



Article

Extending Sustainable Advantage based on John Kay's Distinctive Capabilities, to include Schumacher's Intermediate Technology with applications to Botany etc.

Florentin Smarandache ¹, Victor Christianto ^{2,*}

¹ Dept. Mathematics and Natural Sciences, University of New Mexico, Gallup, NM, USA. Email: smarand@unm.edu

² Dept. Forestry, Malang Institute of Agriculture, East Java, Indonesia. Email: victorchristianto@gmail.com

* Correspondence: victorchristianto@gmail.com

Received: 11 30, 2025; Accepted: 12 12, 2025.

Abstract: It is known that John Kay's Distinctive Capabilities Framework [1] offers a profound and nuanced understanding of organizational achievement, shifting the focus from the static possession of significant assets (Resource-based approach) to the dynamic cultivation of enduring relational contracts (Relationship-based approach). Kay identified three essential capabilities—*Architecture, Reputation, and Innovation*—as the non-replicable sources of performance and sustainable advantage. These capabilities encapsulate "what makes our organization so special," rooted in the continuity and stability of relationships with customers, suppliers, shareholders, and employees. While conceptually powerful, Kay's framework, in its original form, often lacks the operational precision required for modern execution, and the present article is an attempt to fill the gap. Moreover, in this article we also extend Sustainable Advantage based on John Kay's *Distinctive Capabilities* framework, to include Schumacher's *Intermediate Technology* with applications to Botany etc., for instance new innovative solutions such as laser-culture, gravitational water vortex power plant, confined vortex turbine, new fusion energy theory based on PT-symmetric potential of crystals, and also a plausible new approach to turn plastic waste into biofuel.¹ While several of those innovative solutions are still in "lab scale" phase, it can be expected to yield quite significant results in the near future, especially for less developed countries.

¹ See for instance, our previous articles in, BPAS Journals – Botany section. And also our recent articles, Christianto, Smarandache, Umniyati, ref. [15-17].

Keywords: John Kay, distinctive capabilities framework, Schumacher, plastic waste, PT-symmetric potential, Extended Sustainability Advantage, responsible research and innovation

1. Introduction: The need for measurable distinctiveness

It is known in literature that John Kay's *Distinctive Capabilities* Framework offers a profound and nuanced understanding of organizational achievement, shifting the focus from the static possession of significant assets (Resource-based approach) to the dynamic cultivation of enduring relational contracts (Relationship-based approach). Kay identified three core capabilities—Architecture, Reputation, and Innovation—as the non-replicable sources of excellence performance and sustainable advantage. These capabilities encapsulate "*what makes our organization so special*," rooted in the continuity and stability of relationships with customers, suppliers, shareholders, and employees.

While conceptually powerful, Kay's framework, in its original form, often lacks the operational precision required for modern execution [1]. Theory of planning demands not only *what* to focus on but *how* to measure progress and *when* to adjust course. The abstract nature of "Architecture" or "Reputation" can leave managers without clear metrics, making it challenging to link investments directly to capability development [2][3].

The present article outlines a reformulation of the Distinctive Capabilities Framework, leveraging the principles of **management by measurement** popularized by figures like John Doerr and the Objectives and Key Results (OKR) methodology [6]. By translating Kay's conceptual strengths into a structured, quantifiable system, we create the Distinctive Capabilities Maturity Model (DCMM). This DCMM approach is designed to be as operational and integrative as frameworks like the Risk Maturity Index, providing a clear roadmap and measurable scorecard to guide the organization toward distinctive excellence [4].

2. Methods

We utilized literature survey of relevant books and journal articles, especially those relevant to themes related to John Kay's distinctive capabilities. We also discuss, among other things, how to extend Kay's distinctive capabilities in order to achieve extended Sustainable Advantages. Several examples of responsible research are also discussed.

3. Results

I. The Essential Framework: Kay's Distinctive Capabilities

Before operationalizing the framework, it is essential to re-examine Kay's three capabilities through the lens of measurement potential.

A. Architecture (Relational Structure)

Architecture refers to the intricate structure of internal and external relational contracts. It embodies tacit organizational knowledge, shared routines, and the ease of information exchange that allows for flexible, collaborative responses to change. Distinctive Architecture is a collective interest sustained by mutual commitment and trust, generating value through coordination.

The Measurement Challenge: Architecture is largely intangible. Measuring it requires quantifying the health and efficiency of relationships and knowledge flows, rather than simply counting assets.

B. Reputation (Information Signal)

Reputation serves as a powerful signal of quality and intent to customers, especially when information asymmetry makes informed decisions difficult. Built over time through consistent experience, quality signals (price, promotion), and word-of-mouth, a strong reputation reduces transaction costs and builds a sequence of trust-based relationships.

The Measurement Challenge: Reputation is often measured reactively (e.g., via brand surveys). Operationalizing it requires metrics that track the *antecedents* and *consistency* of the reputation signal itself.

C. Innovation (Sustainable Uniqueness)

Innovation is an undeniable source of distinctiveness. However, Kay noted that successful innovation is often neither sustainable nor easily appropriable, as it quickly attracts imitation. Transforming an innovation into a lasting competitive advantage requires a range of supporting strategies that protect and leverage the initial breakthrough.

The Measurement Challenge: Simply counting patents or new product launches is insufficient. The key is measuring the **appropriability**—the ability of the firm to capture the value of its innovation—and its contribution to long-term revenue streams.

II. The Operational Imperative: Bridging Kay and Doerr

The leap from conceptual capability to measurable action is best facilitated by the OKR methodology. John Doerr's principle, "*Measure What Matters*," advocates for setting an Objective (what is to be achieved) and coupling it with a set of measurable Key Results (KRs) (how we know we achieved it). By applying this framework, Kay's distinctive capabilities can be transformed into actionable strategic mandates.

A. Operationalizing Architecture: The Efficiency and Trust OKRs

Architecture is operationalized by measuring the quality of coordination and the depth of trust within the organization and across its value chain.

Table 1. Operationalizing Architecture based on OKR Framework

Objective (O)	Key Results (KR)	Kay's Rationale
O: Achieve Best-in-Class Internal Knowledge Transfer Efficiency.	KR1: Reduce time-to-onboard new employees/project members by 30% through codified routines.	Measures organizational knowledge and routines efficiency.
	KR2: Increase the percentage of cross-functional projects delivered on-time and under budget to 95%.	Measures flexible response to change and coordination.
O: Cultivate a Collaborative and Resilient External Value Chain Architecture.	KR3: Achieve a Supplier Relationship Index (SRI) score of 4.5/5.0 with top-tier suppliers.	Measures the relational contracting strength with suppliers.
	KR4: Decrease average B2B customer issue resolution time requiring cross-party communication by 40%.	Measures open exchange of information and collective problem-solving.

B. Operationalizing Reputation: The Signal Consistency and Trustworthiness OKRs

Reputation is operationalized by measuring the reliability of the quality signal and the depth of customer/stakeholder trust it generates.

Table 2. Operationalizing Reputation based on OKR Framework

Objective (O)	Key Results (KR)	Kay's Rationale
O: Establish an Unimpeachable Brand Reputation for Quality and Ethics.	KR1: Achieve and sustain a Net Promoter Score (NPS) of 70+ in core customer segments.	Measures customers' own experience and willingness to recommend.
	KR2: Reduce the volume of negative social media mentions across all platforms by 50% relative to industry average.	Measures the strength and protection of the quality signal.
O: Transform Reputation into a Tangible Competitive Differentiator.	KR3: Increase the price premium over the closest competitor to 15% without loss of market share.	Measures the commercial value of the reputation signal (willingness to pay).
	KR4: Achieve 80% customer retention solely through brand loyalty (excluding contractual lock-in).	Measures the ability to build a relationship based on trust and prior reputation.

C. Operationalizing Innovation: The Appropriability and Diffusion OKRs

Innovation is operationalized by measuring the effectiveness of methods that support and protect the initial innovation, ensuring its value is captured by the firm and not quickly imitated.

Table 3. Operationalizing Innovation based on OKR Framework

Objective (O)	Key Results (KR)	Kay's Rationale
O: Develop a Sustained Pipeline of Defensible, Market-Leading Innovations.	KR1: 35% of annual revenue derived from products/services launched in the last three years.	Measures the long-term success and reliance on recent innovation.
KR2: Increase the 'Patent Strength Index' (a measure of patent breadth and enforceability) by 15% annually.	Measures appropriability (the ability to protect the innovation).	
O: Embed Innovation into the Organisational Architecture for Rapid Diffusion and Adaptation.	KR3: Reduce the time-to-market for innovations from concept to commercial scale by 25%.	Measures the supporting strategies required to commercialize innovation efficiently.
KR4: Increase the number of successful cross-platform (internal/external) technology transfers by 50%.	Measures the effectiveness of linking Innovation back to Architecture.	

III. The Distinctive Capabilities Maturity Model (DCMM)

To move beyond episodic OKR measurement toward continuous evaluation, we introduce the Distinctive Capabilities Maturity Model (DCMM). The DCMM serves as the integrative framework, similar to a Risk Maturity Index or the Competencies Maturity Index, to assess the current state of each capability on a structured, five-level scale. This framework allows the organization to benchmark progress and allocate resources more effectively (see for instance Antonucci, 2016).

The five maturity levels, inspired by the Capability Maturity Model Integration (CMMI), are:

Table 4. Operationalized Kay's framework into Distinctive Capabilities Maturity Model

Level	DCMM Name	Description	Score (out of 5.0)
1	Initial (Ad Hoc)	Capability is largely undefined, reactive, and reliant on individual heroism. Outcomes are unpredictable.	1.0 - 1.9

2	Managed (Repeatable)	Basic processes exist, often localized, but are managed and tracked. Success is repeatable, but not yet standardized across the organization.	2.0 - 2.9
3	Defined (Standardized)	The capability (e.g., the relational contract structure or reputation signalling) is clearly documented, standardized, and integrated across all relevant business units.	3.0 - 3.9
4	Quantitatively Managed (Measured)	The capability is managed using specific, data-driven metrics and OKRs. Performance is predictable and variances are understood and controlled.	4.0 - 4.4
5	Optimizing (Distinctive)	The organization is focused on continuous process improvement and adaptation.	4.5 - 5.0

DCMM Scoring and Radar Chart Visualization

The DCMM assigns a quantifiable score (Level 1.0 to 5.0) to each of the three capabilities (Architecture, Reputation, Innovation) based on the criteria in the table above and the achievement of their corresponding OKRs.

This framework is best presented visually through a **Radar Chart**, just like the Core Competencies Maturity Index. The chart plots the three DCMM scores on distinct axes, creating a unique signature for the organization's distinctiveness. A large, balanced polygon indicates high, sustainable, and well-managed distinctive capabilities.

The primary function of the DCMM is to diagnose the organization's competitive edge:

1. Identify Gaps: Low scores (e.g., Innovation at 2.1) signal an urgent need for targeted investment and a renewed OKR cycle.
2. Ensure Balance: A heavily skewed chart (e.g., high Reputation, low Architecture) suggests a brittle advantage, where a change in the market could quickly undermine the single strength.
3. Benchmark Progress: Quarter-over-quarter improvements in the DCMM score demonstrate the success of the overarching methods and the OKR execution.

IV. Implementation: From Measurement to Action

The operationalization of Kay's framework is complete only when the DCMM and its supporting OKRs are fully integrated into a firm's annual cycle.

The ultimate goal of this reformulation is to make Kay's relationship-based approach a practical reality. By continuously measuring and managing Architecture, Reputation, and Innovation, the organization ensures that its superior performance is not accidental or temporary, but rather the predictable outcome of deliberate investment in its distinctive strengths.

- A high **Architecture** score guarantees a low-cost, flexible, and efficient response to market changes.
- A high **Reputation** score provides a premium in pricing and a buffer during crises, reducing the cost of sales.
- A high **Innovation** score, particularly in its **appropriability** elements, ensures that R&D investments yield proprietary value that competitors cannot easily erode.

When the Overall Weighted Average of the DCMM pushes into Level 4 (Quantitatively Managed) and approaches Level 5 (Optimizing), the organization is no longer just *performing well*; it has attained a **sustainable, measurable, and properly managed advantage**—the ultimate promise of John Kay's profound framework, now equipped with the operational rigor of modern management science.

4.Applications

Plausible ways to extend John Kay's *Distinctive Capabilities*, to include Schumacher's Intermediate Technology with applications to Botany etc.

The pursuit of Sustainable Competitive Advantage (SCA) often focuses on a firm's internal resources and market position, as articulated by John Kay's concept of Distinctive Capabilities. These capabilities—rooted in Architecture (relationships/reputation), Reputation, and Innovation—offer a robust framework for long-term organizational achievements. However, in an increasingly resource-constrained world, this framework must be broadened to incorporate a fundamental principle: that economic activity must serve humanity and the planet.

This article proposes an extension of Kay's model to include E.F. Schumacher's "Intermediate Technology" (which can be conceptualized as "*development as if people mattered*"). By weaving Schumacher's focus on appropriate, human-scale, and environmentally benign technologies into the essence of an organization's distinctive capabilities, we can cultivate a truly Extended Sustainable Advantage (ESA) that is economically resilient, socially responsible, and ecologically regenerative.

Schumacher's Philosophy and the Imperative for Appropriateness

Schumacher's seminal work, *Economics as if People Mattered*, challenged the relentless pursuit of large-scale, capital-intensive technology characteristic of mainstream economics. He advocated for **Intermediate Technology**: methods and tools that are *small* enough to be accessible to local communities, *simple* enough to be maintained without highly specialized expertise, and *non-violent* toward both people and nature.

The essential tenets of this philosophy, which underscore the development of ESA, are:

- **Human Scale:** Technology should enhance human skill, not replace it, and should be comprehensible at the local level.

- **Ecological Soundness:** It must operate within natural limits and promote the regeneration of resources.
- **Accessibility:** Low budget and local material sourcing ensure widespread adoption, especially in developing countries or marginalized communities, whom often have budget constraints.

Intermediate Technology as a Distinctive Capability

When viewing Schumacher's *Intermediate Technology* through the lens of John Kay's Distinctive Capabilities, its value becomes clear:

Table 5. Comparison between Kay's capability and Extended Sustainability Advantage

Kay's Capability	Integration with Schumacher's Technology	Extended Sustainable Advantage (ESA)
Architecture	Fostering local, participatory development of technology, emphasizing knowledge-sharing over proprietary secrets.	Creates trust, community resilience, and a robust supply/knowledge network that is geographically dispersed and less prone to single-point failure.
Reputation	Being known for ethical sourcing, sustainable production, and genuine community empowerment.	Strong, authentic customer loyalty and social license to operate, appealing to socially conscious consumers and investors.
Innovation	Focusing R&D on simple, elegant, and resource-efficient solutions inspired by natural processes (to learn from Nature, as Schauberger wrote).	Generates low-budget, resource-frugal, and easily adaptable technologies that circumvent high capital barriers and appeal to vast, underserved markets.

By prioritizing "**appropriate innovation**," companies build an architectural advantage rooted in mutual local dependence and a reputational advantage of true organizational/community responsibility.

Intermediate Technology in Action: Botany and Water-Scarce Farming

The agricultural sector, particularly in water-stressed regions, offers a vital application for this Extended Sustainable Advantage model. Here, the integration of innovative, yet appropriate, technology can address both ecological necessity and market demand.

1. Botany-Inspired Techniques: Electric-Culture and Laser-Culture²

² See for instance, our previous articles in, BPAS Journals – Botany section.

In drylands, reducing water consumption is paramount. Instead of relying solely on capital-intensive desalination or deep-well pumping, ESA suggests investing in technologies that *enhance plant efficiency* with minimal external input.

- **Electric-Culture:** This technique involves using low-level atmospheric electricity or electric fields to stimulate plant growth. Research suggests that it can enhance growth, improve drought tolerance, and potentially reduce the need for certain fertilizers and pesticides. While its mechanisms in botany are still being explored, its application—often involving simple wire antennae or buried conductors—is inherently **intermediate**: low-budget, low-energy (potentially solar-powered), and manageable by local farmers. This addresses water scarcity by requiring less water per unit of yield.
- **Laser-Culture (Biostimulation):** The precise application of low-power lasers at specific wavelengths to seeds or young plants has shown potential for biostimulation, leading to improved germination rates, increased vigour, and enhanced resistance to stress. Used for seed treatment before planting, this can be a simple, non-chemical way to maximize the potential of a limited water supply, embodying appropriate innovation through highly focused energy use.

Both of these "high-tech" concepts are re-imagined through the Intermediate Technology lens: they are applied in a targeted, resource-light manner to boost the natural capabilities of the plant, rather than forcing growth through chemical or brute-force irrigation.

2. Schauberger's Implosion and the Gravitational Water Vortex

Schauberger, the Austrian forester and inventor, championed the idea of learning from nature, particularly the role of the vortex in water and air dynamics. He believed conventional technologies were "violent" (exploiting pressure and heat) while nature's processes were "implosive" (utilizing cooling, suction, and spiralling motion).

The **Gravitational Water Vortex Power Plant (GWVPP)** is a direct embodiment of this insight and an exemplary Intermediate Technology for energy generation and water remediation.

Principle: Water is channelled into a round basin where it forms a stable, powerful vortex over a central drain. This vortex drives a low-speed turbine that generates electricity. The required hydraulic head is very low (less than 3 meters).

Distinctive Advantage (Reputation & Architecture): The GWVPP is not only an energy generator but also a water health device. The gentle, spiralling flow (implosion) naturally aerates and "vitalizes" the water, minimizing damage to aquatic life (fish passage is often unharmed) and mimicking the self-healing process of a natural river. This holistic benefit of simultaneous power generation and environmental restoration create a powerful reputational advantage far surpassing conventional

micro-hydro plants. Its simplicity, low maintenance, and fish-friendliness make it ideal for decentralized, local-level power architecture.

The Path to Extended Sustainable Advantage

As the world faces complex challenges of climate change, resource depletion, and growing inequality. Relying solely on the traditional model of Sustainable Competitive Advantage, which often prioritizes profit and market share above human and ecological cost, is insufficient. It is our consideration here, that Extended Sustainable Advantage (ESA), built on the synergistic basis of Kay's Distinctive Capabilities and Schumacher's Intermediate Technology, offers a powerful way forward. By deliberately choosing to innovate for human scale and ecological health—as demonstrated by appropriate innovations like electric-culture in dryland farming and the gravitational water vortex power plant—firms can unlock unique, non-imitable sources of value. This approach moves the goal from simply *sustaining* an advantage to *extending* it through the creation of shared, regenerative value for all stakeholders: the community, the environment, and the enterprise itself. True distinction, in the 21st century, comes from mattering.

Evaluating Kay's Frameworks and Novel Innovations through the Lens of Responsible Research and Innovation (RRI)

The shift from purely competitive advantage to **Extended Sustainable Advantage (ESA)**—combining John Kay's Distinctive Capabilities with E.F. Schumacher's Intermediate Technology—is a necessary but theoretically driven step. To ground this concept in practical application and ethical accountability, we must evaluate it against the contemporary standard of Responsible Research and Innovation (RRI).

RRI, particularly promoted by the European Union, is an overarching governance framework that seeks to align the process and outcomes of R&I with societal values, needs, and expectations. Its essential methodological elements are the AREA framework: Anticipation, Reflection, Engagement, and Action (Responsiveness).

We can assess how well Kay's model and Schumacher's philosophy inherently satisfy the criteria of RRI, identifying where they complement and where they fall short.

John Kay's Distinctive Capabilities (Architecture, Reputation, Innovation)

Kay's framework, being an economic theory of firm success, primarily focuses on **appropriability** (the ability of a firm to retain the value it creates) and **sustainability** (the durability of the competitive advantage).

Table 6. Comparison between Kay’s Distinctive Capabilities and RRI alignment

RRI Criterion	Kay's Distinctive Capabilities	RRI Alignment / Deficiency
Anticipation	Focuses on anticipating competitor moves and market shifts to maintain advantage.	Deficiency: Lacks systematic anticipation of societal, ethical, and environmental risks (e.g., unintended social displacement from innovation, or long-term ecological footprint).
Reflection	Focuses on reflection regarding internal efficiency, alignment, and competitive position.	Deficiency: Purpose of innovation is primarily profit-maximization, not the social desirability or ethical acceptability of the research itself.
Engagement	The Architecture capability is based on strong, long-term relationships with employees, customers, and suppliers.	Alignment: Strong internal and essential external engagement, but typically excludes broader civil society, NGOs, and marginalized communities that may bear the innovation's external costs.
Action (Responsiveness)	The model encourages action to build the advantage.	Partial Alignment: Responsiveness is driven by market and competitive pressure, not necessarily by a commitment to societal values beyond consumer satisfaction.

Conclusion on Kay's Model: While excellent for competitive sustainability, Kay's framework is ethically and socially neutral by design. It requires a deliberate, external commitment to RRI principles to ensure the distinctive capability itself is socially desirable.

E.F. Schumacher's Appropriate Technology

Schumacher's philosophy of “economics as if people-mattered” and “*appropriate technology*” is fundamentally normative, built on a human-centric and ecological worldview.

Table 7. Comparison between Schumacher’s Appropriate Technology and RRI Alignment

RRI Criterion	Schumacher's Appropriate Technology	RRI Alignment / Deficiency
Anticipation	Inherently anticipates and avoids negative social and ecological impacts by prioritizing small scale, low capital, and non-violence against nature.	Strong Alignment: It is a proactive risk mitigation methods against the scale-related, <i>capital-intensive problems of modern technology.</i>
Reflection	The core principle is deep reflection on the purpose of technology: <i>to serve human dignity, creativity, and community, not merely maximize output.</i>	Strong Alignment: The very choice of Appropriate Innovation is an act of ethical reflection on societal goals and the nature of “progress.”

Engagement	IT is designed to be comprehensible, locally maintained, and locally owned, requiring active participation and inclusivity of the users in its design and deployment.	Strong Alignment: Its focus on decentralization and local materials/skills embodies democratic, bottom-up engagement.
Action (Responsiveness)	IT is defined by the action of adapting technology to local conditions (e.g., resources, climate, culture), making it inherently responsive to the needs of the user community.	Strong Alignment: The focus is on capital-saving, labor-intensive action that responds directly to unemployment and resource scarcity in developing nations.

Conclusion on Schumacher's Model: Schumacher's Appropriate Technology approach is arguably a historical precursor to RRI. Its principles align nearly perfectly with the RRI goal of ethical acceptability, sustainability, and societal desirability, making it an ideal component for the "Innovation" capability in an ESA framework.

RRI Evaluation of Specific Novel Innovations

Applying the AREA criteria to the specific innovations illustrates how the ESA framework (Kay + Schumacher) can guide development, particularly for Less Developed Countries (LDCs).

Table 8. Agricultural & Water Solutions

Innovation	Key Benefit for LDC / ESA Capability	RRI Evaluation (AREA)
Laser-Culture (Seed/Plant Biostimulation)	Intermediate Innovation: Low-energy, non-chemical, high-precision boost to yield/stress resistance.	Anticipation: Low risk of large-scale ecological disruption compared to GM/chemical farming. Reflection: Ethically sound as it enhances natural plant potential. Engagement: Technology transfer must be simple enough for local technicians to maintain. Action: Adoption is quick and local.
Gravitational Water Vortex Power Plant (GWVPP)	Architecture/Reputation: Decentralized, low-head hydropower that also heals (aerates/vitalizes) the water.	Anticipation: Highly positive environmental anticipation (fish-friendly, non-violent flow). Reflection: <u>Aligns with Schauberger's "learning from nature."</u> Engagement: Ideal for co-ownership by small communities; promotes local energy sovereignty. Action: Directly provides clean energy and improves river health.

Florentin Smarandache, Victor Christianito, Extending Sustainable Advantage based on John Kay's Distinctive Capabilities, to include Schumacher's Intermediate Technology with applications to Botany etc.

<p>Confined Vortex Turbine (CVT)</p>	<p>Intermediate Innovation: A simple, high-efficiency micro-hydro turbine suited for low-flow/low-head sites.</p>	<p>Anticipation: Low environmental impact due to small scale and minimal civil works. Reflection: The focus on low-flow efficiency aligns with resource-frugality. Engagement: Design must be modular and maintainable with local workshops. Action: A <u>cheap, reliable source of decentralized rural power.</u></p>
--------------------------------------	---	--

Table 9. Energy and Waste Solutions

<p>Innovation</p>	<p>Key Benefit for LDC / ESA Capability</p>	<p>RRI Evaluation (AREA)</p>
<p>Plastic Waste to Biofuel (Pyrolysis/Catalysis)</p>	<p>Architecture/Innovation: Turns a local pollution problem (plastic waste) into a local energy source (biofuel).</p>	<p>Anticipation: Highly positive on waste management; potential negative risk from air emissions (pyrolysis fumes) and end-use combustion pollution. Reflection: Addresses the ethical dilemma of non-biodegradable waste. Engagement: Requires engagement with waste pickers and local government for efficient feedstock collection; ensures fair value capture. Action: <u>Creates circular economy jobs and reduces dependence on imported fossil fuels.</u></p>
<p>New Fusion Energy Installation (PT-Symmetric Crystal Potential)</p>	<p>Innovation (Long-term): Breakthrough in clean, near-limitless energy via novel material science.</p>	<p>Anticipation: Extremely high positive potential (zero-carbon, high power) but significant long-term safety, regulatory, and proliferation risks typical of advanced nuclear/fusion. Reflection: The purpose is clean energy, but the scale (Kay) may be too large to align with IT/local architecture unless modular. Engagement: Requires massive, international, and transparent public engagement from the start due to high complexity and potential societal transformation. Action: Must build in robust governance (RRI) from the outset to manage ethical dilemmas.</p>

The Synergy: ESA as an RRI-Conscious Approach

The evaluation reveals that an approach based purely on Kay's framework risks developing innovations that are competitively strong but socially and ecologically harmful. Conversely, Schumacher's Intermediate Technology approach inherently satisfies RRI criteria but may struggle to achieve the global scale and financial appropriability needed to attract mainstream capital and compete with high-tech solutions.

The proposed Extended Sustainable Advantage (ESA) model resolves this tension by using Kay's framework to provide the structure, finance, and durability while embedding Schumacher's IT as the RRI-mandated DNA of the Innovation and Architecture capabilities.

- ESA's Innovation → RRI: The firm only pursues innovations (like the GWVPP or simple laser-culture) that are not just clever, but appropriate, ensuring ethical acceptability (no environmental harm) and societal desirability (local employment, resource healing).
- ESA's Architecture → RRI: The structure is built around long-term, trust-based relationships (Kay) that extend to include the local community as a true stakeholder and co-creator (Schumacher/RRI), ensuring genuine engagement and local ownership.

By embracing RRI, the ESA framework transforms competitive advantage from merely achieving high profits into an ambition for co-created, resilient societal value, making the business model itself resistant to ethical backlash or regulatory failure—a truly sustainable form of distinction.

Case Example: Applying RRI to Intermediate Technology - Action Plans

The combination of E.F. Schumacher's Intermediate Technology and the Responsible Research and Innovation (RRI) framework provide a robust blueprint for developing ethical, sustainable, and locally appropriate solutions, particularly in Less Developed Countries (LDCs). Intermediate Technology's intrinsic focus on human scale, simplicity, and ecological non-violence directly addresses the *ends* of RRI (societal desirability). The RRI AREA framework (Anticipation, Reflection, Engagement, Action) then formalizes the *means* to achieve these ends.

Here an example of detailed RRI Action Plans for key innovations, designed specifically for LDCs, emphasizing Schumacherian principles.

RRI Action Plan for Laser-Culture in Dryland Farming

Innovation: Low-power laser biostimulation of seeds/plants to enhance germination, growth, and drought resistance, reducing the need for water and chemical inputs. **Schumacher Principle:** Highly sophisticated science translated into a simple, low-budget, capital-saving application, increasing the productivity of land and labor.

Table 10. Action plan for laser-culture in LDC countries

RRI Criterion	Action Plan for Laser-Culture in LDCs	Schumacher/Intermediate Tech Alignment
Anticipation	A1: Hazard Mapping & Risk Assessment: Anticipate risks related to the technology's application. Focus on potential eye safety hazards for operators and long-term biological effects (e.g., unintended genetic shifts, ecological niche changes).	Action: Develop solar-powered, enclosed laser treatment units that minimize external risk and are designed for use by non-specialist local technicians.
	A2: Socio-Economic Impact Forecasting: Model how yield increases might affect local food prices, market structures, and labour requirements. Anticipate the risk of small farmers being excluded by requiring high upfront costs.	Action: Focus research on low-budget, durable equipment designs (capital-saving) that can be collectively owned by farmer cooperatives (architecture).
Reflection	R1: Ethical Purpose Review: Continuously reflect on the essential purpose: Is the goal to enrich a few large agribusinesses or to enhance local food sovereignty and resilience?	Action: Adopt Open-Source Hardware/Design for the laser treatment units to ensure the technology remains accessible and adaptable to diverse local crops and climates.
	R2: Resource Frugality Check: Evaluate the energy source and materials. Does the device consume minimal energy and use locally repairable components?	Action: Mandate the use of locally available materials for casing and focusing on simple, modular electronic components for easy maintenance (appropriate technology).
Engagement	E1: Community Co-Design: Engage women and local farming elders in testing different laser wavelengths and exposure times for indigenous seeds and local staple crops.	Action: Establish local Technology Transfer Centres run by trained local individuals who provide the service, ensuring the knowledge is embedded in the community, not just the hardware (building local skill).
	E2: Transparency & Training: Clearly communicate the science behind biostimulation (avoiding high-tech jargon) and provide hands-on, vocational training.	Action: Training manuals must be in local languages and based on visual, step-by-step instructions—a practical hallmark of Intermediate Technology.

Action (Responsiveness)	Ac1: Iterative Adaptation: Establish a feedback loop where initial field trial results and farmer observations (e.g., "The treatment works better on millet than on sorghum") lead to immediate, simple design or application parameter adjustments.	Action: <i>Utilize local extension agents to collect and relay field data</i> directly to the engineering team for rapid, context-specific changes.
	Ac2: Governance & Regulation: Work with local authorities to create simple certification standards for locally-made laser units to ensure safety without creating prohibitive regulatory barriers.	Action: <i>Champion a decentralized production model</i> , supporting local artisans/technicians to manufacture and repair the equipment.

The aforementioned RRI Action Plans give simple example to convince us that **Intermediate Technology** provides the **ethical starting point** for innovation, while the **RRI framework** provides the **governance and process** to ensure that this technology remains appropriate over time and through deployment. For LDCs, this combined approach offers a compelling path toward development that is not only economically viable but also socially just and environmentally restorative, fulfilling Schumacher's vision that humanity must be at the centre of the economic equation.

5. Concluding remark

John Kay's Distinctive Capabilities Framework is arguably one of the most insightful theories on the source of enduring organizational achievement based on capabilities. By moving the discussion from significant assets to relationships, it highlights the non-replicable complexity of human and organizational interactions. The challenge of translating this wisdom into day-to-day modern execution is overcome by the Distinctive Capabilities Maturity Model (DCMM). By rigorously operationalizing Architecture, Reputation, and Innovation through the definition of Objectives and Key Results (OKRs) and placing them on a measurable, five-level maturity index, we have transformed an essential concept into a powerful management tool.

When the Overall Weighted Average of the DCMM pushes into Level 4 (Quantitatively Managed) and approaches Level 5 (Optimizing), the organization is no longer just *performing well*; it has attained a sustainable, measurable, and properly managed advantage—the ultimate promise of John Kay's profound framework, now equipped with the operational rigor of modern management science.

This synthesized framework provides the required operationality and measurability, enabling organizations to not only understand what makes them special but, critically, to consistently measure, manage, and optimize the very basis of their distinctive capabilities.

We also discuss in this article, among other things, how to extend John Kay's Distinctive Capabilities, to include Schumacher's Intermediate Technology with applications to Botany etc, which aim to make sustainable advantages more in tune with Schumacher's philosophy of economics as if people-mattered in order to achieve sustainable ecosystem as well.

As the world faces complex challenges of climate change, resource depletion, and growing inequality. Relying solely on the traditional model of Sustainable Competitive Advantage, which often prioritizes profit and market share above human and ecological cost, is insufficient. It is our consideration here, that Extended Sustainable Advantage (ESA), built on the synergistic basis of John Kay's Distinctive Capabilities and Schumacher's Intermediate Technology principles, offers a powerful way forward.

Funding: Please add: "This research received no external funding".

Acknowledgments: Discussions with colleagues, who have specializations in risk management and risk maturity index practices, are gratefully acknowledged. These authors would like to extend sincere gratitude to several colleagues, including Dr. Yunita Umniyati, and other younger scientists from Swiss-German University, Tangerang, Indonesia.

Conflicts of Interest: "The authors declare no conflict of interest."

References

- [1] Kay, John. *Why firms succeed*. Oxford: Oxford University Press, 1995.
- [2] Eden, C., and Fran Ackermann. "COMPETENCES, DISTINCTIVE COMPETENCES, AND CORE COMPETENCES," in *Identifying, Building, and Linking Competences, Research in Competence-Based Management*, Volume 5, 3–33. Emerald Group Publishing Limited, 2010. ISSN: 1744-2117/doi:10.1108/S1744-2117(2010)0000005004
- [3] Žitkienė, R., E. Kazlauskienė, Mindaugas Deksnys. "Dynamic Capabilities for Service Innovation," in *Management International Conference 2015*, Slovenia, May 2015.
- [4] Antonucci, Domenic. *Risk maturity models*. London: Kogan Page Ltd., 2016
- [5] Schumacher, E.F. *Kerja bermartabat*. Yogyakarta: Kreasi Wacana, 2008.
- [6] Doerr, J. *Measure what matters*. Kindle Edition, 2017. 299 p.
- [7] Buyer, P. *Working toward excellence*. New York: Morgan James Publishing, 2012. ISBN 9781614481768 (paperback), ISBN 9781614481775 (eBook)
- [8] Blanchard, K. *Everyone's coach*. Michigan: Zondervan & HarperBusiness, 1995
- [9] Olson, M. *Kebangkitan dan kemerosotan perkembangan bangsa-bangsa*. Jakarta: Rajawali, 1988.
- [10] Ślędzik K. *et al.* "Are Schumpeter's Innovations Responsible? A Reflection on the Concept of Responsible (Research and) Innovation from a Neo-Schumpeterian Perspective," *Journal of the Knowledge Economy* (2023) 14:5065–5085; <https://doi.org/10.1007/s13132-023-01487-3>

- [11] Patel, M., S. Weerawardhana, L. Moreau. "Jointly navigating through RRI in practice: lessons from technology design," *JOURNAL OF RESPONSIBLE INNOVATION* 2024, VOL. 11, NO. 1, 2425091 <https://doi.org/10.1080/23299460.2024.2425091>
- [12] Jia, J., *et al.* "The research of ammonium acetate electrolyte with Prussian blue analogue cathode for high performance ammonium ion battery," College of Chemical Engineering, Hebei Key Laboratory for Environment Photocatalytic and Electrocatalytic Materials, North China University of Science and Technology, Hebei.
- [13] Yekti Bagastyo, A., E. Nurhayati *et al.* *Elektrokimia Lingkungan*. Yogyakarta: Penerbit ANDI, 2025.
- [14] Flavin, C. & N. Lenssen. *Gelombang revolusi energi - Power Surge: Guide to the Coming Energy Revolution*. Jakarta: Yayasan Obor Indonesia, 1995.
- [15] Christianto, Victor & F. Smarandache. *Bulletin of Pure and Applied Science Physics*, Vol.44D No.1 (2025)
- [16] Christianto, Victor, F. Smarandache, Yunita Umniyati. "Three plausible ways to improve performance of seawater battery for Low Budget Electrical Energy Storage System (EES) in particular for developing countries," *presented at International Physics Seminar, UNJ, Indonesia, June 2025*.
- [17] _____. "Note on Design Parameters and Performance of a Gravitation Vortex Water Turbine (GVWT) with Zotloeterer Turbine (updated)," forthcoming issue, *Bulletin of Pure and Applied Science Physics*, Vol.44D No.2 (2025).