CERN IdeaSquare Journal of Experimental Innovation, 2024; 8(2): 11-22
DOI: https://doi.org/10.23726/cij.2024.1505 ***ORIGINAL ARTICLE***

Introducing Progressia: A simple, field-validated method for technological innovation

Francesca Turetta[1], Enrico Costanzo[1,2*]

[1]Dipartimento Ricerca & Innovazione, Cereal Docks SpA, Camisano Vicentino (VI), Italy
[2]Grey Silo Ventures Srl, Camisano Vicentino (VI), Italy
*Corresponding author: enricocostanzo@cerealdocks.it

ABSTRACT

Innovation, a vital driver of growth, often lacks structured methodologies. This article proposes a novel approach: the Progressia method, which integrates the Technical Readiness Level (TRL) ladder from NASA with a Need/Market Assessment ladder. Tested by Cereal Docks Group across two technological innovation projects—an overhaul of supply chain operations and the development of a plant-based food ingredient—the method effectively aligns technological advancements with market demands, facilitating smooth transitions to industrialization and market readiness. This research introduces a valuable methodology for managers and innovation experts, offering a systematic means to mitigate uncertainty and navigate innovation projects within corporate settings.

Key words: Innovation; technology; method; science, user-research; TRL

Received: January 2024. Accepted: September 2024.

THEORETICAL BACKGROUND

This paper aims to share with the innovation community a new method, Progressia, developed specifically for technological innovation. As it is well known, innovation is a keyword of current business jargon, to the extent that some commenters started calling it a mot-valise (Guizen, 2017). However, innovation genuinely stands out as one of the primary drivers of economic growth. Peter F. Drucker asserted that 'the business enterprise has two--and only two--basic functions: marketing and innovation. Marketing and innovation produce results; all the rest are costs' (Cohen, 2013). Before Drucker, Joseph Schumpeter highlighted change as the underlying element of economic development. As it is well known, Schumpeter identified innovation as the main causative factor of that change, providing a straightforward definition of innovation: 'doing things differently in the realm of economic life' (Sweezy, 1943). Despite the historical significance, this early definition is at the same time too broad ('doing things differently', without any specification) and too narrow ('in the realm of economic life'), as it excludes other areas and disciplines, which also are subjected to innovation, such as politics, education, or healthcare.

A notable comparison can be drawn between the practice of innovation and the practice of science, which is firmly grounded in the scientific method, extensively developed since the time of Descartes and Galileo (Ariew, 1986). Moreover, our contemporary understanding of science has significantly broadened, with the implementation of several concepts such as: verification (Srivastava, 2018), falsification (Popper, 2002), change of paradigm (Bird, 2022), just to name a few, even with the contribution of fields such as sociology (e.g., Bruno Latour's exploration of a lab (Gross, 2016)). Today, innovation's practice is still lacking a comparable, structured, method. Despite this gap, investments in innovative companies, commonly referred to as startups (one definition often used for startups is: new, innovative companies seeking a repeatable and highly scalable business model (Onetti, 2014)), have consistently risen over the last few decades. To better grasp such an increase, in the USA investment figures surged from a rough 30 billion $ in 2006, till peaking at roughly 345 billion $ in 2021(Statista, 2024). Moreover, established companies have begun to engage in high-risk, high-reward investments in startups by establishing Corporate Venture Capital (CVC) entities, or even build 'innovation centres', on top of classical Research & Developments (Fecher et al., 2020), sometimes aimed at developing 'corporate startups' (Ammirati, 2019).

While certain tools, practices, and frameworks have emerged to provide a better structure for innovation, especially technological innovation, none of these can be precisely defined as a 'method'.

For the sake of this article, we will use the following definitions for the terms 'tools,' 'methods,' 'frameworks,' and 'practices.' A 'tool' is defined as a specific instrument used to perform a particular task or achieve a specific objective within a precise context. Tools can be conceptual aids that assist individuals or teams in various aspects of the creative process, such as idea generation, analysis, or validation. They provide a structured approach to handling specific challenges or activities. A 'method' is a systematic and organized approach or procedure for accomplishing a specific task or solving a problem. In the context of innovation, methods are step-by-step processes that guide individuals or organizations through a series of actions or activities aimed at achieving a particular goal. Methods are often repeatable and can be applied in various situations to yield consistent results. A 'practice' is defined as the application of a set of concepts and guidelines that provide a practical way to approach and address complex problems or tasks. It offers a high-level structure that can be adapted and supported by specific needs and contexts. In the context of innovation, a practice involves the intentional application of tools and methods to foster continuous improvement and development. Practices are often shaped by experience, expertise, and ongoing learning. Finally, we define a 'framework' as an overarching structure, the high-level container of a specific set of tools, methods, and even practices within a given domain. Frameworks in innovation often serve as organizing principles, helping individuals and teams to navigate and structure their efforts in a cohesive manner.

In summary, tools, methods, practices, and frameworks are distinct elements in the innovation landscape, each playing a unique role in guiding and supporting the creative and problem-solving processes. Tools are specific instruments, methods offer systematic approaches yielding consistent results, practices involve the intentional application of these elements in a real-world context, and frameworks provide an overarching structure that acts as a high-level container for a specific set of tools, methods, and practices within a given domain. Depending on whether they contain all the previous items or only some of them, innovation frameworks can be further classified as complete (Fig. 1, A), or incomplete (Fig. 1, B, C).

In simpler terms, all the aforementioned tools, methods, practices, and frameworks, find relevance in different contexts and across various phases of innovation development (Table 1). However, among them, only TRIZ can be effectively classified as a method 'strictu sensu.' TRIZ is strictly linked to problem-solving that demands novel ideas, based on 40 principles and 76 standard solutions as a foundation for generating innovations. Despite its usefulness, TRIZ is often considered too rigid in its classification, making it challenging to adapt for application in various situations. The method could be defined as 'incomplete,' serving as a starting point for generating new ideas but lacking flexibility in considering multiple aspects of the environment, such as socio-economic factors, resources, cultural issues, and more (Ilevbare et al., 2013).

We will briefly apply the previous classification to two often-confused items: Agile and Lean Startup. Agile serves as a framework for project management under incomplete information, making it particularly useful for innovations, which inherently deal with incomplete information regarding value proposition, technology, market considerations, and more. It is crucial to note that this framework was originally designed for IT projects, complicating its translation to deep-tech projects.

As for Lean Startup, despite its association with 'startups,' it can be viewed as a general innovation practice applicable to technological, deep-tech innovation. However, its broad scope is also a weakness since it is not structured nor precisely defined as a step-by-step algorithm. This flexibility opens the door to a wide range of interpretations. We should think of 'Lean Startup' as the innovation equivalent of the 'Blue Ocean strategy' (Kim and Mauborgne, 2005)—a powerful, inspiring practice whose actual implementation relies more on the abilities and goodwill of its practitioners than on a rigid instruction manual.

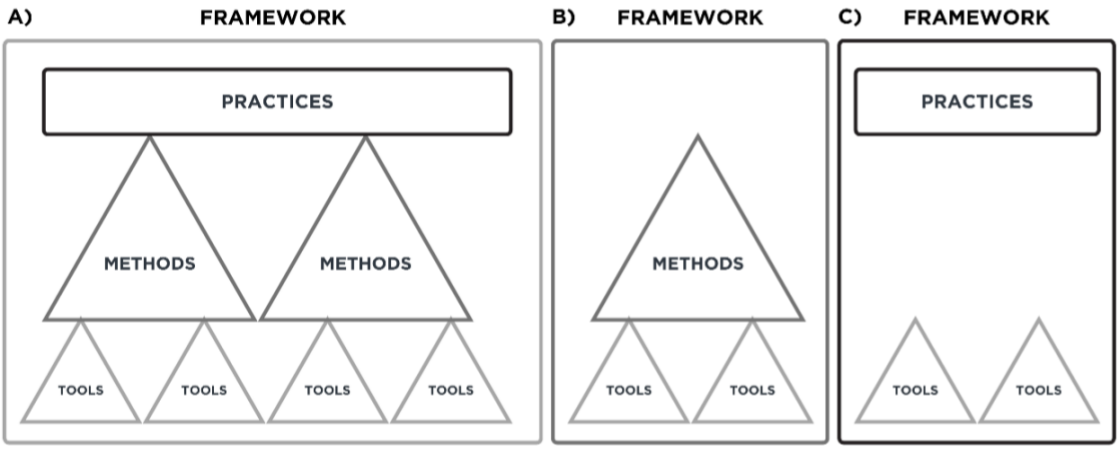

Fig. 1. Tools, Methods, Practices, and Frameworks. Tools are specific instruments, methods offer systematic approaches, practices involve the application of these elements in a real-world context, and frameworks provide an overarching structure, which acts as high-level containers for a specific set of tools, methods, and even practices within a given domain. Depending on whether they contain all the previous items or only some of them, innovation frameworks can be further classified as complete (A), or incomplete (B, C).

We developed a new method, Progressia, specifically designed for technological innovation, leveraging a sometimes underrated but potent tool: the Technology Readiness Level (TRL) ladder. Initially developed by NASA in the mid-1970s, the TRL ladder was created to establish a structured tool for assessing technology maturity.

NASA recognized the necessity of a systematic approach to evaluate technology maturity in response to the increasing complexity of space programs, crucial for assessing risks in technical, cost, and scheduling aspects of spacecraft design. The TRL ladder provided a standardized method to measure the complexity of research and technology development programs.

NASA acknowledged its effectiveness in evaluating and communicating the maturity of new technologies, making it a valuable tool for assessing critical technologies essential for mission objectives. Essentially, the TRL ladder served as a simplified metric, enhancing communication within NASA and becoming a widely accepted framework in the aerospace industry for evaluating technology readiness in space exploration (Mankins, 2009). However, the TRL tool lacked a key element of innovation: the user, and consequently, need/market assessment. Progressia addresses this gap by managing technological assessments alongside user assessments, enabling integrated project management to cope with the inherent high level of uncertainty in technological innovation.

Table 1. Classification of existing tools, methods, practices, and frameworks in the context of technological innovation.

Segment	Classification	Examples
Idea generation	Method	TRIZ (*Ekmekci and Nebati, 2019*)
Idea generation	Practice	Design Thinking (*Interaction Design Foundation, 2016*)
Testing value proposition	Tool	Pre-totyping (*Savoia, 2019*)
	Practice	User Research (*Interaction Design Foundation, 2016*)
Project management under incomplete information	Practice	Stage-Gate (*Cooper, 1990*)
		Agile (*Rigby et al,. 2016*)
	Framework	SCRUM (*Scrum Guides, 2020*)
Idea to business journey	Framework	Lean startup (*The Lean Startup Methodology, 2023*)
Innovation management	Tool	Innovation portfolio
	Practice	Concept of disruptive innovation (*Christensen et al., 2015*)
Business Model design	Tool	Business model canvas (*Osterwalder, 2013*)
Evaluating technological advancements	Tool	Technical Readiness Level (TRL) ladder (*NASA, 2023*)

METHODOLOGY

Progressia emerged from an action-research activity(Lewin, 1946) in which we simultaneously investigated and addressed the challenge of structuring the innovation activities (Guertler et al., 2020) of a newly established corporate department: the Research & Innovation division of Cereal Docks Group. This leading agro-industrial company, headquartered in Italy, had a consolidated economic value of 1.6 billion euros in 2023 and is herein referred to as “the Company.” The new department was founded in 2020, and our findings are encapsulated in two case studies that illustrate the implementation of different types of innovation projects, serving as our "units of analysis."(Priya, 2021) These cases allowed for a differentiated evaluation of innovation in action within the same organization but in varying contexts.

The projects differ in terms of user (internal vs. external) and technology type (deep-tech vs. digital), which enabled us to test the applicability boundaries of Progressia. Specifically, the units of analysis are as follows:

Project 1: A digital transformation project that primarily addresses the pain points of an internal user, the Sustainability Department of the Company, and the latent needs of external users (farmers) through part of the Company's supply chain.

Project 2: A deep-tech project aimed at an external user, specifically a customer in the B2B food ingredients market.

Although both projects are related to the agrifood industry, their distinct nature suggests that Progressia has the potential for broader applicability across various economic sectors.

The starting point in developing Progressia was to acknowledge that the well-known Technical Readiness Level (TRL) ladder (NASA, 2023) was insufficient on its own to assess the innovation of a project (Olechowski et al., 2020) which we define as the novelty addressing the pain points or needs of a target user (market). Therefore, our first action was to design a second ladder, the Need/Market Assessment ladder (Figure 2), specifically intended for this purpose. We identified the following steps in this ladder:

Step 1: Analysing Trends and Defining the Business Concept

Step 2: Conducting Target Analysis and Preliminary Economic Assessments

Step 3: Crafting the Business Model and Initiating User Research

Step 4: Advancing User Research and Identifying Critical Issues

Step 5: Validating the Business Model and Pre-validating the Market

Step 6: Developing the Minimum Viable Product (MVP)

Step 7: Testing the MVP with Potential Customers or Users

Step 8: Achieving the First Sale or "Proof of Sale"

Step 9: Defining the Production Strategy

This final step involves developing a production strategy based on sales forecasts and cost optimization. Upon completing this phase, the project can be launched in the market and considered under implementation.

It is worth noting that the ladder, a new tool, already incorporates some existing tools used in innovation, such as the Business Model Canvas (which is needed from Step 3 onwards), and the MVP (Minimum Viable Product).

We then combined the two ladders into a single tool, which happens to resemble a Cartesian plane, with one ladder as the x-axis and the other as the y-axis. We named this tool the "innovation matrix." With this tool, we could track the advancement of innovation projects along the two axes and chart them graphically in an intuitive manner. We will now go through a detailed analysis of two projects, presented as use cases.

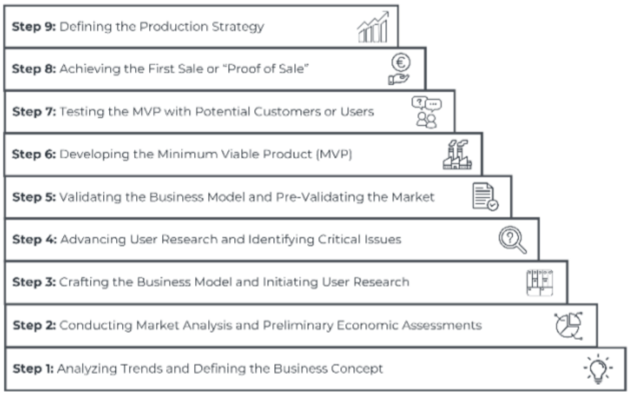

Fig.2. Need/Market Assessment ladder

CASE STUDIES: TWO INNOVATIVE PROJECTS IN THE AGRI-FOOD INDUSTRY

Case Study 1: A Digital Revolution in Agriculture: Transforming Supply Chain Management through Innovation (Fig.3)

Background

In the rapidly evolving landscape of Agriculture 4.0, digital innovation has become paramount. This case study highlights the journey of a Company that successfully digitalized its supply chain by implementing a customized web and mobile application for farmers, leveraging an innovative startup's digital logbook. This process was meticulously aligned with the Need/Market Assessment ladder and the Technology Readiness Level (TRL) ladder to ensure a comprehensive and effective approach.

The Company, a pure B2B entity, has long developed sustainability metrics and reports from "farm to gate." Historically, data from farmers were collected on paper, which required extensive work to gather, check, clean, and digitally store and analyze the data. The need for efficient sustainability data collection became urgent following the Company's transformation into a Benefit Corporation, aligning with the local version of the B Corp scheme.

Users

1.Suppliers (Farmers): Primarily of oilseeds.

2.Company's Sustainability Department: Responsible for data analysis and reporting.

Technology

Data Collection and Analysis, Data Management, Smartphone App.

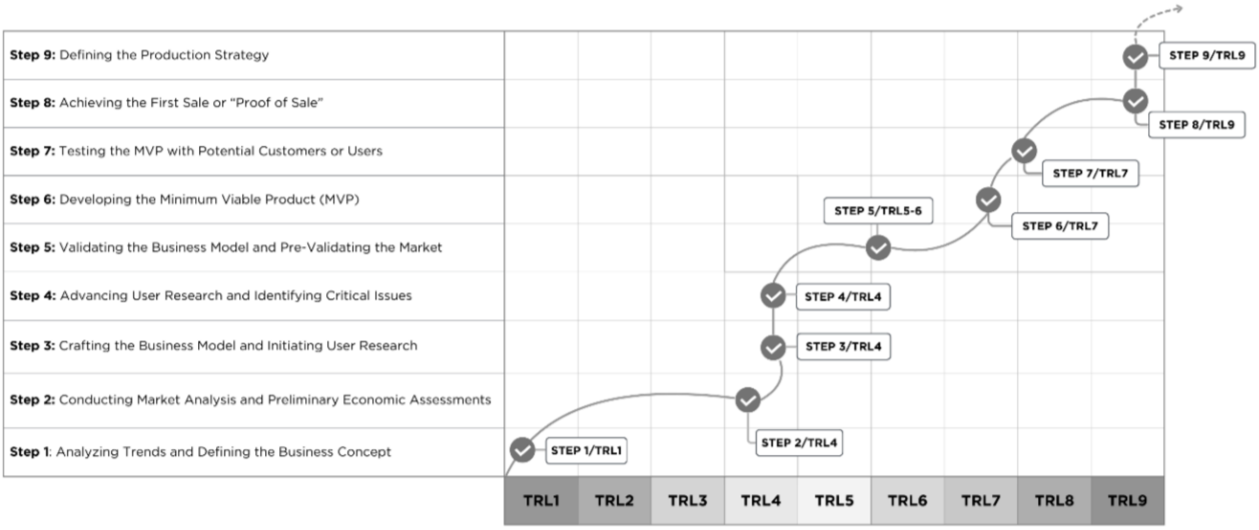

Fig.3. Innovation Matrix Journey of Case Study 1: A Digital Revolution in Agriculture Transforming Supply Chain Management through Innovation

Addressed Pain Points and Needs
User 1: Company's Sustainability Department
Pain Points and Needs: Excessive paperwork required to collect and refine field data from farmers for the sustainability portal and reporting.
User 2: Farmers
Pain Points and Needs: Farmers need to provide clean data to comply with European regulations and obtain subsidies. The digital logbook could lead to more efficient agricultural practices, though this benefit was not the primary focus.

Value Proposition
A smartphone-based farmer logbook for "real-time" data collection and storage in the Company's sustainability portal.

Innovation matrix journey of the Project

Step 1/TRL1: Analysing Trends and Defining the Business Concept
The initiative began with a thorough analysis of trends and the formulation of a business concept. Recognizing the increasing importance of digital tools in agriculture, particularly those compliant with European regulations, the Company aimed to adapt an existing digital logbook app for its supply chain. The primary goals were to digitalize data, minimize paper usage, and reduce digital transcription time by at least 30%.

Step 2/TRL4: Conducting Target Analysis and Preliminary Economic Assessments
Starting with an uncustomized version of the app at TRL4 as provided by an external startup, the project team defined specific targets, focusing on farmers within the soybean crop supply chain due to its prominence within the Company. Preliminary economic assessments were conducted to understand the financial implications and potential benefits.

Step 3/TRL4: Crafting the Business Model and Initiating User Research
The business hypothesis was established: a customized web and mobile app for soybean farmers to enhance sustainability monitoring from farm to gate. The tool aimed to digitize traditional paper-based data collection processes, thus supporting sustainable agricultural practices.

Step 4/TRL4: Advancing User Research and Identifying Critical Issues
With the uncustomized version of the app at TRL4, initial testing was conducted with the Company's Agronomic Department and a selected group of farmers. This phase revealed critical issues related to tool acceptance and adoption, influenced by factors such as age and user-friendliness.

Step 5/TRL5-6: Validating the Business Model and Pre-validating the Market
Based on initial feedback, the app was further tailored to meet the specific needs of the Company's supply chain, reaching TRL6. Expanded testing with a broader user pool confirmed the tool's potential in improving responsiveness and usefulness, though ease of use required further enhancement. The positive reception from farmers validated the project's alignment with the Company's core business and agricultural trends.

Step 6/TRL7: Developing the Minimum Viable Product

In collaboration with the startup, the tool was refined and advanced to TRL7. This step culminated in the development of a fully customized version of the web and mobile app, ready for broader testing.

Step 7/TRL7: Testing the MVP with Potential Customers or Users

The updated tool at TRL7 was tested with a small group of farmers to verify its effectiveness and alignment with project objectives. The feedback confirmed the app's value in improving agricultural practices and reducing paper usage.

Step 8/TRL9: Achieving the First Sale or "Proof of Sale"

The tool was officially launched as a service offered by the Company to its supply chain collaborators. At TRL8-TRL9, the app was fully operational, having undergone final adjustments and received necessary licensing.

Step 9: Defining the Production Strategy

The scale-up strategy was meticulously planned, including year-long training sessions for farmers to enhance app adoption and ensure widespread adherence across the sector. The Agronomic and Communication Departments led this effort, while the IT Department ensured compliance with the internal sustainability data collection server and managed technical updates.

Conclusion

By following the structured steps of the Need/Market Assessment ladder and advancing through the TRL ladder, the Company successfully digitalized its supply chain. This initiative not only enhanced sustainability reporting and compliance but also supported farmers in adopting more efficient and sustainable practices. This case exemplifies how strategic innovation and digital transformation can revolutionize traditional industries, paving the way for a more sustainable future in agriculture.

Case Study 2: An Innovative Plant Protein Ingredient for the Food Sector (Fig.4)

Background

Following the vision "from commodities to ingredients," the Company embarked on developing a novel plant-based protein ingredient. The project aimed to valorize one of the Company's main crops in the human nutrition sector, exploring new markets and opportunities.

Users

Food Companies and Manufacturers of Semi-Finished Products

Technology

Deep-tech: Plant-based protein extraction.

Pain Points and Needs

These users are looking to replace existing plant protein ingredients with those that are allergen-free, non-GMO, and have an enhanced sensory profile. Specifically, they need novel ingredients with neutral and pleasant tastes, avoiding typical off-notes of plant-based proteins such as the beany taste of soybean protein and the greeny taste of pea protein.

Value Proposition

A novel protein ingredient that is allergen-free, GMO-free, and has a neutral taste, while being aligned with the Company's supply chain.

Innovation Matrix Journey of the Project

Step 1/TRL1: Analysing Trends and Defining the Business Concept

The project began with a trend analysis of the plant-based industry, revealing a significant rise in plant-based products. This analysis identified key challenges such as the need for ingredient with good or neutral taste, free from allergens and GMOs. These findings highlighted the market's demand for innovative solutions addressing sustainability, traceability, allergenicity, and functionality. In response, the Company developed a business idea to create a new plant-based protein ingredient to meet these needs. A technological analysis of plant protein extraction methods was conducted (TRL1). It also emerged that another differentiation among protein ingredients is related to their protein content, leading to the following commercial classification: flour (up to 50% on dry substance), concentrate (50% to 80%), and isolate (80% and above).

Step 2/TRL2-3: Conducting Target Analysis and Preliminary Economic Assessments

The Research & Innovation department conducted a literature study and validated the extraction process at the laboratory scale (TRL2-3). A preliminary economic assessment followed, evaluating the potential market size and target customers based on preliminary data derived from the lab trials.

Step 3/TRL3: Crafting the Business Model and Initiating User Research

The Company identified the specific target market for the new ingredient and assessed market size and opportunities. To gather primary data, a digital user-research tool called Protilla was launched. Protilla helps food manufacturers find the perfect protein ingredients based on their needs. In this deep-tech context, Protilla acted as pre-totyping tool, whose insights confirmed the demand for a novel protein ingredient with high protein content (isolate), good taste, free from allergens and GMOs. Consequently, the business idea was further defined to develop a novel protein isolate ingredient based on a specific, underutilized crop.

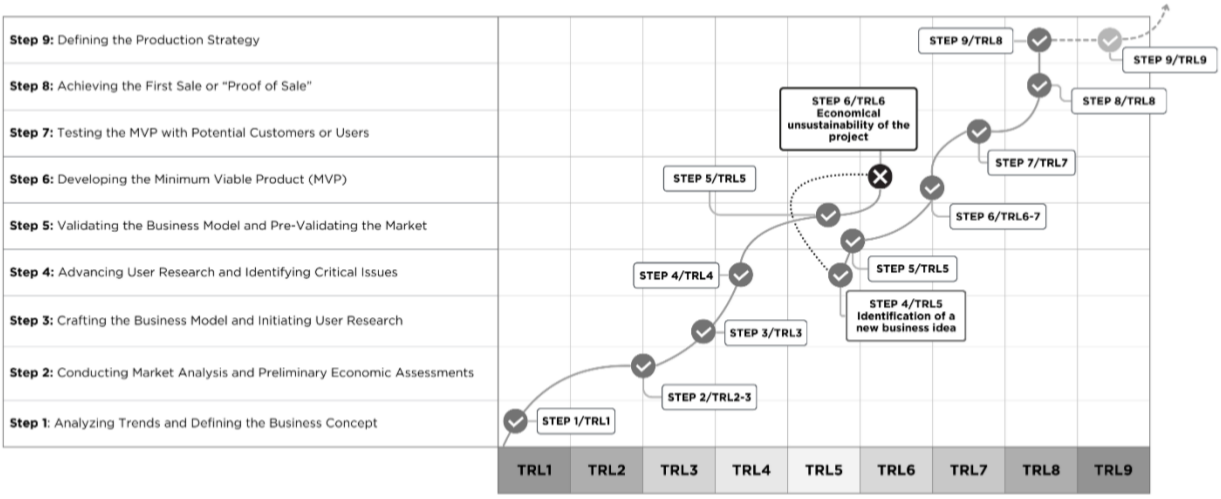

Fig.4. Innovation Matrix Journey of Case Study 2: An innovative plant protein ingredient for the food sector

Step 4/TRL4: Advancing User Research and Identifying Critical Issues

The Company continued laboratory trials to gain technical knowledge about potential critical issues in ingredient production, such as color, taste, or protein content (TRL4). The obtained product met key attributes—neutral taste, allergen-free, GMO-free, good functionality—reinforcing the previously developed business concept.

Step 5/TRL5: Validating the Business Model and Pre-validating the Market

Pilot-scale tests were conducted, and the Company gained specific technical knowledge about the process, validating the technology on a larger scale (TRL5), producing a few Kg of the new ingredient. Moreover, initial approaches with potential prospects confirmed interest in the new protein ingredient.

Step 6/TRL6: Developing the Minimum Viable Product

The Company produced an MVP at an industrial pilot scale (TRL6) (tens of kilograms) to obtain a first batch of the product for testing with potential prospects. This advanced user research and provided more technical details on ingredient production. Thanks to industrial-scale production, the Company effectively tested the initial pricing with potential prospects, receiving negative feedback on the proposed price but positive feedback on the ingredient functionalities, suggesting a mismatch among the two. Concurrently, the Company conducted a thorough analysis of the Business Model and the project's economic sustainability using the detailed technical data gathered through the industrial pilot.

While the industrial pilot-scale trials confirmed the technology's feasibility, a mass balance analysis and refined financial calculations revealed that the project was not economically sustainable at the proposed pricing level, as a lower price led to non-compliant payback and IRR. Consequently, the Project regressed on the Innovation Matrix to Step 4/TRL5.

Pivot: Coming Back Along the Innovation Matrix

Step 4/TRL5: Advancing User Research and Identifying Critical Issues

The Company revisited the project and, after gathering data from the previous step, identified a different quality of the ingredient—flour instead of an isolate—as the one meeting pricing requirements and most of the technical functionalities sought by prospects. The cost structure of the production process was intimately linked to this decision. Technically, flour is already part of the same process used to produce an isolate, so the technology and knowledge to produce this quality of the ingredient were already available. However, producing flour required lower Capex and Opex compared to the isolate. Therefore, Step 4/TRL5 was carried out using this different quality of the ingredient.

Step 5/TRL5: Validating the Business Model and Pre-validating the Market

At this point, the business model remained unchanged, and pre-market validation was adjusted with a lower price and a slightly revised market size hypothesis, excluding customers only interested in the "isolate" quality.

Step 6-7/TRL6-7: Developing the Minimum Viable Product

The Company proceeded with developing the MVP of protein flour (TRL6), validating and demonstrating production feasibility. This involved testing in various formulations used by target users (food companies), addressing aspects important to both industrial users and end consumers, before sending out the product (the MVP) for the identified applications.

Step 7/TRL7: Testing the MVP with Potential Customers or Users

Based on results gathered from the internal formulation lab with different recipes in various areas (e.g., bakery, meat alternatives), samples were sent to potential prospects for their feedback on the suggested application (TRL7). This process confirmed the interest from potential customers, validating both the product and the business idea.

Step 8/TRL8: Achieving the First Sale or "Proof of Sale"

With the product reaching TRL8, indicating a fully complete and qualified system, the Company began the process of industrial production, including shelf-life studies and obtaining necessary certifications.

Step 9/TRL9: Defining the Production Strategy

The Company is currently in the process of defining the production strategy, aligning all required operational departments in preparation for full production (TRL9).

Conclusion

By following the structured steps of the Need/Market Assessment ladder and advancing through the TRL ladder, the Company effectively monitored the project at each step, focusing on technological aspects and market validation. This approach allowed early identification of potential issues, reducing project uncertainty. The project is now undergoing full industrialization and sales. This methodology enabled the Company to address market needs efficiently, resulting in the development of a novel, sustainable plant-protein ingredient that aligns with modern food industry demands.

RESULTS

Through relevant use cases involving two different kinds of technological innovations, we developed and tested a method we call Progressia, which is based on progression along two ladders: one for technological assessment (the well-known TRL) and a second specifically designed for need/market assessment. The progression along these two ladders, together forming an Innovation Matrix, allowed the advancement of the projects in terms of both technological readiness and need/market assessment. Unlike the rigid Stage-Gate practice (Cooper, 1990) the Innovation Matrix employs a multidimensional approach, allowing for dynamic progression and enabling pivots when initial hypotheses are not met, as demonstrated in Case 2. This makes the Innovation Matrix more than a hybrid model (Cocchi et al., 2024); it is a pioneering tool for the Progressia method. Each cell of the Innovation Matrix can function as a two-gate stage, with the significant advantage of simplifying the manager's understanding of the project's trajectory.

At each juncture, the following scenarios may unfold:

When the underlying technical or market hypotheses are substantiated:

- The project proceeds to the subsequent stages.
- If the underlying technical or market hypotheses are not corroborated:
- The project is revisited, considering both technical and market perspectives, potentially regressing along one or both evaluation ladders.

If the strategic, economic, or technical conditions for continued progression to subsequent stages are not met:

- The project is terminated.

Transitioning from one cell to the next along one or both ladders involves meeting specific targets for each step. For clarity and completeness, we present the key targets of each step of the Need/Market assessment ladder, in the context of the Innovation Matrix (Fig. 2, 3), as answers to specific questions. This qualitative view does not exclude a further, more detailed quantitative description. We will not describe in detail the targets of the TRL ladder, as this tool has already been described elsewhere (Yfanti and Sakkas, 2024)

Detailed description of the Need/Market Assessment Ladder

For the need/market assessment, we adopted a specific ladder to outline the various steps required for testing market readiness and suitability for the intended users, as shown in Fig. 5 This ladder serves as a foundational tool in establishing the new method. It comprises nine steps:

Step 1: Analyzing Trends and Defining the Business Concept

Step assessment: Is there a clear concept of the business idea derived from trend analysis?

Step 2: Conducting Target Analysis and Preliminary Economic Assessments

Step assessment: How many targets (or markets) do we have? Should we focus on one or multiple? How large is the target market? Is the target market economically attractive to justify investment in the business idea?

Step 3: Crafting the Business Model and Initiating User Research

Step assessment: How do we achieve economic sustainability? What kind of economic viability are we looking for (e.g., investment returns)? What type of Business Model should be adopted for the project?

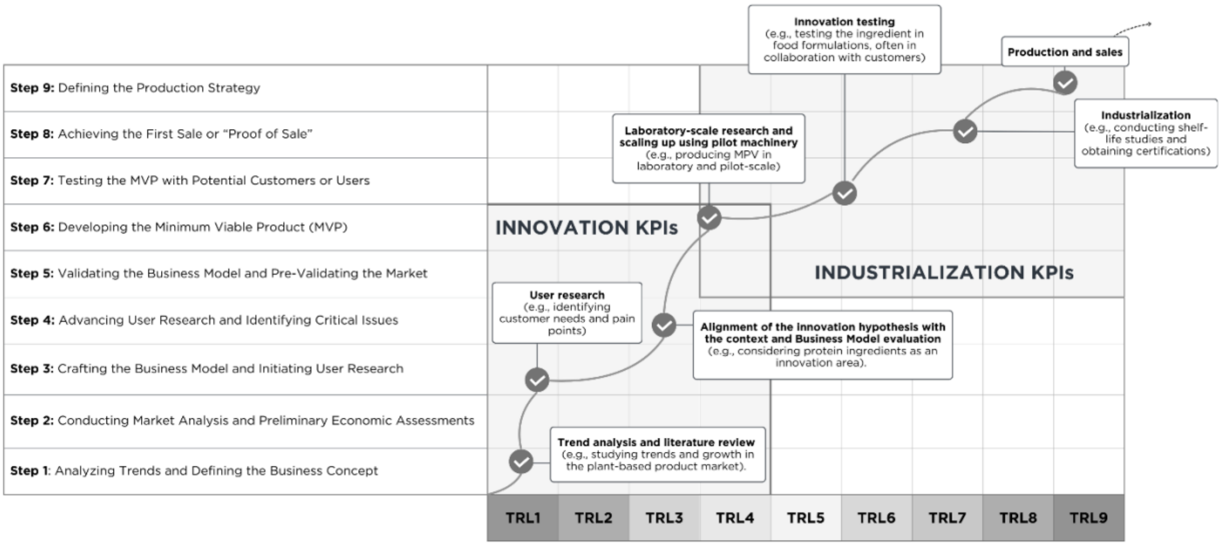

Fig.5. Ideal trajectory of a project tracked with the Innovation Matrix

Step 4: Advancing User Research and Identifying Critical Issues

Step assessment: Has the user/consumer of the product/service been precisely identified? What do

consumers think about the product/service? Can we test the product/service through simple tools like pretotyping, or do we need to use focus groups, shadowing, or other proxy techniques? Have any critical issues been identified?

Step 5: Validating the Business Model and Pre-validating the Market

Step assessment: Based on previous analyses, can it be affirmed that the project is economically attractive? Have hypothetical volumes, prices, and production costs been further refined based on user research data?

Step 6: Developing the Minimum Viable Product

Step assessment: Is the MVP satisfactory? Does the MVP correctly showcase all the differentiating properties of the product/service? Do we understand the limits of our MVP, such as testing pain points and business model(s) or pain points only? Should we produce different versions of the MVP to further refine our findings?

Step 7: Testing the MVP with Potential Customers or Users

Step assessment: Was the feedback from target users/customers sufficient to determine the sale/use potential of our product/service? Have we assessed future recurrent sales/usage? What were the positive and negative feedback? Should we redefine our product/service and/or business model? Are we confident enough to proceed with selling the actual product/service?

Step 8: Achieving the First Sale or "Proof of Sale"

Step assessment: Has the product/service been sold at least once? If the product/service was not sellable before industrialization (common in CAPEX-intensive projects), were we able to secure pre-sale contracts? (A pre-sale contract here is defined as any agreement between a Letter of Intent and an actual future sale contract).

Step 9: Defining the Production Strategy

This final step involves developing a production strategy based on sales forecasts and cost optimization. Upon completing this step, the project can be launched in the market and should be considered under implementation.

DISCUSSION AND CONCLUSIONS

By examining two case studies, we developed a new method specifically designed for technological innovation, which we named Progressia. This method involves progression along two ladders that jointly define a new, bidimensional space known as the Innovation Matrix, the playground for technological innovation. The two projects we described, although from the same company, are sufficiently different in terms of target and technology to suggest a broader applicability of the method across various contexts and economic sectors tied to technological innovation. Specifically, Case 1 involved a typical digital transformation project aimed at improving internal processes, whereas Case 2 was a deep-tech project focused on developing a new product in the constrained sector of food ingredients.

The actual trajectories of the projects along the Innovation Matrix demonstrate Progressia's flexibility in managing the uncertainty inherent in innovation. Case 1 illustrates a linear progression, where the evaluated need remained unchanged throughout the project timeline. In contrast, Case 2 shows what happens when need assumptions are unmet. This could be due to the inability to conduct thorough analysis until pricing, even through pretotyping, as was the case here—B2B businesses are particularly challenging to validate in terms of pricing through pretotyping, often requiring an MVP for deep evaluation—or because the target needs evolve during the project timeline. Regardless of the reason, Progressia optimally leverages available information to enable pivoting. In Case 2, most product qualities were already validated, facilitating a switch to a simpler industrial process that leveraged the existing technical expertise.

From a theoretical perspective, we observed that the optimal path of a project along the Innovation Matrix should maximize knowledge acquisition at minimal cost (both in time and money), thereby mitigating risk, as represented in Figure 5. Consequently, monitoring a real project using Progressia to keep it as close as possible to this trajectory can help avoid common mistakes in managing innovative technological projects, such as:

- Lack of need/pain point assessment (Viki et al, 2019)
- Inadequate or absent market study (Cooper, 1990)
- Confusion between technical pilot and minimum viable product (Brikman, 2016)
- Pursuit of technical “perfection” without considering actual usage (Calder et al., 2024)

Interestingly, Progressia potentially allows innovation project management to be split among different departments or units, functioning as an alignment tool, thereby not necessarily requiring a single project manager as postulated by Cooper (Cooper, 1990).

As a further line of research, we envision enhancing the efficacy of the Progressia method through tailored metrics for distinct project steps, potentially inspiring the development of additional tools. We identified two distinct areas of KPIs within the Innovation Matrix (Figure 5). The green area, defined by TRL4 and Step 5 at a minimum, can be evaluated with industrial KPIs such as payback, IRR, and similar metrics. In contrast, the orange area, extending to the boundaries of Step 7 and TRL5 and overlapping with the green area, requires specific KPIs dedicated to innovation. At this stage, the focus is more on the potential of the business concepts rather than their estimated economic returns, which will be evaluated later using industrial KPIs in the green area.

Furthermore, we did not incorporate time into the Innovation Matrix because different projects can have vastly different timelines based on the underlying technology (e.g., digital projects typically progress much faster than new drug developments). This flexibility is a strength of Progressia, allowing for broad applicability. However, time can be conveniently incorporated into project-specific KPIs, whether in the INNOVATION quadrant, the INDUSTRIALIZATION quadrant, or both. Notably, open innovation appears in Progressia as a means to bypass certain steps, thereby accelerating the project, as demonstrated in Case 1. When multiple innovation projects are displayed simultaneously on the Innovation Matrix, it creates a novel type of innovation portfolio. This approach facilitates a clear understanding of the various pipelines, particularly distinguishing between technology-pushed and market-driven projects (Fig. 6). Such insights can lead to more informed decision-making and more effective strategic actions.

Ultimately, we believe that the Progressia method provides enhanced visual clarity, potentially resonating powerfully with senior stakeholders in innovation management, where a good graphic is often more impactful than an abundance of words.

By adhering to the Progressia method, project managers, startups, and corporate departments can systematically advance their innovative projects, ensuring both market readiness and technological viability. We hope that the presented method will be further enriched with feedback and tools from readers who choose to implement Progressia in their own departments, organizations, or companies.

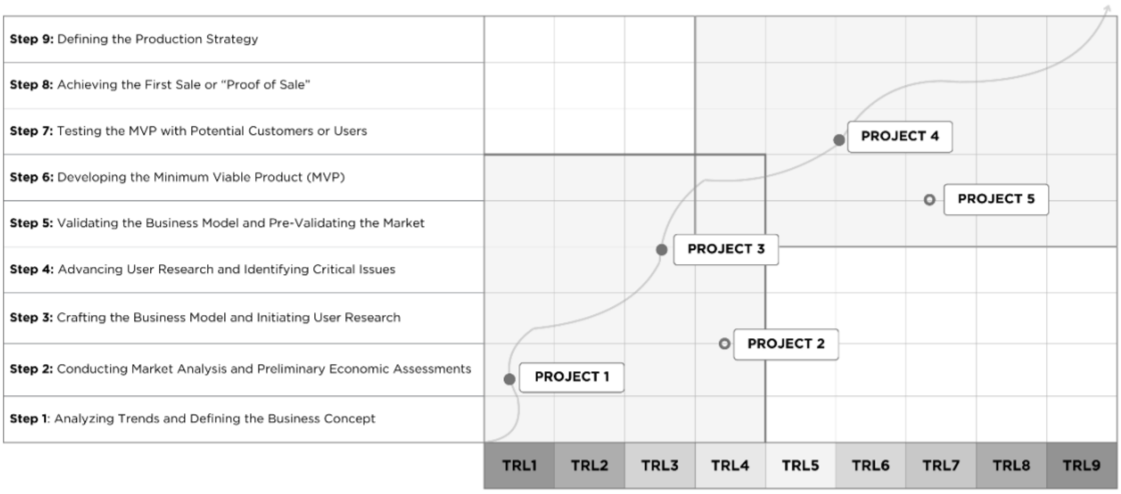

Fig.6. Progressia also incorporates an Innovation Portfolio. Different projects are displayed on the Innovation Matrix at a given moment. It is easy to spot technology-pushed projects (solid circles) and market-driven projects (open circles), making it an effective tool for more targeted decision-making.

REFERENCES

Ariew, R., (1986). *Descartes as critic of Galileo's scientific methodology.* Synthese, 67(1), 77–90. https://doi.org/10.1007/BF00485511

Bentley, D. (2022). *Using Readiness Levels To Improve The Success Rate Of Large-Scale Change Initiatives*, Forbes, https://www.forbes.com/sites/forbesbusinesscouncil/2022/06/13/using-readiness-levels-to-improve-the-success-rate-of-large-scale-change-initiatives/?sh=20b586047cfd

Bird, A. et al., (2022), *Thomas Kuhn, The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, https://plato.stanford.edu/archives/spr2022/entrieshomas-kuhn/

Brikman Y., (2016), *A Minimum Viable Product Is Not a Product, It's a Process*, Y Combinator, https://www.ycombinator.com/blog/minimum-viable-product-process

Calder, N., et al (2024). *Overcoming Common Challenges to Disruptive Innovation*. Harvard Business Review. https://hbr.org/2024/03/overcoming-common-challenges-to-disruptive-innovation

Christensen, C. M. et al, (2015). *What Is Disruptive Innovation?* Harvard Business Review. https://hbr.org/2015/12/what-is-disruptive-innovation

Cocchi, N. et al, (2024). *Stage-Gate Hybridization Beyond Agile: Conceptual Review*, Synthesis, and Research Agenda. IEEE Transactions on Engineering Management, 71, 6435–6453, https://doi.org/10.1109/TEM.2023.3282269

Cohen, W., (2013). *Drucker on Marketing: Lessons from the World's Most Influential Business Thinker*. McGraw Hill Professional, ISBN 0071778624, 9780071778626

Cooper, R.G. (1990). *Stage-gate systems: A new tool for managing new products*, Business Horizon, 33(3), 44-54, https://doi.org/10.1016/0007-6813(90)90040-I

Dickens, L., & Watkins, K. (1999). *Action Research: Rethinking Lewin*. Management Learning, 30(2), 127–140. https://doi.org/10.1177/1350507699302002

Ekmekci, I., & Nebati, E. E. (2019). *Triz Methodology and Applications.* Procedia Computer Science, 158, 303–315. https://doi.org/10.1016/j.procs.2019.09.056

Fecher, F. et al, (2020). *Innovation labs from a participants' perspective*, Journal of Business Research, 110, 567-576, https://doi.org/10.1016/j.jbusres.2018.05.039.

Gross, M., (2016), *Give Me an Experiment and I Will Raise a Laboratory*, Science, Technology & Human Values, 41(4), 6-20. https://journals.sagepub.com/doi/10.1177/0162243915617005

Guertler, M. R. et al, (2020), *Encouraging and enabling action research in innovation management*. R&D Management, 50(3), 380–395. https://doi.org/10.1111/radm.12413

Guizien, D. (2017). *Le feuilleton de l'été « Les mots valises »: L'innovation* (chapitre 3, épisode 1). Eco-Bretons. https://www.eco-bretons.info/feuilleton-de-lete-mots-valises-linnovation-chapitre-3-episode-1/

Ilevbare, I. M. et al, (2013). *A review of TRIZ, and its benefits and challenges in practice.* Technovation, 33(2), 30–37. https://doi.org/10.1016/j.technovation.2012.11.003

Interaction Design Foundation, (2016). *What is Design Thinking?,* The Interaction Design Foundation, https://www.interaction-design.org/literature/topics/design-thinking

Interaction Design Foundation, (2016). *What is User Research?,* The Interaction Design Foundation, https://www.interaction-design.org/literature/topics/user-research

Kim, C. & Mauborgne, R. (2023), *What is Blue Ocean Strategy: About Blue Ocean Strategy,* https://www.blueoceanstrategy.com/what-is-blue-ocean-strategy/
Lewin K., (1946), *Action Research and Minority Problems,* Journal of Social Issues, 2, 34-46, https://doi.org/10.1111/j.1540-4560.1946.tb02295.x
Mankins, J. C. (2009). *Technology readiness assessments: A retrospective.* Acta Astronautica, 65(9), 1216–1223. https://doi.org/10.1016/j.actaastro.2009.03.058
NASA (2023), *Technology Readiness Levels,* NASA, https://www.nasa.gov/directorates/somd/space-communications-navigation-program/technology-readiness-levels/
Olechowski, A. et al, (2020). *Technology readiness levels: Shortcomings and improvement opportunities,* Systems Engineering, 23. https://doi.org/10.1002/sys.21533
Onetti, A. (2014). *Scaleups. When does a Startup turn into a Scaleup*, Startup Europe Partnership, https://startupeuropepartnership.eu/scaleups-when-does-a-startup-turn-into-a-scaleup/
Osterwalder, A. (2013). *A Better Way to Think About Your Business Model*. Harvard Business Review, https://hbr.org/2013/05/a-better-way-to-think-about-yo
Popper, K. R. (2002). *The Logic of Scientific Discovery*. Psychology Press. ISBN 0415278449, 9780415278447
Priya, A. (2021). *Case Study Methodology of Qualitative Research: Key Attributes and Navigating the Conundrums in Its Application.* Sociological Bulletin, 70(1), 94–110. https://doi.org/10.1177/0038022920970318
Rigby, D. et al, (2016), *Embracing Agile, Agile Project Management,* Harward Business Review https://hbr.org/2016/05/embracing-agile
Savoia A., (2019) *The Right It: Why So Many Ideas Fail and How to Make Sure Yours Succeed,* HarperOne, ISBN 0062884654, 978-0062884657
Scrum Guides. (2020). *The 2020 Scrum Guide™*, https://scrumguides.org/scrum-guide.html
Srivastava, S. (2018). *Verifiability is a core principle of science*. Behav Brain Sci. 2018 Jan;41: e150. 10.1017/S0140525X18000869
Statista, (2024). *Value of venture capital investment U.S. 2006-2022,* Statista, https://www.statista.com/statistics/277501/venture-capital-amount-invested-in-the-united-states-since-1995/
Sweezy, P. M. (1943). *Professor Schumpeter's Theory of Innovation.* The Review of Economics and Statistics, 25(1), 93–96. https://doi.org/10.2307/1924551
The Lean Startup Methodology, (2023). *The Lean Startup Methodology*, The Lean Startup https://theleanstartup.com/principles
Viki, T. ET AL, (2019). *The Corporate Startup: How Established Companies Can Develop Successful Innovation Ecosystems.* Management Impact, ISB: 9462763070, 978-9462763074.
Yfanti, S., & Sakkas, N. (2024). *Technology Readiness Levels (TRLs) in the Era of Co-Creation.* Applied System Innovation, 7(2), Articolo 2. https://doi.org/10.3390/asi7020032