options for Developing Countries". It also identifies my Kizuki[1] model as first developed in 2002. These dates refer to different stages in the development and presentation of the ideas. This draft brings that earlier thinking into conversation with established innovation scholarship and more recent evidence on artificial intelligence. It is a reflective, research-informed article, not an empirical evaluation of Innovation SL's programmes. Proposed Sierra Leone applications are identified as proposals or illustrations, rather than presented as completed projects.

II Abstract

Developing countries do not have to invent every technology they need, but they must develop the capacity to understand, adapt, improve, and govern the technologies they use. This article examines the relationship between invention, innovation, and development, moving from early industrial change to the knowledge economy and artificial intelligence. It reassesses technology-push, market-pull, chain-linked, closed, open, systems, network, and development-driven approaches, alongside user innovation, frugal innovation, place-based innovation, and mission-oriented policy. Its central argument is that Sierra Leone needs a combination of models organised around learning, practical demand, local capabilities, and accountable collaboration. Place-based innovation grounds this combination in the assets, needs, and institutions of particular communities and productive territories. Open innovation is especially relevant because useful knowledge is distributed across universities, enterprises, communities, government, and the diaspora. Yet, openness only produces development when participants can absorb knowledge and negotiate a fair share of the resulting value. AI can widen access to expertise and accelerate experimentation while creating new dependencies and verification requirements. Revisiting the Kizuki model, the article proposes an approach in which education, entrepreneurship, shared knowledge, and productive adoption reinforce one another, with success judged through sustained improvements in livelihoods, services, and capabilities.

[1] The Japanese concept of *kizuki*—the act of noticing or becoming aware—reminds us that innovation often begins with recognising something previously overlooked: an everyday difficulty, an unmet need, or a possibility for doing things differently.

II The question that has stayed with me

Which innovation models should African countries adopt? That question appears near the end of my lecture notes. It remains the right question, provided we resist the temptation to answer it with a fashionable label. A model should help us organise work, allocate scarce resources and learn from results. It should explain how knowledge becomes useful in the conditions in which people actually live. For Sierra Leone, the question is therefore inseparable from another: how do we turn the intelligence and creativity already present in our society into a sustained improvement in living standards?

My notes treated innovation as problem solving, interaction and learning. They emphasised the exchange of both codified knowledge, which can be written down, and tacit knowledge, which people acquire through practice. They also argued that innovation is a team activity dependent on trust. These propositions connect directly to the work of building an entrepreneurship ecosystem. A country can have competitions, training programmes, talented graduates and committed entrepreneurs without having reliable pathways between them. The important work is often the connection: enabling someone with a problem to meet someone with relevant knowledge, resources or a route to market. [1, 2]

Since 2023, I have been a guest lecturer at Fourah Bay College, teaching Entrepreneurship, Innovation and Creativity to third year students in Human Resource Management[2]. I encourage my students to embrace open innovation: to recognise that useful ideas and expertise extend beyond their own discipline, classroom or organisation. That is an intellectual stance, but it is also a practical response to resource constraints. A student should be able to ask what already exists, who knows something useful, what can be adapted and what must be tested locally. Originality and collaboration can reinforce one another.

The arrival of widely accessible generative AI makes this discussion more urgent. More people can now obtain explanations, draft software and explore designs with relatively little initial technical training. Yet the ability to generate an answer is different from the ability to establish that it is correct or useful. The historical questions return in a new form: who controls the tools, who can use them well, who captures the value, and what institutions help the benefits spread? My argument is that open innovation should be central to Sierra Leone's response, supported by deliberate investment in local learning and productive capability.

III Invention, innovation and diffusion: different achievements

Invention concerns the creation of a new technical idea, device or method. Innovation involves putting something new or significantly improved into use. Diffusion is its spread across users, organisations and places. These activities overlap, and feedback can run in every direction. A practical difficulty encountered during adoption may stimulate a further invention. An invention can

[2] Prior to my guest lectureship, I began assisting Dr. David Sengeh with his Enterpreneurship program to third and final year Engineering students. I teach the Business Model component of the program.

remain unused for years, while an established technology can support a valuable local innovation through a different production method, service arrangement or business model.

The OECD/Eurostat Oslo Manual makes implementation central to innovation and recognises significant novelty relative to the organisation concerned. Its 2018 business framework groups innovations into products and business processes. This is helpful for developing countries because it does not confine innovation to world-first discoveries or formal research laboratories. However, it does not mean every purchase of equipment or routine change qualifies: the improvement must be significant and introduced into use. [3]

Consider an illustrative cassava processor. Buying an ordinary replacement machine may maintain production without changing much. Introducing a drying and quality-control system that substantially improves consistency, reduces rejected batches and enables new sales could constitute a process innovation for that enterprise. The components might be imported, locally fabricated or combined from both sources. The development question is whether the enterprise can operate and maintain the system, pay for it, retain the knowledge and repeat the improvement. The birthplace of every component is only one part of that assessment.

Creativity provides possibilities. Invention establishes a new technical possibility. Entrepreneurship may organise the people, finance and commercial arrangements that bring it into use. Public institutions and communities can also innovate without creating a private company. A better referral system, a reliable laboratory service or a community-managed maintenance arrangement may have considerable value. We should therefore avoid making either patent ownership or startup formation the sole test of an innovative society.

> Implementation itself is not proof of social benefit. A new service may be commercially successful while excluding low-income users, increasing surveillance or shifting costs onto workers. My preferred development test asks three further questions: does the change improve an important outcome, can that improvement be sustained, and how are its benefits and burdens distributed? This moves the discussion beyond novelty without dismissing the creativity needed to achieve it.

IV A longer history than the industrial revolution

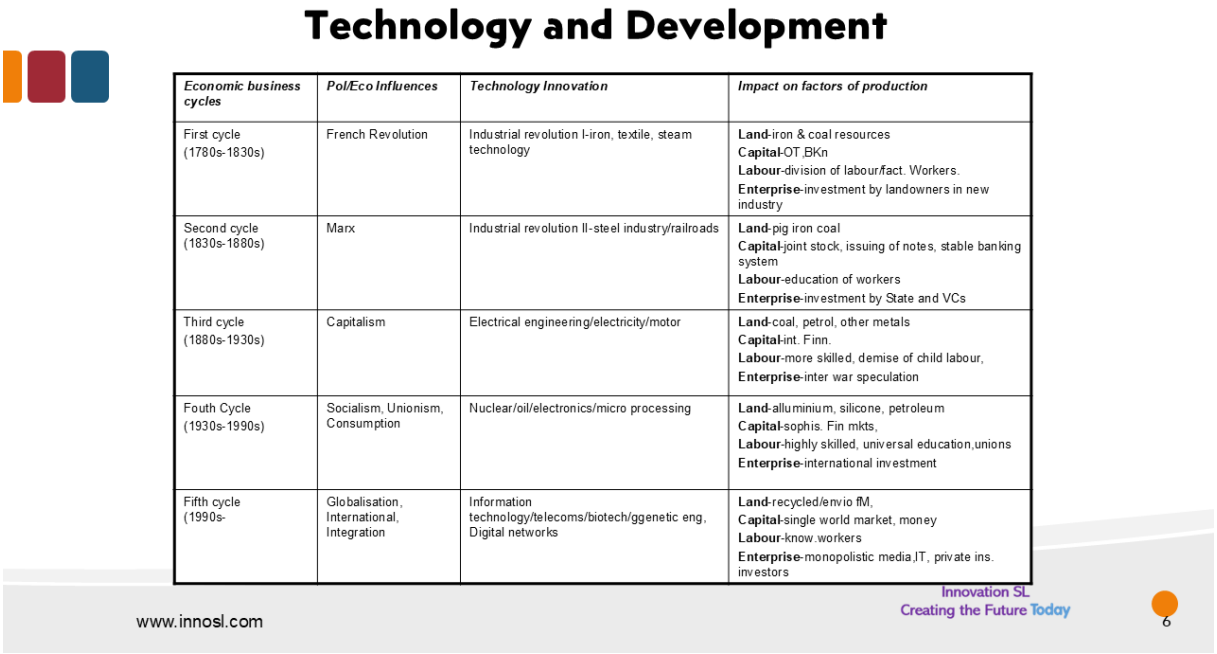
The history of innovation cannot reasonably begin in eighteenth-century Europe. Agriculture, navigation, building, metallurgy, medicine and systems of exchange developed across many societies through observation, experimentation and the movement of people. West Africa's ironworking traditions provide one reminder that African communities were producers of technical knowledge long before contemporary development institutions existed. The Metropolitan Museum's account of iron in West Africa describes both its productive significance and its relationship with specialised craft and social life. [4]

An earlier example from another part of Africa is Imhotep, the ancient Egyptian official traditionally credited with designing King Djoser's Step Pyramid at Saqqara. His architectural legacy offers a useful perspective on innovation: turning an ambitious idea into a built reality requires the

combination of knowledge, materials, skilled labour and organisation. Read through this lens, innovation involves both creative insight and the collective capacity to implement it.

Imhotep also has a personal resonance for me, reflected in my recently published novel, *Camp NoE-The Revelation* . His story invites us to recognise Africa's place in the history of knowledge and technical achievement. For developing countries today, that recognition should encourage a practical question: how do we build the institutions, skills and relationships that enable local ingenuity to become useful, sustained innovation?

This wider perspective matters because the familiar list of great inventions can unintentionally become a hierarchy of civilisations. The wheel, compass, printing press, vaccines and internet are useful teaching examples, and several appear in my notes. But such lists compress collective histories into named objects. They can conceal the craftspeople, translators, technicians, traders, public institutions and users who made those objects workable and widely available. We should teach inventions as entries into a history of connected problem solving.



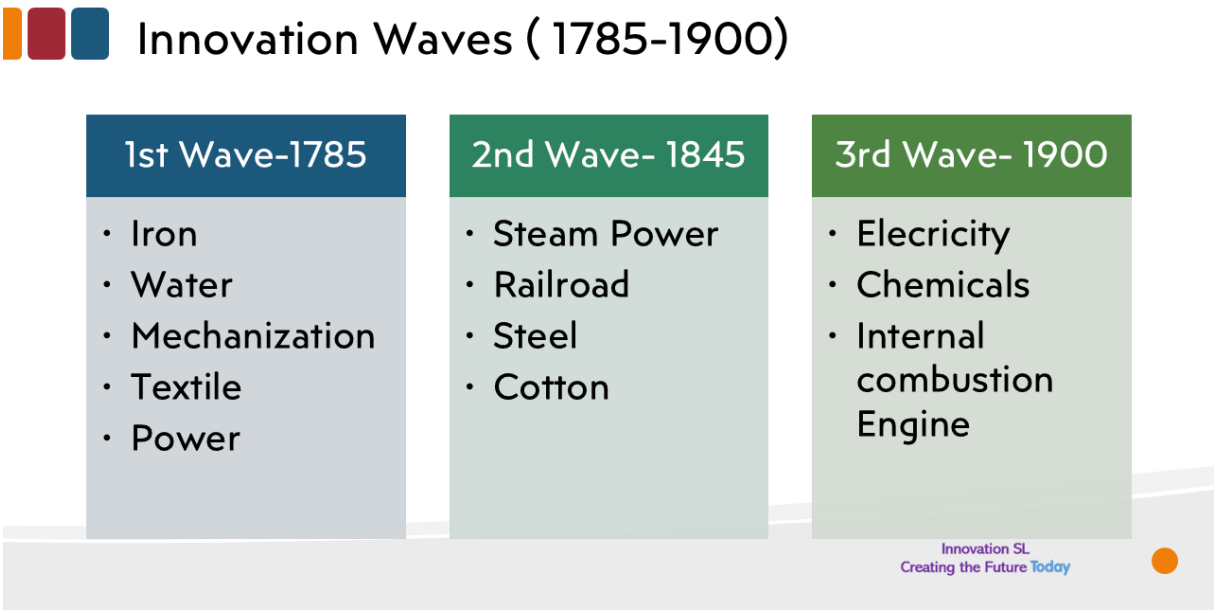
The example of electric lighting is particularly instructive. Edison's contribution included an organised laboratory and work on a practical electric-light system, rather than an isolated flash of individual inspiration. The US National Park Service's account describes his collaborators and the development of the wider electrical system. [5] For a contemporary development strategy, the lesson is straightforward: a device requires complementary arrangements. A solar-powered machine needs installation, operating routines, payment, repair and a useful workload. Funding the visible object while neglecting these arrangements weakens the entire investment.

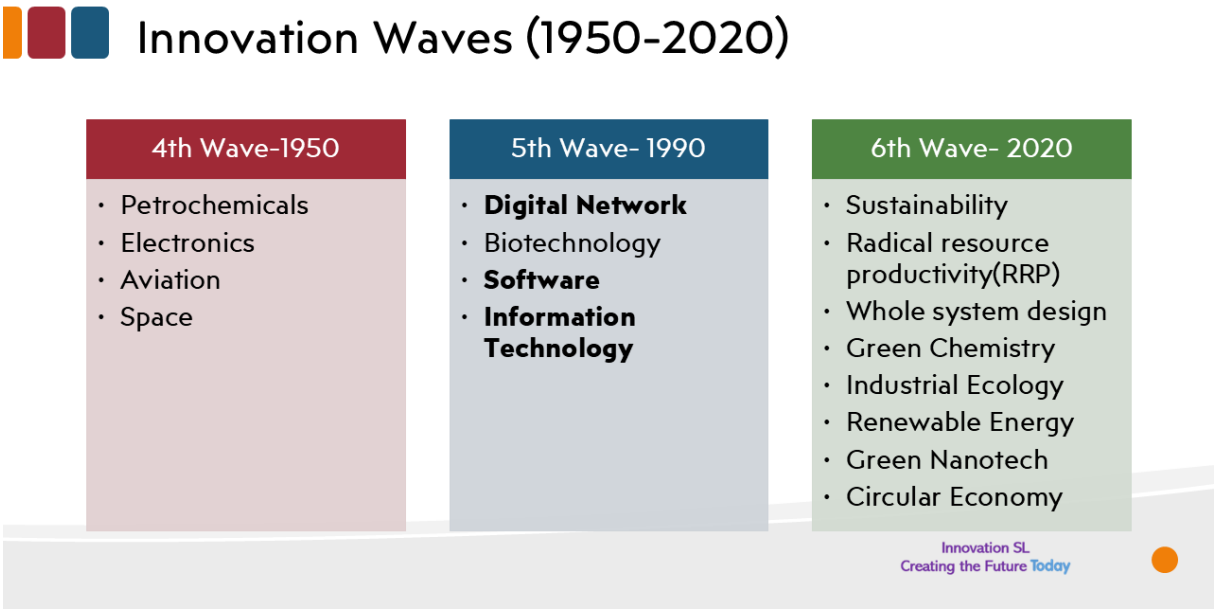
Penicillin provides another distinction between discovery and delivery. Fleming's observation in 1928 was followed by the work of other researchers, including the Oxford team, and by major production efforts that made treatment available at scale. The American Chemical Society documents this progression from discovery through development and manufacture. [6] The implication I draw is that development can depend as much on process engineering, quality assurance and distribution as on the original discovery. Those are demanding fields of innovation in their own right.

The internet likewise emerged through the work of multiple researchers, institutions and technical communities. The Internet Society's history, written by participants in its development, describes both networking technologies and the processes through which systems were connected. [7] It illustrates why shared protocols and sustained coordination matter. For Sierra Leone, access to a global technology is an opportunity to create local services, but those services still depend on affordable access, skills, trust and functioning organisations. Historical invention becomes development only through these further acts of institution building and use.

V Technological waves: useful perspective, imperfect timetable

My notes arrange technological change into waves: mechanisation and textiles; steam, railways and steel; electricity and chemicals; petrochemicals, electronics and aviation; digital networks and biotechnology; and a more recent sustainability-oriented cluster. The accompanying table links technology with changes in land, capital, labour and enterprise. This is a valuable teaching device because it shows that a major technology does more than create a product. It changes what skills are valuable, how production is organised and what infrastructure an economy needs. [1, pp. 3–7]





Nevertheless, the dates in a wave diagram should not be treated as scientific boundaries. Steam, steel, electricity and computing did not arrive everywhere at once, and older technologies did not disappear when newer ones emerged. The long-wave tradition associated with Kondratiev and the innovation-centred approach associated with Schumpeter offer interpretations of economic transformation, rather than a dependable timetable for national development. The notion of innovation as new combinations is especially useful: change may come from reorganising available resources, not only from discovering a new physical principle.

I would also qualify the proposition in the notes that only innovation can overcome depression. Innovation can support productivity and structural change, but economic recovery also depends on demand, finance, political stability and institutional conditions. A technically inventive economy can still experience unemployment or financial crisis. Similarly, describing the period after 2020 as a sustainability wave expresses a direction of possibility and policy ambition. It does not establish that the global economy has already become environmentally sustainable.

Sierra Leone *can* experiences several technological layers simultaneously. The strategic agenda can include basic mechanisation, dependable electricity, digital record keeping and advanced AI applications. Treating these as mutually exclusive stages would be a mistake. A firm might use an AI assistant to understand a maintenance manual while still struggling with a broken bearing or unreliable power. Sophisticated information access and basic productive constraints can coexist within the same workshop.

The practical lesson is to identify combinations that solve present problems while building future capability. Leapfrogging can be possible in a particular service or delivery channel, but it does not abolish the need for complementary skills and infrastructure. We should ask exactly what is being bypassed, what new dependency is introduced and who remains excluded. Otherwise, the language of a new industrial revolution can obscure the ordinary work needed to make technology useful.

VI Development is also a question of power and learning

The spread of industrial technology has never been detached from power. Trade, empire, ownership and control over production influenced who could accumulate knowledge and who supplied labour or materials. A development perspective must therefore examine more than whether a technology reached a territory. It must ask whether people gained the ability to operate it, modify it, produce complementary inputs and participate in decisions about its use. Technology can circulate while valuable knowledge and decision-making remain concentrated elsewhere.

This distinction is still relevant when a country imports software, machinery or consultancy. Importing is not inherently a failure of innovation. The difficulty arises when repeated purchases leave no stronger domestic capacity to diagnose faults, choose suppliers, train workers or design improvements. In that situation, a country may modernise the appearance of its activities while remaining dependent for every significant adjustment. An innovation policy should make the learning content of investment explicit.

The World Bank's Innovation Paradox, by Xavier Cirera and William Maloney, argues that the apparent gains from adopting existing technologies are constrained by missing complementary capabilities and inputs. The presence of a technology elsewhere does not make its productive adoption automatic. [8] My policy inference is that management, maintenance and technical assistance deserve a place in the innovation budget. They should not be treated as administrative expenses that can be removed without changing the prospect of success.

There is also no single developing-country condition. Economies differ in industrial depth, market size, research capacity, fiscal resources and political institutions. A policy appropriate for a large manufacturing exporter may be unsuitable for a small enterprise economy. Even within Sierra Leone, the capabilities of a university laboratory, an urban software firm and a rural processor differ substantially. The appropriate innovation model must be matched to the actor and the task, rather than selected once for the whole country.

This suggests an ambitious but grounded objective: increase the number of problems that Sierra Leoneans can understand and solve through their own organisations, while remaining connected to knowledge elsewhere. Local capability does not require isolation. It requires the ability to choose partners, evaluate claims, negotiate terms and continue learning after an external project ends. That is the form of technological agency that should guide the models we adopt.

VII Closed innovation and the limits of geographical labels

My earlier notes refer to a US-style closed innovation model and a European or early-industrial model. I would now replace those geographical categories with a more precise distinction between organisational arrangements. Neither the United States nor Europe has followed one uniform model. Both have histories of private research, public science, inter-firm learning, collaboration and competition. National labels conceal these differences and can encourage the mistaken belief that choosing a model means copying an entire economy.

In a relatively closed approach, an organisation relies heavily on its own research, development and commercialisation resources, controlling access to important knowledge. This can support

accountability, concentrated expertise and protection of commercially sensitive work. It can be appropriate where safety, confidentiality or tightly integrated engineering makes unrestricted sharing impractical. A food business may collaborate on general quality standards while protecting a recipe. A software company may share interfaces while retaining proprietary components.

The weakness arises when closure becomes a presumption that useful knowledge must originate inside the organisation. This is particularly costly for a small enterprise that cannot employ every specialist it needs. It may duplicate existing work, overlook customer expertise or abandon a potentially useful idea because it lacks an internal route to market. The opportunity cost of isolation can exceed the benefit of control.

Closed innovation is therefore not simply obsolete, despite the stronger wording in my teaching slides. The practical question is what to keep internal, what to obtain externally and what to develop jointly. An organisation needs enough internal knowledge to judge its partners even when it collaborates extensively. In Sierra Leone, I would encourage selective protection within a broadly outward-looking learning strategy. Protection should support useful investment and fair value capture; it should not become an excuse to avoid feedback.

VIII Technology push, market pull and feedback

Technology-push thinking begins with a scientific or technical capability and searches for uses. It remains important because some possibilities cannot be specified through customer interviews before they exist. Research can reveal a new material, diagnostic method or production technique that changes what people can ask for. A country that funds only immediately articulated demand risks weakening the research capacity needed to recognise future opportunities. Technology push becomes problematic when a successful laboratory result is assumed to guarantee a workable product or service.

Market-pull thinking begins with demand. It directs attention to what people need, what organisations will procure and what customers will pay for. This is valuable for entrepreneurs who might otherwise develop an attractive solution with no plausible user. But expressed demand is shaped by income and experience. Poor households may urgently need a service while being unable to finance it individually. Public purchasing, collective payment or a different delivery model may be needed to convert social need into effective demand.

For example, a proposed food-testing service could begin with laboratory capability [3] or with processors' difficulty proving product quality. Either starting point is legitimate. A useful design would connect both: which tests matter, which methods are reliable, how frequently they are needed, what turnaround time is acceptable and who pays. The service might fail because of scheduling or transport even if the analytical method is excellent. These are innovation problems, not peripheral inconveniences.

The chain-linked tradition associated with Stephen Kline and Nathan Rosenberg explicitly challenges a one-directional account. Design, production, markets and the available knowledge base interact,

[3] I recently attended the opening of a Instrument Room at the Chemistry Dept at the FBC. During the demo sessions, I could not help but to think of the commercial opportunities the dept could exploit- food testing among others.

with research called upon when existing knowledge cannot resolve a difficulty. [9] This is closer to the experience of practical development. A customer complaint can send a team back to design; a manufacturing constraint can change the product; an operating failure can create a research question.

My recommendation is to fund these feedback loops. A grant should allow a team to revise a design after a field test and explain why the revision was needed. It should require evidence of learning, rather than reward adherence to an initial specification regardless of results. Time spent understanding a failed trial can be productive if the knowledge changes the next decision. Repeated failure without recorded learning is a different matter.

IX Systems and social networks: making connections productive

Systems-of-innovation thinking shifts attention from an isolated firm to the institutions and relationships through which knowledge is developed and used. Universities, enterprises, finance, public agencies, training providers and standards bodies have different functions, but innovation depends partly on whether those functions connect. My notes explicitly include technological networks and social network theory, recognising that knowledge moves through relationships as well as documents. [1, pp. 8–11, 26]

A systems approach helps explain why a promising venture can stall despite competent founders. A prototype may need testing that is unavailable or unaffordable. A buyer may require consistent volume that depends on working capital. A bank may require records that the enterprise has never been helped to maintain. In each case, another pitch competition may add little. The necessary intervention is to resolve a particular missing connection or service.

The university–industry–government relationship, often discussed as a triple helix, provides a useful starting point. In Sierra Leone, I would widen the working picture to include communities, informal enterprises, civil society and the diaspora. These groups should not merely be consulted after the technical agenda is fixed. They can identify problems, provide operating knowledge and challenge unrealistic assumptions. The point of widening participation is to improve decisions and accountability, rather than to produce a longer list of stakeholders.

Social networks explain part of what formal structures miss. People exchange knowledge when they trust one another, expect reciprocity and have a reason to communicate. Close relationships can sustain difficult work; connections across sectors and locations can introduce unfamiliar information. However, a network can also become exclusive. If opportunities circulate only among familiar organisations, well-connected founders or Freetown-based participants, the system may reproduce the barriers it claims to overcome.

For Innovation SL, the implication I draw from the ecosystem-building material is that convening should lead to observable transactions and learning. [2] A useful connection might result in a test, referral, shared facility, purchase order or design improvement. Attendance numbers do not tell us whether this happened. A practical ecosystem would track where referrals stop, why collaborations break down and whether entrepreneurs outside established circles obtain meaningful access. Networks deserve support when they perform this work consistently.

X Place based innovation and the conditions for local development

Place-based innovation (PBI) adds a question that is essential to the choice of innovation models: where, and with whom, will a proposed approach become useful? I use the term here for an approach that shapes innovation priorities and support around the assets, problems, capabilities and institutions of a particular territory. The place can be a city, a district, a university's surrounding economy or a production corridor. Its boundaries should reflect the relationships through which people work, learn and reach markets. Simply locating a programme outside the capital does not make its design place-based.

This is a complementary organising approach, rather than a universal sequence through which innovation must pass. Technology push and market pull describe starting points; chain-linked thinking describes feedback; open innovation describes knowledge crossing organisational boundaries. PBI asks how these processes should be combined in particular local conditions and who should influence the choices. A national innovation system provides a wider institutional setting. Place-based work examines how that setting functions for people and enterprises in a specific location.

The relevance to developing countries follows from the uneven distribution of productive capability. The article has already argued that access to technology is insufficient without complementary skills and institutions. [8] My inference is that those complements must be examined at the level where adoption takes place. The same equipment, training package or digital service can encounter different conditions in two districts. The appropriate response may vary with transport, seasonal supply, maintenance access, language, trust or the presence of a willing buyer. A common national ambition therefore needs differentiated local implementation.

For Sierra Leone, I would begin by mapping what already works: enterprises, practical knowledge, university capabilities, trading relationships, community organisations and existing support services. This avoids treating a place as an empty space awaiting an imported solution. It also avoids assuming that every existing activity offers a viable growth opportunity. Local assets should be assessed alongside demand, operating costs and the scope for improvement. Priorities should emerge through investigation with affected people, rather than from a list of fashionable sectors.

PBI gives a geographic and institutional expression to ideas that run through my earlier notes: knowledge sharing, tacit learning, trust and creative entrepreneurship. [1, 2] People learn within relationships, and those relationships are shaped partly by proximity and repeated interaction. A place-based approach can make these connections more deliberate through shared testing, local mentoring and collaboration between enterprises and educational institutions. However, proximity alone does not guarantee learning. A network may remain closed to newcomers or circulate the same assumptions unless it connects to outside knowledge.

That is why I see PBI and open innovation as mutually reinforcing. Local participants should help define the problem and judge whether the response works, while universities, suppliers, diaspora specialists and other partners can contribute knowledge that is unavailable locally. The relevant boundary is not a rule that everything must originate within the district or country. It is the responsibility to ensure that collaboration strengthens local capacity and provides fair terms for using the results. A locally grounded innovation system should remain outward-looking.

The cassava-drying partnership discussed below illustrates how this would change programme design. Through a PBI lens, the enquiry would extend beyond a single dryer to the particular production and market area: seasonal root supply, distances between processors and buyers, energy costs, available repair skills and quality requirements. A shared testing service or coordinated delivery arrangement might prove as important as equipment. These are proposed lines of investigation, not established findings about a specific corridor. The local diagnosis should determine which combination deserves a trial.

Other models then perform distinct tasks within that effort. Market pull establishes the buyer's requirements; technology push introduces technical possibilities; user-led and frugal approaches bring operating experience and affordability into design. Chain-linked work allows revisions after testing, and open innovation connects the necessary expertise. A mission could supply a shared outcome, such as reducing avoidable losses, while PBI defines the territory, participants and operating conditions within which that outcome is pursued. Neither the mission nor the place should predetermine the winning technology.

This also clarifies how PBI fits Kizuki. My original framework places education, information literacy and creative entrepreneurship in a relationship with employment, income and living standards. [1, p. 24] PBI helps specify the setting in which those links would have to work: which educational capabilities, which enterprises, which markets and which institutional obstacles? It turns a broad capability ambition into questions that a local partnership can investigate. This is a proposed extension of my framework today; I am not claiming that the 2002 diagram explicitly presented PBI or that the combined approach has been empirically validated.

Practical delivery would require an accountable convenor, willing problem owners, a modest trial budget and clear arrangements for continued use. Innovation SL could help connect participants and document learning, while universities, enterprises, communities and relevant public bodies retain responsibilities suited to their capabilities. Local leadership should include young people, women and informal enterprises in setting priorities. Otherwise, place-based decision-making could simply concentrate resources among the best-connected local actors.

National institutions still have an essential role in infrastructure, standards, finance and coordination across territories. Local partnerships cannot independently remove every constraint they encounter. They should identify which obstacles they can address and which require national action. Equally, a focus on existing strengths should leave room for new activities and external partnerships. The aim is to expand a place's opportunities, not to fix its economic identity permanently around its current limitations.

I would judge this approach through continued adoption, productive improvements and local ability to solve the next problem. Relevant evidence might include repeat orders, reliable maintenance, reduced rejection rates and access to useful services by enterprises previously excluded from support. Learning could then travel to other places, with a fresh assessment of their conditions. What scales is a tested method and usable knowledge; the precise institutional arrangement or technical solution may need to change. In that sense, PBI supports the central argument of this article: development requires the capacity to adapt and learn together.

XI Open innovation as a development strategy

Henry Chesbrough gave open innovation its influential modern formulation in 2003. Its central organisational insight is that firms can use external knowledge and external routes for exploiting their own knowledge, alongside internal development. Berkeley Haas describes practices including partnerships, licensing and spin-offs. [10, 11] This gives structure to an intuition already prominent in my notes: an organisation's boundaries need not be the boundaries of its learning or its opportunities.

Three practical directions are useful. Inbound openness brings external knowledge into an organisation: a processor learns from a supplier, a researcher or an experienced operator. Outbound openness allows knowledge to travel through another organisation's resources or market channels: a team licenses a method or enables another business to manufacture it. Joint development connects participants in a shared effort, with each contributing resources and receiving agreed rights or benefits. These arrangements can overlap within the same project.

For Sierra Leone, I see a strong case for such an approach because the knowledge needed for a practical solution is often distributed. A university may understand a test method, a processor the realities of production, a fabricator the available materials and a buyer the required consistency. An entrepreneur may identify the service model that connects them. An overseas specialist can contribute an important technique, but no participant necessarily understands the whole problem alone.

Open innovation also needs to be distinguished from related concepts. Open-source software grants specified permissions through a licence; the precise obligations depend on that licence. Open science concerns access to and participation in research. Open data concerns access and reuse under stated conditions. Open innovation concerns how knowledge crosses organisational boundaries to support innovation. A collaboration can use proprietary technology, and an organisation can use open-source software without engaging in meaningful collaboration. The terms should not be treated as interchangeable.

Nor is openness costless. Finding a suitable partner, agreeing responsibilities, translating technical language and documenting results take time. Smaller organisations may struggle to contribute to a partnership on equal terms. The management task is to make collaboration proportionate to the problem. A short, carefully scoped trial with clear deliverables can be more useful than a broad agreement promising cooperation across every possible field.

Most importantly, openness must be reciprocal. A community should not supply its knowledge and data while someone else retains all the useful outputs. A university should not contribute unpaid work indefinitely in the hope of future recognition. A small firm should understand what happens to improvements it helps develop. Fair arrangements make collaboration more durable because participants have a reason to continue contributing. In this sense, trust and clear written terms support one another.

XII What an open innovation partnership would require

Consider a proposed partnership to improve cassava drying. This is an illustrative design, not a claim that a particular pilot has achieved results. The starting point would be an agreed problem statement based on observed losses, inconsistent quality or missed sales. Before selecting equipment, the partners would record current practices, energy use, processing time, batch quality and customer requirements. They would also identify whose experience is missing, including workers who operate and clean the equipment.

A small team could combine a processor, a university specialist, a local fabricator and a relevant buyer. Innovation SL could help organise the process and connect technical assistance. The partners would compare available designs, identify what can be adapted and define a limited test. If a proposed dryer improves technical performance but requires unaffordable fuel or unavailable spare parts, that result should change the design. The objective would be a usable production improvement, rather than a demonstration that works only while specialists are present.

Before work starts, the agreement should distinguish knowledge and equipment each participant already owns from results created jointly. It should specify who can use drawings, publish findings, train other businesses or commercialise improvements. It should also state how costs, revenue and liability will be handled. The exact terms need competent local review, but the management principle is simple: discuss rights and responsibilities while interests are still aligned, rather than after something valuable has emerged.

Information can be shared at different levels. A network might publish general maintenance lessons and anonymised trial findings while protecting a processor's prices, worker information and customer contracts. A shared testing protocol can benefit the sector without exposing every participant's commercially sensitive data. Deliberate choices about what is shared make openness more credible. They allow firms to cooperate on common problems while continuing to compete in the market.

The partnership should end its first stage with a decision: continue, adapt, stop or transfer the approach to another setting. That decision should consider unit cost, quality, maintenance, willingness to pay and who can operate the system independently. Documentation and training should be delivered before external support withdraws. A successful open innovation process leaves participants more capable, including when a particular technical option is rejected.

XIII Absorptive capacity: why access is not enough

The concept of absorptive capacity, associated with Wesley Cohen and Daniel Levinthal, concerns the ability to recognise useful external knowledge, understand it and apply it. [12] It provides an essential qualification to enthusiasm about openness. Two enterprises can receive the same manual, training or software and achieve different results because their prior knowledge, management routines and technical resources differ. Access creates a possibility; an organisation must still develop the ability to act on it.

For a small business, this capacity may look ordinary: recording breakdowns, measuring inputs, checking product quality, maintaining accounts and assigning someone responsibility for

improvement. These practices create a memory that survives staff changes and makes outside advice easier to evaluate. Without them, every consultant begins again, and the enterprise may find it difficult to distinguish a persuasive presentation from a technically sound recommendation.

The same principle applies to universities. A laboratory needs technicians, consumables, calibration and predictable access arrangements. A collaboration needs staff time and a way to recognise contributions. Funding a building without these operating provisions can leave impressive infrastructure unable to support regular learning. Applied capability resides in people and routines as much as in equipment, and it deteriorates when maintenance and use are irregular. The fact is that universities in the developing world are supported with state of the art laboratories, but after a few years they fall into disuse and decay. This common failure illustrates the Innovation Paradox in practice, as funders consistently favor capital-intensive equipment grants while neglecting the recurring operational budgets required for consumables, technician training, and regular calibration.

My proposal is to make capability-building an explicit output of innovation support. An enterprise should be able to show what it can now do without assistance: run a test, interpret results, revise a process or negotiate a specification. Training attendance is useful information, but demonstrated competence is a stronger result. This would also change procurement: relevant suppliers would be assessed partly on their ability to transfer usable knowledge, not simply to deliver an item.

XIV Frugal, user-led and development-driven innovation

My notes include a development-driven or technopreneurial model. I would retain this orientation while making the objective more explicit: start from a development problem and identify the technical, organisational, and commercial changes required to address it. This is not a single universally standardised model, but rather a way of selecting and combining approaches. The problem might concern access, productivity, environmental damage, or a missing service, where technology is often only part of the answer.

Within this framing, frugal innovation is vital when it concentrates effort on affordability, robust performance, and the functions users actually need. It should not mean accepting unsafe equipment or permanently lowering expectations for poorer people. Instead, the appropriate question is what can be simplified without compromising essential outcomes. A repairable design with available parts may deliver more value than a complex imported alternative, even when the latter performs better under ideal conditions.

User innovation adds another crucial perspective by recognizing users as active developers of improvements rather than passive buyers. For my purposes, this means taking operators' modifications seriously. A fabricator, farmer, or shopkeeper may have already developed a workaround that reveals both a problem and a potential solution. However, we should not romanticise improvisation, as some workarounds merely compensate for dangerous conditions or absent services. Community knowledge and formal expertise are most effective when they challenge and improve one another.

Finally, reverse innovation, where an approach developed in a lower-income setting finds users elsewhere, is a possible outcome, but it should not become the primary test that validates local creativity. A solution that improves livelihoods locally is important regardless of whether it enters wealthy markets. Wider commercial potential should be assessed on objective evidence, while local public value must be recognised on its own terms.

XV Being precise about radical, architectural and disruptive change

The innovation-type matrix in my slides is useful for initiating discussion, but I would revise it for publication. A diagram based only on new or existing technology and markets cannot reliably distinguish all the concepts placed within it. Incremental and radical describe degrees of change, while architectural innovation concerns relationships among components. Disruption is a particular competitive process. These categories answer different questions and can overlap. [1, pp. 12–14]

Architectural innovation, in Henderson and Clark's formulation, changes how existing components are linked, potentially challenging organisations whose knowledge is organised around the old arrangement. [14] This has relevance for developing economies because substantial improvements can come from system configuration. Combining established collection, processing, energy and payment technologies may require considerable innovation even when none of the individual components is new. The practical difficulty lies in making their interfaces work reliably.

Disruptive innovation should be used more carefully. The Christensen Institute describes entry through simpler, more accessible offerings and movement towards established markets. [15] A new technology serving existing high-paying customers is not automatically disruptive. An AI-enabled service is not disruptive merely because it uses AI. For a proposed Sierra Leone venture, I would ask which previously excluded or overserved users it reaches, how its economics differ and whether it has a credible path to improve over time.

The larger point is that development programmes should not rank every modest improvement below every dramatic idea. An incremental change adopted across many enterprises may create greater immediate value than an unproven breakthrough. Equally, an economy needs room for riskier exploration whose benefits are distant. A balanced portfolio can support both. Decisions should be based on the problem, evidence, potential benefit and available capacity, rather than the prestige of the label attached to the innovation.

XVI Missions, public institutions and practical demand

Mission-oriented innovation policy attempts to organise effort around a defined societal challenge and coordinate instruments that would otherwise remain fragmented. Philippe Larrue's OECD study discusses this approach as a response to weaknesses in strategic direction and policy coordination. [16] For Sierra Leone, the appeal is the possibility of bringing research, enterprise support, procurement and skills development into a common programme of work. The risk is that an expansive mission becomes another slogan without accountable delivery.

A useful mission would specify an outcome rather than prescribe a fashionable technology. For example, a proposed programme could seek to reduce avoidable losses in a defined food corridor, with the target set only after establishing a credible baseline. Different teams might address

handling, storage, transport, quality or buyer coordination. Some solutions could be digital; others might involve equipment or operating procedures. The mission would create coherence while allowing more than one route to the result.

Government has important roles in this arrangement: providing public goods, enabling fair access, setting legitimate standards and becoming a reliable buyer where public demand is appropriate. It should avoid automatically replacing existing delivery organisations with new structures. Universities, firms and entrepreneurship support organisations can carry out defined tasks under transparent arrangements. Responsibilities need to be clear enough that an entrepreneur knows where to obtain a service and who is accountable when it is unavailable.

Public procurement can also help promising solutions reach regular use, but a pilot is not an entitlement to a contract. Trials need fair selection, clear performance requirements and a feasible route to subsequent purchasing. Standards should protect users without becoming unnecessarily expensive barriers to small suppliers. The design challenge is to make experimentation compatible with integrity and predictable payment. A programme that approves innovation but cannot pay reliably can undermine the firms it intends to support.

XVII Artificial intelligence changes the cost of exploration

AI can affect both what is innovated and how innovation is carried out. Predictive systems can support classification or forecasting; generative systems can help produce text, code and design alternatives. Their usefulness depends on the task, the available data and the quality of verification. For a student or small business, the immediate opportunity may be quicker access to explanations and a cheaper first attempt at a prototype. That can widen participation in activities previously requiring scarce specialist time.

I would distinguish three routes for Sierra Leone. The first is using available tools to improve ordinary work. The second is building locally relevant services around existing models, data and workflows. The third is undertaking specialised AI research or model development where there is a credible capability and purpose. These routes have very different resource requirements. A national strategy should not measure seriousness only by the ambition to train a large general-purpose model.

An especially relevant study comes from Sierra Leone itself. In the December 2025 version of Could AI Leapfrog the Web?, Björkegren and colleagues analyse 40,350 queries from 529 teachers over 17 months. They report sustained use of an AI-powered WhatsApp service, lower bandwidth requirements than the web pages used for comparison, and favourable independent teacher ratings of responses. This is a working paper, and these findings should not be interpreted as proof of improved pupil learning or universal AI accuracy. [17]

The implication I draw is that delivery design matters. A low-bandwidth service in a familiar channel may be more useful than an elaborate platform that users cannot afford to access consistently. For entrepreneurship support, a comparable hypothesis would be that a carefully bounded assistant could help founders understand records, prepare questions or navigate approved guidance. It would still need local testing, human escalation and a viable operating budget.

AI could also support open innovation by helping teams search documentation, translate technical language, compare designs and organise experimental findings. But generated suggestions remain

hypotheses. A model cannot verify a processor's actual throughput by producing a plausible number, nor establish customer demand by inventing a persuasive interview response. In an innovation programme, the evidence trail should distinguish observations, calculations, external sources and machine-generated proposals.

> Lowering the cost of producing a prototype can shift the scarce resource towards evaluation. If many more ideas can be generated quickly, programmes need stronger problem definition and selection. Teams should be asked what would disprove their assumption and what evidence would justify further spending. AI therefore increases the value of disciplined inquiry. It gives another reason to connect technical capability with the habits of observation and experimentation already emphasised in my notes.

XVIII AI, openness and a new risk of dependence

The language of open AI requires particular care. Access to a chatbot is not ownership of its underlying model. Access to model weights does not necessarily provide the training data, full development process or unrestricted rights of use. A downloadable system may still require substantial computing resources and technical maintenance. Teams should examine the actual permissions and requirements of the system they propose to use, instead of assuming that the word open settles the question.

Dependence can arise through service pricing, incompatible data formats, a single supplier or a workflow that local staff cannot maintain. These risks suggest practical design choices: exportable records, clear documentation, an exit plan and the ability to change providers where feasible. Domestic capability need not mean building everything domestically. It means retaining enough knowledge and control to make choices when conditions change. This is the same concern that appears in the history of imported machinery, now expressed through software and data.

There are also questions of accuracy, privacy and representation. A system may perform unevenly across language varieties or produce confident errors about local institutions. Sensitive business or personal information should not be placed in an external service without a legitimate basis and appropriate arrangements. UNESCO's Recommendation on the Ethics of Artificial Intelligence places human rights, fairness, transparency and human oversight at the centre of responsible use. [18] These principles have practical implications for who reviews outputs and how users can challenge a decision.

The African Union's Continental AI Strategy provides a regional frame for development-oriented and responsible AI, including cooperation and capacity-building. [19] My inference is that Sierra Leone should pursue useful regional collaboration on skills, evaluation and infrastructure where joint provision makes sense. Regional cooperation can expand options without requiring every country to replicate every costly resource. Local participation is still necessary to ensure that shared systems reflect local needs and constraints.

AI may improve some jobs, change others and remove demand for particular tasks. It is therefore unwise to assume that access automatically produces employment growth. A programme should examine whether adoption increases output, strengthens workers' capabilities or merely reduces

paid work without creating alternatives. Education should prepare people to question and supervise systems as well as operate them. The distribution of benefits will depend on organisational decisions and public policy, not simply on technical performance.

XIX What I want students to learn about open innovation

My encouragement to FBC students to embrace open innovation is not an invitation to substitute other people's work for their own understanding. It asks them to become better collaborators and more capable evaluators. They should be able to identify useful knowledge, give proper credit, understand the conditions of reuse and contribute something themselves. These are professional habits that remain valuable whether they become entrepreneurs, managers, researchers or public servants.

A teaching exercise I would develop further begins with a problem outside the classroom. Students would observe a work process, speak with people affected and distinguish evidence from assumptions. They would then identify relevant existing solutions and the people whose knowledge could improve their understanding. The assignment would reward the quality of the investigation, not simply the novelty of the final pitch. A team that discovers its first idea is unnecessary has learned something valuable if it can explain the evidence.

The next stage would be a limited test with a partner. Students would record what they expected, what happened and what they changed. They would also discuss how contributions are recognised and what information can be shared. This introduces open innovation as an actual working arrangement. It teaches that collaboration includes negotiation, documentation and reliability, rather than ending with the exchange of contact details.

AI can support this process, provided its use is visible. Students could use it to explore questions or draft a prototype, then submit a record of what was generated, what they checked and what they rejected. Oral explanation and direct observation would help establish their understanding. A convincing AI-written business plan should not be accepted as evidence that a customer exists. The educational objective is independent judgement strengthened by access to others' knowledge.

The different roles listed in my notes also remain useful: observer, experimenter, collaborator, cross-pollinator and storyteller, among others. These echo Tom Kelley and Jonathan Littman's The Ten Faces of Innovation and should be attributed accordingly. [1, pp. 17–19; 20] Students need not all perform the same role. A strong team needs people who notice, test, organise and communicate. Recognising this diversity can make innovation education more inclusive than a model that rewards only the most confident presenter.

XX Revisiting Kizuki: a model built around capability

The Kizuki diagram in my notes links education and information literacy with creative entrepreneurship, new products and services, employment, income and rising living standards. It gives diaspora engagement a role as a source of knowledge and skills and includes open-source solutions, entrepreneurship training and adult education. The slide identifies the model as first developed in 2002. [1, p. 24] Its central concern was the ability to participate productively in an economy increasingly shaped by knowledge.

I would retain that concern while making the causal links more conditional. Education does not automatically produce a viable enterprise. An enterprise does not automatically create decent work. Income does not automatically become productive investment. These transitions depend on demand, infrastructure, access to resources and the distribution of opportunity. The model is therefore best presented as my organising framework for action and inquiry, rather than as a validated predictive theory.

> An updated Kizuki approach would begin with people's capabilities and a well-defined problem. It would connect them to external knowledge, support an appropriate experiment and help establish the commercial or public-service arrangements required for sustained use. It would then examine the results and return that learning to education and enterprise support. Open innovation would connect the stages; AI could assist several of them; neither would remove the need to test outcomes.

Place-based innovation would provide the setting for this updated Kizuki cycle. Education and information literacy would be connected to identified opportunities in a particular community, district or productive corridor; external knowledge would enter through open collaboration; and evidence from use would return to teaching and enterprise support. Kizuki expresses the capability ambition, while PBI helps organise its application under identifiable local conditions.

The diaspora role should also be practical. Contributions could include remote technical review, supervised student projects, introductions to specialised knowledge or short assignments focused on a defined bottleneck. Their value would depend on what local participants can do afterwards. A lecture or visit can be useful, but a documented method that a local team can apply repeatedly may create more lasting capability. The relationship should allow learning in both directions.

This version of Kizuki also makes room for people whose route is not startup creation. A skilled technician, cooperative manager, researcher or employee improving a production process can contribute to innovation-led development. Broadening participation in this way strengthens the original intention of the model. The objective is a society with more opportunities to create and use knowledge, rather than an expectation that everyone must become a founder.

XXI Choosing models for the task

A synthesis of the approaches discussed in this article; these are complementary choices at different levels, not competing national identities.

Innovation Approach	Useful starting point	Sierra Leone application	Main condition or risk
Closed / internal	Sensitive or integrated development	Protect a recipe or core design	Maintain access to outside learning
Technology push	New technical capability	Explore uses for laboratory research	Verify demand and delivery costs
Market pull	Observed demand or unmet need	Design a service with actual buyers	Need may exceed ability to pay
Chain-linked	Iterative design and testing	Revise equipment after field trials	Fund feedback and redesign
Systems / networks	Missing services and connections	Connect testing, finance and firms	Avoid exclusive networks and duplication
Open innovation	Distributed expertise and resources	Joint development with clear rights	Build capability and fair value sharing
User-led / frugal	Local experience and constraints	Adapt for repairability and affordability	Test safety; avoid inferior provision
Mission-oriented	A defined societal outcome	Coordinate a food-loss programme	Specify ownership, budget and evidence
Place-based innovation	Local assets, needs and institutions	Coordinate adaptation in a defined corridor	Ensure inclusion, external links and local ownership
Development-driven / Kizuki	Capability and participation	Link education, enterprise and adoption	Test the links to sustained livelihoods
AI-assisted	A bounded information or design task	Support guidance and prototyping	Verify outputs and operating costs

Source: author's synthesis of the supplied notes and the frameworks referenced in the text. The PBI application is the author's synthesis of the local-capability and collaboration arguments. AI is an enabling capability, not a replacement for an innovation model.

XXII A practical portfolio for Sierra Leone

My notes propose criteria for choosing models: their knowledge focus, availability, practical usefulness, potential for local development, documentation and implementation requirements. [1, p. 27] I would retain those questions and add affordability over the full operating life, local ability to maintain the solution, terms of reuse, distribution of benefits and the strength of demand. The resulting approach would select a portfolio of interventions instead of announcing one model as the national answer.

One part of that portfolio should support broad enterprise improvement: better production methods, quality, records and maintenance. Another should support collaborative adaptation around well-defined sector problems. A smaller, deliberately selected part can support research with greater technical uncertainty and longer time horizons. These activities need different evidence and financing arrangements. Expecting every initiative to attract venture capital would exclude valuable improvements with different growth patterns and revenue structures.

The portfolio should also have a place-based dimension. I would select initial locations through transparent criteria: the significance of the problem, existing capabilities, willingness to collaborate, market or public-service demand and the scope to include underserved participants. Each location would need its own diagnosis and operating plan, linked to national services. This would allow a common learning framework without assuming identical interventions across Sierra Leone.

There is already a public digital-development effort to connect with: the official Sierra Leone Digital Transformation Project describes a World Bank-funded programme supporting connectivity, digital skills and public digital services. [21] That does not prove that all intended benefits have been delivered. It does mean proposed innovation activities should establish where they can use or complement existing provision. New programmes should begin with an inventory of functioning services and genuine gaps, including the organisations already providing support.

As a proposed first phase, I would select a small number of practical challenges with willing users and identifiable problem owners. Over an initial six months, the work would establish baselines, map relevant knowledge and agree limited trials. A subsequent phase would compare results, strengthen operating capability and assess continued use. Scaling would follow evidence of demand and reliable delivery. These are suggested stages for design, not a claim that a funded national programme has been agreed.

Innovation SL could contribute as a connector and capability-building organisation, working with universities, other support organisations, enterprises and public institutions. The role should be defined through deliverables: functioning referrals, completed tests, documented improvements and ventures obtaining appropriate support. A healthy system would allow several organisations to perform complementary roles and would make their services understandable to users. Local leadership should be demonstrated through responsibility and learning, not claimed through institutional ownership of the entire ecosystem.

XXIII Measuring what survives the pilot

The easiest innovation indicators are often the least conclusive: ideas submitted, people trained, prototypes displayed and events held. These are useful measures of activity, but they cannot establish that a service is used or an enterprise has become more productive. A first set of outcome measures should therefore examine continued use, reliability, quality and actual demand. A pilot that is abandoned when free support ends needs a different assessment from one that users continue to operate and finance.

At enterprise level, relevant evidence might include reduced rejection rates, lower operating costs, repeat purchases or improved delivery consistency. **At capability level**, it might include independent operation, successful maintenance or the ability to conduct a further experiment. **At system level**, it might include faster access to testing, successful referrals or more participation from previously excluded groups. The measures should be selected for the problem; collecting every possible number can become a burden that discourages participation.

Evaluation should also avoid attributing every improvement to the programme. Baselines, comparable observations and follow-up can help distinguish the contribution of an intervention from seasonal changes, market conditions or other support. The strength of the claim should match the strength of the evidence. A small pilot can establish feasibility and generate hypotheses without proving national impact. Publishing that distinction would improve the quality of ecosystem learning.

Finally, unsuccessful trials should leave useful records. Why did the equipment fail? Why did users stop returning? Which assumption about payment was wrong? A shared account can prevent other teams from repeating an avoidable mistake, provided confidential information is protected. Open innovation includes sharing well-documented limits as well as successes. That is one way for publicly supported experimentation to produce value beyond the immediate recipient.

XXIV The future belongs to societies that can learn together

Returning to these notes has reinforced my belief that innovation belongs at the centre of development thinking. It has also made me more cautious about simple sequences: invention does not automatically become innovation, innovation does not automatically diffuse, and diffusion does not automatically produce shared prosperity. Each transition requires people, institutions and practical arrangements. Understanding those transitions is where a useful innovation model earns its place.

Sierra Leone should keep its ambition to invent while becoming much better at adapting, combining and improving what already exists. Technology push can expand possibilities; market pull can establish relevance; feedback can improve design; systems thinking can identify missing connections; and open innovation can bring distributed knowledge into productive use. Place-based innovation can ground that combination in local assets, participation and operating conditions. Development priorities should guide the combination. There is no reason to choose between curiosity about the frontier and serious attention to the constraints of an ordinary enterprise.

AI increases both the possibilities and the responsibility. It can help more people explore ideas, but it can also multiply confident errors and deepen dependence on systems they do not understand. The answer is stronger judgement, practical competence and fair collaboration. These are also the habits I want my students to develop when I encourage them to embrace open innovation.

The aspiration behind Kizuki remains relevant: people should gain the knowledge and opportunity to participate creatively in the economy and improve their standard of living. Today I would express the task through a more explicit commitment to shared learning. We need institutions that help knowledge travel, enterprises that can put it to work, and public choices that make the benefits more widely accessible. That is how the history of invention can become a future of development shaped by Sierra Leoneans themselves.

XXV References and source notes

The references distinguish the author's supplied materials from external evidence. Web sources were checked on 8 September 2026. Source-linked claims in the text use bracketed reference numbers; proposed applications and policy recommendations are the author's analysis. Historical classroom categories are discussed critically rather than treated as settled classifications.

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