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Research Article

The Timeless Value of Experience: the Role of Emeritus Professors in Shaping the Future of Innovation

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Abstract

Innovation is often associated with youth, speed, and disruption. However, sustainable and transformative innovation requires more than fresh ideas: it needs vision, and the capacity to integrate knowledge across generations. Emeritus professors play a unique role in this ecosystem, acting as custodians of institutional and technological memory while mentoring young scientists and advising policymakers. The paper examines the dual mission of academia, the challenges of deep-tech innovation, and the strategies needed to overcome the "death valley". It concludes by proposing concrete ways to integrate emeriti into innovation ecosystems to ensure that Europe's future is not only fast, but also wise and inclusive.

Key Words: Emeritus Professors; Innovation Policy; Technology Transfer; Mentorship; Technological Sovereignty

Introduction

Innovation is often associated with youth and start-ups. While these elements are important, they can overshadow a fundamental truth: innovation does not arise in a vacuum. It is built upon accumulated knowledge, reflection, and the ability to navigate complex historical and societal dynamics. In this context, emeritus professors are more than retired academics. They represent a strategic resource for universities, industries, and governments. Their experience spans decades of scientific discovery and institutional evolution, enabling them to act as bridges between generations, sectors, and disciplines. In a world facing twin transitions, digital and green, the role of emeriti is essential for shaping a future that is not only technologically advanced, but also ethically sound and socially resilient.

This article will first examine the dual mission of academia and international approaches to emeritus roles, then explore the challenges of deep-tech innovation, before concluding with policy recommendations for integrating emeriti into the European innovation ecosystem.

The Strategic Mission of Academia and the Global Role of Emeritus Professors

The academic profession fulfills a strategic dual mission: advancing the frontiers of knowledge through original research and translating this knowledge into innovation, generating tangible benefits for society, industry, and public policy. This dual responsibility requires both scientific excellence and the capacity to guide discoveries toward societal impact.

Emeritus professors occupy a unique position within this framework. Even after formal retirement, they remain able to contribute actively to both missions, thanks to their long careers and systemic vision, which integrates decades of scientific, technological, and cultural evolution. Their experience allows them to bridge past and future, connecting younger generations with the lessons of history while fostering sustainable and ethically responsible innovation.

A notable example is Nobel laureate Rita Levi Montalcini, who continued her scientific activity late into life, creating intergenerational research teams grounded in curiosity, ethics, and creativity. Such models demonstrate how emeriti can mentor young researchers not only in technical skills but also in leadership,

resilience, and social responsibility. In doing so, they prevent the loss of institutional memory, ensuring that tacit knowledge is passed on through doctoral schools, master's programs, and specialized courses. Beyond teaching, emeriti can play key roles in advisory boards and governance bodies, aligning academic priorities with long-term national and international strategies.

However, the extent of emeriti engagement varies significantly across countries and university systems.

According to Saner [1], a fundamental distinction lies between systems with mandatory retirement and those with flexible retirement policies.

In many European countries, including Italy, France, and Greece, the retirement system for university professors is characterized by a mandatory retirement age, typically between 67 and 70 years old. At this point, academics are formally required to leave their full-time positions, and while they may receive the honorary title of Professor Emeritus, their active role within the institution often becomes limited. This model, as highlighted by Saner, is designed to ensure generational turnover, opening positions for younger researchers and promoting a continuous renewal of academic staff. However, it also has significant drawbacks, particularly in the current context of longer life expectancy and extended periods of good health after the age of 65. This system can lead to a loss of valuable knowledge and expertise, as highly experienced academics are abruptly separated from their teaching and research environments. In a rapidly evolving technological and scientific landscape, this can negatively affect the scientific excellence and innovation capacity of a country, as it limits opportunities for senior academics to mentor younger generations or continue contributing to ongoing projects.

Conversely, in countries such as the United States, the United Kingdom, Canada, and Australia, there is no mandatory retirement age for professors. Academics can continue working well into their seventies or even eighties, depending on their health, motivation, and institutional needs. In these systems, the title of Emeritus Professor is often accompanied by tangible rights and opportunities: access to university facilities, participation in research projects, involvement in mentoring, and even entrepreneurial activities. For instance, many retired professors continue to act as consultants, policy advisors, or founders of start-ups, thereby leveraging their experience to foster innovation and societal development.

Saner's study emphasizes that this flexibility allows for a "productive aging" approach, where retired academics remain active contributors to both the academic ecosystem and broader society. They may engage in roles aligned with the United Nations' 2030 Agenda for Sustainable Development, supporting projects related to education, sustainability and social innovation. This model creates a virtuous cycle: while senior professors pass on their knowledge through mentorship and training, institutions benefit from a broader pool of expertise without the full cost of permanent positions.

However, the absence of mandatory retirement can also create bottlenecks, as seen in Canada and other countries, where a high proportion of senior faculty members can limit career advancement opportunities for younger academics. This risk is often mitigated through structured emeriti programs that gradually reduce teaching responsibilities while increasing mentorship and advisory roles.

In (Table 1), a comparison of the two models that highlight positive and negative key aspects has been reported.

ASPECT	MANDATORY RETIREMENT	NON-MANDATORY RETIREMENT
Knowledge Transfer	✗ Loss of expertise when professors retire suddenly	✓ Continuity through mentorship and active involvement
Generational Turnover	✓ Promotes access and career progression for young academics	✗ Risk of bottlenecks and limited opportunities for younger faculty
Innovation and Research Valorization	✗ Disruption of innovation networks and long-term projects	✓ Strengthens innovation ecosystems and research continuity
Institutional Budget Planning	✓ Predictable financial planning	✗ Higher long-term costs without structured transition plans
Societal Engagement	✗ Limited post-retirement contribution to societal challenges	✓ Active involvement in policy, innovation, and SDGs
Flexibility for Individuals	✗ No choice to remain active despite health and motivation	✓ Freedom to decide when to retire or reduce workload
Adaptation to Demographic Trends	✗ Does not leverage longer life expectancy and healthy aging	✓ Aligns with aging population and extended productive years
Risk of Intellectual Stagnation	✓ Renewal of ideas through generational change	✗ Risk of stagnation if older professors dominate leadership roles
Recognition of Emeriti Role	✗ Mostly symbolic title with limited institutional access	✓ Emeriti have resources and meaningful roles

Table 1: Comparison between Mandatory and Non-Mandatory Retirement Models the for university professors, highlighting whether each key aspect is positive (✓) or negative (**X**) for the respective system.

Moving forward, European countries could consider hybrid models, where emeriti are actively integrated into research valorization processes, entrepreneurial initiatives, and mentoring programs. Such reforms would not only preserve invaluable intellectual capital but also strengthen the link between academia and society, fostering sustainable innovation and global competitiveness.

A hybrid retirement model represents the most effective approach for balancing generational renewal with the preservation of scientific excellence, particularly in disciplines such as the hard sciences. In these fields, the sudden retirement of senior professors often results in the disruption of complex innovation networks, which require decades to establish through collaborations, research infrastructures, and international partnerships.

By allowing experienced professors to transition gradually into emeriti roles, institutions can maintain continuity in research and technology transfer activities, while simultaneously opening opportunities for younger academics to assume leadership positions. This model leverages the deep tacit knowledge and strategic connections of senior scholars, who can act as mentors, advisors, and innovation catalysts, without blocking the progression of new generations.

In an era of increasing scientific complexity and global competition, such a balanced system is crucial to sustain long term research capacity and to ensure that universities and research centers remain competitive drivers of innovation at both national and international levels.

Experience as a Catalyst for Sustainable Innovation

Technological innovation follows a cyclical path: discovery, early enthusiasm, adoption, critical evaluation, and often reinvention. Emeritus professors, having lived through several such cycles, can distinguish between transient trends and transformative breakthroughs. In materials science, for instance, plastics were initially celebrated as revolutionary. Decades later, their environmental impact became evident, necessitating entirely new approaches. Similarly, advanced composites, now key to aerospace innovations like the Boeing 787, which is over 70% composite by weight, emerged from decades of research before becoming industrial assets. These examples show that sustainability must be embedded from the outset, and that long-term perspective is essential to avoid unintended consequences.

Today, Europe faces a pressing challenge: building technological sovereignty. The European Chips Act aims to double Europe's global market share in semiconductors from 9% to 20% by 2030, reducing reliance on external suppliers [2]. Similarly, the Strategic Technologies for Europe Platform (STEP) seeks to identify and finance transformative technologies, focusing on the twin transitions of digitalization and sustainability [3].

The growing complexity of European innovation policies requires decision-making processes that balance scientific vision, industrial feasibility, and long-term societal impact. In this context, the accumulated experience of emeritus professors represents a strategic resource. Having witnessed multiple technological cycles and policy transitions, emeriti can provide critical insights to identify priority research areas, anticipate potential ethical and regulatory challenges, and guide investments toward technologies that are not only competitive but also sustainable. Their involvement in advisory boards and policy-shaping bodies would ensure that these ambitious European programs are grounded in both cutting-edge science and a deep understanding of historical and institutional dynamics, reducing the risk of short-termism and fragmented strategies.

Bridging the Second Death Valley

In the field of innovation policy, the expression "death valley" traditionally refers to the difficult transition from basic research to the development of a functional prototype. This is the first critical gap where scientific discoveries, however promising, often fail to generate a tangible outcome due to lack of funding, expertise, or institutional support. Yet, there is a second and even more treacherous valley, one that is often overlooked but is decisive for the survival of deep-tech projects: the phase between securing intellectual property and achieving sustainable market adoption.

Crossing this second valley requires much more than scientific excellence. At this stage, the challenge shifts from laboratory success to industrial scalability, regulatory compliance, supply chain design, market positioning, and the mobilization of what investors call patient capital. Deep-tech start-ups, unlike purely digital ventures, must operate within complex ecosystems involving high technical risk, long development cycles, and stringent quality and safety standards. Without a carefully designed strategy and the right support structures, many promising technologies become trapped in this stage, resulting in the loss of years of research and public investment. A recent report by the Boston Consulting Group highlights that this phase represents the greatest vulnerability for deep-tech companies, as both entrepreneurs and investors frequently lack the specialized expertise needed to navigate regulatory frameworks and industrial scale-up processes [4].

In Italy, one example of an organization designed to address this critical stage is Materials, a venture builder focused on deep-tech innovation in advanced materials. By integrating scientific expertise with industrial and managerial skills, Materials has developed a model that supports technologies in overcoming the second valley of death, bridging the gap between research and sustainable market adoption. Over time, Materials became convinced that a critical factor determining success in this delicate phase is the presence of individuals with deep, accumulated experience. This does not simply mean people with a record of academic publications or technical achievements, but rather those who have lived through the complexities of bringing innovations to market, who have witnessed both successes and setbacks, and who can anticipate obstacles that are invisible to less experienced teams.

Experience provides what theories and data cannot. It embodies tacit knowledge about manufacturing bottlenecks, regulatory

pitfalls, and market dynamics. This type of insight often comes only from having personally navigated challenging projects. For example, in the world of medical devices, there are countless cases where groundbreaking prototypes were delayed for years because design teams underestimated the time and complexity of clinical validation and certification processes.

Emeritus professors are uniquely positioned to play a decisive role in this context. Their careers have given them not only technical expertise, but also a holistic perspective on how innovation ecosystems evolve over time. They have seen multiple waves of technological change and understand the importance of aligning research with regulatory frameworks, industrial capacities, and societal needs. Their involvement provides a stabilizing influence, counteracting the tendency toward short-term thinking that often characterizes both political decision-making and venture capital cycles. Moreover, their networks, built over decades of collaboration with universities, governments, and industries, offer young innovators access to partnerships and resources that would otherwise take years to establish.

The second death valley, therefore, is not crossed by technology alone, but by communities of practice in which different forms of knowledge are integrated. Emeriti bring to these communities a depth of insight that complements the creativity and drive of younger generations. Their experience enables them to identify which risks are worth taking, which processes require early investment, and which regulatory or societal shifts may affect long-term viability.

A notable example of the impact emeritus professors can have on innovation is the work of James Dahlberg, Professor Emeritus at the University of Wisconsin–Madison [5]. His research on gene variation mechanisms led to the development of technologies behind Collogued, a groundbreaking at-home screening test for colorectal cancer. Dahlberg's continued involvement after retirement demonstrates how emeriti can bridge basic research and industrial application, transforming scientific discoveries into life-saving innovations.

Conclusions

Emeritus professors represent a unique and underutilized resource. Their value lies not only in their knowledge, but in their ability to integrate past experience with future vision. In teaching, they ensure that students and young researchers inherit not just techniques, but also ethics and critical thinking. In research, they act as mentors, fostering interdisciplinary collaborations and preserving institutional memory. In governance, they offer long-term perspectives essential for sustainable innovation policies. Europe's ambition to achieve technological sovereignty will require bridges between generations.

To fully harness the potential of emeritus professors, universities and policymakers should move beyond symbolic recognition and design structured programs that actively integrate emeriti into innovation ecosystems. One possible approach is to create dedicated Emeriti Innovation Programs within Technology Transfer Offices (TTOs), where emeritus professors serve as mentors, evaluators, and strategic advisors for start-ups and research projects, particularly in deep-tech sectors.

At the policy level, governments could introduce regulatory incentives to encourage universities and companies to involve emeriti in technology exploitation activities, such as tax credits for organizations that formalize emeriti mentorship roles or advisory positions. Additionally, pilot projects funded at the national or European level could test hybrid retirement models, allowing emeriti to contribute part-time to research and industrialization efforts without blocking generational turnover.

These measures would transform emeriti from passive holders of honorary titles into active agents of sustainable innovation, bridging generational divides and strengthening Europe's capacity to compete in global technology markets.

As Leonardo da Vinci once said, "I'm looking for the Light of Science…and its benefit". This dual aspiration, knowledge and utility must guide our collective efforts to build a wise, inclusive, and sustainable future.

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