

The spontaneous ideation for the nascent entrepreneurs: The reasonings, learning loops and outcomes matrices, models and visual tools for collaborating with AI in support of innovative sustainable business solutions

La ideación espontánea para los emprendedores emergentes: los razonamientos, los ciclos de aprendizaje y las matrices de resultados, modelos y herramientas visuales para colaborar con la IA en apoyo a soluciones empresariales innovadoras y sostenibles

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ABSTRACT

The paper summarizes in a step-by-step guiding format a model for developing new ideas (Ideation) that can be used to form a new spontaneous venture or accelerate the development of a new service or product, augmenting sustainable solutions. The proposed guidelines are widely

used and can be applied in tandem with other prevalently available models or tools. The paper intends to serve as a resource for entrepreneurs and innovators, as well as for teaching and training nascent entrepreneurs. The author has used the framework and the tools described here in numerous Ideation and Entrepreneurship classes taught for over a decade in several countries around the world. The purpose is to provide an effective and efficient set of tools, models, and techniques that can assist the entrepreneur in her accelerated journey to create and achieve her dreams. Such tools are the matrix of Reasonings-Outcomes, the matrix of Reasonings-Learning Loops, and the matrix of Outcomes-Learning Loops introduced here for the first time. The paper adds an academic review when and where appropriate, as well as a discussion of how the incorporation of Artificial Intelligence (AI) can broaden the scope, accelerate the process in an effective and efficient way by providing practical, innovative, and sustainable illustrations and examples. This is exemplified by developing business models in a circular economy of a socially responsible business idea.

Keywords. Ideation, innovation, creativity, Reasonings-Outcomes Matrix, Reasonings-Learning Loops Matrix, data, knowledge management, sustainable business model

RESUMEN

El artículo resume, en un formato de guía paso a paso, un modelo para el desarrollo de nuevas ideas (ideación) que puede utilizarse para crear un nuevo emprendimiento espontáneo o acelerar el desarrollo de un nuevo servicio o producto, fortaleciendo soluciones sostenibles. Las guías propuestas son ampliamente utilizadas y pueden aplicarse de manera complementaria con otros modelos o herramientas de uso común. El artículo pretende servir como un recurso para emprendedores e innovadores, así como para la enseñanza y capacitación de emprendedores en etapa inicial. El autor ha utilizado el marco conceptual y las herramientas aquí descritas en numerosos cursos de ideación y emprendimiento impartidos durante más de una década en varios países alrededor del mundo. El propósito es proveer un conjunto efectivo y eficiente de herramientas, modelos y técnicas que apoyen al emprendedor en su camino acelerado hacia la creación y el logro de sus metas y sueños. Entre estas herramientas se encuentran la matriz de Razonamientos-Resultados, la matriz de Razonamientos-Ciclos de Aprendizaje y la matriz de Resultados-Ciclos de Aprendizaje, que se presentan aquí por primera vez. El artículo incorpora, cuando y donde es pertinente, una revisión académica, así como una discusión sobre cómo la integración de la Inteligencia Artificial (IA) puede ampliar el alcance y acelerar el proceso de manera efectiva y eficiente, al proveer ilustraciones y ejemplos prácticos, innovadores y sostenibles. Esto se ejemplifica mediante el desarrollo de modelos de negocio dentro de una economía circular a partir de una idea empresarial socialmente responsable.

Palabras clave. Ideación, innovación, creatividad, Matriz Razonamientos-Resultados, Matriz Razonamientos-Bucles de Aprendizaje, datos, gestión del conocimiento, modelo de negocio sostenible

INTRODUCTION

Innovation is the driving force of advancement in society and organizations. Nimble start-up firms are rapidly generating innovative product/service ideas with customer-centered strategies at an increasingly faster rate, and some of them are changing society as well. The author became aware of this phenomenon and the power of new ideas as a founder of a new venture in the late 1980s. Since then, the author's research, teaching, and consulting on the subjects of ideation, entrepreneurship, and new venture formation have been a passion and a cornerstone of his

professional activities. Following the author's recent papers, discussing the new economic and social era of continuous technological revolutions (Russ, 2021a; Russ & Herron, 2026), and the early use of Artificial Intelligence (AI) and Knowledge Management (KM) in business strategy (Russ and Lytras, 2026a; Lytras and Russ, 2026), the author reasoned that now would be the right time to revisit his earlier thinking and models (Russ, 2021b) of ideation for entrepreneurs and innovators. Such a revisit is also timely since recent research suggests that the innovation ecosystem is slowing down (Arora et al. 2019), there is a decline in the number of breakthrough ideas (Vranceanu, 2024) affecting opportunity entrepreneurship, while blue and white color jobs are increasingly disappearing (World Economic Forum, 2023), startup failure rate is extremely high (75%-90%; Howarth, 2025), and the unemployment and underemployment of the younger generation is a global crisis (Mercy Corps, 2020) affecting necessity entrepreneurship (e.g., Fossen, McLemore, & Sorgner, 2024).

The paper's intention is not to conduct a systematic review on the subject of new venture creation or propose a new research agenda (for that, see, for example, Mumi et al., 2025; Park et al., 2025; Shepherd et al., 2021; or Uriarte et al., 2025). This manuscript is written more as a guide for aspiring spontaneous entrepreneurs or practicing nascent entrepreneurs (cf. Aulet, 2013) and as a teaching manuscript.

The novel application of the three proposed matrices (introduced here for the first time in the context of entrepreneurship): Reasonings–Outcomes, Reasonings–Learning Loops, and Outcomes–Learning Loops—offers a distinctive contribution by triangulating three core dimensions of ideation: the underlying logics of reasoning, the emergent outcomes, and the recursive learning processes. Unlike prior frameworks, which typically emphasize either feedback (Argyris & Schön, 1996), dynamic complexity (Sterman, 2002), technical problem-solving (Altshuller, 1996), or outcome tracking (Earl et al., 2001), this approach provides an integrative, comparative, and scalable set of tools. In this sense, the matrices function as a design science artifact (Gregor & Hevner, 2013), bridging theory and practice. They extend existing theories of organizational learning, systems thinking, and innovation management by providing a new representational format that captures the interplay between reasoning, outcomes, and learning loops. As such, they hold the potential to enrich both academic inquiry and practical applications in ideation, strategy development, and knowledge management. By operationalizing these relationships in a matrix format, the tool enables: 1. systematic mapping of reasoning strategies to both immediate and long-term outcomes; 2. identification of how different reasoning approaches foster single-, double-, triple-, or quadruple-loop learning; and 3. structured comparison across teams, organizations, or projects, making the ideation process more transparent and replicable.

THEORETICAL BACKGROUND

Introduction

The contemporary entrepreneurial landscape is shaped by the Post-Accelerating Data and Knowledge Networked Economy (PADKNE), an environment characterized by continuously intensifying technological change, dense digital interconnections, and expanding knowledge flows that reshape how value is created, diffused, and sustained (Russ, 2021a). Within this context, entrepreneurship functions as a critical engine of economic growth, innovation, and systemic renewal, yet nascent entrepreneurs face heightened liabilities of newness and periphery as they attempt to operate under conditions of uncertainty, limited legitimacy, and accelerated competitive pressures (Stinchcombe, 1965). Artificial intelligence (AI) has emerged as a foundational technological infrastructure in the PADKNE, profoundly influencing entrepreneurial reasoning, opportunity recognition, and decision-making by augmenting information processing, pattern recognition, and scenario exploration (Davenport & Ronanki, 2018). The innovation process itself has become increasingly non-linear and iterative, relying on continuous learning loops,

experimentation, and feedback, with AI supporting the generation, evaluation, and recombination of ideas across multiple stages of innovation (Shahzad et al., 2025). Central to this process are ideation, creativity, and visualization, which enable entrepreneurs to externalize tacit knowledge, explore alternative futures, and structure complex problem spaces; AI-enabled tools further extend these capabilities by facilitating generative ideation, visual thinking, and collaborative sensemaking (Bell & Bell, 2023; Shneiderman, 2020a). At the same time, the growing reliance on AI introduces significant risks, including cognitive offloading, automation bias, and diminished critical thinking, which may undermine creative agency and reflective judgment if left unmanaged (Gerlich, 2025; Tian & Zhang, 2025). Consequently, entrepreneurship education assumes a structurally central role in the PADKNE and circular economy, serving as a multi-level learning architecture that integrates AI while preserving human cognition, ethical reasoning, and sustainability-oriented innovation. Together, these interrelated theoretical perspectives provide the foundation for examining spontaneous ideation, learning loops, and outcome matrices as mechanisms through which nascent entrepreneurs collaboratively engage with AI to develop innovative and sustainable business solutions.

The Post-Accelerating Data and Knowledge Networked Economy (PADKNE)

The PADKNE economy constitutes a qualitatively distinct developmental regime characterized by continuously compounding technological revolutions, heightened systemic interdependencies, and increasingly compressed decision-making cycles. Within this regime, value creation and capture no longer follow linear trajectories but emerge recursively through feedback-intensive material, informational, and knowledge flows, necessitating new forms of individual and organizational sensemaking (Russ, 2021a). The PADKNE circular economy represents a structurally necessary response to climate change, environmental degradation, and the demand for sustainable growth, marking a decisive shift from a linear “take–make–waste” logic toward regenerative, closed-loop systems (Ellen MacArthur Foundation, 2015; Scipioni et al., 2021). This transition emphasizes the elimination of waste, continuous circulation of material value, and regeneration of natural systems, while relying on rapid innovation cycles and systemic resilience enabled by digital platforms, real-time analytics, and AI-supported decision-making (Geissdoerfer et al., 2017; Lewandowski, 2016).

For nascent entrepreneurs, this environment amplifies the importance of spontaneous ideation as a dynamic, learning-driven process embedded in evolving socio-technical systems rather than as a discrete act of opportunity recognition. Learning loops—iterative feedback processes that enable continuous refinement of assumptions, strategies, and outcomes—become central mechanisms through which entrepreneurial reasoning unfolds (Ericsson & Simon, 1993; Russ, 2021c). Artificial intelligence further intensifies this dynamic by functioning as a meta-cognitive collaborator that augments pattern recognition, accelerates hypothesis generation, and supports iterative experimentation across ideation, validation, and implementation phases (Russ & Lytras, 2026b). Consequently, entrepreneurial action increasingly emerges through non-linear, co-evolving human–AI learning loops that generate emergent, rather than predetermined, outcomes. Within this context, the circular economy evolves into a knowledge-centric system integrating sustainability objectives with accelerated innovation. Visual tools, outcome matrices, and AI-enabled modeling environments function as critical boundary objects that structure collaboration, surface latent assumptions, and enable higher-order (quadruple-loop) learning across individual and organizational levels (Bocken et al., 2014; Russ, 2021c). The PADKNE circular economy thus reframes entrepreneurship as an adaptive, learning-intensive process in which sustainable value creation arises from continuous interaction among cognition, technology, and evolving systemic constraints.

Entrepreneurship as a critical ingredient for economic growth

Entrepreneurship constitutes a critical engine of economic growth within the PADKNE circular economy by translating sustainability imperatives into actionable, scalable, and profitable business models. In this accelerated developmental regime, the economic contribution of entrepreneurship extends beyond traditional indicators such as firm formation, employment generation, and GDP growth to include systemic innovation, productivity gains through resource efficiency, and the strengthening of resilient local and regional economies. Nascent entrepreneurs are uniquely positioned to identify and enact value-creation opportunities that simultaneously address environmental constraints and market demands, thereby functioning as key agents of creative destruction within sustainability-oriented transitions (Schaltegger & Wagner, 2011). Embedded within iterative learning loops, entrepreneurial ideation becomes a structured yet adaptive process in which experience, feedback, and data-informed reflection continuously shape strategic choices and outcome matrices, as Kolb's (1984) Experiential Learning Theory implies. As technological disruption and global interconnectedness intensify competitive pressures, ventures that integrate circular principles—such as product-as-a-service models, closed-loop production systems, and regenerative design—demonstrate enhanced potential for sustained financial, social, and environmental impact (Ellen MacArthur Foundation, 2015; Geissdoerfer et al., 2017). Empirical research consistently confirms that entrepreneurship drives economic growth through job creation, productivity enhancement, and innovation-led structural transformation, particularly when supported by enabling institutional and entrepreneurial conditions (Maaitah, 2023; Urbano et al., 2019; Xu et al., 2021). Within the circular economy, these effects are amplified as entrepreneurial activity facilitates economic diversification, decouples growth from resource depletion, and enhances systemic resilience (Ziane et al., 2025). From an evolutionary perspective, entrepreneurship stimulates regional and national development by intensifying competitive dynamics, accelerating knowledge spillovers, and fostering adaptive variation across industries (Audretsch & Kielbach, 2004). The PADKNE economy further elevates the cognitive and learning demands placed on nascent entrepreneurs, requiring higher-order reasoning, rapid experimentation, and continuous feedback integration under conditions of uncertainty (Bruton et al., 2021). In this framing, entrepreneurship emerges as a multi-level learning engine—linking individual cognition, organizational learning loops, and ecosystem-level outcomes—whose effectiveness increasingly depends on the entrepreneur's capacity to leverage advanced learning tools, including AI-enabled models and visual analytics, to support spontaneous ideation, strategic sensemaking, and sustainable value creation (McAfee & Brynjolfsson, 2017; Russ, 2021b).

Entrepreneurship and Liability of newness and liability of the periphery

Nevertheless, nascent entrepreneurs face persistent structural disadvantages commonly conceptualized as the liability of newness and the liability of the periphery, both of which significantly shape early-stage entrepreneurial reasoning, learning, and outcomes. The liability of newness reflects the heightened vulnerability of newly formed ventures arising from the absence of established routines, legitimacy, and social capital, often resulting in elevated failure risks and inefficient decision-making (Cafferata et al., 2009; Stinchcombe, 1965; Yang & Aldrich, 2017). Concurrently, the liability of the periphery captures the disadvantages experienced by entrepreneurs positioned outside dominant networks or industry clusters, where access to critical knowledge flows, partnerships, and resources is constrained (Powell et al., 1996; Russ & Jones, 2011a). From a systems and learning perspective, these liabilities represent incomplete learning architectures and weak feedback mechanisms rather than static contextual constraints. In accelerated and sustainability-oriented economic environments, such deficiencies amplify uncertainty and hinder adaptive experimentation (Brown & Eisenhardt, 1997). AI-enabled models, predictive analytics, and visual outcome matrices offer mechanisms to partially offset these liabilities by supporting scenario simulation, resource contingency planning, and iterative learning

loops that enhance sensemaking and strategic alignment. Within circular economy contexts—where coordination across extended value networks is essential—AI-supported boundary-spanning artifacts can reduce informational asymmetries, accelerate legitimacy formation, and strengthen ecosystem connectivity. In this framing, addressing the liabilities of newness and periphery becomes a dynamic, learning-centered process through which nascent entrepreneurs enhance resilience, integrate into networks, and generate sustainable business solutions (Russ, 2021b).

Entrepreneurship and Artificial Intelligence

Entrepreneurship and artificial intelligence (AI) increasingly co-evolve within the PADKNE economy, fundamentally reshaping how nascent entrepreneurs engage in ideation, judgment, and decision-making under conditions of heightened complexity and uncertainty. Rather than displacing entrepreneurial agency, AI functions as a cognitive and epistemic amplifier that augments opportunity recognition, market sensing, and strategic experimentation through advanced analytics, pattern recognition, and generative capabilities (Giuggioli & Pellegrini, 2023; Uriarte et al., 2025). Predictive analytics, machine learning, and natural language processing enable entrepreneurs to simulate business scenarios, analyze market signals, and optimize resource allocation, thereby reducing cognitive load and decision ambiguity (Cockburn et al., 2018). Embedded within iterative learning loops, AI supports rapid hypothesis testing, outcome visualization, and the construction of decision matrices that surface interdependencies among strategic choices (McAfee & Brynjolfsson, 2017).

AI-enabled collaborative platforms further enhance co-creation with stakeholders, expanding creative search spaces and aligning entrepreneurial innovation with environmental, social, and governance objectives (Gretzel et al., 2015). Conceptual and empirical studies demonstrate that AI-supported entrepreneurial reasoning improves alignment with customer preferences, industry benchmarks, and internal knowledge flows, particularly in resource-constrained and emerging market contexts (Amoako et al., 2021; Jatmika et al., 2024). From a learning perspective, AI facilitates recursive feedback loops in which entrepreneurs iteratively refine mental models, accelerate experiential learning, and adapt business solutions in near real time (Townsend & Hunt, 2019). These dynamics are especially salient for micro-entrepreneurs and cognitively diverse individuals, for whom AI tools can reduce informational asymmetries and lower barriers to entrepreneurial action (Mumi et al., 2025; Ruffner, 2023).

At the same time, the growing role of generative AI introduces epistemic risks, including cognitive offloading, automation bias, and erosion of critical thinking, necessitating higher-order learning loops and reflective governance mechanisms (Gerlich, 2025; Hannigan et al., 2024; Tian & Zhang, 2025). Recent syntheses emphasize that AI should be conceptualized not merely as a technological input, but as an integral component of entrepreneurial learning architectures shaping cognition, collaboration, and value creation across individual, organizational, and ecosystem levels (Mugunzva & Manchidi, 2024). In this framing, AI-enabled visual tools, models, and outcome matrices function as boundary objects that support spontaneous ideation, sensemaking, and sustainable innovation, reinforcing entrepreneurship as a knowledge-intensive, adaptive process embedded in continuously accelerating socio-technical systems (Russ, 2021b; Russ & Lytras, 2026b).

Innovation Process

Innovation is fundamentally a dynamic, iterative, and learning-intensive process through which novel ideas are generated, refined, and implemented to create economic, social, and environmental value (Fagerberg, 2005; Tidd & Bessant, 2021). Rooted in Schumpeterian logic, innovation represents the practical exploitation of change through new combinations of knowledge, technologies, and organizational practices. Rather than unfolding linearly, the innovation process

begins with entrepreneurial cognition and environmental scanning, followed by recursive cycles of experimentation, prototyping, and validation that integrate continuous feedback from markets, stakeholders, and ecosystems (Nonaka & Takeuchi, 1995; Rothwell, 1994). Contemporary frameworks emphasize that innovation emerges from complex, networked interactions involving co-creation, cross-functional integration, and open knowledge flows, highlighting reflexivity and knowledge synthesis as core entrepreneurial capabilities (Brem, 2011; Chesbrough, 2006). Within the PADKNE circular economy, innovation is best conceptualized as a multi-stage learning system in which knowledge creation, recombination, and application unfold through non-linear learning loops rather than predefined sequences (Russ, 2021c). Empirical research demonstrates that innovation capability is embedded in the interaction among individual creativity, organizational routines, and ecosystem-level knowledge flows, particularly within SMEs and knowledge-intensive contexts (Edwards-Schachter et al., 2015; Soriano & Huarng, 2013). University–business collaboration and network diversity further strengthen these learning architectures by expanding the search space and enabling non-redundant knowledge recombination under resource constraints, albeit with increased coordination demands (Karlsson et al., 2021; van der Poel et al., 2024). In this environment, visual tools, outcome matrices, and modeling frameworks—increasingly augmented by AI—function as cognitive scaffolds that support sensemaking, scenario simulation, and rapid experimentation, enhancing the robustness of sustainable business solutions (Bocken et al., 2014; Russ, 2021a). While AI accelerates pattern recognition and predictive insight, it also necessitates higher-order learning loops to mitigate cognitive offloading and preserve entrepreneurial judgment (Gerlich, 2025). Consequently, innovation is reframed not as a discrete outcome but as an adaptive, knowledge-centric learning process integrating human creativity, organizational learning loops, and AI-supported sensemaking within complex socio-technical systems.

Innovation Process and Artificial Intelligence

The innovation process for nascent entrepreneurs is being fundamentally reconfigured through the integration of artificial intelligence (AI), shifting it from a predominantly linear sequence of ideation, development, and implementation toward a recursive, data-intensive, and learning-driven system (Russ & Lytras, 2026b). Rather than substituting entrepreneurial agency, AI operates as a cognitive and epistemic augmentor that expands problem identification, enhances opportunity evaluation, and accelerates experimentation through simulation, rapid prototyping, and predictive analytics (Cockburn et al., 2018; Gerlich, 2025). This human–AI collaboration enables a hybrid agency, in which routine cognitive tasks are increasingly automated while higher-value entrepreneurial functions—creative judgment, ethical reasoning, and strategic sensemaking—remain firmly human-centered (Russ, 2021c; Tian & Zhang, 2025). As a result, innovation becomes more agile, continuously adaptive, and responsive to sustainability constraints characterizing the PADKNE economy. AI-driven tools support spontaneous ideation by scanning vast datasets, detecting latent patterns, and generating alternative solution pathways that may exceed individual cognitive limits (Agrawal et al., 2018). Embedded within entrepreneurial learning loops, AI also functions as a reflective feedback mechanism, enabling rapid hypothesis testing, iterative model refinement, and real-time recalibration of assumptions (Ransbotham et al., 2018). Increasingly, innovation outcomes are structured and visualized through outcome matrices, computational models, and AI-enabled visual tools that integrate qualitative judgment with quantitative analytics, thereby supporting decision-making under uncertainty (Jordan & Mitchell, 2015). Systematic research further demonstrates that AI influences not only incremental and radical innovation outcomes, but also the governance, coordination, and temporal dynamics of innovation processes across organizational and ecosystem boundaries (Haefner et al., 2021; Mariani et al., 2023). From a knowledge management perspective, AI-enabled innovation is inherently recursive and path-dependent, characterized by continuous feedback between human cognition, algorithmic outputs,

and evolving contextual constraints (Russ, 2021c). In this framing, AI-supported visual tools and outcome matrices function as boundary objects that facilitate sensemaking, interdisciplinary collaboration, and higher-order learning, while preserving human agency. Innovation in the age of AI is thus best understood as a co-evolutionary learning process in which entrepreneurial creativity, organizational learning loops, and intelligent systems jointly generate adaptive and sustainable business solutions.

Ideation

Ideation represents the foundational cognitive and learning phase of the innovation process in which nascent entrepreneurs generate, elaborate, and transform emergent insights into potential entrepreneurial opportunities (Amabile et al., 1996; Amabile & Mueller, 2024; Osborn, 1979). Rather than a singular moment of spontaneous creativity, ideation is increasingly conceptualized as a structured, yet emergent process characterized by divergent thinking, iterative refinement, and recursive feedback loops that integrate individual cognition, experiential knowledge, and contextual cues (Dorow et al., 2015; Rae, 2000). Research emphasizes the importance of future envisioning, user-centered reframing, and experiential sensemaking in expanding the solution space and enabling the emergence of novel value propositions, particularly under conditions of uncertainty and acceleration (Moon & Han, 2016). From a knowledge management perspective, ideation functions as a sensemaking mechanism in which tacit and explicit knowledge are continuously recombined, externalized, and recontextualized through cognitive experimentation and reflective learning (Russ, 2021a,c). Visual and embodied practices—such as drawing, sketching, and conceptual mapping—support external cognition and non-verbal reasoning, thereby enhancing early-stage exploration and iterative concept development (Novica et al., 2023). In contemporary entrepreneurial environments, ideation thus evolves into a recursive learning loop rather than a linear front-end activity, enabling entrepreneurs to adapt mental models and revise assumptions in response to emergent insights (Russ, 2021c). The integration of AI-supported tools further transforms ideation by providing data-driven insights, pattern recognition, scenario simulation, and collaborative visualization, which augment human creativity while preserving entrepreneurial judgment (Russ & Lytras, 2026b; Townsend et al., 2025). Within this framing, AI-enabled models, visual tools, and outcome matrices act as cognitive scaffolds that structure exploration, reduce cognitive bias, and accelerate feedback integration across distributed teams (Rosenbusch et al., 2011). Consequently, ideation becomes a dynamic intersection of human creativity and computational augmentation, supporting spontaneous entrepreneurial action while aligning emerging ideas with environmental, social, and economic sustainability objectives in complex socio-technical systems.

Ideation and Artificial Intelligence

The convergence of ideation and artificial intelligence (AI) fundamentally reconfigures how entrepreneurial ideas are generated, expanded, and evaluated in the PADKNE economy. Rather than replacing human creativity, AI functions as a generative and combinatorial partner that extends cognitive search spaces, surfaces non-obvious associations, and supports systematic exploration during early-stage ideation (Girotra et al., 2023; Pescher & Tellis, 2025). Large language models and AI-enabled ideation systems enable rapid production of diverse idea sets, lowering the cost of experimentation while intensifying the need for human judgment, selection, and sensemaking (Lehmann et al., 2025). From a learning perspective, AI-supported ideation introduces recursive feedback loops in which entrepreneurs iteratively prompt, evaluate, and refine ideas, accelerating cognitive learning cycles and enabling higher-order reframing of problem definitions (Russ, 2021c). Visual AI tools further enhance this process by externalizing thought, supporting embodied cognition, and facilitating collaborative sensemaking across disciplinary and stakeholder boundaries (Owen & Roberts, 2024). However, the abundance and apparent fluency of AI-

generated ideas heighten epistemic risks, including cognitive offloading, automation bias, and superficial novelty, underscoring the need for reflective learning loops that preserve critical evaluation and entrepreneurial agency (Gerlich, 2025; Tian & Zhang, 2025). Structured human–AI collaboration—rather than uncritical reliance—emerges as a key condition for creative and sustainable outcomes by aligning algorithmic generativity with human intentionality, contextual awareness, and ethical oversight (Chang & Li, 2025; Shneiderman, 2020a). Within a knowledge management perspective, AI-enabled ideation systems function as boundary-spanning artifacts that structure exploration, support spontaneous ideation, and integrate qualitative judgment with quantitative insight through visual tools, computational models, and outcome matrices (Russ, 2021b; Russ & Lytras, 2026b). Consequently, ideation becomes a co-evolutionary learning process in which human creativity, organizational learning routines, and AI-generated variation interact dynamically to generate robust, sustainable, and market-relevant entrepreneurial solutions within complex socio-technical systems.

Visualization and visual thinking

Visualization and visual thinking constitute pivotal cognitive, epistemic, and collaborative mechanisms in nascent entrepreneurship, particularly within accelerated and complexity-intensive environments such as the PADKNE circular economy. Beyond graphical representation, visualization enables the translation of abstract entrepreneurial concepts into perceptible forms that support pattern recognition, scenario exploration, and strategic foresight (Eppler & Burkhard, 2007). By externalizing mental models through diagrams, conceptual maps, prototypes, and interactive interfaces, visual thinking activates both analytical and creative cognition, facilitating richer problem framing, opportunity recognition, and collective sensemaking (Suthers, 2003; Ware, 2019). Cognitive research demonstrates that visual attention supports both broad exploratory scanning and focused local selection, enabling the detection of relationships and anomalies that remain obscured in purely textual or numerical reasoning (Shioiri et al., 2016). In entrepreneurial decision-making, visualizations function not merely as representational artifacts but as active components of cognition that shape judgment, inference, and learning by structuring attention and reducing cognitive load (Eberhard, 2023; Padilla et al., 2018). From a knowledge management perspective, visualization operates as a boundary-spanning mechanism that integrates tacit and explicit knowledge through iterative externalization and reflection, reinforcing higher-order learning loops at both individual and organizational levels (Russ, 2021a). Within sustainable business model innovation, visual tools and outcome matrices enhance mutual understanding among stakeholders, surface interdependencies across economic, environmental, and social dimensions, and enable rapid prototyping and testing prior to resource-intensive commitments (Scipioni et al., 2021). When integrated with AI-enabled systems, visual thinking becomes a central modality for collaborative exploration, hypothesis testing, and reflexive learning, supporting negotiation between human judgment and algorithmic insight while mitigating risks of cognitive offloading (Gerlich, 2025; Tian & Zhang, 2025). Consequently, visualization and visual thinking function as cognitive scaffolds that support spontaneous ideation, adaptive learning, and resilient decision-making, enabling nascent entrepreneurs to co-create innovative and sustainable business solutions within evolving socio-technical systems.

Visualization and Artificial Intelligence

Within nascent entrepreneurship, the integration of visualization and artificial intelligence (AI) represents a substantive cognitive and epistemic shift in how spontaneous ideation, learning loops, and strategic reasoning are enacted under conditions of complexity and acceleration. AI-enhanced visualization systems function as cognitive amplifiers that translate large-scale, multidimensional data into interpretable visual forms, enabling pattern recognition, scenario exploration, and decision-making under uncertainty (Chen et al., 2019; Kumari & Prabhakaran, 2025; Yin et al.,

2024). By coupling algorithmic generativity with human visual cognition, these systems support iterative learning loops in which entrepreneurs can rapidly externalize abstract concepts, test alternative hypotheses, and visually evaluate outcomes, thereby accelerating ideation cycles while preserving reflective judgment (Shneiderman, 2020b; Ware, 2019). From a knowledge management perspective, AI-driven visualization operates as a mediating artifact that bridges tacit and explicit knowledge, structures outcome matrices, and reinforces higher-order learning at both individual and organizational levels (Russ, 2021a,c). Importantly, AI does not replace entrepreneurial creativity but augments it by expanding the solution space through generative variation, predictive simulation, and real-time feedback, enabling exploratory recombination of economic, environmental, and social value propositions central to sustainable and circular business models (Bocken et al., 2016; Grech et al., 2023). At the same time, effective human–AI collaboration requires advanced critical learning loops to mitigate risks of automation bias and cognitive offloading, ensuring that human judgment remains central to ethical oversight, strategic coherence, and value alignment (Gerlich, 2025; Tian & Zhang, 2025). Within this hybrid agency, visualization serves as the primary interface for sensemaking, negotiation, and co-creation, allowing entrepreneurs to interrogate AI-generated insights, refine assumptions, and translate spontaneous ideation into actionable and sustainable business models. Consequently, visualization integrated with AI emerges as a foundational modality for entrepreneurial reasoning, enabling reflective experimentation, accelerated learning, and adaptive decision-making within continuously evolving socio-technical systems.

Creativity

Creativity constitutes a foundational mechanism in spontaneous ideation and problem-solving for nascent entrepreneurs operating in complex, knowledge-intensive, and accelerated environments. Cognitive research emphasizes that creative processes are driven by divergent thinking and iterative mental simulations, through which multiple solution pathways are explored and recombined across domains to generate novelty and value (Runco & Acar, 2012; Xie, 2023). Grounded analyses of artistic and design practices further demonstrate that creativity unfolds through recursive cycles of idea generation, evaluation, reflection, and refinement, supported by feedback-rich learning loops that progressively shape actionable solutions (Güss et al., 2021; Mace & Ward, 2002). Within entrepreneurial contexts, creativity is not merely an individual trait but an emergent, context-sensitive process arising from interactions among diverse knowledge bases, experiential insights, and resource constraints (Amabile, 1996). From a knowledge management perspective, creativity functions as a boundary-spanning dynamic in which tacit and explicit knowledge co-evolve through structured reasoning and higher-order learning loops, enabling the emergence of innovative and sustainable value propositions (Russ, 2021b,c). The integration of artificial intelligence further extends creative capacity by providing generative alternatives, pattern recognition, and scenario simulations that expand the solution space beyond human cognitive limits (Du Sautoy, 2020; Fountaine et al., 2019). In this hybrid human–AI environment, entrepreneurs increasingly assume the role of curators and strategic directors of the creative process, critically evaluating AI-generated outputs to mitigate automation bias and ensure ethical alignment, originality, and sustainability relevance (Gerlich, 2025). Visual tools, models, and outcome matrices serve as cognitive scaffolds that externalize thought, structure ideation flows, and enable systematic evaluation of creative options, thereby operationalizing creativity within decision-support frameworks (Dietrich, 2004; Sawyer, 2019). Through iterative engagement across single-, double-, and higher-order learning loops, creativity becomes a disciplined yet generative process that supports adaptive reasoning, opportunity recognition, and the co-creation of innovative, economically viable, and environmentally sustainable business solutions.

Creativity and Artificial Intelligence

Creativity in contemporary entrepreneurship is increasingly shaped by the integration of artificial intelligence (AI), particularly generative systems that augment both divergent and convergent thinking processes. Rather than functioning merely as automation tools, AI systems act as cognitive amplifiers that provide novel stimuli, simulate alternative scenarios, and surface latent patterns that extend the boundaries of human ideation (Boden, 1998; George & Mathew, 2025; Sobetska, 2025). Generative AI platforms enable rapid exploration and refinement of ideas through visual and conceptual outputs, supporting co-creative workflows in which human intuition, contextual judgment, and ethical reasoning interact with algorithmic suggestions (Fang et al., 2025; Tan & Luhurs, 2024). Within nascent entrepreneurial contexts, this human–AI collaboration represents a shift toward hybrid agency, where creativity emerges as a distributed, context-sensitive process embedded in iterative learning loops and structured reasoning frameworks (Russ, 2021c; Russ & Lytras, 2026b). AI-supported ideation enhances opportunity recognition by synthesizing large-scale data, identifying market gaps, and simulating outcome matrices that integrate economic, environmental, and social sustainability considerations (Colton & Wiggins, 2012; Lecocq et al., 2024). At the same time, research cautions that uncritical reliance on AI may lead to cognitive offloading and automation bias, underscoring the necessity of maintaining human oversight, critical evaluation, and reflective learning (Gerlich, 2025; Tian & Zhang, 2025). Consequently, the entrepreneurial role evolves from sole idea generator to curator and strategic director of AI-augmented creativity, guided by structured visual tools, outcome matrices, and higher-order learning loops that preserve agency and ethical alignment. Collaborative AI-enabled visualization systems further support co-creation and sensemaking by externalizing ideas, enabling comparison of alternatives, and accelerating experimentation within complex socio-technical systems (Shneiderman, 2020a; Wang et al., 2025). In this framing, creativity and AI jointly function as a disciplined yet generative engine for spontaneous ideation, enabling nascent entrepreneurs to systematically translate emergent insights into innovative, resilient, and sustainable business solutions in support of the circular economy.

The negative impact of Artificial Intelligence

Despite its transformative potential for ideation, knowledge management, and entrepreneurial decision-making, artificial intelligence (AI) introduces substantive risks that may undermine the cognitive foundations required for sustainable entrepreneurial innovation. A central concern is cognitive offloading—the delegation of analytical and reasoning tasks to AI systems—which can erode critical thinking, independent judgment, and adaptive problem-solving capacities (Gerlich, 2025; Tian & Zhang, 2025). Within nascent entrepreneurship, excessive reliance on AI-generated outputs may foster automation bias, whereby recommendations are accepted uncritically, bypassing reflective evaluation and ethical scrutiny (Chan, 2023). This tendency can generate cognitive inertia, reinforcing “generate-first, think-later” behaviors that weaken resilience and diminish the iterative, multi-loop learning processes essential for navigating uncertainty and the liabilities of newness (Russ, 2021c; Stinchcombe, 1965). Empirical evidence further suggests that younger users are particularly vulnerable to AI dependence, exhibiting reduced reasoning performance and heightened reliance on algorithmic guidance (Tian & Zhang, 2025). Paradoxically, the need to monitor, verify, and adapt AI outputs may also induce cognitive fatigue, further constraining deliberative reasoning and reflective sensemaking (Gerlich, 2025). Beyond cognitive effects, broader structural concerns—including algorithmic bias, opacity of decision processes, environmental costs of large-scale computation, and potential labor displacement—raise ethical, social, and sustainability challenges for entrepreneurial ventures (Acemoglu & Restrepo, 2018; Burrell, 2016; Mehrabi et al., 2021; Strubell et al., 2019). Collectively, these risks suggest that unstructured AI adoption may hinder rather than enhance entrepreneurial creativity and judgment. Consequently, effective collaboration with AI requires deliberately designed learning loops,

outcome matrices, and visual reasoning frameworks that preserve human agency, critical reflection, and ethical oversight (Russ & Lytras, 2026b). In this framing, AI should function as a disciplined cognitive partner—augmenting, but not replacing, the reflective reasoning and learning processes that underpin innovative, resilient, and sustainable entrepreneurial solutions.

In this paper, it is argued that nascent entrepreneurs should first develop the cognitive, methodological, and reflective competencies required to effectively apply the proposed tools, thereby acquiring the foundational knowledge and interpretive capacity necessary for informed decision-making, before integrating AI into the ideation process. This sequencing is essential given the challenges inherent in human–AI collaboration, including risks of cognitive offloading, automation bias, and superficial ideation discussed above.

Entrepreneurship and education in the PADKNE, circular economy

Entrepreneurship education occupies a structurally central position within the PADKNE circular economy, where accelerating technological change, sustainability imperatives, and pervasive uncertainty fundamentally reshape how entrepreneurial capabilities are formed and enacted. In this context, education is no longer a linear, preparatory phase preceding venture creation, but a recursive and adaptive learning system that continuously shapes entrepreneurial reasoning, opportunity recognition, and strategic judgment. Empirical research consistently demonstrates that entrepreneurship education enhances entrepreneurial readiness, intention, and competence by developing higher-order cognitive skills, creative problem-solving abilities, and resilient mindsets required to navigate complex and rapidly evolving environments (de Sousa et al., 2024; Hasan et al., 2024; Liu et al., 2022). Within the circular economy, these learning outcomes expand further to include systems thinking, ethical reasoning, and sustainability-oriented innovation, enabling entrepreneurs to design business models that integrate economic viability with social and environmental responsibility (Cohen & Winn, 2007; Miço & Cungu, 2023; Mushtaq et al., 2024). Higher education institutions function as critical knowledge hubs within this ecosystem, translating interdisciplinary research, digital capabilities, and sustainability insights into entrepreneurial practice while facilitating access to networks, legitimacy, and resources (Sevilla-Bernardo et al., 2024). The PADKNE environment also necessitates pedagogical transformation, as traditional linear teaching models prove insufficient under conditions of ambiguity, rapid feedback, and continuous experimentation. Experiential, visual, and design-oriented approaches—such as design thinking, visual reasoning, co-opetitive learning, and project-based experimentation—have been shown to enhance entrepreneurial motivation, creativity, and opportunity recognition by engaging learners in iterative learning loops that mirror real-world entrepreneurial dynamics (Erdmann et al., 2022; Gismera Tierno et al., 2021; Neck & Greene, 2011; Sutadi, 2021). More recently, the integration of generative artificial intelligence into entrepreneurship education has emerged as a powerful accelerator of ideation, experimentation, and reflective sensemaking, enabling learners to simulate complex scenarios, visualize outcome matrices, and engage in human–AI collaborative reasoning (Bell & Bell, 2023; Park et al., 2025; Winkler et al., 2023). However, this integration introduces cognitive risks, particularly cognitive offloading and automation bias, which may undermine critical thinking and independent problem-solving if AI substitutes rather than augments human reasoning (Gerlich, 2025; Tian & Zhang, 2025). Consequently, effective entrepreneurship education in the circular economy must emphasize structured learning loops, visual models, and reflective frameworks that preserve human agency while leveraging AI as a collaborative cognitive partner (Russ, 2021c; Russ & Lytras, 2026b). From a knowledge management perspective, entrepreneurship education thus operates as a multi-level learning architecture linking individual cognition, organizational learning, and ecosystem-level transformation, equipping nascent entrepreneurs with the cognitive, technological, and ethical capabilities required to co-create innovative, resilient, and sustainable business solutions within an increasingly accelerated and interconnected economic system.

Closing

Taken together, the theoretical perspectives reviewed in this section underscore the fundamentally transformed conditions under which nascent entrepreneurs operate within the Post-Accelerating Data and Knowledge Networked Economy (PADKNE). Entrepreneurship emerges not only as a primary driver of economic growth and sustainability but also as an inherently cognitive, iterative, and learning-intensive process shaped by accelerating technological change, heightened uncertainty, and structural liabilities of newness and periphery. Artificial intelligence increasingly permeates every stage of the innovation and ideation processes, augmenting creativity, visualization, and decision-making while simultaneously introducing risks related to cognitive offloading, automation bias, and diminished critical reflection (Gerlich, 2025; Tian & Zhang, 2025). These tensions highlight that effective entrepreneurial use of AI is neither purely technological nor deterministic but deeply contingent on how human reasoning, learning loops, and evaluative judgment are structured and sustained. Within entrepreneurship education and the circular economy, this necessity becomes even more pronounced, as sustainable innovation requires the integration of economic, environmental, and social considerations through continuous feedback and adaptive learning architectures. Consequently, the theoretical synthesis points toward a critical gap: the absence of integrative frameworks that systematically align spontaneous ideation, AI-augmented creativity, visualization, and outcome evaluation while preserving human agency and ethical oversight. Addressing this gap requires models and visual tools that explicitly operationalize learning loops, outcome matrices, and collaborative human–AI interactions as dynamic mechanisms rather than static supports. The following sections build on this theoretical foundation by proposing and elaborating such frameworks, offering structured yet flexible approaches through which nascent entrepreneurs can harness AI to support innovative, resilient, and sustainable business solutions.

Next, the methodology used in developing the tools described in this paper will be discussed.

METHODOLOGY

This narrative multidisciplinary literature review draws on multiple academic literatures. Among them are the creative economy literature, technology management and business innovation literatures, human capital and knowledge management literatures, and psychology and organizational behavior literatures. The main focus has been on articles and books published during the last ten years, but earlier literature was used as well, as needed. The literature of creativity, ideation, innovation and entrepreneurship in the new economy is voluminous (see recent examples at: Suchek et al., 2021; Suchek et al., 2022) and systematic review of such literature is beyond the scope of this paper, as such this paper is selective in that it exposit only some of the most significant research contributions and highlights the most important aspects as relevant to the teaching and training of ideation and entrepreneurship in the new, networked, knowledge-driven economy.

Three databases were utilized, continuously using a snowballing process among references (backward and forward) for over 9 years. The author used: ABI, EBSCO-Business Source Premier, and Google Scholar. All three databases were employed since, for many aspects of the research, the author found them to be complementary. Initial screening was conducted using keyword searches of titles and abstracts, followed by a review of full texts; however, this approach proved to be of limited usefulness. The following keywords were used (in different combinations): creativity, ideation, new idea development, innovation, visualization, data, information, knowledge, Artificial Intelligence (AI), and sustainable economy. In total, the number of references used (see below) is 295.

Each year, the newly acquired knowledge was applied when teaching ideation, knowledge management, and entrepreneurship face-to-face and online classes, raising new questions and issues. The undergraduate and graduate classes took place in the US, Poland, and South Africa, where each class had between 14 and 35 students, allowing for diverse feedback and exchange with the students.

Heidegger's (1954) ontology of knowledge was used since it allowed us to cover the broad scope of the multidisciplinary nature of the subject. The five components of the framework: operational, collaborative, organizational, instrumental, and holistic were adopted and modified to outline the three proposed matrices—Reasonings–Outcomes, Reasonings–Learning Loops, and Outcomes–Learning Loops (see below). The narrative multidisciplinary literature review used was a modified version of an integrative literature review (Torraco, 2005). This methodology allows for initial conceptualization, resulting in the new frameworks, offering a new perspective on a multidisciplinary topic (pp. 357-8). See summary of the research process in Figure 1 (cf. with Fig. 1 in Iñigo & Albareda, 2016: 3), below.

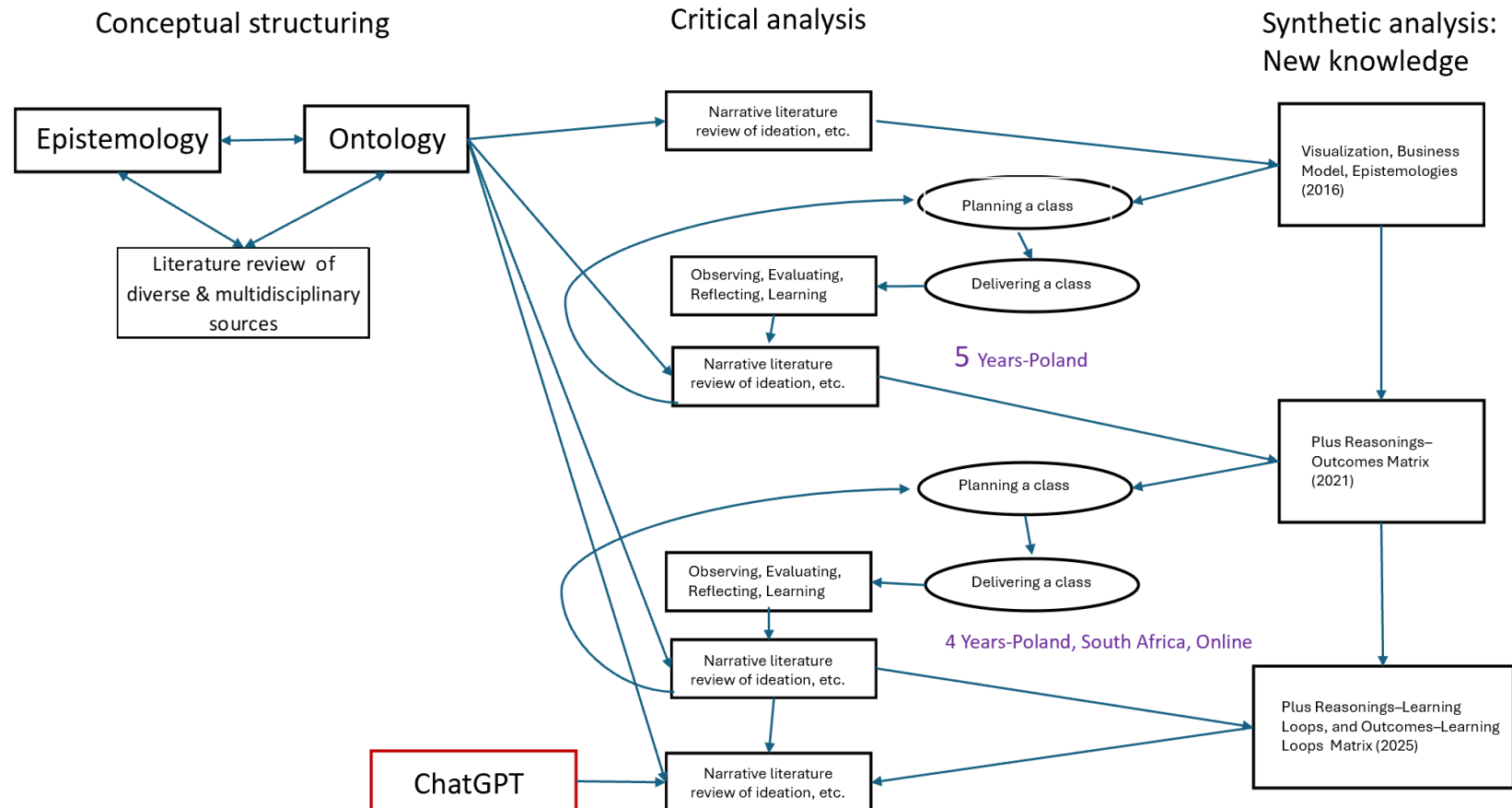


Figure 1: Summary of the research process: A narrative interdisciplinary integrative literature review process

IDEA GENERATION AND CREATIVITY

Ideas have a life cycle. This means that ideas should also be allowed to die, especially when they fail. As Einstein said, if you did not fail, you did not take a risk. So, in some cases, the company founder needs to develop an immune system (personal and/or organizational) that kills ideas (especially if they are bad or fail). This is one more reason why the company founder/owner needs to have measurable key success indicators and/or use a business model (see below). Such constraints will help the founder to be creative in her context, since creativity lives on the edge of chaos. No constraints (as well as too many) are not helpful for creativity, but counter-intuitively, constraints might provide an opening for fruitful creativity (Russ 2021b). Several creative methods and tools are available (see examples at MindTools, n.d.). For an early review of the generation of AI textual support systems, see an example in Blazevic et al. (2024).

A word of caution is in place here. Ideas or concepts are the source of innovation and are vital, but not sufficient, to the successful launch of a new platform, product, or service (cf. Sedniev, 2013). Also, the entrepreneur should not confuse creativity with innovation; they are not synonymous. Every innovation begins with creativity, but not every creative idea ultimately becomes an innovation (Russ, 2021b).

Creativity was defined as “Originality is vital, but must be balanced with fit and appropriateness” (Runco, 1988, p. 4) and requires both originality and effectiveness (Runco & Jaeger, 2012). Amabile (1983, 1996) proposed a three-component model of creativity that includes domain-relevant skills, creativity-relevant processes, and intrinsic task motivation as the essential components underlying creative performance. Domain-relevant skills refer to the knowledge, technical abilities, and expertise individuals bring to a task; these form the foundational base upon which creative work can build (Amabile, 1983). Creativity-relevant processes involve cognitive styles and strategies such as divergent thinking, breaking away from established patterns, and flexibility in approaching problems (Amabile, 1996). Finally, intrinsic motivation—the drive to engage in a task for its inherent interest and satisfaction rather than for external rewards—is considered a critical factor, as it sustains persistence and fosters openness to novel ideas (Amabile, 1997). Later research has reinforced the significance of this model, showing that the interplay between skills, processes, and motivation shapes creative outcomes across organizational, educational, and individual contexts (Amabile & Pratt, 2016). Boden (1990) distinguishes between combinational creativity, exploratory creativity, and transformational creativity as the three principal forms of creative thought. Combinational creativity refers to the generation of novel ideas by combining previously unrelated concepts, a process often associated with analogies, metaphors, or conceptual blending (Boden, 1990). Exploratory creativity involves the systematic exploration of structured conceptual spaces—such as artistic styles, scientific paradigms, or musical genres—by applying established rules and methods to generate new outputs within an existing framework (Boden, 2004). Finally, transformational creativity represents the most radical form, entailing the alteration or expansion of the underlying conceptual space itself, thereby enabling entirely new forms of expression or problem-solving (Boden, 2009). This tripartite model has been influential in both cognitive science and artificial intelligence, offering a theoretical basis for understanding how collaboratively humans, rationally and irrationally (Sobetska, 2025), and machines can produce novel, valuable ideas.

Academic research seems to suggest that creativity can be taught, and that creativity is not a fixed trait but a skill that can be nurtured and developed through appropriate methods, environments, and training interventions. Amabile’s (1983, 1996) componential theory of creativity (mentioned above) suggests that creativity comprises three components: domain-relevant skills,

creativity-relevant processes, and intrinsic task motivation. Both skills and processes can be cultivated through education and practice, making creativity amenable to teaching and training. Empirical studies reinforce this claim. Scott, Leritz, and Mumford (2004) conducted a meta-analysis of creativity training programs and found significant positive effects across diverse instructional approaches, particularly when training emphasized cognitive strategies, divergent thinking, and problem-solving, focusing on the development of cognitive skills and the heuristics involved in skill application, using realistic exercises appropriate to the domain at hand. Similarly, Sternberg (2003) argued that creativity training is effective when it focuses on enhancing both divergent and convergent thinking, combined with providing supportive contexts. Educational literature also supports the idea that structured interventions can foster creativity. Cropley (2001) emphasized that teaching creativity involves developing flexible thinking, tolerance for ambiguity, and openness to new perspectives. Moreover, Craft (2005) highlighted the importance of "possibility thinking" in education, showing that pedagogical methods encouraging questioning and exploration enhance creative potential.

In entrepreneurship education, creativity teaching is more goal-oriented and application-driven, directly tied to innovation, venture creation, and opportunity recognition. For example, Neck and Greene (2011) argue that entrepreneurship education must move beyond passive knowledge transfer toward experiential learning approaches that cultivate creative problem-solving, resilience, and opportunity development. Techniques such as design thinking, ideation matrices, and business model experimentation are specifically employed to foster practical, market-oriented creativity (Rae, 2006; Fayolle, 2018).

Furthermore, entrepreneurship contexts often integrate constraint-based creativity — working within resource limitations or market demands to generate novel, viable solutions. This aligns with Amabile's (1996) notion that creativity in applied fields must be both novel and useful. Thus, while general education nurtures broad creative capacities, entrepreneurship education channels creativity toward innovation and value creation in uncertain environments.

To conclude, research suggests that creativity can indeed be taught, provided that the instructional process goes beyond rote learning and instead emphasizes skills, processes, and motivational environments that enable novel and valuable idea generation.

Regardless of the source of the idea, insight, serendipity, or tool used, the generation of ideas should be practiced extensively, since the success rate is very low (there is a need for over 100 ideas for one successful venture; Savoia, 2019). Using an idea log and visual thinking (see below) might be a healthy practice.

INNOVATION PROCESS

The traditional approach for innovation calls for a staged process (see Cooper, 1990; and example in Ettlie & Elsenbach, 2007), and for using the innovation funnel (Dunphy, Herbig, & Howes, 1996; Wheelwright & Clark, 1992; see also decision-making tools at IfM, n.d.). In this paper, the author proposes a more organic, cycled, integrated, and iterative approach (see Figures 2A and 2a below - Russ 2021b) (cf. Spruijt, 2016).

The models described in Figure 2 identifies four different aspects/ingredients needed to be carried by an actor for successful ideation, specifically, [1] an issue to be solved, [2] a solution to resolve the issue, [3] a practical (physical, biological or digital) prototype, and [4] a sustainable (financial, social and environmental) business model that can carry the idea into the real world and make it a profitable reality in an economic, socially and environmentally sustainable manner (Russ, 2021b).

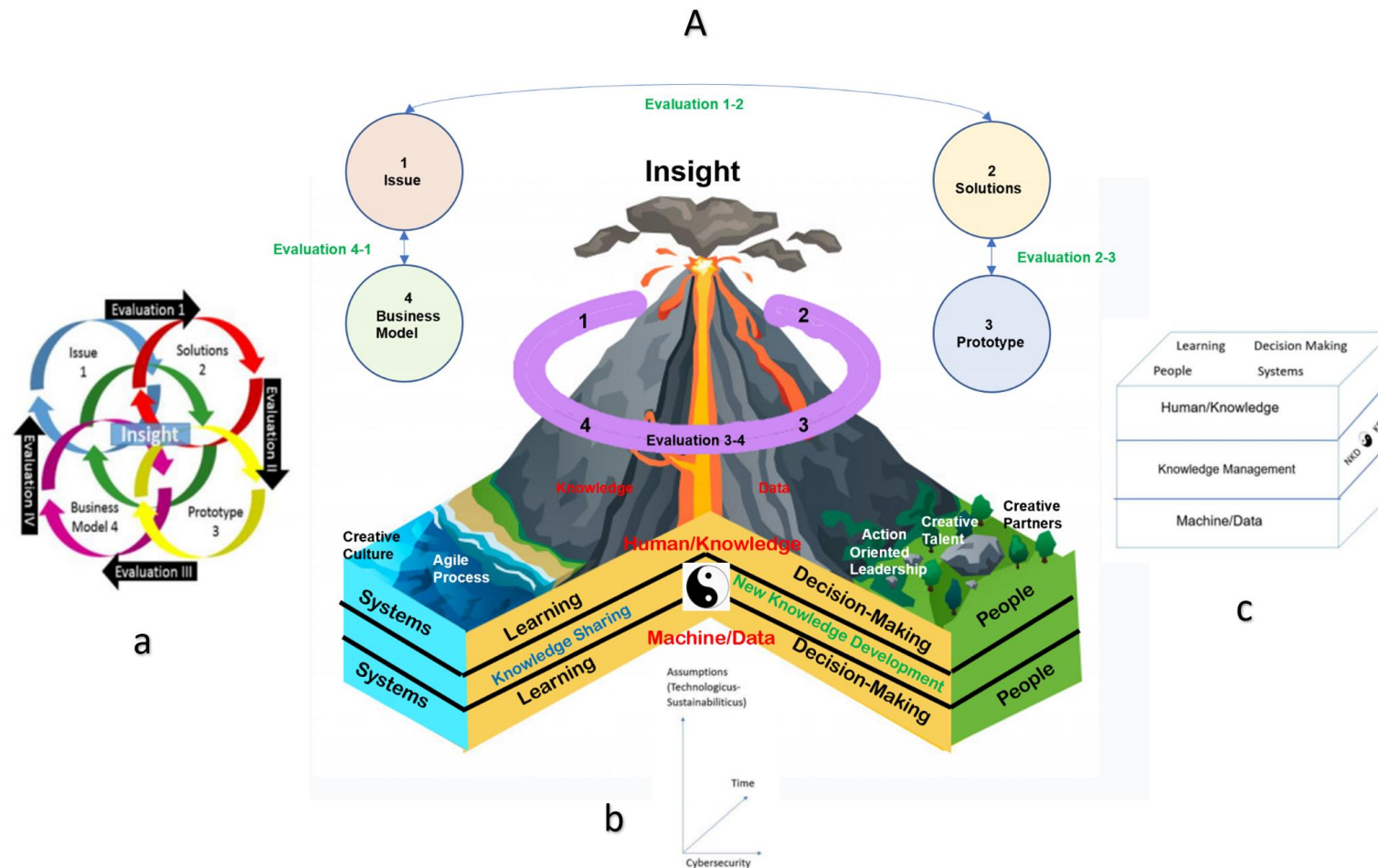


Figure 2: Spontaneous Ideation: Process, actors, and models (author elaborations and Russ, 2021b)

Such a process is dynamic, interactive, and symbiotic; it can start almost at any point in time, but the process must pass successfully (at least once) throughout all the four aspects and be carried on/driven by an action oriented, visionary and creative actor/leader, collaborating with internal and external talents and partners (Russ, 2021b). This approach aligns closely with contemporary methodologies such as design thinking, agile, and scrum, which emphasize iterative, user-centered development through a series of adaptive sub-cycles. Each cycle is characterized by a lean and evolving definition of requirements, obstacles, and potential solutions, informed by continuous learning and feedback. Such frameworks support founder-driven learning and team-based self-organization, enabling ventures to respond dynamically to uncertainty and complexity (Beck et al., 2001; Brown, 2009; Denning, 2018).

The volcano metaphor described in Figure 2A is helpful but has limitations, since the background view (not shown in Figure 2A) or the business landscape (or eco-system, see more in D' Alessandro et al., 2024; Russ & Lytras, 2026a, and Lytras & Russ, 2026) is continuously changing (using the Industrial-Organizational model as the strategic paradigm – outside-in; Porter, 1980, 1985) and/or the volcano can relocate to a whole different scenery (using the Resource-Based strategic paradigm inside out, Barney, 1991). To elaborate briefly on this point, the Industrial-Organizational model focuses on satisfying current or latent customer needs as a starting point (which is why it is outside-in). On the other hand, the Resource-Based model's starting point is the unique internal resources and reaching out, finding the landscape where they can be used fruitfully (which is why it is inside-out) (Russ, 2021b). Regardless, the landscape is embedded in the three-dimensional space of Ethics, Cybersecurity, and Time as discussed below.

For example, the classic stage process suggests defining the issue (gap, problem) first and then looking for a creative solution. However, sometimes, the solution comes first, or the first duo (issue [1]- solution [2]) does not work, and the 'actor' needs to redefine the issue-solution duo before proceeding to the next stage (evaluation). Here, the four loops of learning (see Figure 3 below) can be useful for opening a broader set of options (out-of-the-box thinking), both for framing the issue and for defining the solution (see more about the use of the learning loops in the decision-making process in Russ 2021c). And what if, after successfully passing the evaluation stage (using Table 1 below), it is determined that the goals cannot be achieved, then what? Change the goals? Reevaluate? Find another solution? Redefine the issue? Again, the four loops of learning can be helpful here. Similar dynamics can be seen when exerting rapid prototyping [3] and business model development [4]. Which comes first: building a prototype according to a business model (as is the Japanese or the Lean approach to innovation, e.g., Blank, 2013), or developing a business model enabled by a prototype (the traditional approach)? And if the performance of the prototype is not satisfactory, what should be changed? The evaluation criteria? The business model? Or, if the business model does not deliver the expected financial outcomes, what should be done? So, the leader/actor (e.g., company owner) can have insight at any stage, which can energize each one of the four stages, as well as build on itself. Also, the four evaluations included in the model (evaluations 1-2; 2-3; 3-4; and 4-1 in Figure 2A) should have clear criteria for passing/moving to the next stage, and the overall evaluation should center around five questions: 1) What is the issue? 2) What is the solution? 3) Could it work? 4) Can the founder/owner generate profit by doing this? 5) Is the solution socially and environmentally responsible and sustainable? But a word of warning: an evaluation too early can stifle creativity (Russ, 2021b).

One early critical stage of an innovation process is idea development, or what has been referred to as 'concept generation' or 'Ideation'. To develop ideas effectively and efficiently, one needs to marshal and utilize the needed resources and access to networks within their environment, which specifically includes leadership, a culture of creativity and action, a culture of learning, access to

talent, digital systems, and processes. Such access to and use of networks will also be needed later when the ideas are brought to fruition as a new product, service, process, and/or business model (Russ, 2021b).

The model above (Figure 2) describes the dynamic process as mentioned above, as the author sees it. Please note that one part of the model is the three-dimensional “space” of Ethics, Cybersecurity, and Time (Figure 2b) within which the “volcano” operates.

Ethical considerations, as well as sustainability, must always be a part of the entrepreneurs’ concerns. Ethics are strategic levers in deployment that can accelerate scaling, investment, and long-term impact (Yee et al., 2025, p.4). Ethics should always occupy a paramount position in the entrepreneurial decision-making process because it fundamentally shapes the legitimacy, sustainability, and long-term success of any new venture. Entrepreneurs operate in conditions of uncertainty, where choices regarding resource allocation, stakeholder engagement, and innovation often involve moral trade-offs that extend beyond financial considerations (Freeman, 1984). Ethical reasoning serves as a guiding framework that not only constrains opportunistic behavior but also promotes trust, transparency, and reputational capital—critical intangible assets for new ventures seeking legitimacy in the market and among investors (Hosmer, 1995; Spence & Rutherford, 2001). Moreover, in an era increasingly defined by environmental and social consciousness, ethical entrepreneurship ensures alignment between organizational goals and broader societal expectations, thus fostering long-term stakeholder value creation rather than short-term profit maximization (Carroll & Shabana, 2010). Ethical awareness also enables entrepreneurs to anticipate regulatory and social changes, mitigating reputational and legal risks while contributing to systemic sustainability and equitable development (Sarasvathy, 2001; Shepherd et al., 2021). Ultimately, ethics is not an external constraint on entrepreneurial freedom but rather a constitutive element of responsible innovation—ensuring that creativity, risk-taking, and value creation are pursued within the bounds of integrity, fairness, and respect for human and ecological systems.

Sustainability should be a central concern for every new venture and embedded as a fundamental component of every strategic business plan due to its critical implications for long-term value creation, risk mitigation, and societal and legal legitimacy. As businesses increasingly operate in complex global environments marked by climate change, resource scarcity, and social inequalities, integrating sustainability into strategy is not only ethically imperative but also strategically advantageous (Porter & Kramer, 2011). New ventures have the opportunity to embed sustainable practices from inception, enabling them to align with evolving regulatory frameworks, consumer expectations, and investor preferences that favor environmental, social, and governance (ESG) performance (Eccles, Ioannou, & Serafeim, 2014). Furthermore, sustainable business strategies can contribute to innovation by driving efficiency, reducing costs, and uncovering new market opportunities (Hart & Milstein, 2003). Neglecting sustainability can expose ventures to reputational damage, legal penalties, and reduced access to capital. Thus, sustainability is not merely an add-on but a strategic necessity that enhances resilience, stakeholder trust, and long-term competitiveness (Bocken et al., 2014).

Entrepreneurs contribute to sustainability by developing innovative solutions for environmental problems, fostering circular economy models, promoting eco-friendly practices, creating and transforming green jobs, and influencing policy through education and advocacy. By prioritizing social, economic, and environmental goals, they drive systemic change and advance sustainable business solutions by developing green technologies and sustainable products, and services. They contribute to promoting economic growth and the circular economy, and short and long-term job creation (Gebhardt & Bachmann, 2023; Kritikos, 2024; Russ & Herron, 2026; Son & Suh, 2024; Talukdar & Saikia, 2025; Veleva, 2021). For these reasons, sustainability should be embedded in the strategic planning process of every business, startup, and incumbent alike. See Appendix B for an example of a business model of a socially responsible new venture idea, applying the concept of the circular economy.

Single, Double, Triple and Quadruple Loop Learnings

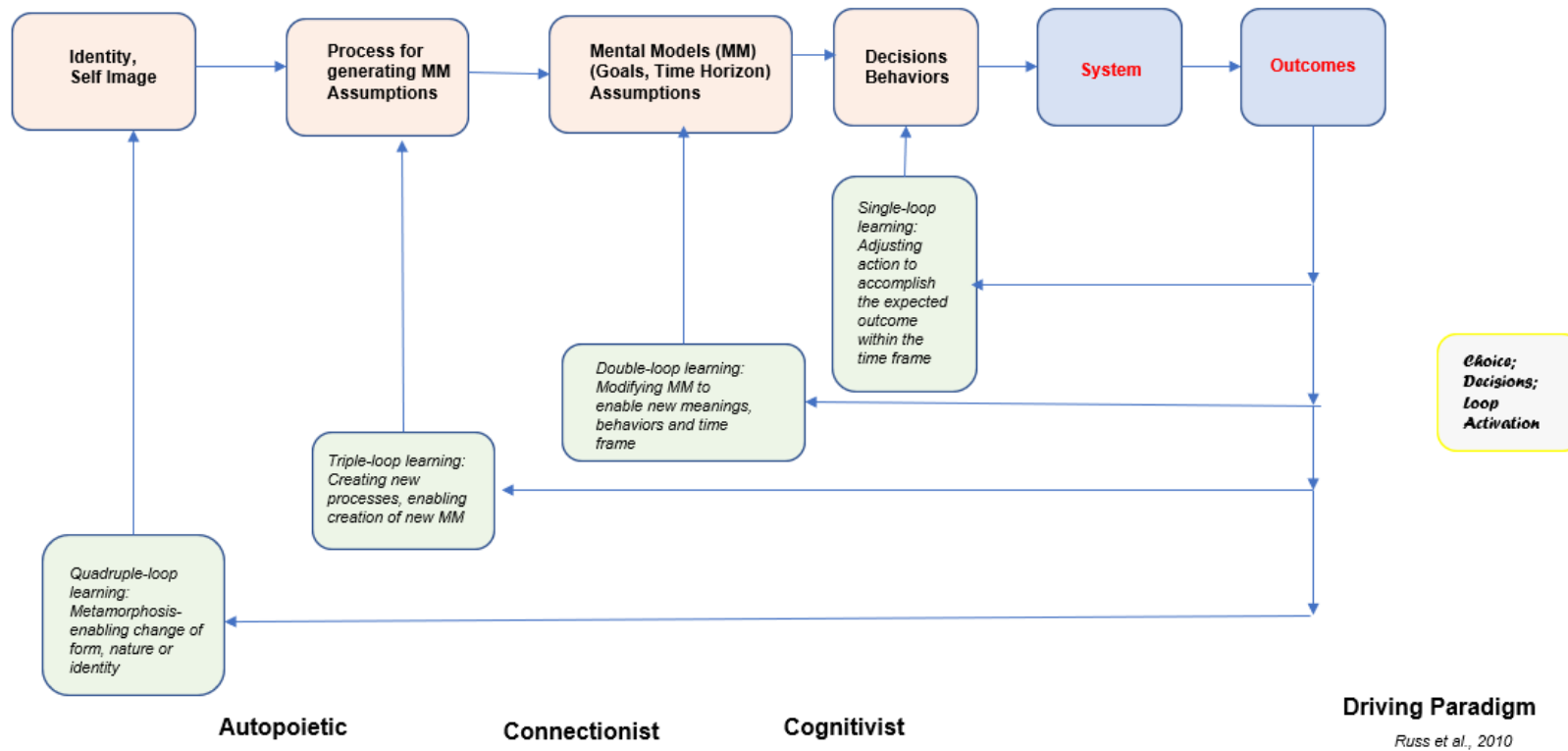


Figure 3: Single, Double, Triple, and Quadruple Loop Learnings (adopted from Russ, 2021c)

Cybersecurity and digital trust should be considered today from the inception of the business and incorporated at every step of the venture development and implementation to maintain secure customer and user experiences (Yee et al., 2025). Cybersecurity and digital trust are foundational to the viability and credibility of any entrepreneurial venture operating in today's data-driven economy. As new ventures increasingly rely on digital platforms, cloud computing, and artificial intelligence to manage operations, customer interactions, and value creation, they simultaneously expose themselves to significant risks of data breaches, identity theft, and cyberattacks (Von Solms & Van Niekerk, 2013). For entrepreneurs, cybersecurity is not merely a technical safeguard but a strategic imperative that underpins operational continuity, customer confidence, and regulatory compliance (Pfleeger & Pfleeger, 2012). A robust cybersecurity framework enables entrepreneurs to protect proprietary knowledge, maintain the integrity of digital transactions, and secure stakeholder information—core elements that sustain trust in virtual exchanges and brand reputation (Bada & Nurse, 2020). Digital trust, in turn, represents a form of social and relational capital that reinforces consumer loyalty and facilitates ecosystem collaboration in digital markets (Rindfleisch & Heide, 1997; Rousseau et al., 1998). In an environment shaped by data privacy regulations such as the General Data Protection Regulation (GDPR), establishing transparent data governance and accountability mechanisms has become a precondition for ethical legitimacy and market access (Taddeo & Floridi, 2018). Consequently, for entrepreneurs, integrating cybersecurity and digital trust from the inception of a venture not only mitigates systemic vulnerabilities and reputational risks but also enhances the firm's competitive advantage and resilience in an increasingly interconnected and volatile digital economy.

Managing time effectively and efficiently is one characteristic of successful entrepreneurs (e.g., Ge et al., 2022). Time management, time orientation, and the recognition of windows of opportunity are critical determinants of entrepreneurial success, influencing both strategic decision-making and venture performance. Effective time management enables entrepreneurs to allocate limited cognitive and operational resources efficiently, balancing exploration and exploitation activities under conditions of uncertainty (Brinckmann et al., 2010). Entrepreneurial time orientation—the way individuals perceive, value, and act upon temporal dimensions—shapes their capacity to anticipate market shifts, align actions with long-term objectives, and synchronize innovation cycles with stakeholder expectations (Lumpkin et al., 2010). Furthermore, the entrepreneurial process is inherently temporal, as opportunities are often perishable and embedded within dynamic socio-economic and technological contexts (Shane & Venkataraman, 2000). Recognizing and acting within these “windows of opportunity” demands both temporal sensitivity and strategic agility—the ability to make timely decisions while adapting to feedback and emerging constraints (McMullen & Dimov, 2013). Entrepreneurs who fail to align their temporal frameworks with external market rhythms risk missing critical inflection points, such as shifts in consumer demand, technological disruption, or regulatory change (Baker et al., 2003). Conversely, those who master temporal coordination can leverage timing as a strategic resource, translating opportunity recognition into competitive advantage. Ultimately, time management, orientation, and opportunity framing are not merely operational competencies but temporal forms of strategic cognition that govern the entrepreneur's ability to navigate uncertainty, mobilize resources, and sustain venture momentum in fast-evolving markets.

See more about the three dimensions in Russ (2021a) and also about the decision-making process and the quadruple learning in Russ (2021c).

An alternative integrative process was described recently by Güss et al. (2021), based on their study of the work of Leonardo da Vinci, one that contains nine iterative stages.

Next, a number of matrices and visual tools that can facilitate spontaneous ideation will be introduced.

REASONINGS-OUTCOMES MATRIX AND THE REASONINGS-LEARNING MATRIX

Considering evaluation (or thinking, reasoning), there are numerous reasoning approaches that the entrepreneur can use. For example, deduction, induction (enumerative or eliminative), and abductive (e.g., presencing) reasoning are some of the common (e.g., Güss et al., 2021) reasoning perspectives. Others may include counterfactual, intuitive, logical (e.g., critical or scientific thinking), backward, defeasible, heuristic, and causal (e.g., Bryant, 2007; Duggan, 2013; Gaglio, 2004; Krueger Jr, & Day, 2010). See the brief description of these reasoning approaches in Appendix A.

As for the expected outcome of the ideation process (insight), the entrepreneur can try to develop new knowledge, data, language, tools, experience, system, process, and affect (in tandem with the new product or service), she¹ wants to offer, above and beyond the expected traditional financial outcomes. This will offer an intriguing matrix (see Table 1) of Reasonings-Outcomes possibilities that the entrepreneur can use while going through the iterative stages discussed above. Each cell in the matrix is an option the entrepreneur can use/proceed with, and the author's recommendation to the entrepreneur is to develop (or use) a basket of options, while considering how to invest their resources (attention, time, capital, etc.) and what outcomes to pursue (see examples at Scharmer, 2016). Table 1 presents an illustrative, detailed example of such a matrix.

An alternative avenue to the different reasoning approaches (in Table 1) that the entrepreneur can use, in case she is not satisfied with the results of her evaluation, is to apply the four learning loops described above (in Figure 3) for the purpose of ideation, to broaden the scope of choices the entrepreneur could consider. The result will be the matrix of Reasonings-Learning Loops described in Table 2, and illustrated with a detailed ideation example, in the context of new ideas.

TOOLS FOR SPONTANEOUS IDEA DEVELOPMENT AND IMPLEMENTATION

In order to develop ideas rapidly, the founder needs to familiarize herself and get practice with many tools. Here are a few that the author is recommending based on his practical experience, consulting, research, and teaching.

Data and Knowledge

At every stage and at every point, the founder has access to data and knowledge that she can utilize. The author proposes the use of the new model of Knowledge Management (Figure 2c) that was recently proposed by Russ (2021c). The model suggests that the founder learns new knowledge and makes data-supported decisions, at the same time, continuously and seamlessly. As such, the founder is developing new knowledge while using her existing knowledge (see Fig 2A and 2c above) simultaneously. In the process, data is accessed, and it is expected that big data and machine learning will be engaged in the process as well, at different stages in the very near future (see examples in Russ & Lytras, 2026a, and in Lytras & Russ, 2026). To accelerate decision-making at any stage, the entrepreneur can collaborate with the currently under-development Agentic AI autonomous systems that could enable her to focus on strategic issues, for example,

¹ I use "she" in a reference to an 'entrepreneur'

Table 1. Matrix of Reasoning Approaches and Entrepreneurial Outcomes for Startup Ideation

This matrix maps 13 types of reasoning processes against 12 entrepreneurial outcomes, offering concrete examples of how human-AI collaboration can facilitate startup ideation and value creation processes across multiple dimensions.

Reasoning \ Outcome	Knowledge	Data	Language	Tools	Experience	System	Process	Affect	Product	Service	Profits	Sales
Deductive	Use known legal precedents to structure a knowledge services startup	Apply GDPR ⁽¹⁾ principles to generate structured compliance datasets	Use grammar rules to build AI-powered editing tools	Design chatbot decision trees from logic frameworks	Use case studies to create immersive onboarding systems	Use deductive logic to organize logistics dashboards	Apply Six Sigma tools to reduce defects in the product (e.g., food) delivery	Use behavioral rules to craft tone-checking AI	Derive product features from regulations (e.g., fintech compliance app)	Apply deductive checklists to telemedicine triage	Forecast revenue from the logic-based tiered pricing model	Use deductive filters to prioritize high-converting leads
Induction (Enumerative)	Extract trends from customer feedback	Use AI to mine reviews for recurring themes	Build natural language summaries of multiple documents	Aggregate commonly used AI tools by startup founders	Use internship journals to compile experiential learning modules	Develop HR systems from patterns in successful organizations	Map operational bottlenecks from multiple workflows	Summarize satisfaction trends to shape UX ⁽²⁾	Identify design themes from maker forums	Build services based on aggregated user complaints	Use historical launch data to shape profit estimates	Induce winning ad messages from customer comments
Induction (Eliminative)	Eliminate failing hypotheses to refine knowledge maps	Identify irrelevant data fields through iterative pruning	Discard misunderstood terms to train NLP ⁽³⁾ better	Eliminate redundant tools through A/B ⁽⁴⁾ testing	Filter ineffective team training by survey analysis	Remove ineffective scheduling submodules in SaaS ⁽⁵⁾ systems	Prune unnecessary manufacturing steps	Eliminate off-brand emotional cues from UI ⁽⁶⁾	Narrow features to the most used functions	Tailor services by discarding the least-used options	Maximize profit by eliminating unprofitable product lines	Improve sales by removing the least effective sales channels
Abductive (Presencing)	Create a new knowledge framework for	Generate novel insights from weak signals in	Invent new metaphors for emotional branding	Create AI-based design fiction	Envision new customer onboarding	Design anticipatory logistics for emerging needs	Envision new workflow patterns for edge cases	Detect emergent customer	Conceptualize wearable products that don't yet exist	Invent anticipatory support models	Envision platform monetization from emerging	Predict demand in unseen niche markets

	digital mindfulness	diverse datasets		prototyping tools	journeys based on weak cues			sentiment trends			usage behaviors	
Counterfactual	Use "what if" AI simulations to explore alternate learning paths	Generate hypothetical scenarios to test database robustness	Explore alternate phrasings for product names using GPT	Model outcomes of tool changes in operational AI	Simulate outcomes if users had the opposite onboarding flows	Compare counterfactual structures in CRM ⁽⁷⁾ design	Model process changes in high-risk environments	Test the emotional impacts of alternate UX choices	Prototype alternate UI paths and analyze the reaction	Simulate demand if new service tiers were offered	Analyze profits if the cost of goods were halved	Forecast the market reaction if a new vertical is entered
Intuitive	Use human hunches combined with AI clustering	Spot meaningful outliers quickly via AI + intuition	Let intuitive design guide voice assistant scripting	Choose tools based on user intuition & visual simplicity	Build onboarding based on the felt sense of ease	Sketch systems from instinct, refined via prototyping	Define lean process maps through intuitive diagramming	Use gut-feeling feedback loops to adjust tone	Intuitively design product aesthetics before testing	Co-create wellness services through founder-client resonance	Use intuition to balance profit and accessibility	Choose channels that feel "natural" to the brand voice
Critical Thinking	Analyze conflicting sources to construct new knowledge	Evaluate data quality and bias rigorously	Refine brand language through philosophical analysis	Evaluate tools on value vs. cost thoroughly	Dissect experience reports for contradictions	Audit systems for misalignment with strategy	Redesign inefficient processes through root cause analysis	Scrutinize emotional branding for manipulation	Dissect over-engineered product features	Refine the service model after rigorous stakeholder analysis	Calculate profits with conservative assumptions	Analyze the market to detect false sales trends
Scientific Thinking	Build knowledge models through A/B testing	Design controlled experiments for dataset curation	Test message clarity via randomized surveys	Measure tool ROI ⁽⁸⁾ through controlled rollout	Test onboarding pathways experimentally	Evaluate system scalability via simulations	Pilot processes in sandbox environments	Study affective responses under lab conditions	Run MVP ⁽⁹⁾ tests for core feature validation	Try new service frameworks iteratively	Optimize pricing through repeated field tests	Measure conversion rates across personas
Backward Reasoning	Start from expert knowledge and trace back the needed preconditions	Map the required data backward from the desired outputs	Reverse-engineer effective brand messages	Identify precursor tools to the current AI stack	Deconstruct the customer journey from outcomes	Design systems by working backward from impact	Reverse-process bottleneck discovery	Infer affective triggers from purchase decisions	Design product features to trigger intended outcomes	Develop concierge services from reverse-mapped pain points	Calculate break-even backward from desired margins	Set sales goals based on the desired revenue model

Defeasible	Revise the knowledge model with real-time data updates	Adjust training data with ongoing customer behavior shifts	Tweak brand tone in response to social feedback	Retrain AI models to improve tool efficacy	Update training experience with emerging user feedback	Refactor CRM systems based on recurring exceptions	Shift process designs when original assumptions fail	Shift emotional appeals based on backlash	Adapt product spec as technology or user context changes	Evolve services as user expectations shift	Rework the profit model as assumptions change	Adjust sales approach after pilot misalignment
Heuristic	Use fast-and-frugal mental models with AI support	Apply the "80/20" rule to prioritize relevant data	Use AI autocomplete in co-writing brand slogans	Choose toolkits based on what has worked before	Apply quick experiential fixes based on prior cases	Build systems from common software stacks	Improve flow using UX design heuristics	Choose emotional framing from existing brand maps	Select features using MVP heuristics	Launch services from industry best practices	Guess margins from rule-of-thumb estimates	Rely on referral-based selling norms
Causal	Model cause-effect in user learning with explainable AI	Establish data pipelines based on behavior-cause modeling	Link user phrasing patterns to buying behaviors	Develop tools that trigger measurable user habits	Study causal links between feature use and user success	Build systems that reduce churn based on causal loops	Map production outcomes to specific workflow variables	Tie the user's mood to support response timing	Correlate materials used to improve product durability	Link service wait times to satisfaction metrics	Tie customer engagement directly to pricing triggers	Link demo availability to conversion spikes

Note-Table 1 was populated with the following prompt for Chat GPT, July 10, 2025; see below:

While creating new ideas, I suggested several specific reasoning: Deduction, induction-enumerative, induction-eliminative, abductive (e.g., presencing), counterfactual, intuitive, critical thinking, scientific thinking, backward, defeasible, heuristic, and causal. To create a matrix, I also suggested a number of expected outcomes above and beyond the traditional financial outcomes: Knowledge, data, language, tools, experience, system, process, affect, product, and service. Can you please give me specific examples for each reasoning and outcome cell (including the finances) in such a matrix? Consider ideas to start a new startup and populate each cell with full examples.

General Data Protection Regulation (GDPR⁽¹⁾) User experience (UX⁽²⁾) Natural Language Processing (NLP⁽³⁾) A/B testing (split testing⁽⁴⁾)
Software as a Service (SaaS⁽⁵⁾) User Interface (UI⁽⁶⁾) Customer Relationship Management (CRM⁽⁷⁾) Return on Investment (ROI⁽⁸⁾)
Minimum Viable Product (MVP⁽⁹⁾)

Table 2. Matrix of Reasoning Approaches and of Learning-Loops for Startup Ideation

This table presents detailed examples of how each of the twelve reasoning processes intersects with the four organizational learning feedback loops. These examples are contextualized around startup ideation and innovation.

Reasoning Process	Single-Loop Learning	Double-Loop Learning	Triple-Loop Learning	Quadruple-Loop Learning
Deductive	Use legal principles to guide how an AI startup structures its user license terms	Challenge assumptions about intellectual property restrictions in software licensing	Create a new AI startup legal framework that merges open-source and proprietary benefits	Reinvent what "ownership" means in collaborative AI platforms
Induction (Enumerative)	Extract patterns from user feedback to refine UI features	Modify mental models about user behavior based on clustered feedback	Develop new user personas and design processes based on emerging behavioral trends	Redefine how users and systems co-evolve and co-learn in human-AI interactions
Induction (Eliminative)	Remove failing ad strategies to optimize the campaign	Change assumptions about what motivates customers by eliminating failed triggers	Create a new customer motivation model using iterative exclusion of outdated touchpoints	Shift from targeting to resonance-based design philosophy in startup marketing
Abductive (Presencing)	Use weak signals to hypothesize new niche product features	Reframe customer needs based on emotional or intuitive projections	Design new ideation processes that tap into future-sensing and foresight rituals	Embody a startup identity that acts as a foresight-driven social catalyst
Counterfactual	Use simulations to test alternate price points	Challenge pricing models by simulating alternate market entry points	Build simulation-based ideation environments where new business models can emerge	Adopt speculative design as a way of transforming the startup role in future societies
Intuitive	Follow gut instinct to choose a co-founder or an MVP feature	Revise initial team assumptions based on affective trust and chemistry	Develop intuition-led design labs that integrate founder instinct with AI ideation tools	Reimagine intuition as a collective intelligence, transforming the identity of team formation
Critical Thinking	Identify inconsistencies in financial projections	Critically question investor expectations and redefine success metrics	Establish critical ideation circles to surface assumptions and create reflexive frameworks	Transform startup governance to be transparency-first, embedding critique into operations

Scientific Thinking	Test hypotheses about product features using A/B testing	Challenge MVP assumptions by running null-hypothesis tests on core value propositions	Create experimentation-driven ideation processes using continuous evidence gathering	Develop a startup culture that treats failure as a hypothesis-driven evolutionary opportunity
Backward	Reverse-engineer competitor success to plan startup milestones	Rethink what constitutes success by starting from the long-term social impact	Design ideation backward from the desired legacy or social change impact	Transform business as a vehicle for multi-generational regeneration and meaning
Defeasible	Adjust the roadmap after a failed pilot launch	Shift beliefs about product-market fit based on new, contradicting feedback	Build adaptive ideation cycles that change with each new market signal	Use perpetual beta as an identity model for the startup, always evolving
Heuristic	Use the rule of thumb to prioritize features based on the 80/20 rule	Question reliance on expert heuristics by identifying contextual mismatches	Create new startup rules based on lived founder/team experience and adaptive practice	Evolve heuristics into fluid wisdom practices that change with organizational learning identity
Causal	Analyze feature impact on user retention	Rethink which variables truly affect churn by causal mapping and sensemaking	Design ideation sprints based on identifying and testing new causal loops	Evolve beyond causality to relational systems thinking in the startup-environmental interaction

Note- Table 2 was populated with the following prompt for Chat GPT, July 13, 2025; see below:

While creating new ideas, I suggested several specific reasoning: Deduction, induction-enumerative, induction-eliminative, abductive (e.g., presencing), counterfactual, intuitive, critical thinking, scientific thinking, backward, defeasible, heuristic, and causal. To create a matrix, I also suggested four learning feedback loops: single-loop learning: Adjusting action to accomplish the expected outcome within a given time frame; double-loop learning: Modifying mental models to enable new meanings, behaviors, and time frame; triple-loop learning: Creating new processes to enable new mental models; quadruple-loop learning: metamorphosis, enabling change of form, nature or identity. Can you please give me specific examples for each reasoning and learning loop cell in such a matrix? Consider ideas to start a new startup and populate each cell with full examples.

on serving a long tail of unpredictable tasks and generating work plans that can be understood, modified, and implemented (Yee et al., 2025).

To enable new ventures' agility and resilience for the future, the author is recommending developing ambidextrous knowledge management strategies, using, for example, the C³EEP topology (see Russ & Jones, 2011b) that includes the capabilities needed to respond to the six strategic knowledge management dilemmas of: Codification-Tacitness; Complementary-Destroying; Concealment-Transparent; External Acquisition-Internal Development; Exploration-Exploitation; and Product-Process.

Idea log

In a new venture creation context, the cultivation of innovative and analytical thinking is crucial for problem-solving and creativity. Idea logs are an effective tool for enhancing these skills, serving as structured journals for recording, organizing, and reflecting on ideas, issues, and solutions. Idea logs help individuals track their thought processes, document their creative inspirations, and analyze the evolution of their concepts over time (Russ, 2021b).

Idea logs can be graphics (see, for example, CS 247 Human Computer Interaction, Stanford, n.d.a) or written (see, for example, CS 247 Human Computer Interaction, Stanford, n.d.b).

This section provides a comprehensive guide on how to effectively implement and use idea logs, outlining specific guidelines to maximize their utility. By adopting these steps, entrepreneurs can use idea logs to foster deeper learning, facilitate long-term project planning, and enhance both critical thinking and idea generation.

Here are the author's guidelines for how to write an idea log:

Record the issue to be resolved (it is OK to refine it again and again). List at least three solutions. There is nothing wrong with starting with an 'aha' moment (solution), then defining the issue, and then suggesting at least two additional solutions (the entrepreneur can always have more than three alternative solutions).

- a. Do it daily; incorporate it into a daily routine.
- b. Record everything.
- c. Have a clear set of "success" criteria--write them down; They MUST be specific, measurable, and within a time frame (see, for example, SMART goals at Tigar, 2025).
- d. Review them (the criteria, the issues, the solutions) occasionally; choose the best; and reflect.
- e. While reflecting, consider these questions (at least, you can always add):
 1. Was the idea challenging?
 2. Did I force myself out of my comfort zone?
 3. Would I accomplish the goals I intended to?
 4. Am I using the right criteria?
 5. Was I clear about how to make it work?
 6. Did I consider all possible scenarios, contingencies?
 7. What did I learn from this?
- f. Involve other trusted people; be sure to collect both positive and negative feedback (see more, for example, in Verganti, 2016).

Idea logs should be seen in this context as a preparatory tool. For example, when the opportunity to practice spontaneous creativity arises, the entrepreneur will have the experience and the skills needed to effectively benefit from the window of opportunity.

Visual thinking²

Visual thinking, the process of using imagery, diagrams, and other visual aids to process information and solve problems, has gained increasing recognition as a powerful tool in both educational and professional contexts (Amheim, 2023; Roam, 2009) and seems to be common among entrepreneurs (Hayati & Umer, 2018). By leveraging visual representations, individuals can break down complex concepts, identify patterns, and foster creativity. Research also suggests that

² The author is suggesting that the reader, while reading this part (pages 14-36), has a specific issue at hand, and, after watching the examples and videos referenced in this document, apply them to her specific issue, so the tools will make sense and be practiced.

the use of visual thinking tools can enhance entrepreneurial intent among students (Gismera Tiemo et al., 2021). This paper briefly explores the concept of visual thinking and offers specific guidelines on how to effectively incorporate visual strategies into learning and problem-solving activities. With structured methods, such as mind mapping, sketching, and diagramming, visual thinking can enhance comprehension, improve memory retention, and facilitate innovative approaches to tackling challenges across various disciplines (Albert et al., 2022).

There are four steps of visual thinking (Roam, 2009, pp. 32-42). For a summary, watch the short videos at Roam (n.d.a and n.d.b).

1. Look -- semi-passive process of observing the situation (using existing metadata, baskets).
2. See -- proactively re-categorizing the view of the situation (rearranging the metadata and data into 'new' information which will enable the creation of 'new' knowledge). See also Roam (n.d.c) and Brandenburger (2022).
3. Imagine -- utilizing the new knowledge for creative possibilities, enabling value creation.
4. Show -- effectively communicating the output to the audience of interest.

The process is not always linear (1 to 4), and may require reprocessing, consistent with the models introduced in Figures 2 and 3 above. In his book, Roam (2009) elaborates on each of the four steps listed above.

Below, the author will briefly cover a few of the most important aspects (in the author's opinion) of these steps.

Roam (2009, pp. 67-88) suggested six formulas to structure the proactive re-categorizing of the situation (mentioned above) by using the 6w's (or 5w2h) --see a brief introduction in Polaine (2009).

The 6w's are:

1. Objects -- relate to who and what
2. Quantities -- measurement of how many and how much
3. Position in space -- where in space and process
4. Position in time -- when and timing
5. Influence/cause and effect -- how (system thinking)
6. Putting it together (the big picture) -- why

Roam (2009, pp. 89-120) also suggested five dilemmas (the SQVID) to consider and resolve when thinking about visualization (see a summary video at Roam, n.d.d). These five are:

1. Simple vs. elaborate
2. Quality vs. quantity
3. Vision vs. execution
4. Individual attributes vs. comparison
5. Change vs. status quo

To facilitate the visual thinking process, Roam (2009, pp. 121-130) also proposed a framework and a set of specific tools for showing -- what we see and what we show -- see summary in Roam (n.d.c).

1. Why -- multiple variable plot
2. How -- flowchart
3. When -- timeline
4. Where -- map
5. How many -- chart
6. Who, what -- portrait

Two additional examples of the graphic tools by Roam can be found at:

Visual Thinking Codex -- Six W by SQVID; Roam (2009, pp. 131-136). See Roam (n.d.e) and the VIVID grammar at Roam (n.d.f).

Moreover, additional examples of visual thinking from other sources that you may want to consider:

- A new advanced tool: visual thinking for business, and a video can be found at Griffin (n.d.).
- A Master's project from Buffalo State College by Melinda Walker (2012). "Visual Thinking: Sketching my Future as a Visual Practitioner".

At this point, the founder should have gone iteratively through steps 1-3 (in Figure 2 above) a few times and have practiced all the tools described above at least once before moving to the next stage.

Value Proposition and Evaluation-Business Model

For the business model, the author recommends using Osterwalder and Peigner (2010) as a canvas. See a preview at Akash (n.d.).

A well-defined business model is essential for understanding how a company creates, delivers, and captures value. It serves as a blueprint for the organization's strategy, helping to clarify the pathways to profitability and growth. The Business Model Canvas, a widely adopted tool for business model design, offers a visual framework that breaks down the key elements of a business into nine interconnected components, such as customer segments, value propositions, and revenue streams. This paper provides a brief guide on how to effectively use the Business Model Canvas for planning, refining, and innovating business strategies, demonstrating how businesses can leverage this tool to analyze their operations, identify new opportunities, and build sustainable models for success, before starting the business and committing major resources.

A key aspect of the business model is its value proposition. A strong business proposition is a fundamental element in attracting customers, partners, and investors, as it clearly articulates the unique value a company offers within the market. It distinguishes a business from its competitors by addressing the specific needs and pain points of target audiences and explaining how the business's products or services deliver superior benefits.

Important considerations about the business model at the stage of idea development and management include the following:

1. Have some numbers, so if asked by a banker or a Chief Financial Officer, the supporting numbers and data (based on insight) will be available.
2. Using the canvas and its nine building blocks (customer segments, value proposition, channels, customer relationships, key resources, key activities, key partnerships, revenue stream and cost structure) is one way to explicitly formalize a value proposition (which is the core of the canvas) from the customer's perspective (NOT the founder's) and how value will be created (or profit) from the idea.
3. What is really important is the focus on cash flow, which is the 'killer' of any new idea or new venture. Using this tool will force the founder to think in terms of customer needs and finance and will help to crystallize key success indicators.
4. You can also consider canvases that contemplate sustainability (see, for example, Cardeal et al., 2020).

See additional resources at Cowan (n.d.).

Evaluation- Six Hats

Another technique that the author likes to use for evaluation is the 'Six Thinking Hats' developed by de Bono (1985). Using this technique will allow the business founder to access multiple perspectives and will be helpful in the evaluation of her idea. The six hats are:

1. Green--Creativity -- statements of new ideas, possibilities; visualizing a potential future; go-with-the-flow and out-of-the-box thinking.

2. White--Information, data -- considering what information is available, what the facts are, what data is missing and needed.

3. Red--Emotions -- intuitive or instinctive (no need for justification or rationale) reactions of emotional feeling.

4. Black--Judgment – cold, practical, realistic logic; reasons to be cautious and conservative. The devil's advocate (this is the ONLY time disagreement is acceptable and the only time it is required).

5. Yellow--Optimistic response -- logic applied to identifying benefits and value. Sees the positive, sunny side of the state of affairs.

6. Blue--Managing the six hats thinking process -- what is the subject? What are we thinking about (which hat are we using now)? What is the goal? Preventing negative, disagreeing thinking (unless you are using the black hat). Look at the big picture.

The above is based on and modified from The de Bono Group (n.d.).

Planning for application and implementation– Leading with a culture of creativity and action

To succeed, the founder will need to establish an organization (since seldom is anything accomplished alone) and lead and think with a bias toward action while being creative. As Belsky (2010) suggested, to make ideas happen, the founder will need: ideas, organization, communal forces, and leadership capability. For that, she will need innovation, which is ideation and execution (to create value), and to increase impact, she will have to combine creativity and organization. To accomplish this, the founder will need to harness a community and the forces around her. Such an organization should include a network of different players like dreamers, doers, and incrementalists (Belsky, 2010), so stimulation from serendipity can be sought, and complementary skill sets can be cultivated. As a leader, the founder/owner should also learn to talk last, develop a tolerance for failure and ambiguity, and avoid the trap of visionary narcissism (cf. Miller, 2021). The founder may also play different roles in supporting innovation, depending on the specific context (see, for example, Hyypiä et al., 2016, who use the Cynefin framework (Snowden & Boone, 2007) for context analysis).

While the development of a well-structured business plan is fundamental to organizational success, the greater challenge often lies in its effective implementation. This phase involves translating strategic objectives into actionable initiatives, aligning organizational resources, and ensuring coherent execution to achieve intended outcomes. A robust implementation plan is ideally underpinned by a compelling metanarrative and a clearly articulated vision. As discussed by Knaflic (2015), visual communication tools—such as storytelling and storyboards—can significantly enhance this process. Her work offers valuable guidance in formulating vision and mission statements, and even preparing concise and persuasive ‘elevator pitches’. Additionally, Knaflic (2015) provides detailed methodologies for data analysis and visualization, equipping entrepreneurs with the skills needed to identify and communicate critical implementation challenges. Her book serves as a practical resource for presenting quantitative data and business intelligence to diverse audiences, while also introducing contemporary techniques in visual reporting. Through the development of effective visualizations—such as charts, infographics, and dashboards— spontaneous entrepreneurs can easily extract and communicate key insights, improve decision-making, and align stakeholders around tactical and strategic goals. Ultimately, these tools foster greater audience engagement, enhance storytelling capabilities, and strengthen communication with key stakeholders.

The critical process of implementing a business plan emphasizes the importance of clear communication (see more below), resource allocation, and performance monitoring. A good implementation plan also provides specific guidelines for navigating common challenges in implementation, such as coordinating teams, managing timelines, and adapting to unforeseen obstacles. By following these guidelines, businesses can bridge the gap between planning and

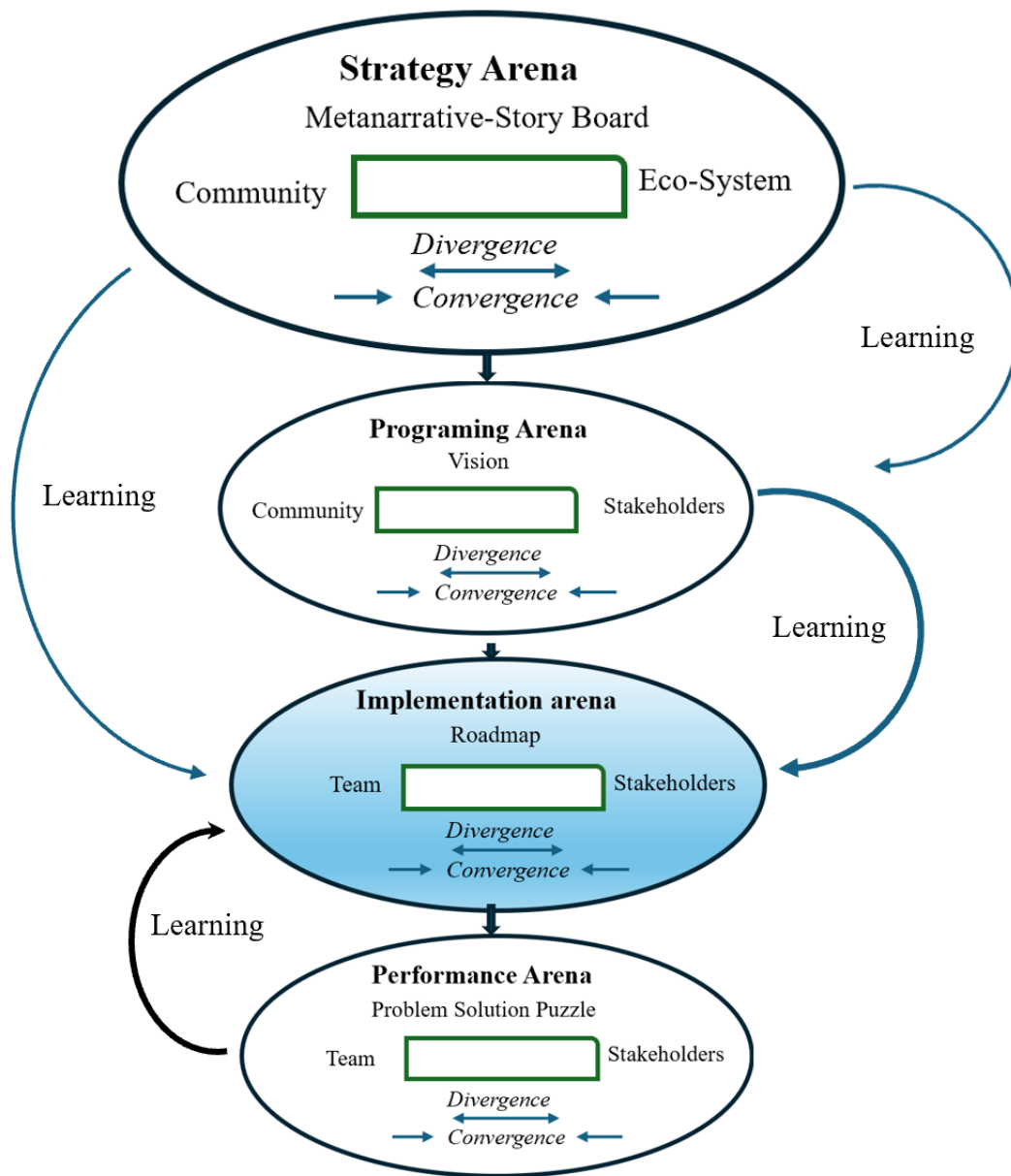
execution, ensuring that strategic objectives are met with precision and efficiency (see Figure 4, below).

A visual roadmap is an effective strategic tool for planning the implementation of a business plan, as it translates complex objectives into a clear, time-bound sequence of actions. By visually mapping key milestones, responsibilities, resource allocations, and interdependencies, the roadmap enhances organizational alignment and facilitates stakeholder communication. It serves not only as a planning instrument but also as a dynamic guide for monitoring progress and adapting strategies in response to evolving conditions. As such, visual roadmaps support both strategic clarity and operational agility in executing business objectives. See good examples of road mapping at Seet (n.d.).

While tackling roadblocks at the implementation stage, the founder can use the data analysis and visual tools provided by Knafllic (2015) and apply the problem-solving puzzle technique to resolve your dilemmas. The problem-solution puzzle technique offers a structured analytical framework for addressing challenges and dilemmas that arise during the implementation of a business plan. By framing the core issue as a "puzzle" composed of interrelated variables, constraints, and uncertainties, this method encourages systematic problem decomposition and the generation of evidence-based solutions. It supports critical thinking by requiring decision-makers to assess alternative pathways, weigh trade-offs, and align proposed interventions with strategic objectives. As such, the approach enhances organizational capacity for adaptive problem-solving and informed execution under dynamic conditions (see an example of such an approach at Paul (2018).

A successful implementation plan includes the most important specific steps to achieve a measurable key success indicator, within a specific time frame, the party accountable for the implementation, and the resources allocated. The author found a matrix that includes the specific action, the expected outcome, the party responsible, the start and end date, and unique resources (human, financial, and organizational assets) allocated to the action, as a helpful tool for planning. Clearly, different time frames and organizational scopes will require more or less detailed planning. Additional helpful information can be seen at Agency for Healthcare Research and Quality (n.d.a. and n.d.b.), while an example of a matrix can be seen in Table 4.1.5 on pages 50-55 at Kugula et al. (2012).

Figure 4. Planning implementation as a roadmap (based on and modified from Figure 3 in Janssen et al., 2023)



The successful translation of a business's metanarrative and vision into effective implementation critically depends on learning processes at the individual, team, and organizational levels. Individual learning ensures that employees develop the necessary knowledge, skills, and alignment with strategic goals, fostering personal ownership of the mission (Kolb, 1984). Team learning, in turn, facilitates collaborative problem-solving and adaptive responses to evolving challenges, enhancing the collective capacity to operationalize strategic objectives (Edmondson, 1999; Levy, 2025). At the organizational level, learning supports the institutionalization of best practices, continuous improvement, and alignment of structural processes with strategic intent (Senge, 1990). These interconnected learning processes enable businesses to bridge the gap between abstract vision statements and real-world execution, creating a dynamic capability for sustainable competitive advantage (Teece, Pisano, & Shuen, 1997). See an example of organizational learning in the context of a circular economy at Scipionni et al. (2021).

The Matrix of Outcomes and Learning-Loops

Changing the expected outcome as a result of learning and decision-making is a central feature of the entrepreneurial process, reflecting the adaptive and iterative nature of venture creation under uncertainty. Entrepreneurs rarely operate with complete information; instead, they engage in continuous cycles of learning, experimentation, and feedback interpretation that reshape their expectations and strategic trajectories (Sarasvathy, 2001). This adaptive behavior, often framed within the effectuation logic, allows entrepreneurs to modify goals and expected outcomes based on emerging insights rather than adhering rigidly to predetermined plans (Dew et al., 2009). Through experiential learning and real-time feedback from markets, networks, and stakeholders, entrepreneurs recalibrate their mental models and reconfigure resources to align with newly identified opportunities or constraints (Minniti & Bygrave, 2001). Decision-making in such contexts is inherently dynamic, where each decision not only responds to current information but also generates new data that transforms future expectations (Holcomb et al., 2009). This recursive process of learning enhances cognitive flexibility and resilience, enabling entrepreneurs to navigate ambiguity, pivot strategically, and capitalize on serendipitous discoveries (Corner et al., 2017). Consequently, the evolution of expected outcomes is not a sign of strategic inconsistency but rather evidence of entrepreneurial intelligence—an adaptive capability that integrates learning, judgment, and creative problem-solving to optimize value creation amid environmental complexity and change.

If following this step, the entrepreneur wants to consider additional and/or alternative outcomes for their venture, a matrix that incorporates outcomes and learning loops might be an option (see a detailed example below in Table 3).

Appendix B details the use of divergent and convergent thinking and provides an example of a business model canvas for alternative outcomes.

Table 3. Matrix of Outcomes and Learning-Loops for Startup Evaluation

Outcome	Single-Loop Learning (Adjust Action)	Double-Loop Learning (Modify Mental Models)	Triple-Loop Learning (Create New Processes)	Quadruple-Loop Learning (Metamorphosis)
Knowledge	Launch a blog for customer education based on existing FAQ content.	Shift from thinking knowledge is static to seeing it as co-created with users (e.g., live knowledge bases).	Build a crowdsourced AI-driven knowledge-sharing platform that evolves through interaction.	Redefine knowledge as an experiential asset, creating immersive AR learning communities where knowledge is embodied.
Data	Use AI analytics to refine ad targeting for a campaign.	Change the view from “data as a by-product” to “data as a strategic asset” (e.g., monetize anonymized user data).	Implement a data trust model where customers control and share data in exchange for benefits.	Transform the venture into a data-driven ecosystem, enabling decentralized data cooperatives with blockchain.
Language	Update chatbot scripts to fix misinterpreted queries.	Reframe language from a technical feature to a branding tool (e.g., voice tone as identity).	Develop a real-time AI language personalization engine for cross-cultural UX.	Reimagine language as multimodal interaction (speech + gestures + emotions) in immersive virtual environments.
Tools	Add an automation feature to reduce manual reporting.	Shift thinking from tools as support to tools as core value proposition	Create a modular AI tool marketplace for niche industries.	Build an adaptive, self-evolving tool ecosystem that integrates with human

Outcome	Single-Loop Learning (Adjust Action)	Double-Loop Learning (Modify Mental Models)	Triple-Loop Learning (Create New Processes)	Quadruple-Loop Learning (Metamorphosis)
		(e.g., SaaS as the main product).		cognition (e.g., brain-computer interface).
Experience	Improve onboarding UX based on usability testing.	Move from linear onboarding to adaptive experience journeys using behavioral AI.	Design processes where customers co-create the experience (e.g., personalized AR product demos).	Turn the experience into an identity—users become part of an immersive AI-driven lifestyle ecosystem.
System	Add missing features in CRM to improve retention.	Reinterpret the system from a functional network to a learning network that adapts.	Implement self-optimizing systems through reinforcement learning.	Build a decentralized autonomous organization (DAO) where governance is system-embedded.
Process	Automate one manual workflow to cut delays.	Redefine process as value creation flow rather than a task list.	Create AI-designed workflows that reconfigure themselves based on live data.	Abandon fixed processes—create process fluidity where humans and AI dynamically co-shape tasks.
Affect	Add positive feedback in the app to enhance user delight.	Shift the mental model from affect as “aesthetic” to affect as a behavioral driver.	Build AI models that predict and adapt to emotional states in real time.	Transform affect into the core brand identity, e.g., emotional ecosystems in VR communities.
Product	Fix a design flaw based on customer complaints.	Rethink product from physical item to service-enabled platform (e.g., hardware-as-a-service).	Launch generative AI-designed products that continuously evolve.	Shift from product to post-product identity—e.g., user self-expression becomes the product in AR worlds.
Service	Reduce response time in customer support.	Change from reactive service to proactive service orchestration using AI predictions.	Implement AI service agents that learn and personalize autonomously.	Redefine service as a co-experience—blurring human-agent boundaries in mixed reality.
Sales	Increase ad spend during peak seasons.	Reframe sales as relationship-building rather than transactions.	Use predictive AI for dynamic pricing and hyper-targeted sales journeys.	Transform sales into immersive experience commerce within AI-driven metaverses.
Profits	Cut operational costs by automating billing.	Shift mental model to view profit as ecosystem sustainability rather than short-term gain.	Build a multi-sided platform monetization strategy powered by AI.	Move to tokenized profit models using blockchain for community-driven ventures.

Note- Table 3 was populated with the following prompt for Chat GPT, July 17, 2025; see below:

While creating new ideas, I suggested four learning feedback loops: single-loop learning: Adjusting action to accomplish the expected outcome within a given time frame; double-loop learning: Modifying mental models to enable new meanings, behaviors, and time frame; triple-loop learning: Creating new processes to enable new mental models; quadruple-loop learning: metamorphosis, enabling change of form, nature or identity. To create a matrix, I also suggested

several expected outcomes above and beyond the traditional financial outcomes: Knowledge, data, language, tools, experience, system, process, affect, product, and service. Can you please give me specific examples for each learning loop and outcome cell (including the finances) in such a matrix? Consider the evaluation of a new startup and populate each cell with full examples.

Planning for communication

There are two types of communication the company founder needs to plan for: internal, within her organization, and external.

Internally, the key points for planning communication are: 1) to frame the space where creativity can and should happen; and 2) ongoing alignment of activities, processes, resources (time, social, human, and financial capital), and actors.

Externally, the founder must communicate effectively with a diverse constituent base, including: supporters, naysayers, customers, suppliers, etc. Academic studies have shown that involving customers and suppliers in the innovation process could result in greater success in new product/service development (e.g., Menguç et al., 2014). This is especially so when the founder can identify lead users, those who seek new products or innovative services (Von Hippel, 1989). An alternative approach could be using experts' opinions and/or open innovation (see, for example, King & Lakhani, 2013 <http://www.openinnovation.eu/22-01-2016/the-lean-scale-upinnovation-entrepreneurship-for-new-ventures/>). Employees' participation, when appropriate, can be helpful as well.

Kotter and Whitehead (2010) present an interesting perspective on how to understand the generic attack strategies that naysayers and obfuscators utilize and how to minimize the risk of their potential future attacks. They also suggest how to encounter these adversaries with tactics tailored to each strategy. For example, by "inviting in the lions" to critique an idea--and being prepared for them--the attention of rigorous individuals will be captured, which will help them grasp the value of the proposal and secure their commitment to implementing the solution. By considering probable attacks and responses, the value proposition can be crystallized and the image and brand strategy sharpened. Founders can also use prosumers to improve their products and/or services (see, for example, Ziemba & Eisenhardt, 2015).

ARTIFICIAL INTELLIGENCE AND INNOVATION

Artificial Intelligence (AI) is seen as the creator of a \$1.34 trillion global market by 2030 (Haan, 2024) and \$4.8 trillion global market by 2033, but if corrective actions are not taken, those benefits will be shared by a privileged few (UN, 2025). About 75% of businesses have adopted AI for at least one business function, 64% of businesses expect AI to increase productivity, and over 60% of business owners believe AI will improve customer relationships (Haan, 2024), even though MIT research reveals that 95% of companies currently investing in AI are not yet seeing meaningful ROI (Challapally et al., 2025). As mentioned earlier, one major reason for the update of the above proposed models and tools is the recent rapid evolution of AI, especially the Large Language Models (LLM) and image generators (Davenport and Mittal, 2022).

Large Language Models (LLMs) are significantly impacting creativity and innovation by providing tools for idea generation, problem-solving, and creative support. They can analyze vast amounts of data, generate novel ideas, and even guide users through creative thinking processes, blurring the lines between human and artificial creativity. By understanding their capabilities and limitations, individuals and organizations can leverage LLMs to unlock new possibilities and push the boundaries of human creativity (see example in the art world at George & Susan Mathew, 2025). However, it's crucial to approach LLM integration with a critical perspective, ensuring

responsible and ethical use to maximize the benefits while mitigating potential risks (Haarmann, 2024; Hannigan et al., 2024; Niu et al., 2024; Park et al., 2025).

AI image generation tools are transforming the creative landscape by providing unprecedented speed, efficiency, and access to powerful design capabilities, enabling users to produce new images and customize existing ones with minimal input and effort. These tools leverage AI and machine learning to create or edit images in various ways, such as altering style, color, and content, or generating entirely new images from prompts (Attié, 2025). While ethical and practical challenges need to be addressed, embracing AI as a collaborative partner will enable creators to explore new frontiers of imagination and innovation (Kahn, 2025) and augment the effectiveness of spontaneous ideation.

AI can enhance innovation and creativity (Deambrosi, 2025; Eapen et al., 2023; Lehmann et al., 2025) by:

1. Expanded possibilities: AI allows creators to explore new styles, concepts, and aesthetics that may be difficult to achieve manually.
2. Faster ideation: These tools enable rapid prototyping and concept development, generating multiple variations of an idea quickly. This speeds up the creative process and allows for faster exploration of different styles and visual variations.
3. New creative workflows: AI shifts the focus from the technical execution to the core ideas and storytelling, freeing up designers to focus on creative exploration and experimentation.
4. Inspiration boost: AI visual assistants can spark new ideas, offering unique compositions, color palettes, and design concepts.
5. Challenge expertise bias: AI can facilitate thinking beyond preconceptions of the possible and desirable of the idea form and function.

Still, major ethical and practical considerations remain (Puś, 2025):

1. Originality and authenticity: Questions arise about authorship and whether AI-generated art can be considered truly original, as it is based on existing data. Some critics express concerns about a potential homogenization of visual content if AI becomes too dominant.
2. Copyright and ownership: Legal frameworks around AI-generated content are still developing, and determining ownership and copyright can be complex.
3. Bias: AI can perpetuate biases present in the training data, leading to biased representations.
4. Job displacement: Concerns exist about AI's potential impact on traditional creative jobs, but many see AI as a complementary tool that enhances human creativity rather than replacing it.
5. Human-AI collaboration: The future lies in finding the right balance between human and AI input, embracing AI as a co-pilot that amplifies creative capabilities.

Next, the impact of AI and visual thinking on ideation, innovation, and new venture creation will be discussed.

The use of artificial intelligence and visual thinking for ideation

The use of artificial intelligence (AI) in conjunction with visual thinking for ideation in new venture development is a growing area of interest, as AI-driven tools can enhance creativity, problem-solving, and strategic planning in early-stage business ventures (e.g., Townsend & Hunt, 2019). Six specific areas are briefly identified below:

1. AI-Powered Visualization Tools

AI tools can generate visual aids, such as mind maps, flowcharts, and design sketches, which help entrepreneurs and teams visualize complex ideas. Tools like AI-driven diagram generators or data visualization platforms can automatically suggest relationships between different business components, providing a clearer picture of potential opportunities or gaps in the new venture (e.g., Chen, 2021; Jin et al., 2024).

2. Idea Generation and Exploration

AI can support the ideation process by analyzing vast amounts of data and offering suggestions or patterns that might not be immediately obvious. For example, AI can use machine learning to identify trends in the market, customer behaviors, or competitor strategies. When integrated with visual thinking tools, these insights can be mapped out graphically, aiding in brainstorming sessions and helping teams explore new angles for product or service innovations (e.g., Chen et al., 2019).

3. Collaborative Platforms for Visual Thinking

AI enhances digital whiteboard tools and visual collaboration platforms that allow team members to brainstorm and visualize ideas in real time. These platforms can utilize AI to organize and synthesize the input, offering smart suggestions or highlighting key insights. AI can also track the development of ideas, suggesting improvements or changes as the venture evolves, helping teams stay agile during the ideation process (e.g., Huang & Zheng, 2023; Owens and Roberts, 2024).

4. Enhanced Prototyping and Simulation

For product development within new ventures, AI can assist in visualizing prototypes or concepts. AI algorithms can simulate different business scenarios, testing how ideas might function in the real world, and generating visual representations of outcomes. This allows entrepreneurs to visually explore the potential success or failure of ideas before investing significant time and resources (e.g., Feng, 2024).

5. Automating Routine Tasks to Focus on Ideation

AI can handle routine or repetitive tasks such as data gathering or market research, freeing up time for teams to focus on high-level creative thinking. When used in visual thinking exercises, the results of these AI tasks can be presented visually, helping decision-makers more quickly understand insights and make informed decisions (e.g., Qiao et al., 2025).

6. AI-Powered Creativity Boosters

AI is also becoming a creative partner in ideation. Tools like generative AI can suggest new ideas or variations based on prompts, which can then be visually mapped and refined through human input. For example, AI-driven design tools can propose different ways to visually communicate business ideas or design elements for a new venture, stimulating creative exploration (e.g., Albakry et al., 2025; Owens and Roberts, 2024; Sobetska, 2025).

Examples of AI tools for visual ideation (e.g., Jenkin, 2025; Smriti, 2025)

In new venture development, AI can significantly enhance visual thinking by providing tools that help entrepreneurs and teams conceptualize, organize, and refine their ideas more effectively (see another example at Valk et al., 2023). By leveraging AI's ability to process data, automate tasks, and suggest creative possibilities, visual thinking becomes a more dynamic and productive process, allowing new ventures to innovate and iterate faster while maintaining a clear strategic vision. Such integration ultimately improves the ability to identify viable opportunities, refine business models, and increase the likelihood of success in competitive markets (Mumi et al., 2025; Owen & Roberts, 2024) by utilizing spontaneous ideation.

Mind mapping and diagramming tools: MyMap.AI, Miro AI Assist, and Whimsical AI

Generative image tools: DALL-E 3, Midjourney, and Leonardo AI

Visual content creation platforms: Canva AI and Slidesgo

The use of artificial intelligence and visual thinking for innovation

The use of artificial intelligence (AI) in conjunction with visual thinking for innovation is a growing area of interest. The major trends and the major AI tools (see examples in Table 4) are identified below (Grech et al., 2023; Nazemi et al., 2022; TIP Staff, n.d.):

1. AI-Enhanced Visual Ideation in Design Thinking

Platforms like Miro, FigJam, and MURAL are integrating AI to automate idea clustering, mind-map creation, and visual prompt generation—accelerating design thinking phases like empathize, ideate, prototype, and test (Crumbine, n.d.).

2. Text-to-Visual Creativity with Generative AI

Tools such as DALL·E 3, Midjourney, and Canva's AI features transform textual ideas into polished visuals, enabling fast prototyping and mood-boarding even for non-designers (Eghosa, 2025).

3. Conversational Visual Tools

Chat-based AI assistants (e.g., Claude integrated with Canva) allow users to generate and edit designs through natural language prompts, blending AI with visual thinking seamlessly (Pathak, 2025).

4. Multi-Agent AI for Visual and Cognitive Collaboration (Agentic AI)

The emergence of agentic AI frameworks—modular AI agents specializing in image generation, emotional analysis, and decision-making—supports more complex ideation pipelines and visual reasoning workflows (Rao, 2025).

5. Visual-to-Insight Pipelines in Innovation Platforms

Tools like Clueso convert screen recordings and workflows into annotated videos and docs, bridging visual thinking with systematic documentation and knowledge sharing (Basole et al., 2024).

6. AI-Guided Brainstorming and Creative Prompts

LLM-based tools like ChatGPT, Gemini, Claude, and HyperWrite are used to enhance visual ingenuity—not only textually but also by generating ideation prompts that can be visually mapped later in mind-maps or boards (Musallam, 2025).

Owen and Robert (2024) proposed a 5-part prompt framework to support collaboration between the human innovator and AI. The framework includes:

1. **Subject** (data, relationships, key variables): This defines what the visualization is about, focusing on the dataset, the attributes to be emphasized, and the structural relationships (e.g., correlations, hierarchies). Clear articulation of the subject anchors the visualization to its core analytical purpose.

2. **Aesthetics** (appearance, color, style): This relates to the how of representation, covering visual encoding strategies such as color palettes, shape, texture, contrast, or even animation. Properly chosen aesthetics can enhance interpretability and emotional resonance, influencing how effectively users engage with the visualization.

3. **Context** (domain, medium, audience): This dimension situates the visualization in its environment of use, considering disciplinary conventions, cultural interpretations, and the platform of delivery (print, web, VR). Context ensures that visualizations are not only technically accurate but also socially and culturally legible to their intended audiences.

4. **Application** (use-case, purpose, interaction): This highlights the why of the visualization, aligning design with intended tasks—exploration, explanation, persuasion, or decision-making. Applications also include interaction modes, which define how users will navigate, manipulate, or drill down into the visualization.

5. **Priorities** (constraints, emphasis, trade-offs): This category concerns the balancing act of design, where trade-offs between detail and clarity, speed and complexity, or creativity and reproducibility are negotiated. Explicitly stating priorities helps guide AI systems to align outputs with the most critical needs of the project.

Owen and Robert's (2024) framework also includes a five-step ideation process and a suggested vocabulary set that could be very helpful to the collaborating innovator.

Table 4. Key Tools for Visual & AI-Powered Innovation (TIP Staff, n.d.)

Tool	Description	Visual Thinking Feature
Miro AI	Collaborative whiteboard with AI sticky-note clustering, mind-map generation, idea summarization, and Smart Drawing to clean sketches	Generates visual structures automatically, ideal for ideation workshops
FigJam AI (via Figma)	Workspace for brainstorming & mapping; AI generates templates, scatters ideas, summarizes, and visualizes flowcharts based on natural language input	Converts text into visual layout templates and mind-maps
Whimsical AI	Mind maps, flowcharts, wireframes, and docs with AI suggestions and sticky note auto-branching; integrates with platforms like Notion, Asana, GitHub	Streamlines the generation of flowcharts and diagrams
Slatebox AI	Turns prompts into diagrams, mind-maps, and SWOT analyses—designed for collaboration across platforms like Teams, Slack	Auto-diagramming from text or URL ⁽¹⁾
XMind AI / GitMind	AI-enhanced mind-mapping tools: auto-expand nodes, suggest branches, transform documents into maps	Visual hierarchical thinking via mind maps
Canva (AI features)	Includes text-to-image, smart layouts, image generation powered by Claude integration; great for quick visuals, mood boards, posters	Rapid prototyping of branding visuals and concept art
DALL·E 3 + ChatGPT	Text-to-image generation and interactive ideation prompts; ideal for visual storyboarding and concept sketches	Generates refined visual outputs from ideational prompts
Midjourney	High-detail generative art for ideation—allows creative exploration of product form, brand aesthetics, visual storytelling	Supports visual exploration and iteration in product design
Clueso	AI tool that converts screen recordings into annotated video walkthroughs and documentation—useful for process visualization	Translates visual workflows into structured insight-rich docs

URL⁽¹⁾ - Uniform Resource Locator is a web address

The use of artificial intelligence and visual thinking for new venture creation and growth

The use of artificial intelligence (AI) in conjunction with visual thinking for new venture creation and growth is also a growing area of interest (see example in Xie and Wang, 2025). The major trends and the major AI tools (see examples in Table 5) are identified below (e.g., Mukherjee & Chang, 2023).

- Major Trends
- 1. AI-Enhanced Design Thinking & Ideation (e.g., IDEOU, 2025)
 - a) What’s happening: AI is embedded in tools for brainstorming, mapping, and rapid prototyping.
 - b) Why it matters: Reduces time for concept generation and improves clarity in early-stage ideation.
 - c) Example: Miro AI automatically clusters sticky notes, generates mind maps, and summarizes ideas.
 - 2. Generative AI for Visual Prototyping (e.g., Studio labs, n.d.)

- a) What's happening: Founders use text-to-image tools to create quick prototypes, branding assets, or MVP visuals.
- b) Why it matters: Allows non-designers to produce high-quality visuals for investor decks, marketing, and product design.
- c) Example: DALL·E 3, Midjourney produces photorealistic product concepts in minutes.
- 3. Conversational & Interactive Visual Tools (e.g., Mentimeter, 2024; Valk et al., 2023)
 - a) What's happening: AI assistants embedded in platforms like Canva, Figma (FigJam) let users create designs using natural language prompts.
 - b) Why it matters: Lowers barriers for creative expression and collaboration.
- 4. AI-Augmented Mind Mapping & Knowledge Visualization (e.g., Gaiwal et al., 2025)
 - a) What's happening: Tools like Whimsical AI and XMind AI auto-generate mind maps, SWOT charts, and innovation frameworks.
 - b) Why it matters: Helps startups visualize complex strategies, customer journeys, and business models instantly.
- 5. AI-Driven Business Model Visualization (e.g., Scoble and Cronin, 2025)
 - a) What's happening: AI-powered templates help founders create dynamic Business Model Canvases or Value Proposition Maps based on input prompts.
 - b) Why it matters: Accelerates business planning and scenario modeling.
- 6. Immersive Visualization (AR/VR + AI) (e.g., Al-Ansi et al., 2023)
 - a) What's happening: Combining AI with XR technologies for immersive prototyping and investor pitches.
 - b) Why it matters: Creates powerful storytelling for new ventures.
- 7. Data-to-Visual Dashboards for Growth Decisions (e.g., Srivastava, 2024)
 - a) What's happening: AI generates real-time dashboards for financial, operational, and customer insights using tools like Tableau with AI plugins, Power BI + Copilot.
 - b) Why it matters: Enables agile pivoting and data-driven scaling.
- 8. Simulation using Virtual Reality (e.g., Carter, 2023; Grech et al., 2023)
 - a) What's happening: AI-powered VR simulations enable entrepreneurs to create immersive, interactive environments that replicate real-world scenarios—ranging from prototyping products to simulating customer experiences or operational workflows.
 - b) Why it matters: Reduces risk and enables faster iterations in customer-centered innovation.
 - c) Example: Varjo Reality Cloud supports realistic simulations with cloud-based rendering and AI enhancement.

Table 5. Major AI Tools for Visual Thinking in Entrepreneurship (e.g., Phillora and Whitman, 2025)

Category	Tool	Key Features for Startups
Whiteboards & Ideation	Miro AI, FigJam AI	AI-powered brainstorming, auto-clustering, flowchart generation, sticky note summarization
Mind Mapping	Whimsical AI, XMind AI, GitMind AI	Auto-generate mind maps, SWOT charts, and process diagrams from prompts
Prototyping & Visual Design	Canva (AI), Figma AI, Adobe Firefly	Generate brand kits, social media visuals, and pitch decks via natural language commands
Text-to-Image Generation	DALL·E 3, Midjourney, Stable Diffusion	Create product mockups, UI concepts, and marketing assets quickly

Category	Tool	Key Features for Startups
Presentation & Investor Decks	Beautiful.ai, Tome AI	Automated pitch decks, story-driven presentations with visuals
Workflow Visualization	Slatebox AI, Clueso	Converts prompts or processes into diagrams and annotated workflows
Data Visualization	Tableau + AI, Power BI + Copilot	Generates interactive dashboards, predictive growth charts

Why this matters for spontaneous ideation and for new venture growth (e.g., Mukherjee & Chang, 2023):

1. Faster Minimum Viable Product (MVP) cycles: Visual AI tools reduce time to first prototype.
2. Lower design costs: Democratizes design for non-technical founders.
3. Better investor communication: Improves clarity of pitch decks and storytelling.
4. Scalable knowledge sharing: Visualizations enhance team alignment and stakeholder buy-in.

LIMITATIONS AND FUTURE RESEARCH

Limitations

This study is subject to several limitations that should be acknowledged when interpreting its theoretical contributions and practical implications. First, the paper adopts a deliberately broad and integrative scope, spanning entrepreneurship, learning theory, knowledge management, visualization, and artificial intelligence. While this breadth is necessary to articulate a coherent conceptual framework for spontaneous ideation and AI-supported collaboration, it may result in uneven depth across specific theoretical streams. Certain domains—such as sector-specific innovation processes, advanced AI governance mechanisms, or micro-level cognitive dynamics—are necessarily treated at a high level, and some relevant perspectives may remain underexplored.

Second, the paper reflects the perspective of a single author, which introduces the possibility of theoretical, methodological, and interpretive bias. Although the framework is grounded in an extensive interdisciplinary literature, the selection, synthesis, and framing of concepts are influenced by the author's prior research trajectory and epistemological assumptions. Future research could mitigate this limitation through multi-author collaborations, empirical validation, and comparative studies that test and refine the proposed models across diverse contexts.

Third, the proposed tools—such as reasoning loops, outcome matrices, visual models, and AI-supported ideation frameworks—may not be equally applicable across all industries or institutional settings. Sectors characterized by long innovation cycles, heavy regulation, or capital intensity (e.g., utilities or infrastructure) may require substantial adaptation of these tools. Similarly, geographic and socio-economic contexts, particularly in the Global South or peripheral regions, may face constraints related to data availability, digital infrastructure, institutional support, and cultural norms that limit the immediate applicability of AI-enabled approaches.

Finally, as this paper is primarily conceptual, it does not empirically test the effectiveness of the proposed tools or learning architectures. Empirical studies are needed to assess their impact on entrepreneurial outcomes, learning quality, and sustainability performance across different contexts and stages of venture development.

Additional limitations may include:

Conceptual Abstraction and Operationalization-

The proposed reasoning loops, outcome matrices, and visual tools are intentionally abstract to ensure cross-contextual applicability. However, this level of abstraction may complicate operationalization, measurement, and empirical testing. Translating these constructs into observable variables, metrics, or experimental designs may require further methodological refinement and contextual adaptation.

AI Maturity and Rapid Technological Change-

The framework assumes a relatively stable baseline of AI capabilities. In practice, AI tools evolve rapidly, potentially rendering specific collaborative practices, interfaces, or cognitive assumptions obsolete. As a result, the durability and generalizability of the proposed models may be constrained by the pace of technological change.

Cognitive Load and Over-Reliance Risks-

While AI-supported visualization and ideation tools are positioned as cognitive scaffolds, their intensive use may inadvertently increase cognitive load or foster over-reliance on AI-generated outputs. This may undermine critical thinking, reflective judgment, and entrepreneurial intuition—particularly for nascent entrepreneurs with limited domain expertise.

Ethical, Epistemic, and Agency Concerns-

The paper does not fully address ethical issues related to AI-mediated ideation, including epistemic opacity, algorithmic bias, data provenance, and questions of authorship and agency in human–AI co-creation. These issues may affect trust, legitimacy, and accountability in entrepreneurial decision-making.

Entrepreneurial Heterogeneity-

Nascent entrepreneurs are treated as a conceptual category, but they vary widely in prior experience, cognitive style, cultural background, and risk tolerance. The framework may not equally support all entrepreneurial profiles, particularly those with low digital literacy or limited exposure to design- or systems-thinking approaches.

Ecosystem and Institutional Dependencies-

The effectiveness of AI-supported learning loops and visualization tools presupposes access to supportive entrepreneurial ecosystems, including mentors, data, funding, and digital infrastructure. In weak or fragmented ecosystems, the proposed mechanisms may not function as intended.

Causality and Performance Attribution-

As a conceptual framework, the paper cannot establish causal relationships between AI-supported ideation practices and entrepreneurial performance or sustainability outcomes. Observed benefits in future empirical applications may be influenced by confounding factors such as team composition, market timing, or institutional support.

Temporal Bias Toward Early-Stage Entrepreneurship-

The framework is optimized for nascent and early-stage ventures. Its relevance for later-stage firms, scale-ups, or mature organizations remains uncertain and may require additional theorization.

Future research

Future research should extend this conceptual work through systematic empirical investigation that validates the relevance, usability, and effectiveness of the proposed reasoning loops, outcome matrices, and visual tools for AI-supported ideation. Experimental and longitudinal study designs could assess whether structured human–AI collaboration measurably improves idea novelty, feasibility, sustainability performance, and learning outcomes when compared to unstructured or purely human-driven ideation approaches. In particular, research is needed to examine how different configurations of visual tools and AI prompting strategies influence cognitive load, critical evaluation, and entrepreneurial agency over time. A second promising avenue concerns

prerequisite knowledge and skill development. Future studies could explore which forms of domain expertise, systems thinking, sustainability literacy, or AI literacy are necessary for nascent entrepreneurs to productively collaborate with AI without falling into cognitive offloading or automation bias. This includes investigating pedagogical interventions, training sequences, and scaffolding mechanisms that prepare entrepreneurs to engage in reflective learning loops before and during AI-supported ideation. Additionally, generational differences represent an important but underexplored dimension. Comparative research across generational cohorts—such as Generation Z, Millennials, and later-career entrepreneurs—could illuminate how cognitive styles, digital fluency, risk perceptions, and attitudes toward AI shape tool adoption, trust, and creative outcomes. Cross-cultural and Global South contexts further warrant attention, as infrastructure, institutional constraints, and sustainability priorities may mediate tool effectiveness. Finally, future research could examine how these tools evolve across the entrepreneurial lifecycle, from nascent ideation to scaling and organizational learning, as well as how ethical, epistemic, and governance considerations influence long-term human–AI co-creation. Collectively, these research directions would deepen theoretical understanding while supporting evidence-based design of AI-enabled ideation systems for sustainable entrepreneurship.

Additional research ideas may include:

Dynamics of Trust and Calibration in Human–AI Ideation-

Future research could examine how nascent entrepreneurs develop, adjust, and sometimes miscalibrate trust in AI during repeated ideation cycles. Studies could explore how over-trust, under-trust, and trust repair affect idea quality, ethical judgment, and learning-loop effectiveness over time.

Cognitive and Epistemic Effects of Prolonged AI Use-

Longitudinal research could investigate how sustained collaboration with AI shapes entrepreneurs' cognitive skills, such as problem framing, analogical reasoning, and systems thinking, as well as epistemic vigilance and originality. This would address whether AI augments or gradually reshapes entrepreneurial cognition.

AI Explainability and Ideation Quality-

Another avenue is to assess how different levels of AI transparency and explainability influence ideation outcomes. Research could test whether explainable AI improves critical evaluation, learning-loop depth, and sustainability-oriented reasoning compared to opaque generative systems.

Failure, Error, and Negative Ideation Outcomes-

Most ideation studies focus on successful ideas. Future work could examine how entrepreneurs learn from AI-generated failures, flawed suggestions, or ethically problematic outputs, and how such “productive errors” feed higher-order learning loops.

Team-Based and Collective Ideation Contexts-

Research could extend beyond individual nascent entrepreneurs to explore how AI-mediated visualization and outcome matrices function in team-based or multi-stakeholder settings, including power dynamics, conflict resolution, and shared sensemaking.

Ethical and Value Alignment Mechanisms-

Further studies could investigate how sustainability values, social goals, and ethical constraints are embedded, negotiated, or overridden in AI-supported ideation processes, particularly when economic and environmental objectives conflict.

Evolution of Tools Across Technological Generations-

Finally, research could explore how rapidly evolving AI models change the relevance, durability, and transferability of ideation tools over time, raising questions about tool obsolescence, adaptability, and meta-learning.

These or other avenues could deepen theoretical rigor, broaden contextual relevance, and reinforce the paper's contribution to AI-enabled sustainable entrepreneurship and knowledge-based learning systems.

CONCLUSIONS

In closing, the convergence of artificial intelligence (AI) and visualization tools in entrepreneurial ideation and venture development reflects a paradigm shift in innovation methodologies. AI-driven analytics, predictive modeling, and generative design complement visual thinking approaches, enabling entrepreneurs to structure complex information, identify latent opportunities, and engage in systematic scenario exploration. This integration not only reduces cognitive load but also fosters a deeper understanding of market dynamics and user needs through dynamic, data-informed visualization (Mumi et al., 2025). As virtual reality (VR), augmented reality (AR), and advanced simulation platforms evolve, these tools provide an increasingly rigorous foundation for prototyping, experimentation, and iterative refinement of business models (see example at Grech et al., 2023). Consequently, the use of AI-augmented visualization techniques has the potential to enhance both the efficiency and robustness of the innovation process, supporting ventures that are adaptive, evidence-based, and strategically positioned for sustainable growth (e.g., Kumari and Prabhakaran, 2025) while reducing global and local knowledge and economic inequalities.

For practicing and aspiring entrepreneurs, the framework, models, and tools outlined in this paper provide a structured yet flexible pathway to transform abstract ideas into actionable ventures. By engaging with tools such as the Reasonings–Outcomes, Reasonings–Learning Loops, and Outcomes–Learning Loops matrices, entrepreneurs can critically evaluate their assumptions, identify potential impacts, and adapt their strategies in response to emerging insights. These tools not only accelerate the development of new products and services but also encourage alignment with sustainability principles, making them highly relevant for entrepreneurs seeking to address contemporary social and environmental challenges.

For academic researchers, the framework, models, and tools present a structured foundation for advancing inquiry into early-stage entrepreneurial cognition, ideation dynamics, and the integration of AI-enabled decision support systems in venture formation. By formalizing the relationships between reasoning, learning loops, and expected outcomes, the matrices offer a replicable analytical lens through which researchers can investigate how nascent entrepreneurs evolve their thinking, adjust their opportunity framing, and internalize feedback during the creative process. The model further provides fertile ground for empirical testing across cultural, disciplinary, and technological contexts, particularly in understanding how AI-mediated ideation environments reshape entrepreneurial judgment, sustainability orientation, and innovation trajectories. In this role, the framework serves not only as a teaching tool but also as a conceptual research infrastructure—one capable of supporting longitudinal studies, comparative analyses, and the development of new theoretical constructs around cognition, ethics, and technological augmentation in entrepreneurship while collaborating with AI.

For academic instructors, the framework, models, and tools offer a pedagogical scaffold that enhances classroom ideation exercises by combining systematic reasoning with creative exploration. Integrating these matrices into entrepreneurship or creativity curricula enables students to visualize complex interdependencies, practice iterative learning, and engage with problem-solving in a hands-on manner. Moreover, the incorporation of artificial intelligence into the ideation process creates opportunities to simulate circular economy models, generate context-specific case studies, and inspire students to explore socially responsible innovation. Together, these applications position the framework as a valuable bridge between theory and practice, equipping both entrepreneurs and students with the mindset and tools to navigate the uncertainty of innovation with greater confidence and creativity.

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Appendix A

A brief description of the reasoning approaches (e.g., Bryant, 2007; Duggan, 2013; Gaglio, 2004; Güss et al., 2021; Krueger Jr, & Day, 2010).

Deductive Reasoning:

Deductive reasoning derives specific conclusions from general principles or premises, ensuring logical certainty if the premises are valid. It is frequently employed in structured domains where theoretical models or rules can be applied predictably to particular cases.

Inductive Reasoning (Enumerative):

Enumerative induction involves generalizing from a finite set of observations to broader conclusions, often used in pattern recognition or probabilistic forecasting. While powerful for generating hypotheses, its conclusions are inherently uncertain and depend on the quality and representativeness of the data.

Inductive Reasoning (Eliminative):

Eliminative induction works by systematically discarding alternative explanations that are inconsistent with observed evidence. This method refines theoretical models through iterative testing, narrowing possibilities until a plausible explanation remains.

Abductive Reasoning (e.g., Presencing):

Abduction seeks the most likely or creative explanation for incomplete or surprising data, making it central to innovation and hypothesis formation. In entrepreneurial contexts, forms like “presencing” (Scharmer, 2009) integrate intuition and future-oriented sensing to envision emergent opportunities.

Counterfactual Reasoning:

Counterfactual reasoning explores alternative outcomes by imagining “what if” scenarios that diverge from actual events. It plays a key role in learning from failure and simulating strategic decisions under uncertainty.

Intuitive Reasoning:

Intuitive reasoning relies on tacit knowledge, affective judgments, and rapid cognition, often derived from prior experience. Though lacking formal structure, it is valuable in situations requiring swift decisions amid ambiguity.

Logical Reasoning (Critical Thinking):

Critical thinking emphasizes rigorous analysis, logical consistency, and the evaluation of assumptions or arguments. It is foundational to problem diagnosis, argumentation, and evidence-based decision-making.

Logical Reasoning (Scientific Thinking):

Scientific thinking involves hypothesis testing, falsifiability, and systematic inquiry based on empirical methods. It provides a disciplined framework for knowledge generation and iterative refinement of ideas.

Backward Reasoning:

Also known as backward chaining, this approach starts from a desired goal and works in reverse to identify the necessary steps or conditions to achieve it. It is common in diagnostic processes and strategic planning.

Defeasible Reasoning:

Defeasible reasoning allows for conclusions that can be revised or retracted when new evidence emerges. This flexible logic reflects the provisional nature of knowledge in complex and evolving environments.

Heuristic Reasoning:

Heuristics are rule-of-thumb strategies that simplify decision-making by reducing cognitive effort. Though efficient, they can introduce biases or errors and are best used when optimal solutions are impractical.

Causal Reasoning:

Causal reasoning seeks to establish cause-and-effect relationships between events or variables, often guided by mechanisms, experimentation, or longitudinal observation. It is crucial for understanding system dynamics and designing interventions.

Appendix B

Use of AI for Divergent and Convergent thinking – Examples using learning loops and alternative outcomes, including business model canvas.

AI can be a powerful tool for enhancing both divergent and convergent thinking. By leveraging AI's ability to generate a vast array of ideas and then refine them, individuals and organizations can boost creativity and problem-solving capabilities. AI can act as a brainstorming partner, providing diverse options and then assisting in the selection of the most promising solutions (e.g., Fang et al., 2025; Tan & Luhrs, 2024).

Divergent Thinking and AI:

- Generating a wide range of ideas:

AI can be used to brainstorm a multitude of potential solutions to a problem, pushing beyond conventional thinking and exploring unconventional possibilities.

- Overcoming creative blocks:

AI can provide a starting point when individuals are stuck, offering a diverse range of options to inspire new ideas.

- Exploring different perspectives:

AI can analyze data and generate insights from various viewpoints, helping to broaden the scope of problem-solving.

Convergent Thinking and AI:

- Refining and selecting solutions:

AI can help evaluate the generated ideas, identifying the most promising and practical options based on specific criteria.

- Optimizing solutions:

AI can analyze data and identify areas for improvement, helping to refine and optimize chosen solutions for maximum effectiveness.

- Providing structured feedback:

AI can offer structured feedback on ideas, guiding the refinement process and ensuring that solutions are well-defined and feasible.

Balancing Divergent and Convergent Thinking with AI:

Integrating AI into the creative process: AI can be used at different stages of the creative process, from initial brainstorming to final evaluation and refinement.

Augmenting human capabilities: AI can augment human creativity by providing diverse options and assisting in the evaluation and refinement of ideas.

Recognizing AI's limitations: While AI is a powerful tool, it's important to recognize its limitations. Human judgment and intuition are still crucial for making truly innovative leaps and for evaluating the long-term implications of ideas.

Examples of AI in Creative Processes:

Design: AI can generate a multitude of design options based on specific parameters, helping designers explore a wider range of possibilities and refine their designs.

Content Creation: AI can assist with brainstorming article ideas, generating different headlines, and suggesting creative angles for content.

Problem-Solving: AI can be used to analyze complex datasets and identify potential solutions to problems, helping to streamline the problem-solving process.

By understanding how to leverage AI for both divergent and convergent thinking, individuals and organizations can unlock new levels of creativity, innovation, and problem-solving capabilities.

Using the four learning loops (single, double, triple, and quadruple loop learning) for divergent thinking during ideation can create a structured pathway for generating innovative and transformative ideas. Below is an illustration with a specific example in the context of a new service for the circular economy.

Service Concept: “RePairShare” – A Community-Driven Circular Repair Network

Core Idea: A digital platform and physical hubs that connect local communities for repairing, reusing, and upcycling household appliances and electronics, reducing waste and extending product life cycles.

Applying the Four Learning Loops for Divergent Thinking

1. Single-Loop Learning (Adjusting Actions to Achieve Expected Outcome)

- Goal: Generate ideas for incremental improvements or execution within an existing model.
- Question: *“How can we make repair services more accessible and affordable?”*
- Actions:
 - Benchmark existing repair services and DIY platforms.
 - Identify cost, convenience, and trust issues.
- Divergent Thinking Examples:
 - Create a subscription-based repair service for households.
 - Offer on-demand mobile repair vans via an app.
 - Add AI-powered troubleshooting chatbots to reduce initial repair costs.
- Reasoning Used: Deductive (rules → actions), heuristic (80/20 fixes).

2. Double-Loop Learning (Modify Mental Models to Enable New Behaviors & Timeframes)

- Goal: Challenge assumptions about value creation and customer engagement.
- Question: *“What if repair is not just a service, but a community-driven activity?”*
- Actions:
 - Question the assumption that professionals must do all repairs.
 - Explore peer-to-peer and shared-economy models.
- Divergent Thinking Examples:
 - Community repair cafés where people learn and share skills.
 - Gamify repairs: Users earn credits for teaching or completing repairs.
 - Integrate repair education into sustainability programs.
- Reasoning Used: Critical thinking (challenge assumptions), counterfactual reasoning (“What if...”).

3. Triple-Loop Learning (Create New Processes to Enable New Mental Models)

- Goal: Design new frameworks or processes that redefine participation in circular economy services.
- Question: *“How can we repair a default behavior in consumption?”*
- Actions:
 - Reframe the business model: Repair as a social norm and loyalty driver.
 - Design process innovations that reward sustainable choices.
- Divergent Thinking Examples:

- Membership models for manufacturers to fund repair credits for customers.
 - Integrate blockchain-based repair history for product resale value.
 - AI-driven predictive maintenance alerts from IoT-enabled devices.
- Reasoning Used: Scientific thinking (hypothesis testing), abductive (envisioning future systems).

4. Quadruple-Loop Learning (Metamorphosis – Change of Form, Identity, or Purpose)

- Goal: Rethink the identity of the venture within the ecosystem and its societal impact.
- Question: *“What if repair is positioned as cultural and ethical identity, not just an economic activity?”*
- Actions:
 - Explore symbolic and ethical dimensions of repair (status, identity, sustainability).
 - Integrate emotional and experiential values.
- Divergent Thinking Examples:
 - Market the service as a lifestyle movement—repair as a statement of values.
 - Partner with schools and Non-Governmental Organizations (NGOs) to create repair literacy as part of education.
 - Launch AR-enabled cultural storytelling about product life cycles.
- Reasoning Used: Presencing (abductive visioning), systemic reframing, ethical anticipation.

Outcome

By moving through the four loops:

- Single-loop: Improves accessibility and convenience (tactical ideas).
- Double-loop: Builds community-centric approaches (behavioral shift).
- Triple-loop: Redefines the repair process as part of the product life cycle (structural innovation).
- Quadruple-loop: Creates a societal movement where repair reflects personal and cultural identity (transformational change).

Business Model Canvas (BMC)

To continue with the example, the following preferred idea had been chosen: Partner with schools and NGOs to create repair literacy as part of education.

Next, three brief business model canvases were developed. The first is with the preferred outcome being knowledge.

Why This BMC Focuses on Knowledge

- The primary value proposition is education and capacity building.
- Revenue relies on curriculum licensing and partnerships, not just product sales.
- Uses AI tools (adaptive learning, repair simulators) to amplify the knowledge outcome.

Business Idea:

Partner with schools and NGOs to create repair literacy as part of education
Preferred Outcome: Knowledge (with secondary outcomes: skills, sustainability culture)

Business Model Canvas – Knowledge Oriented

BMC Component	Description for Repair Literacy Initiative
1. Value Proposition	<ul style="list-style-type: none"> - Empower students with repair knowledge and practical sustainability skills. - Reduce electronic and household waste by making repairs the default mindset. - Provide NGOs and schools with a structured curriculum integrating circular economy principles.
2. Customer Segments	<ul style="list-style-type: none"> - Primary: Schools (K-12 and vocational), NGOs focusing on sustainability and education. - Secondary: Parents, local communities, eco-conscious brands, municipal sustainability programs.
3. Channels	<ul style="list-style-type: none"> - Workshops at schools and NGO centers. - Digital platform with AI-driven learning modules, AR simulations for repairs. - Teacher training webinars and downloadable toolkits. - Social media campaigns promoting repair culture.
4. Customer Relationships	<ul style="list-style-type: none"> - Collaborative partnerships with NGOs for outreach. - Community engagement through repair fairs and events. - Long-term partnerships with schools through licensing agreements.
5. Revenue Streams	<ul style="list-style-type: none"> - Licensing curriculum and digital platform access to schools. - Government or NGO funding for sustainability education. - Premium features: AR-based repair simulations and certification programs. - Sponsorship from eco-friendly brands (Corporate Social Responsibility (CSR) budgets).
6. Key Resources	<ul style="list-style-type: none"> - AI-powered e-learning platform (repair tutorials, interactive simulations). - Curriculum development team (educators + sustainability experts). - Partnerships with tool manufacturers for demo kits. - AR/VR content for immersive learning.
7. Key Activities	<ul style="list-style-type: none"> - Develop and update repair literacy curriculum. - Build and maintain an AI-driven learning platform. - Run teacher training and workshops. - Organize community repair literacy campaigns.
8. Key Partners	<ul style="list-style-type: none"> - Schools and educational boards. - NGOs in sustainability education. - Local governments (grants and policy support). - Tool and parts suppliers. - Tech companies (AI/AR platform support).

BMC Component	Description for Repair Literacy Initiative
9. Cost Structure	<ul style="list-style-type: none"> - Curriculum development and AI platform creation. - Salaries for trainers and developers. - AR/VR content production. - Marketing and outreach (social media, events).

The second business model canvas looks for profits as the preferred outcome.

Business Model Canvas – Profit-Oriented

Idea: Partner with schools and NGOs to create repair literacy as part of education

Preferred Outcome: Profit (monetization priority while sustaining mission)

BMC Component	Profit-Focused Approach
1. Value Proposition	<ul style="list-style-type: none"> - Offer a commercial repair literacy program integrated with AI/AR for hands-on learning. - Provide schools and NGOs with turnkey packages (curriculum, kits, and software). - Enable schools to monetize student skills via repair fairs.
2. Customer Segments	<ul style="list-style-type: none"> - Primary: Private schools, vocational training institutes, NGOs with funding for education. - Secondary: Government-funded programs, CSR divisions, sustainability-focused brands.
3. Channels	<ul style="list-style-type: none"> - Direct B2B sales team targeting schools/NGOs. - Online subscription platform for curriculum access. - AR-based app stores for paid simulations. - Affiliate marketing with eco-brands.
4. Customer Relationships	<ul style="list-style-type: none"> - Dedicated account managers for institutional clients. - Tiered support (basic → premium service). - Branded certification programs to drive recurring revenue.
5. Revenue Streams	<ul style="list-style-type: none"> - Licensing fees for curriculum + AI platform. - Subscription-based access to digital content. - Premium add-ons (AR/VR toolkits, advanced analytics, teacher dashboards). - Sponsorship and white-label programs for corporations. - Certification exam fees for students.
6. Key Resources	<ul style="list-style-type: none"> - AI-driven adaptive learning platform. - Proprietary AR repair simulation app. - Sales and marketing team for institutional acquisition. - Content IP for ongoing licensing revenue.

BMC Component	Profit-Focused Approach
7. Key Activities	<ul style="list-style-type: none"> - Develop monetizable versions of the repair curriculum. - Implement SaaS delivery and manage subscriptions. - Run upselling campaigns for AR/VR add-ons. - Secure long-term contracts with schools/NGOs.
8. Key Partners	<ul style="list-style-type: none"> - AR/VR developers. - NGOs (as intermediaries for paid programs). - Governments for endorsement and funding. - Hardware/tool brands for sponsored kits. - Certification bodies for credentialing.
9. Cost Structure	<ul style="list-style-type: none"> - Platform development and maintenance. - AR/VR simulation production. - High customer acquisition costs (sales and marketing). - Content licensing and IP protection. - Staff salaries for operations and tech support.

Next, the two models were compared and contrasted.

Comparison: Knowledge-Focused vs. Profit-Focused BMC

Aspect	Knowledge-Focused Model	Profit-Focused Model
Primary Goal	Promote sustainability awareness and skills	Maximize revenue while promoting repair literacy
Value Proposition	Emphasis on social impact and educational empowerment	Emphasis on premium, high-value offerings for institutions
Customer Segments	NGOs, public schools, and communities	Private schools, CSR programs, and vocational institutes
Channels	Community engagement, partnerships	SaaS platform, B2B direct sales, AR/VR marketplaces
Revenue Streams	Grants, small licensing, donations	Licensing fees, subscriptions, premium AR/VR packages
Cost Structure	Moderate (focus on outreach and training)	High (platform scalability, marketing, AR/VR development)
Success Metric	Measured in knowledge dissemination, impact reports	Measured in profitability, recurring revenue streams
AI Use Case	Adaptive learning for inclusivity	AI-driven personalization to increase upsell and retention

Key Difference:

- Knowledge model optimizes for accessibility and inclusiveness (low cost, wide reach).
- Profit model optimizes for scalability and monetization (premium services, recurring revenue).

Finally, a hybrid business model canvas that balances both knowledge and profit was proposed.

The Hybrid Business Model Canvas that balances Knowledge and Profit for the idea:
“Partner with schools and NGOs to create repair literacy as part of education.”

Hybrid Business Model Canvas (Knowledge + Profit Balanced)

BMC Block	Hybrid Approach (Knowledge + Profit)
Customer Segments	Schools (primary & secondary), NGOs, parents, sustainability-driven brands, government education departments
Value Proposition	<ul style="list-style-type: none">- Promote repair literacy to reduce waste (knowledge-driven)- Affordable, practical curriculum with measurable ROI for partners (profit-driven)
Channels	<ul style="list-style-type: none">- Workshops in schools- Online learning platform- Community events sponsored by brands
Customer Relationships	<ul style="list-style-type: none">- Partnerships with schools & NGOs (long-term contracts)- Subscription model for updates and certifications
Revenue Streams	<ul style="list-style-type: none">- Curriculum licensing fees from schools- Corporate sponsorship (CSR & ESG initiatives)- Premium repair kits sales
Key Resources	<ul style="list-style-type: none">- Expert trainers & repair educators- AI-powered learning tools (interactive content)- Partnerships with brands
Key Activities	<ul style="list-style-type: none">- Develop interactive educational content- Deliver training (physical & digital)- Marketing to schools & NGOs
Key Partners	<ul style="list-style-type: none">- Schools & NGOs- Local repair professionals- Tech firms for AI content creation- Corporate sponsors

BMC Block	Hybrid Approach (Knowledge + Profit)
Cost Structure	- Content development & platform maintenance - Trainer salaries - Marketing & partnership management
Preferred Outcome	Balanced Impact: Spread knowledge while ensuring financial sustainability via diversified revenue streams

Key Differences from Other Models

- Knowledge-Focused Model: Free access for schools & NGOs, heavy reliance on grants → low financial sustainability but strong educational impact.
- Profit-Focused Model: Paid training programs, corporate-focused, → risks, excluding low-resource schools.
- Hybrid Model: Blends free basic content with paid advanced certifications & repair kits → sustainable, scalable, and inclusive.