



Strong and resilient women entrepreneurs in biotechnology

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Scientific excellence alone rarely produces a viable Bio-MedTech venture. This article examines how women entrepreneurs can combine scientific, managerial, relational, financial, and market capabilities within enabling ecosystems to turn discoveries into distinctive, commercially successful enterprises that generate economic and social value.

Turning scientific knowledge into a commercially viable product requires more than scientific expertise. In biotechnology and Bio-MedTech, entrepreneurs must combine scientific knowledge with entrepreneurial, managerial, relational, financial, and market capabilities to develop products that respond to societal needs and create value. Bioentrepreneurship therefore involves science, entrepreneurship, intellectual property, investment, regulation, networks, and markets.

Biotechnology refers broadly to the application of biological knowledge and processes to develop products, technologies, and services. Bio-MedTech encompasses innovations at the intersection of biomedical science, biotechnology, engineering, and medical technologies. Bioentrepreneurship refers to the entrepreneurial process through which scientific or technological knowledge is transformed into products, services, or organizations that create economic or social value (Cervini & Dogwiler 2020). Science-based enterprises are characterized by the central role of scientific or technological knowledge in their value proposition and competitive potential.

Entrepreneurship can be understood as the identification and exploitation of opportunities through the mobilization and recombination of resources (Scott & Venkataraman 2000). In science-based sectors, this process is particularly complex because entrepreneurs must translate scientific discoveries into technologies that can be protected, developed, financed, regulated, and adopted by users or markets.

The creation of a science-based company can provide opportunities for professional development, innovation, learning, and greater autonomy in decision-making. However, it also involves uncertainty and requires entrepreneurs to evaluate risks, develop new capabilities, and collaborate across disciplinary boundaries. Entrepreneurial orientation can influence how organizations respond to opportunities and competitive environments (Covin & Slevin 2019; Alam et al. 2022).

Innovation becomes differentiation only when science integrates intellectual property, financing, networks, and market orientation, enabling SMEs to thrive.

Women represent an important proportion of the scientific and STEM talent base, yet their participation in entrepreneurship and commercialization remains comparatively limited. Previous research has documented gender differences in entrepreneurial entry among STEM graduates and has shown that educational experiences can influence these differences (Piva & Rovelli 2022). Recent research similarly indicates that women's entrepreneurship in STEM remains under-explored and requires greater attention to the contexts in which entrepreneurial opportunities are created and pursued (Treanor 2022).

The gender dimension is therefore relevant, but it should not be interpreted as evidence that women lack the characteristics required to become successful entrepreneurs. A gender-aware perspective instead recognizes that entrepreneurial activity takes place within social, institutional, organizational, and economic contexts that can influence access



to resources, networks, recognition, and opportunities (Brush et al. 2019).

This article discusses the capabilities and conditions that support women entrepreneurs in Bio-MedTech, with particular emphasis on the transition from scientific knowledge to market value. The central argument is that scientific novelty alone does not necessarily generate competitive advantage. Innovation becomes a source of differentiation when entrepreneurs can develop, protect, finance, communicate, and commercialize scientific knowledge.

Women are well represented in STEM, yet far fewer become entrepreneurs: the barrier lies in unequal ecosystems, not in ability.

From science to market: the challenge of commercialization

Scientific research can generate knowledge with considerable technological and social potential, but the transition from research to market requires different activities and capabilities. A scientific discovery must be connected to a specific opportunity, developed into a viable product or service, protected where appropriate, financed, and brought to users.

The distinction between an invention and an entrepreneurial opportunity is therefore important. Entrepreneurship research emphasizes that opportunities emerge through the interaction between



individuals, knowledge, resources, and contextual conditions (Scott & Venkataraman, 2000). In Bio-MedTech, this interaction matters because developing a new product may require scientific expertise, engineering capabilities, intellectual property management, regulatory knowledge, financing, clinical or user validation, and market development.

Bio-MedTech entrepreneurship consequently differs from entrepreneurship based primarily on conventional commercial activities. The entrepreneur must bridge two environments: the scientific environment, where knowledge and technological possibilities are generated, and the market environment, where products must demonstrate value and respond to users' needs (Cervini & Dogwiler 2020).

This transition also involves uncertainty. The entrepreneur may not know in advance which technological solution will become commercially viable, which market will adopt it, or which resources will be required at each stage of development. Entrepreneurial action therefore involves evaluating opportunities and adapting to changing circumstances.

For small and medium-sized enterprises (SMEs), differentiation can therefore emerge not only from technological novelty but from the ability to integrate specialized knowledge with customer understanding, intellectual property, partnerships, financing, and commercialization capabilities.

Women in STEM and bio-medtech entrepreneurship

Women have achieved substantial participation in scientific education and research, but this participation has not always translated into equivalent levels of entrepreneurial entry, commercialization, leadership, and business ownership.

Research on STEM graduates shows that women are less likely than men to enter entrepreneurship after graduation,

even when they have comparable scientific qualifications. Importantly, Piva and Rovelli (2022) found that exposure to economics and management education reduced the gender imbalance in entrepreneurial entry among STEM graduates. This finding suggests that entrepreneurial capabilities can be developed and that educational environments can influence the transition from STEM expertise to entrepreneurship.

This perspective is consistent with broader research on women's entrepreneurship, which emphasizes the importance of considering the interaction between individual capabilities and the institutional and social environments in which entrepreneurship takes place.

The issue is therefore not whether women possess the ability to innovate, but whether scientific and entrepreneurial ecosystems provide equitable opportunities for their capabilities to be transformed into entrepreneurial activity.

Networks and strategic relationships

Networks are a central component of science-based entrepreneurship because no individual entrepreneur or small firm is likely to possess all the knowledge and resources required for commercialization. Biotechnology companies rely on relationships with universities, research organizations, investors, pharmaceutical companies, technology providers, clinicians, and other specialized actors, which can provide access to knowledge, funding, talent, market information, and complementary capabilities.

However, the existence of a network does not automatically produce commercialization. Gilding et al. (2020), studying biotechnology firms and collaborations in Australia, found that local collaborations could contribute to knowledge creation and early-stage funding but did not necessarily provide pathways to commercialization. This distinction is particularly important for Bio-MedTech SMEs. Networks should not be viewed merely as a mechanism for obtaining contacts. They become a strategic capability when they connect the firm with actors who provide complementary resources and help it move toward the market.

Capabilities for building a distinctive bio-medtech enterprise

The transition from scientific knowledge to market value requires the integration of several capabilities. Based on the literature reviewed, these capabilities can be organized into six interconnected dimensions. Their value emerges from their interaction rather than from each capability considered independently.

Scientific and human capital

Scientific expertise underpins Bio-MedTech entrepreneurship. Entrepreneurs need sufficient technical knowledge to understand the technology, identify problems, evaluate evidence, and communicate with scientific and technical stakeholders. However, this expertise must





be complemented by education and training in opportunity evaluation, business planning, resource management, and commercialization. Piva and Rovelli (2022) demonstrate that economics and management education can reduce the gender imbalance in entrepreneurial entry among STEM graduates. Human capital therefore includes both scientific and managerial knowledge required to transform scientific knowledge into a viable business.

Entrepreneurial and managerial capabilities

Entrepreneurial capabilities enable entrepreneurs to recognize opportunities, mobilize resources, make decisions under uncertainty, and coordinate activities. Entrepreneurial orientation can influence how firms respond to opportunities and competitive environments (Covin & Slevin 2019; Alam et al. 2022). Strategic thinking, communication, problem-solving, and resilience can support coordinating science-based ventures. Education, mentoring, experience, and interaction with entrepreneurial ecosystems can develop these capabilities. For women entrepreneurs, the focus should therefore be on equitable opportunities to develop capabilities rather than on gender-specific characteristics.

Intellectual property and knowledge transfer

Intellectual property is a critical component of Bio-MedTech commercialization because scientific knowledge can be a central source of competitive advantage. Entrepreneurs must understand how knowledge can be protected, translated into business value, and transferred from research organizations to companies. Commercialization is strengthened when scientific knowledge, intellectual property, and entrepreneurial capabilities are connected. The triple-helix perspective highlights the role of relationships among universities, industry, and government in this process (Etzkowitz & Leydesdorff 2017).

Networks and strategic partnerships

Beyond providing access to resources, networks become a strategic capability when entrepreneurs build and leverage relationships that connect the firm with complementary knowledge, expertise, and market opportunities. The entrepreneurial ecosystem perspective emphasizes interactions among entrepreneurs, organizations, institutions, markets, and support structures (Audretsch et al. 2019), while these ecosystems may also reproduce or reduce gender inequalities depending on resource distribution (Brush et al. 2019). For Bio-MedTech ventures, the strategic value of networks lies in the quality and diversity of relationships and their ability to generate complementarities. Gilding et al. (2020) show that biotechnology collaborations may support knowledge creation and early-stage funding without necessarily enabling commercialization. Strategic networking therefore requires identifying valuable relationships and combi-

ning complementary resources to support market adoption.

Financing and resource management

Financial resources are essential for transforming scientific ideas into commercial products. Bio-MedTech companies may require investment during periods in which revenues are limited or non-existent. Entrepreneurs must therefore assess financing alternatives, manage available resources, and evaluate financial risks. Gender differences in access to entrepreneurial resources have been documented (Guzman & Kacperczyk 2019; Panda 2018) and should be understood as part of the entrepreneurial environment rather than as evidence of lower capability among women. For SMEs, aligning financial resources with technological development and marketstrategy can create differentiation.



orientation therefore requires understanding customers, competitors, industry dynamics, adoption barriers, and the context in which the technology will be used. Branding, communication, and sales capabilities help translate technical value into a proposition that responds to market needs. Commercialization should therefore begin early rather than being treated as the final stage of scientific development.

From capabilities to differentiation

The previous sections demonstrate that Bio-MedTech competitiveness cannot be explained by scientific novelty alone. A science-based company may possess a technically innovative product but still fail to commercialize it if it lacks intellectual property protection, financing, market knowledge, regulatory capabilities, strategic networks, or entrepreneurial management.

Differentiation is therefore the result of combining capabilities and resources to create value that is difficult for competitors to replicate. This perspective is particularly relevant for SMEs, which often cannot compete through scale but may differentiate themselves through specialized knowledge, agility, strategic partnerships, customer understanding, and responsiveness to emerging opportunities.

Entrepreneurial ecosystems can strengthen these capabilities by connecting SMEs with universities, research institutions, investors, government agencies,

and industry partners (Audretsch et al. 2019). However, these connections do not necessarily lead to commercialization, as biotechnology firms may gain knowledge and early-stage resources without establishing pathways to markets (Gilding et al. 2020). The central challenge is therefore to develop the conditions and capabilities that enable scientific innovations to become distinctive and commercially viable enterprises.

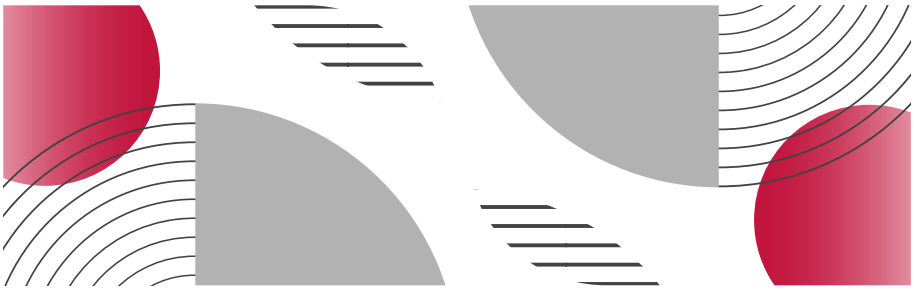
From science to the market

Transforming scientific knowledge into a competitive Bio-MedTech enterprise requires integrating scientific expertise with entrepreneurial, managerial, relational, financial, and market capabilities. Women represent an important source of scientific and entrepreneurial potential, yet their participation in entrepreneurship and commercialization remains comparatively limited. A gender-aware perspective recognizes that these outcomes are shaped not only by individual capabilities but also by institutional, social, organizational, financial, and network contexts (Brush et al. 2019; Treanor 2022).

This article proposes six interconnected dimensions that can support the development of distinctive Bio-MedTech enterprises: scientific and human capital, entrepreneurial and managerial capabilities, intellectual property and knowledge transfer, networks and strategic partnerships, financing and resource management and market orientation, and commercialization.

These capabilities are mutually reinforcing scientific knowledge provides the technological foundation; entrepreneurial capabilities support decision-making and resource mobilization; intellectual property structures value; networks provide complementary resources; financing enables development; and market orientation connects innovation with users and customers.

For SMEs, the implication is clear: innovation becomes a source of competitive differentiation when organizations can mobilize the capabilities required to transform scientific novelty into market value. The transition from science to market is therefore the central challenge of Bio-MedTech entrepreneurship and can determine whether scientific knowledge remains within the research environment or becomes an innovation capable of generating economic, organizational, and social value.



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