

Bucking the Trend: NIO's Road to Global Electric Vehicle Scale

Gerald Scott and Ryan Lunsford, PhD

School of Professional Studies, University of The Incarnate Word

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Abstract

NIO Inc. is an emerging Chinese automotive manufacturer of premium smart connected electric vehicles. As of November 2021, the company has a market cap of nearly \$70B, making it the world's 254th most valuable company, 11th most valuable automotive company, and 4th most valuable pure EV (electric vehicle) manufacturer globally (Companies Market, 2021). While NIO has achieved over 145K cumulative vehicle deliveries as of November 2021, it has over 1.6M registered NIO app users, demonstrating that consumer interest in the NIO brand far exceeds the EV sales aspect of its business model (Zhang, 2021). One of the differentiating facets of the company's business model is battery swapping technology. With 613 swapping stations in operation and a production schedule of 2.7 stations per day, the company is well on track to exceeding its increased goal of 700 by the end of 2021 (NIO, 2021). The Chinese government's launch of a pilot program in 11 cities to promote battery swapping and the continued adoption of the strategy by competitors suggest that NIO's 466 patents out of 2,768 pertaining to battery swapping will prove pivotal as global EV adoption progresses (Seeking Alpha, 2021). With a sizeable and loyal following of end-users, including institutional and retail investors, NIO has developed a reputation as Tesla's top competitor. However, the two companies' market focus, business model, and product offerings are significantly different as NIO is a much smaller company that pursues business relations towards achieving its objectives. Tolstoy (2014) notes that "research has shown that smaller firms tend to compensate for internal resource shortages by leveraging business relationships to scale up their activities and distribute products in global value chains."

A significant portion of NIO's business revolves around digital products and services in a highly agile environment where functions, infrastructure, and technology-related operations are essential in its viability. Thus, the company resembles and behaves more like a tech business than a traditional automotive manufacturer. Aside from decreasing cost curves quicker than expected due to scaling, cross-sector innovations are frequently overlooked by so-called industry experts who are informed by and contribute to the status-quo (Winton, 2019). NIO's battery swapping technology is a disruptive innovation in that it's significantly altering the way that industries and consumers engage in automotive transportation. Established on the motto "Blue Sky Coming," the translation of its Chinese name Weilai, NIO customers, represents a younger demographic who subscribe to its user experience focus (NIO, 2021). While NIO's long-term success depends significantly on its execution over the next several years, the company has to date demonstrated its ability to beat the odds by leveraging its knowledge and technologies towards becoming a global high-end brand.

Keywords: NIO, battery swapping, battery-as-a-service, navigate on pilot, NIO life

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Introduction

In the 136-year history of the automobile, internal combustable engines (ICE) primarily formed the industry-standard powertrain (Bellis, 2019). The role of the EV in the transition from earlier transportation propulsion often gets marginalized or excluded entirely from the historical account. There's no single person attributed with the invention of the electric car, but rather a series of innovations by several inventors evolving around today's familiar topics of powertrains and energy storage, i.e., electric motors and batteries (Department of Energy, 2014). Though innovators from Hungary, the Netherlands, and the United States were amongst the first to construct a crude version of the electric vehicle, the consensus is that French and English inventors built the first practical electric cars during the second half of the 19th century (Matulka, 2014). At the beginning of the 1900s, a third of all vehicles made in the U.S. were electric. Electric cars were so popular in the U.S. during this period that many cities operated taxi fleets comprised entirely of electric vehicles (Department of Energy, 2014). The benefit is the absence of the noise, vibration, and smells associated with gas engines. The modern electric car, by comparison, is still in its infancy, having given rise within the last two decades. However, for all its advancements, energy storage and replenishment remain a critical component toward mass EV adoption. The growing demand for electric vehicles is primarily due to increased awareness of ICE vehicles' threat to the environment, our health, and our future. As a result, the transition from internal combustable engine vehicles to smart electric vehicles has become a priority of economies worldwide in recent years. Since the release and ultimate success of the Tesla Roadster in 2010, followed by the Model-S in 2012, the number of pure EV startups and

transitioning ICE manufacturers has grown exponentially. However, the U.S. represents a nominal portion of the total 10M EVs sold globally (International Energy Agency, 2020). While EV sales in China and Europe observed 36% and 60% compound annual growth from 2016 to 2020, respectively, the U.S. remained flat at 17% during the same period (Desilver, 2012).

According to the International Energy Agency (IEA) (2020), the move towards EVs is increasing worldwide, and many analysts estimate the transition will be complete in as few as two decades. As a result, internal combustable engine (ICE) manufacturers are under growing pressure to scale EVs research, development, and production, which invariably negatively impact their current market share of annual legacy vehicle sales (Baillie Gifford, 2021). Pressure refers to various tradeoffs at bringing EV models to market, such as internal cannibalization, the use of off-the-shelf technology, and R&D time constraints, which impact the final product's quality and appeal. The number of new EV startups suggests that building an electric vehicle is not difficult; however, the challenge is competing on cost, range, appeal, and scalability with other industry participants vying for the same resources and customers. While the global EV outlook provides a holistic view of total EV sales and adoption, analyzing one of the industry's fastest-growing brands offers valuable insight into best business practices with implications for industry participants and consumers. Ideally, the analysis should reflect current consumer expectations of further technology improvements and new models (IEA, 2021).

Background

The role of consumer adoption of electric vehicles has long been recognized as a solution component for dependency on fossil fuels, increasing carbon dioxide (CO₂) emissions, and other environmental issues (Rezvani et al., 2015). However, numerous vehicle constraints,

including price, availability, features, range, and shared attitudinal factors associated with consumers' view of supportive policy and other contextual forces, continue to stifle EV adoption (Tu et al., 2019)

First and most importantly, the end-user, and their demand, must become the essential element of the operation of infrastructure. Demand can only be understood, managed, and brought down to sustainable levels through end-user integration. The end-user chooses and operates key conversion technologies, such as appliances and vehicles, which are the intermediaries between end-user service demand and infrastructure supply, as well as a common locus of infrastructure integration (Knoeri et al., 2016)

When manufacturers fail to consider the end-user during each phase of the development process, the subsequent disconnect between the product and consumer expectations is predictable. Most current EV offerings industry-wide are technological marvels with a price tag to match. However, notwithstanding the lower operation/maintenance cost over the vehicle's life cycle, the upfront cost makes owning an EV prohibitive for many people (Penn & Chokshi, 2021). Second, the traditional energy replenishing infrastructure is a significant concern in the minds of consumers, whether their destination is across town or the country. Though the availability of public charging piles continues to scale across the nation, the lack of current alternatives and the upfront cost of fast home charging solutions significantly limit the EV as a viable option. Despite decades of reluctance, legacy automotive manufactures are revising their business models in the hope of quickly adapting to a new world where electric vehicles represent the future of automotive (Shoolman, 2019). As the U.S. and the global community move towards smart, sustainable energy transportation, it's equally important to evaluate and

communicate best business practices, including the consideration of the end-user. The adoption of electric vehicles depends significantly on understanding the consumer's perspective and highlighting best industry practices where technology and the end-user converge (Higuera-Castillo et al., 2019).

Only five of the top twenty-five global automakers by market cap are pure EV manufacturers: Tesla-1, Rivian-2, Lucid-3, NIO-11, and Xpeng-16 (Companies Market Cap, 2021). NIO Inc., both the eleventh-most valuable automotive company and the fourth most valuable pure EV company globally, pursues a unique business strategy with potentially significant implications for global EV adoption. Established in 2014 by serial entrepreneur William Li, NIO has a current market cap valuation of just under \$70.B at just seven years of company existence. NIO has several wholly and partially owned subsidiaries that function independently and support the parent brand from its business structure perspective. For example, XPT, NIO's e-propulsion platform, including Electric Drive and Energy Storage Systems, produces electric powertrains for both NIO and planned external customers, including rival Xpeng (XPT Global, 2020). Aside from commanding a sizeable portion of the premium EV market share, NIO has engineered a strategic footprint in both Europe and the United States, which happen to be the second and third largest EV markets (IEA, 2020). One of the more differentiating aspects of the NIO business model is the NIO User Enterprise. This arm of the organization is responsible for the public face of the company. It has invested substantial resources towards cultivating a loyal and dedicated user base through online and direct engagement. For example, NIO cumulative sale since its inception in 2014 is just over 145,000 vehicles total; however, the company has over 1.6M registered NIO app users to date (Zhang,

2021). The company bypasses the middleman by conducting direct sales through meticulously curated establishments named NIO houses and their smaller cousins aptly referred to as NIO spaces. NIO houses are comparable to upscale airline lounges that serve as exclusive spaces for NIO owners and their guests to relax, socialize, and engage in activities tailored to create unique user engagements (NIO, 2021). The NIO House is one cornerstone that the company employs for changing the car ownership experience.

The Competitive Advantage

A business moat is a crucial competitive advantage that sets a company apart from its competitors. In his book "Moats," Labitan (2012) quotes Charlie Munger of Berkshire Hathaway as saying, "how do you compete against a fanatic? You can only try to build the best possible moat and continuously attempt to widen it." From the onset, the goal of NIO's founder and CEO, William Lee, was to build a global brand designed to bring its users the freedom of time through its innovative solutions and to employ premium electric vehicles as the catalyst for his company's vision. Apart from having established the company as a national symbol of China's ambition to become a premium exporter, NIO, along with the government's full support, lies at the cutting-edge of innovations not observed by competitors, foreign or domestic. Put another way, NIO's moat comes from its business model, its products, services, and the matrix it uses to measure success, namely, its users.

Battery Swapping Technology

The global EV battery swapping market share is currently nascent but is projected to grow significantly by 2030 (Prescient & Strategic Intelligence, 2020). While both charging infrastructure and electric vehicle battery range continue to increase, the convenience of

popping into a service station to top off your internal combustible engine vehicle continues to be a significant hurdle to EV adoption (Fortuna, 2021). Back in 2013, the company founders anticipated this drawback and made the critical decision to develop its platform around battery swapping technology from the ground up. Fast-forward eight years, and NIO is the world's only mass-produced, highway-capable automotive manufacture where battery swapping is a standard feature across its entire fleet. Battery swapping technology is a modular powerpack exchange system for electric vehicles that operates along the same principle as traditional gas service stations. "Swappable batteries offer additional traveling options as It takes an average of three to five minutes for the swap to take place, which is on par with getting gas (Baldwin, 2020). Some of the advantages of leveraging battery swapping technology include:

- The elimination of battery degradation over time as NIO systematically analyze, service, and replace modules not adhering to established standards
- The user's flexibility to choose their battery capacity, i.e., higher capacity battery module, during long road trips
- The ability to hedge against battery technology improvement - allowing users to simply swap out their current pack for an improved one as batteries become more advance
- Automated swapping allows autopilot to maneuver the vehicle in and out of the swapping station without user interaction

Battery swapping isn't new, as other manufactures have considered similar technology. In 2013, Tesla implemented a similar feature for the Model-S. However, the company quickly abandoned the program, citing a lack of public interest (Zhang, 2015). What is new, however, is the method and scale of which NIO has employed this technology. NIO has over 613 battery

swap stations across China, with a projected 700 by the end of 2021 and 5000 both home and abroad by 2025 (NIO, 2021). Construction of the swapping units occurs off-site, and installation takes place in less than 24 hours, requiring a footprint only the size of two standard parking spots. Moreover, the company has 466 patents on battery swapping, which holds significant implications for EVs moving forward.

Battery-as-a-Service

Battery-as-a-Service (BaaS) entails leasing instead of buying the battery pack when purchasing a new NIO model, a natural extension of the company's patented battery swapping technology. Though the initial higher cost of electric vehicles continues to decline, currently, electric vehicles are significantly more expensive than their internal combustible engine counterparts, and the battery pack accounts for a large part of this expense. By decoupling the battery from the vehicle, NIO, through its partnership with other vendors, significantly reduces the total cost of its vehicles (Levin, 2021). Battery-as-a-Service users can buy an NIO vehicle without the battery and enjoy more than \$10,000 off any model, which is a considerable amount. Still, when combined with an EV rebate, it places the top-tier brand in the reach of consumers of whom the brand would be otherwise price prohibited.

Moreover, the user chooses the best battery option based on their requirements and can move between plans as necessity dictates. Best of all, users gain peace of mind by eliminating costs associated with battery degradation over time, thus improving resale value when the time comes to upgrade. The value for NIO in offering this service includes increased vehicle sales and additional streams of revenue; however, a not so obvious advantage is that it

entices respective buyers into NIO's growing ecosystem aimed at creating value by cultivating long-term relationships.

NIO Power

A popular opinion amongst many analysts, influencers, and EV enthusiasts is that NIO's battery swapping technology represents a single point of failure in energy distribution (Ulrich, 2021). Put another way, they incorrectly believe that the company has placed all bets on a niche platform potentially only applicable in the Chinese market. While NIO continues to invest heavily in the infrastructure and R&D of battery swap technology, it represents just one pillar of its broader strategy. NIO Power, a mobile internet-based power distribution solution, encompasses the company's extensive network of battery charging platforms and swapping facilities. "Enhanced by Power Cloud, it offers a power service system with chargeable, swappable, and upgradable batteries to provide users with power services catering to all scenarios" (NIO, 2021). Unlike many of its global and domestic competitors, betting on existing and future charging infrastructure development, NIO's charging platform grew in tandem with the company from the ground up. The resulting product is a robust power solution tailored around the user's experience. Currently, six native charging services combine to effectively elevate both the real and perceived frictions of owning an electric vehicle.

Power Home 2.0 (7kW) - a powerful yet compact home charging solution that fully replenishes a 70/100 kWh battery in 7/10 hours

Power Home Plus (20kW) is a three times faster high-speed home charging solution designed for interior and exterior applications. The home plus fully replenishes a 70/100 kWh battery in 2.5/3.5 hours

Power Swap - a key differentiator for NIO enabled by technology that allows users to complete a one-click, self-service battery swap via the NIO app while remaining in their vehicle (Shahan, 2021)

Power Charger - 180kW and 250A charging piles that provide fast and reliable charging for NIO and non-NIO vehicles in the public sphere and support both plug-and-charge and scan-and-charge payment processing for speed and efficiency

Power Mobile - a convenient app-based, one-click service that dispatches a mobile power van to come and charge your vehicle on the spot. It's the equivalent of a portable power bank for your vehicle

Power Cloud - at the center of the NIO power platform lies the power cloud and map service that synchronizes and leverages NIO's growing infrastructure for the convenience and safety of its users

NIO Life

NIO describes NIO Life as "food, music, exploration, being together, living well, learning, the places you go, how you dress, and the joy you feel, in short, the experiences in shaping a joyful life (NIO, 2021). With the advent of NIO Life, the company effectively blurs the line between manufacturing smart EVs and being a full-blown lifestyle brand, which none of the other industry participants are remotely doing. Like other aspects of the company's business model (or master plan, if you will), NIO is deliberately pushing the boundaries of what a company can, is, or should be. With millions of products sold annually through its online presence, the outside world is quickly waking up to the Chinese electric vehicle maker's popularity and broad appeal beyond the vehicles it produces. NIO is as much an eCommerce

platform as it is an automotive company, a technology company, and a lifestyle brand with the stated mission of shaping joyful lives. In the description for its consumable products, NIO lists the principles for its food development as follows; safe Ingredients, traceability, over 400 quality control points, and no extra additives. Suffice to say, this represents a standard second to none. At first glance, it might be tempting to conclude that the company is a jack of all trades but the king of nothing, as the saying goes—however, the company's penchant for delivering quality products and service states otherwise. Moreover, the revenue for the different facets of the business model continues to grow year-over-year (YoY), which both institutional and retail investors tend to rally around (Macrotrends, 2021).

Navigate On Pilot

Navigate on Pilot (NOP) is NIO's advanced driver-assistance system, frequently referred to as autonomous driving. Introduced in 2020 through an OS update, the system offers, among other features, automatic navigation on both highways and ramps, smart lane switching, and vehicle overtake based on road conditions. Currently, NIO is one of only three companies within the broader EV space that offers this feature. The arrival of NIO-OS update 2.10.0 now allows vehicles to maneuver into NIO's 2.0 battery swap stations automatically. The Navigate on Pilot system is constantly evolving. Updates occur automatically via the Firmware Over the Air protocol, ensuring that all NIO vehicles operate with the latest software push. The Navigate on Pilot system in the company's first sedan with scheduled deliveries starting in Q1 2021 will boast 33 high-performance sensing units, including eleven 8-megapixel and LiDAR with 500 meters detection range and 1,016 tera ops of computing power.

While other EV manufactures are closing in on adding similar features to their driver assistance stacks, respectively, NIO and perhaps Tesla is several years ahead of the rest of the field. In May of 2021, the company announced a cumulative 1.2B miles driven, achieved in just three years with a fleet of under 100,000 vehicles. Having expanded the fleet beyond 100,000 units on April 7, 2021, it's safe to say that this figure is accelerating rapidly. Moreover, its dedication to continuous improvement means that it's a competitive moat that's not likely to be circumvented for several years to come.

Artificial Intelligence

Cathie Woods of Ark Invest list five innovations that her team believes represent a multi-trillion-dollar platform. These include blockchain technology, energy storage, artificial intelligence or AI, robotics, and DNA sequencing, or BEARD for short (Ark Invest, 2021). Of the five technologies, NIO and its subsidiaries directly engage in three platforms, including Energy storage, robotics, and our current topic, artificial intelligence. When you think of AI, the automotive industry isn't likely the first thought that comes to mind. However, in this age of new energy vehicles, the automotive industry is being forced into a new era of smart vehicle technology by a few disruptive startups, and NIO is at the cutting edge of the transformation (Shoolman, 2019).

Artificial intelligence refers to the simulation of human intelligence in machines programmed to think like humans and mimic their actions. The term may also apply to any machine that exhibits traits associated with a human mind, such as learning and problem-solving (Burns et al., 2021).

The collaboration between NIO and a growing list of partners such as NVIDIA with its Orin technology and Intel Mobileye with the Eye-Q stack is rapidly accelerating the application and capability of AI across the broader autonomous space. Making the widespread adoption of smart, performance-packed electric vehicles a reality is a priority at NIO. Its in-house developed autonomous driving algorithms are a direct result of leveraging AI. In March of 2021, NIO was awarded the Artificial Intelligence Excellence award for its in-vehicle artificial intelligence assistance aptly named NOMI, which learns the user behavior and builds an experience based on human sensory (Business Intelligence Group, 2021). NIO's upcoming release of its first sedan in Q1 of 2022, dubbed the ET7, is widely considered a potential game-changer given that it will feature the world's highest-performance AV and robotics processor.

Infrastructure

Upon learning that NIO outsources the assembly of its vehicles, many analysts conclude that such a model presents added risk as it stands in contrast to how other industry participants operate. The notion is that the company can't directly control quality and price by not owning its facilities, i.e., infrastructure. However, both assumptions and the idea that NIO doesn't operate its production lines are inaccurate. While the company does have a multi-year contractual agreement with Jianghual Automobile Company (JAC) motors to assemble its current lineup of vehicles, NIO's production managers are physically embedded in JAC's facilities throughout the day-to-day assembly process. Moreover, the production capacity, which has doubled over the last year to 240K units annually, is specifically reserved for production of NIO vehicles.

NIO is also a significant partner in the Industrial Park currently under construction in the capital of Anhui province, which reportedly has an annual capacity of one million EVs and 100 GWh battery output across a seven square mile complex. "The industrial park will cover the entire value chain for intelligent electric vehicles, from software development for autonomous driving, innovative technologies for complete vehicles, batteries, and the construction of the vehicles themselves" (Randall, 2021). Between the NIO-JAC partnership and the Anhui province Industrial-Park, this alone represents a tremendous infrastructure and capacity for EV production. However, when you consider NIO's full complement of assets, to include:

- XPT Engine production (wholly owned subsidiary)
- 613 battery swap stations (2.7 per day)
- 465 Power Chargers (2,704 piles)
- 574 Destination charging stations (3,170 piles)
- The cooperative charging network (420,000 +)
- 29 NIO Houses
- 337 NIO spaces covering 121 cities

It makes a convincing argument that NIO has a robust infrastructure, and its projected capacity starting the second half of 2022 is expected to be broadly unmatched.

Partnerships

Businesses have been working together for mutual benefits since the days of the first establishments. When two or more establishments combine forces to expand their brand's reach, it results in a strategic partnership. From an investor's perspective, it helps gauge a company's ability to build alliances to execute its business plan. Since NIO pursues a strategy

more closely related to a technology company like Apple rather than a traditional manufacturer, striking the right balance in its partnerships is key to its continued success. Whereas NIO is close hold when it comes to the underlying technology, design language, product function, and user interface, the company prefers to rely on skilled and experienced practitioners to combine these elements into a finished creation. Some of NIO's more notable partnerships include:

Jianghuai Automobile Group – A state-owned manufacturing cooperation that currently assembles all NIO vehicles under the company's close supervision

Mobileye – an Israeli autonomous technology developer – who plan to use NIO vehicles in their Robo-taxi fleet

Hefei Government – Who financially support NIO in exchange to develop an electric vehicle industrial park within the providence, and aptly named NEO Park

Sinopec – A traditional fossil fuel energy giant looking to convert hundreds of prime located petroleum service stations to an EV corridor

Ford Motor Company – Who seek to use NIO's charging infrastructure

Nvidia - A graphic technology company that aims to develop the next generation of automated vehicles

Conclusion

While NIO has yet to turn a profit, fundamentally, the company stands out for its growing market position in an exceedingly competitive electric vehicle industry. By focusing on the user experience through the lens of R&D, technology, design, and lifestyle, NIO continuously expands its market share and influences industry norms and standards with its

innovations. NIO has a much stronger brand than other EV startups and well-established legacy manufacturers moving into the EV space compared to the competition. The company's unique approach towards manufacturing, power delivery, and brand building initially met with skepticism; however, there's little argument about the success over its short existence. While the automotive industry is notoriously difficult to navigate, NIO's leadership excels at leveraging its available assets to solve complex problems. Arguably, both its partnerships and its loyal and expanding user base are amongst the company's most valuable assets. The company targets a more lucrative sector of the EV market and has worked hard to build a differentiated product and secure a loyal customer base. As with any business venture, there's always risk involved, and this is especially true when the industry is undergoing rapid change resulting from disruptive technologies. NIO, like other EV industry participants, is susceptible to this risk. Given that the current global EV market is less than 100M units annually, not every EV manufacturer will achieve global scale. Add to this a crowded space with both new startups and traditional OEMs, a shortage of human capital, supply chain restraints, geopolitical fallout, and historically low vehicle margins, and one begins to question the wisdom of entering this market space. The automotive industry is at a catalyst. Over the next 10 to 15 years, it will undergo a generational transformation, where only the best-positioned companies will reap the benefits of this change. NIO is poised for success in this space as the company has a proven track record of growth and innovation with its:

- Battery swapping technology
- Advanced Driver Assistance System
- Autonomous driving

- Autonomous Driving-as-a-Service
- Battery as a Service
- Expansion into international markets

While not every company will achieve a similar scale as Tesla, NIO remains positioned to be successful in this space, representing a significant opportunity for the EV industry, China, and the global push towards electric and autonomous vehicles.

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