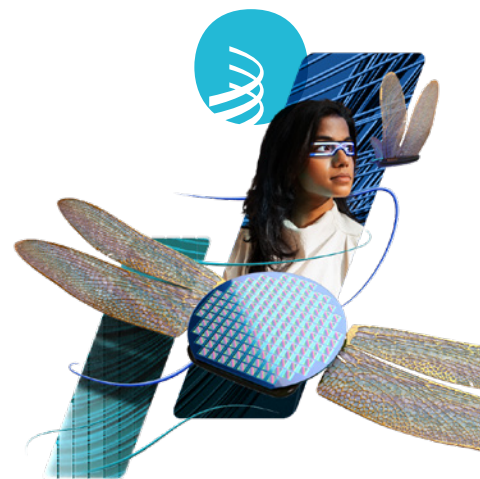


Early-stage intellectual property practices and R&D empowerment the CATL case



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Introduction

This paper examines the role of intellectual property (IP), research and development (R&D) capability and venture formation in the scale-up of science-based enterprises, using Contemporary Amperex Technology Co., Limited (CATL) as a case study. CATL is now one of the world's largest electric-vehicle (EV) battery manufacturers, and public reporting in 2025 described the company as holding close to 38 percent of the global EV battery market while supplying leading automakers (Associated Press, 2025).

The central argument is that IP strategy should not be treated only as a legal compliance function. In sectors such as lithium-ion batteries, IP can shape freedom to operate, access to partners, investor confidence and the ability to scale production. Recent work on high-tech firms also suggests that R&D investment and capital formation can be more closely connected to firm performance than patent counts alone, reinforcing the importance of linking IP strategy to real commercialization capability (Chen, 2025).

The paper therefore focuses on the entrepreneurial mechanisms visible in CATL's trajectory: spin-off formation, strategic use of inherited and externally accessed technology, integration of IP and R&D decision-making, customer validation, reinvestment in proprietary capability and progressive industrial scaling. Public sources are used where available and unsupported claims about specific patent transactions that cannot be independently verified avoided.

1. Science-based entrepreneurship: origins and spin-out pathway

CATL's origins are closely linked to Amperex Technology Limited (ATL), a battery company founded by Robin Zeng in 1999. Public reporting describes CATL as having been founded in 2011 by a team led by Zeng after ATL had developed capabilities in lithium-ion and lithium-polymer batteries for consumer electronics (Associated Press, 2025; Wired, 2022).

This origin matters, because CATL was not a start-up beginning with a blank technological slate. It emerged from an existing industrial knowledge base that included electrochemistry expertise, manufacturing discipline, customer-quality requirements, and experience operating in a patent-intensive battery sector. CATL's science-based entrepreneurship pathway therefore combined founder experience, inherited technical capability, customer demand, and a new market opportunity in EVs.

The venture's early commercial pathway was accelerated by automotive demand. Public reporting identifies BMW as an early customer relationship that was important in CATL's shift into EV batteries, helping the company move from technical capability toward automotive-grade commercialization (Wired, 2022). In that sense, CATL's development illustrates the importance of anchor customers for science-based ventures in capital-intensive sectors.

2. Strategic IP and technology access

In the lithium-ion battery sector, new entrants face dense patent landscapes around cell chemistry, pack architecture, process control and safety systems. Such patent landscapes can create freedom-to-operate risks and raise the cost of market entry. Recent studies on technology transfer within climate-related sectors suggest that IP rights interact with trade, finance, demand-pull policy and local innovation capability, rather than operating as a single stand-alone driver of commercialization (Jee *et al.*, 2024).

CATL's approach can be understood as a hybrid pathway. The company relied on inherited and externally accessed knowledge from ATL's consumer-battery experience, while progressively building its own engineering, manufacturing and IP capabilities. This reduced the time needed to enter a fast-growing market, while allowing the company to strengthen its proprietary position through subsequent R&D.

(Earlier author drafts of this paper referred to a specific Bell Labs patent route. Because stable public documentation of the exact Bell Labs-to-ATL-to-CATL patent pathway is limited, the current version frames the issue more conservatively: CATL benefited from ATL's accumulated lithium-polymer battery know-how and then adapted that knowledge to the more demanding automotive and energy-storage context.)

3. Integrated IP-R&D framework

A distinctive element of the CATL case is the close relationship between IP management and technical development. In patent-intensive sectors, IP teams need to do more than file inventions after the fact. They also help identify technical white space, map infringement risks and inform R&D priorities before large-scale capital is committed. WIPO's recent work on innovation policy similarly emphasizes that innovation outcomes depend on the accumulation of local capabilities and the coordination of policy, finance, knowledge and production systems (WIPO, 2024).

For CATL, the integration of IP and R&D appears to have served two functions. First, it reduced risk by identifying legal and technical boundaries before significant investment in manufacturing and customer validation. Second, it turned incremental technical improvements into an accumulating portfolio of proprietary knowledge. The case therefore shows how IP can operate as part of an entrepreneurial capability system, rather than as a purely defensive legal asset.

4. Challenges

4.1 Incumbent patent concentration

CATL entered an industry in which established firms had accumulated significant technical and patent advantages. A neutral way to describe this challenge is "incumbent patent concentration," rather than "foreign monopoly." For an emerging science-based venture, dense patent ownership can raise licensing costs, slow technical experimentation and increase uncertainty for investors and customers.

4.2 Technical viability and product reliability

Battery commercialization depends not only on cell chemistry, but also on manufacturability, safety, cycle life, pack design and quality consistency. Pouch and polymer lithium-ion battery formats can offer design advantages, but they also create technical challenges linked to swelling, mechanical stress and long-term reliability. Indeed, recent technical literature confirms that mechanical stress and swelling behavior remain important issues in pouch-cell design and performance modelling.

The entrepreneurial lesson is that licensed or inherited knowledge is rarely sufficient in itself; commercial value depends on a venture's ability to solve the technical and manufacturing constraints preventing a promising scientific concept from becoming a reliable product.

4.3 Capital intensity

Battery start-ups require substantial capital for R&D, testing, production equipment, quality systems and customer validation. Upfront spending on technology access and IP protection therefore competes with spending on manufacturing scale-up. This is a common challenge for science-based ventures: the venture must de-risk technology, IP and production, all at the same time, often before revenue is stable.

4.4 Limited proprietary leverage at the early stage

A venture that depends heavily on licensed or inherited technology may have limited bargaining power when it comes to cross-licensing discussions. CATL's early challenge was therefore to not only obtain access to existing knowledge, but also to build a stronger proprietary base through R&D, patenting and manufacturing know-how.

5. What worked

5.1 Using inherited capability as a launchpad

CATL benefited from ATL's accumulated experience in lithium-ion and lithium-polymer batteries, including manufacturing discipline and customer-quality requirements (Associated Press, 2025; Wired, 2022). This provided a starting base from which the company could address the more demanding requirements of automotive and energy-storage applications.

5.2 Turning technical constraints into R&D priorities

The case of CATL also shows the importance of secondary innovation. In battery technologies, defects such as swelling, degradation and safety risk cannot be solved by licensing alone. They require materials optimization, electrochemical testing, production engineering and feedback from demanding customers. CATL's trajectory suggests that the commercialization of science-based technologies often depends on this less visible, but decisive layer of engineering work.

5.3 Treating IP as a strategic shield and investment signal

A clearer freedom-to-operate position can reduce legal uncertainty and make a science-based venture more credible to investors, customers and partners. CATL's approach suggests that IP strategy can help a venture move from technical promise to bankable industrial capability, when tied to customer validation and production reliability.

5.4 Reinvesting commercial gains into proprietary capability

CATL's later growth reflects a wider pattern in science-based entrepreneurship: early revenues can be reinvested into R&D, manufacturing capacity and proprietary technology portfolios. Public reporting on the company's 2025 Hong Kong listing highlighted its global scale, profitability and continued investment in international production capacity (Associated Press, 2025).

6. What did not work or remained difficult

The case of CATL should also be treated with caution. First, reliance on externally accessed or inherited technology can create a catch-up position in which the company optimizes within technical paths partly shaped by earlier incumbents. Second, battery commercialization requires large capital commitments before all technical and market risks are resolved. Third, patent accumulation alone does not guarantee innovation success; patents need to be connected to R&D capability, production learning, customer validation and capital access (Chen, 2025).

Table 1 CATL case: challenge, response and transferable lesson

Challenge	CATL response	What worked	Transferable lesson
Incumbent patent concentration	Used inherited and externally accessed knowledge while building internal capability	Reduced time to market and avoided starting from a blank technological base	Map freedom-to-operate early and link IP strategy to venture formation
Technical reliability constraints	Converted product limitations into targeted R&D priorities	Focused secondary innovation on manufacturability, safety and quality	Licensing only creates a starting point; commercialization requires internal engineering capability
Capital intensity	Aligned customer validation, production investment and IP development	Improved credibility with industrial partners and investors	Science-based ventures need capital strategies that match long technical cycles
Early-stage proprietary weakness	Reinvested commercial gains into R&D and proprietary know-how	Built stronger bargaining power over time	Use early revenue to reduce dependence on externally controlled technologies

Source: Authors' synthesis based on public sources and CATL case analysis.

7. Practices others can adapt

Patent-aware venture formation. Science-based start-ups in patent-intensive sectors should map freedom-to-operate risks early, before committing scarce capital to a technical path.

IP–R&D integration. IP staff should work with researchers and engineers throughout the R&D cycle, rather than only after inventions are complete.

Secondary innovation capability. Ventures should treat licensed or inherited technology as a platform for further internal innovation, especially where manufacturing reliability and safety are decisive.

Reinvestment loop. Early commercial gains should be channelled into proprietary R&D and patentable improvements to reduce long-term dependence on externally controlled technologies.

8. Lessons and policy implications

Lesson 1. The CATL case suggests several lessons for ecosystems supporting science-based ventures. Technology-transfer policies should focus not only on licensing patents, but also on supporting the costly adaptation work needed to turn patents into reliable industrial products.

Lesson 2. A safer policy framing is not that governments should “break foreign monopolies,” but that innovation systems can help science-based ventures gain legitimate access to foundational technologies, build internal R&D capability and develop domestic innovation capacity through lawful licensing, partnerships, standards participation and patient capital.

Lesson 3. Policy instruments such as IP advisory services, shared testing infrastructure, commercialization finance and links to anchor customers may be especially valuable in sectors where technical validation is expensive and time-consuming.

Conclusion

CATL's early development illustrates how science-based entrepreneurship within a patent-intensive sector depends on the interaction of IP strategy, R&D capability, customer validation and capital formation. Its trajectory is not a simple story of patent acquisition or manufacturing scale. It is better understood as a staged process in which inherited capability, technical adaptation, freedom-to-operate management and reinvestment into proprietary knowledge combine to support industrial scale-up.

For other science-based ventures, the broader lesson is that IP matters most when it is integrated with product engineering, market validation and financing strategy. The CATL case therefore offers a useful example of how an emerging deep-tech firm can move from technology access to technological capability, provided that IP strategy is closely linked to R&D learning and commercialization discipline.

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WIPO Reference No. GII2026/EN/EXTCONT

DOI: 10.34667/tind.59195

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