CHRISTENSEN INSTITUTE

TATA CONSULTANCY SERVICES

DRIVING DISRUPTION:

Catching the Next Wave of Growth in Electric Vehicles

BY CHANDRASEKAR IYER, VISITING RESEARCH FELLOW
AT THE CLAYTON CHRISTENSEN INSTITUTE FROM TATA CONSULTANCY SERVICES

NOVEMBER 2018

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The automotive industry is undergoing a revolution. With over one billion cars on the road, the automobile has ingrained itself into cultures across the globe. As cars continue to become more ubiquitous, growing concern about their environmental impact is triggering a string of increasingly stringent regulations to improve fuel economy and emission standards.

In response, automakers are embracing a number of measures. One of these strategies—electrification—has rightly generated a lot of buzz. Over the coming years, automakers are expected to invest at least $90 billion USD in order to electrify their lineups. Such a move may help them stay ahead of regulation, but with the entire industry undergoing this shift, where are the most promising opportunities for growth, and what will it take to be competitive in the long run?

Although many may assume that flashy, high-end options such as the Tesla Model S will blaze the path for electric vehicles (EVs), the Theory of Disruptive Innovation indicates a far less assuming frontrunner: low-speed electric vehicles (LSEVs). Their shortcomings—low top speed and limited driving range—are actually hallmarks of disruption and, like all Disruptive Innovations, they compete on new measures of performance such as simplicity, convenience, and affordability that appeal to nontraditional consumers.

LSEVs have found particular success in China, where they are primarily targeting nonconsumers—customers who cannot afford a more traditional car, and are therefore happy to embrace a low-end alternative. A careful assessment of LSEV makers' business model, deployment of technology, and competitive landscape underscores their disruptive potential.

LSEV manufacturers have positioned themselves within a coherent network of suppliers and are targeting the low end of the market with a small-scale, low-cost business model. In doing so, they are well placed to earn profits at low price points, while also having the opportunity to make improvements as they obtain customer feedback and explore new practices.

For LSEVs to be disruptive, they'll eventually need to migrate towards higher-performance, higher profit-margin tiers of the market. Improvements in manufacturing processes, battery, and motor technologies should enable this upmarket march. However, continual innovation will be vital in order to preserve their cost advantage as they aim to appeal to more demanding customers.

Incumbent automakers in China appear to be largely uninterested in competing head-on with LSEVs and show no signs of changing their tune. So long as they remain focused on their traditional customers, LSEV makers' predominant competition will be nonconsumption.

While LSEVs may not pose an immediate threat to mainstream automakers given their initial focus on the low end of the market, their early moves indicate that they soon will—in China and beyond. To that end, both incumbents and new entrant automakers should not dismiss the disruptive potential of LSEVs, but rather chart their own disruptive paths accordingly. By launching their own low-end EVs in China and selectively exploring other emerging markets, forward-thinking automakers stand to not only stay a step ahead of regulation, but also avoid sowing the seeds for their own disruption while capturing the next wave of growth.

INTRODUCTION

Innovative technologies often play a defining role as societies and cultures evolve, and the automobile is no exception. Its global proliferation over the past century has spurred the development of roads and highways, redefined the suburban landscape, and enabled travel to and from places otherwise out of reach. With more than one billion cars and trucks on the road worldwide,[1] it's clear that automobiles have become a staple in many people's lives, providing the convenience and flexibility to run a quick errand to the grocery store, commute across town to work, or hit the road for a long-distance trip.

These benefits, however, are entangled with their own set of problems. Growing concern about the environment and reliance on fossil fuels has prompted governments across the globe to steadily work towards a decarbonized economy. Ten governments, including the European Union, India, China, and the U.S., have established fuel economy or greenhouse gas emission standards for light-duty vehicles.[2] Taking it one step further, some of these governments, including France and Britain, are planning to ban traditional internal combustion engine cars powered by gasoline or diesel in the coming decades.[3]

With increasingly stringent regulations—and the fact that these 10 markets are among the top 15 vehicle markets worldwide[4]—automakers are doubling down on a number of measures, such as embracing lighter materials.[5] However, partly spurred by the reduction in lithium-ion battery pack prices, one of the more high-profile strategies is a renewed focus on electrification.[6] Automakers are offering a range of electrified powertrains, yet battery electric vehicles, referred to as EVs in this paper,[7] and plug-in hybrid electric vehicles are generating the most buzz, since both are less polluting than their gasoline counterparts when electricity is sourced from clean energy sources.[8] Over the coming years, global automakers are expected to invest at least $90 billion USD in order to electrify their offerings.[9]

With automakers and startups racing to win in EVs, where are the most promising opportunities for growth, and how can companies position themselves to capture it and stay competitive in the long run? The Theory of Disruptive Innovation offers a lens to help clearly view the road ahead amid the fog of hype and conjecture.

DISRUPTIVE INNOVATION: A PRIMER

In every market there are consumers who demand and utilize different levels of performance of a given product or service. At the high end are the market's most demanding and most profitable consumers, who are willing to pay more for the industry's very best. At the low end are the market's least demanding and least profitable consumers. For one reason or another, be it cost, limited access, or lack of expertise, they are willing to settle for solutions that are "good enough."

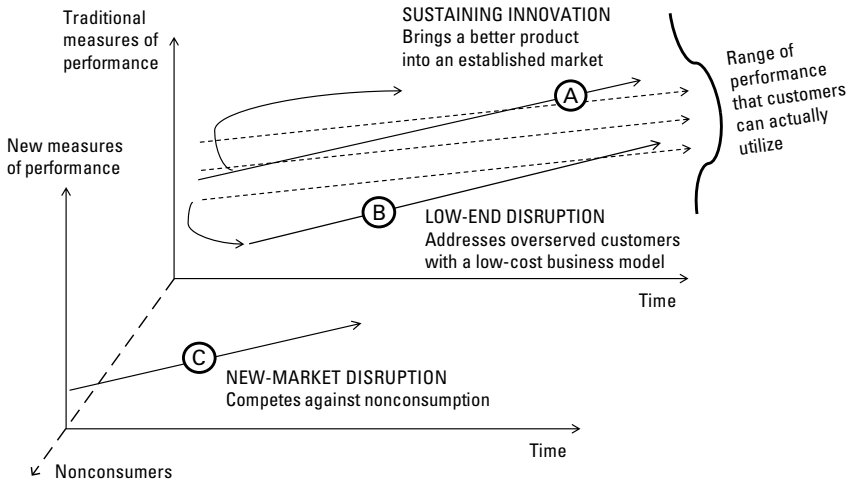
In pursuit of higher profitability, many companies focus on higher-end consumers. They appeal to this group primarily by offering *sustaining innovations*–incremental or breakthrough improvements upon existing solutions, depicted by line A in *Figure 1*. In a nutshell, sustaining innovations make good products better. By their very nature, sustaining innovations preserve and enhance a company's existing business model. In the automotive industry, innovations that make the cars faster, safer, or more luxurious are considered sustaining. Established companies almost always win the battles of sustaining innovations. Because this strategy entails making a better product that can be sold for higher profit margins, industry leaders have powerful motivations to fight sustaining battles—and they have the resources to win.

Sustaining innovations certainly advance an industry. But, in addition to ultimately driving prices higher, they also tend to overshoot the ability of certain consumers to utilize them, creating the space for new companies to enter the market with disruptive alternatives. Unlike sustaining innovations, *Disruptive Innovations* make products and services more accessible and more affordable, thereby making them available to a larger population. Disruption comes in two flavors: low-end and new-market. As the name suggests, low-end disruptions, depicted by line B, establish a foothold among consumers at the low end of the market—consumers who are often overserved by the offerings of established companies, and are willing to accept lower performance for a lower price. Alternatively, new-market disruptions, depicted by line C, target nonconsumers—people who previously could not afford, or who lacked access to, traditional solutions. Notably, new-market disruptions compete on entirely different measures of performance than traditional offerings.

Unlike sustaining innovations, Disruptive Innovations make products and services more accessible and more affordable, thereby making them available to a larger population.

Because they target a market's least profitable consumers with more affordable and accessible products and services, entrants launching Disruptive Innovations typically avoid head-on competition with industry incumbents, who are motivated to cater to the higher-profit tiers of the market. Over time, however, the low-end offerings improve and relentlessly climb upmarket into the tiers served by established leaders. Eventually they gain mainstream adoption—often at a lower price point—resulting in disruption.

Figure 1. Disruptive Innovation



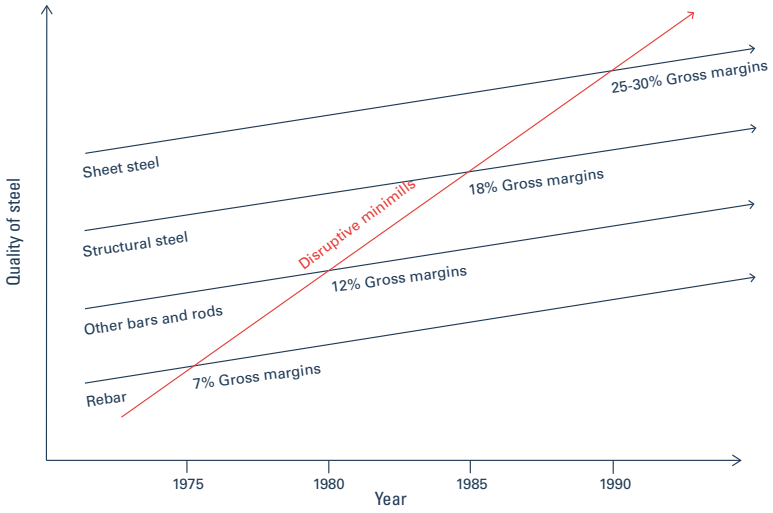
Disruptive Innovations have a record of transforming entire industries and bankrupting some of the world's most successful and established corporations. To illustrate, consider the trajectory of the United States' steel industry in the late 20th century. Traditionally, most steel came from large, integrated steel mills that react iron ore, coke, and limestone in massive blast furnaces. These integrated mills cost billions of dollars to build. Then, in the mid-1960s, minimills became technologically viable.[10] Unlike integrated steel mills, minimills melted scrap steel in electric arc furnaces. Minimills were dramatically cheaper to build, and reduced the cost of making steel by 20%.

But when minimills first showed up on the scene, they had one big problem: because they melted scrap of uncertain and varying chemistry, the steel they produced was of poor quality. Initially, the only market that would buy their steel was the concrete reinforcing bar (rebar) market. The product specifications for rebar were low and loose. The profit margins in the rebar market were also low, and it represented a small percentage of the total market for steel products. As a result, when minimills came along, the dominant integrated mills were not upset to lose their rebar customers. In serving their least profitable customers, minimills posed little threat to integrated steel mills.

Yet minimills were powerfully motivated to move upmarket. Whenever their profit margins declined due to competition with other equally low-cost minimills, they looked for opportunities to move upmarket. Over time, the minimill technology improved. Subsequently, minimills were able to expand into producing angle iron and thicker bars and rods (see *Figure 2*). This was not just a bigger market, it was a better market—it offered nearly twice the profit margins of rebar. But for integrated mills, the bar and rod market had become the least desirable tier of their products. As a result, the integrated mill managers were not overly disappointed to lose angle iron customers. In fact, leaving their lowest-margin products behind, yet again, increased the profitability of the integrated mills.

Minimills resolutely continued to expand their offerings. Finally, in the 1990s, they entered the most profitable segment of the steel industry: sheet steel. These companies continue to dominate the steel market to this day, and many of the integrated players have been driven to bankruptcy.[11]

Figure 2. Minimills' Ascent



This history of the steel industry demonstrates that motivated entrants that offer low-end products at the outset should not be ignored, even by the most formidable industry leaders. Integrated steel mills were competently managed, and each of their decisions to abandon less profitable markets and focus on more valuable customers was rational and defensible at the time. Their conventional approach, however, failed in the context of Disruptive Innovation.

THE GLOBAL EV MARKET MAY BE IMPRESSIVE, BUT IT'S NOT DISRUPTIVE

For many, discussions of EVs center around one company: Tesla, Inc. Less than two decades old, Tesla has developed a cult following of enthusiasts who value luxury and a small carbon footprint. Could "the world's most important car company" disrupt traditional passenger vehicles?[12]

Tesla's founders wanted to prove that people didn't need to strike a trade-off to drive electric—that electric vehicles can be better, quicker, and more fun to drive than gasoline cars.[13] Consequently, Tesla has produced its high-end cars with an impressive range of up to 335 miles,[14] introduced a number of high-tech luxury features, and included mind-boggling acceleration.[15]

Naturally, these features come at a price. The Tesla Model S and Model X cost upwards of $70,000 USD prior to tax incentives.[16] Clearly, they are not targeted at the low end of the automotive market. Instead, they are aggressively targeted at the most high-end, demanding tiers of the automotive market. Hence, as explained by the Theory of Disruptive Innovation, Tesla is not disruptive, but sustaining, to traditional passenger vehicles.

Not all EVs, of course, are as high-end as the Model S. What about less expensive options such as the Tesla Model 3, Chevrolet Bolt, or Nissan LEAF? Are they disruptive? In short, no. These cars, while more affordable than the Model S, are still not targeted at the low end of the passenger vehicle market, costing more than $29,000 USD prior to tax incentives.[17] Given that the average selling price for new vehicles in the U.S. (the second largest automotive market) was roughly $34,700 USD in 2017, these EVs are decidedly targeted at mainstream car buyers.[18]

Furthermore, these EV manufacturers seem to be engaged in an arms race to increase battery range—an improvement definitively sustaining in nature.[19] In addition to other sustaining innovations such as better car design and driver assistance technologies, effort to address "range anxiety" is clearly an attempt to move upmarket and cater to more demanding customers.

This approach is understandable. Automakers are aiming to make their EVs as good as their conventional gasoline or diesel counterparts because sustaining innovations preserve and reinforce a company's existing business model. In the case of EVs, traditional automakers can leverage existing dealerships and target existing customers, who are the lifeblood of any company.[20] With deeply entrenched resources, processes, and priorities, it's easier to deploy a sustaining innovation that allows them to make money in the way they have been structured to make money.

Automakers are aiming to make their EVs as good as their gasoline counterparts because sustaining innovations preserve and reinforce a company's existing business model.

To be clear, sustaining innovations play an important role in the progression of an industry. However, if automakers continue exclusively down this path, they will struggle to move beyond a zero-sum battle—the fight for market share in an existing market instead of growing the pie. A new growth engine can be created only by addressing nonconsumption or unleashing low-end disruption. To that end, we see glimmers of potentially disruptive opportunities in the form of low-speed electric vehicles.

AN INTRODUCTION TO LSEVS

Technology is almost always impartial. It's like a piece of clay. It is the potter who shapes it into the desired form. Likewise, technology can be molded by businesses into sustaining *or* Disruptive Innovations. With mainstream automakers shaping the electric powertrain as a sustaining innovation, would it be wise to discard it as a potentially disruptive technology? We would respond with a resounding *no.*

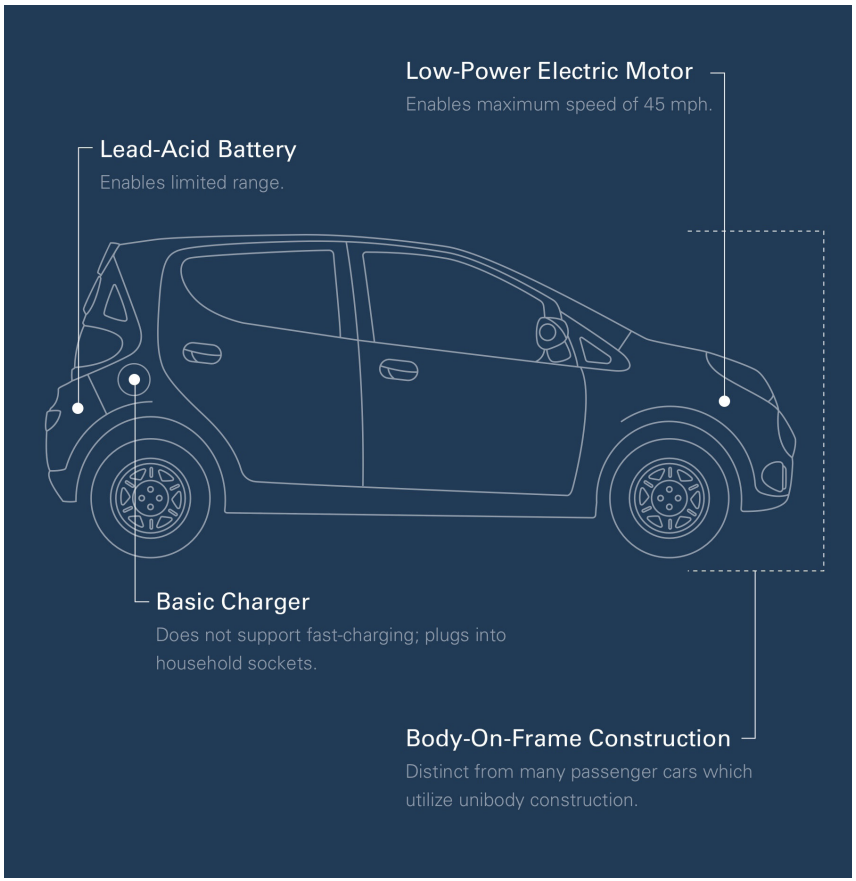
When electric vehicle technology is launched in simpler, less demanding applications—and critically, under the right conditions—it has incredible potential to create new markets by enabling an entirely new set of consumers, who earlier could not afford a car, to own and use one. Furthermore, the electric vehicle technology could be a boon for consumers who are overserved by the bells and whistles of existing passenger vehicles.

Within the space of electrified transportation, these simpler applications generally come in the form of two-wheelers and four-wheeled low-speed electric vehicles (LSEVs). LSEVs can resemble anything from souped-up golf carts to road-ready mini electric cars. As the name indicates, LSEVs typically offer limited top speed—most models top out around 45 mph—and have a limited driving range.[21] Yet, what might appear to be deficiencies are actually hallmarks of disruption. Like all Disruptive Innovations, LSEVs compete on new measures of performance that appeal to nontraditional consumers. So what they lack in speed and range, they make up for in simplicity, convenience, and, typically, a lower sticker price than traditional passenger vehicles.

For instance, with a small battery that can be easily charged overnight in commonly available power outlets, and fewer moving parts than their conventional fuel counterparts, LSEVs are expected to be easier and cheaper to operate and maintain, thereby reducing the total cost of ownership. Because of their compact size, they offer improved maneuverability and hassle-free parking in congested urban centers and on small roads common to places such as college campuses, corporate complexes, resorts, retirement communities, gated neighborhoods, and many rural areas around the world.

LSEVs are taking root in pockets around the world. However, the clearest evidence of their disruptive potential can be seen in one country: China.

Figure 3. An Example of an LSEV



CHINA'S DARK HORSE: LSEVS ON THE RISE

The production of LSEVs commenced in China in 2007,[22] with early models used on farm tracks, carrying people and their loads over short distances.[23] As we might expect, incumbents were not too keen to serve this market. In fact, nontraditional automakers such as Shifeng Group, which is one of the leading players in the Chinese machinery industry that includes agricultural vehicles, and Kandi Technologies, which has its roots in off-road vehicles, are some of the key players in this market.[24] Currently, Shifeng Group is one of the leading companies in the Chinese LSEV market.[25]

Entrants in China are competing against nonconsumption, meaning that they simply have to make cars that are better than no car at all.

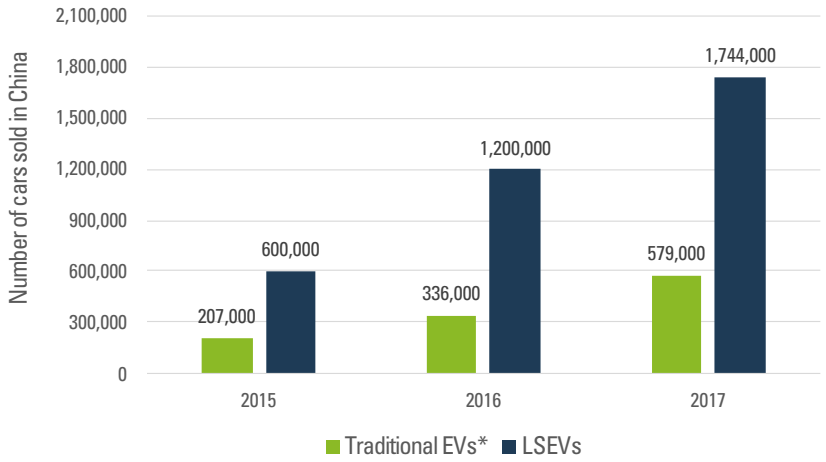
Unlike mainstream automakers that were aiming to make their EVs as good as their conventional fuel counterparts in order to appeal to their existing consumers, entrants in China chose to compete against nonconsumption, meaning that they simply had to make cars that were *better than no car at all*. Given that the per capita annual income of rural households in 2009 was 5153 ¥ ($790 USD),[26] rural customers were more than happy to embrace a vehicle that was inferior to conventional passenger vehicles—after all, an LSEV was infinitely better than no car at all.

Thanks in part to little or no regulation for LSEVs, when compared to that of traditional passenger vehicles, LSEV manufacturers have benefited from being able to roll out models that do not require a driving license or insurance, and offer little to no safety features. In addition, models have not needed to meet a minimum quality threshold, which has resulted in many LSEVs using low-cost, lead-acid batteries that have adverse effects on the environment.[27] These factors have partly contributed to the low cost of LSEVs.

During the decade that LSEVs have been available in China, sales have soared. According to the International Energy Agency's *Global EV Outlook 2017* report, between 1.2 million and 1.5 million units were sold in China in 2016.[28] These numbers are especially impressive given that the central government has provided subsidies for, and prioritized the growth of, traditional battery and plug-in hybrid EVs.[29] However, the sales of traditional EVs wane in comparison to those of LSEVs. For instance, in 2016, only 336,000 battery and plug-in hybrid electric cars were sold in China. In fact, in 2016, the LSEV sales in China overshadowed the battery and plug-in hybrid

electric cars sold globally—approximately 750,000.[30] Lastly, in 2017, the total number of LSEVs on the road in China, estimated at four million units, exceeded the total number of battery and plug-in hybrid electric passenger cars on the road globally—3.1 million.[31]

Figure 4. LSEV Growth in China



Source: IEA Global EV Outlook 2016, 2017, 2018, and China Low-speed Electric Vehicle Industry Report, 2018-2022
*In this case EVs refer to battery electric vehicles and plug-in hybrid electric vehicles

China's LSEVs through the Lens of Disruption

But do LSEVs in China hold the potential to disrupt conventional passenger vehicles—gasoline or electric? To gauge their disruptive potential, let's assess how well they align with the fundamental tenets of Disruption Theory.

The innovation is not as good as existing offerings

LSEVs categorically underperform on traditional measures of performance associated with passenger vehicles, such as acceleration, top speed, and style. LSEVs offer modest acceleration, limited top speed, and unassuming looks. Furthermore, they fail to meet some of the most basic standards that consumers associate with traditional cars—LSEVs cannot travel on highways and have a limited driving range.[32]

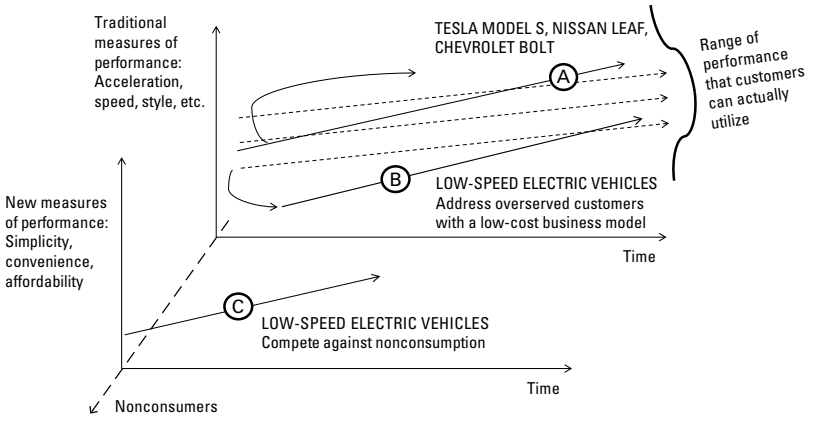
The innovation targets nonconsumption or overserved consumers

LSEV manufacturers forged their business model at the low end of the Chinese automotive market. Prior to the advent of the LSEV market, many people in rural China traveled via a variety of vehicles like bikes, motorcycles, and even three-wheel farm vehicles.[33] This is because conventional four-wheel vehicles were far beyond their financial reach. By targeting these low-income consumers, LSEV makers didn't have to compete head-to-head with leading automakers; they only had to compete against nonconsumption.

The innovation is simpler to use, more convenient, and more affordable

With the cheapest models available for as little as $2,000 USD, LSEVs are certainly more affordable than traditional passenger vehicles.[34] Furthermore, LSEVs are conformable to the way rural consumers live their lives: LSEVs can be easily driven on small roads, parked in small spaces, and usually charged using household power outlets.

Figure 5. LSEV's Disruptive Trajectory



Incumbents are motivated to ignore the innovation

Incumbent automakers in China—which include state-owned automakers such as FAW Group Corp. and SAIC Motor Corp., private automakers such as BYD and Geely, and their joint ventures with global automakers such as GM, Volkswagen, and Toyota—have not made any noticeable moves to compete head-on with LSEV manufacturers with similar low-end offerings, and they do not seem, by and large, interested in changing their tune.

For instance, in 2012, an executive at Changan Automobile Group, one of the leading automakers in China, expressed his opinion about LSEVs: "These cars are illegal, unsafe, and shouldn't be on the road."[35] Many state-owned automakers are wary of distracting their attention from their joint ventures that produce conventional fuel vehicles, which are still in high demand.[36] This is understandable—in pursuit of profit maximization, incumbents are generally upwardly mobile and downwardly immobile.

> In pursuit of profit maximization, incumbents are generally upwardly mobile and downwardly immobile.

The innovation operates within a coherent value network

A value network encompasses the suppliers, manufacturers, dealerships, and other partners that are critical to bring a product or service to life. Value network alignment is needed so that all partners are equally motivated to succeed in the marketplace. For this to happen, each entity in the network needs to grow as the product prospers. A coherent value network is one of the prerequisites for Disruptive Innovation.

In 2015, there were more than 100 LSEV manufacturers in China, and the annual production capability for LSEVs reached about two million units in 2014.[37] However, they do not exist in a vacuum. The supply infrastructure for LSEVs is also becoming more robust. From metal stamping to electric heating/air-conditioning systems to electric power brake systems, suppliers have emerged to serve the LSEV market.[38]

The innovation contains an enabling technology

Improvements in the manufacturing processes, battery, and motor technologies can enable LSEV makers to migrate towards higher-performance, higher-profit margin tiers of the automotive market.

Since LSEV makers are not bound to the well-oiled manufacturing processes of incumbents, they are free to experiment with manufacturing processes. For instance, the majority of passenger cars conform to a unibody construction with body-on-frame design largely limited to SUVs and pickups.[39] In contrast, many LSEV makers are leveraging body-on-frame design—basing LSEVs on a welded steel frame with a stamped steel body on top. Notably, bodies are stamped using low-cost, low-volume stamping dies.[40] As the manufacturing processes improve, LSEV manufacturers should be able to produce safer cars that can cater to more demanding requirements such as higher acceleration and speed.

Similarly, innovation in batteries and electric motors should allow LSEV manufacturers to improve their offerings. Currently, the average LSEV in China is powered by a lead-acid battery and features basic motor technology.[41] Shifting to a lithium-ion battery, or another high-density energy storage mechanism, should enable LSEVs to cater to more demanding requirements such as driving longer distances on a single charge. Also, migrating to higher-power motors should allow LSEVs to handle more demanding payloads and towing requirements.

The technology is paired with an innovative business model

Let's look at some key ingredients of LSEV manufacturers' business model.

Small-scale operations

Generally, small markets do not quench the thirst for revenue and profit margins of established players, who are motivated to build bigger factories that crank out a large number of cars. Demonstrative of the scale of their operations, a typical automotive plant in the U.S. requires up to $2 billion USD in capital investments.[42] On the other hand, LSEV manufacturers are unencumbered by the existing metrics of production and market size that govern the traditional automotive industry, and are not holding back from starting small. A 2012 Reuters article reported that Shifeng Group's 480 million ¥ ($73 million USD) assembly plant had a capacity of just 100,000 cars, and in 2011 delivered approximately 30,000 cars to its dealerships.[43] By starting small, these entrants have given themselves the flexibility to make changes to their vehicles and business models as they obtain customer feedback and explore new practices, while simultaneously unlocking a business model that enables them to make money at low price points.

Low-cost manufacturing practices

Manufacturing practices such as those discussed earlier, combined with the lack of safety and quality thresholds, are enabling LSEV manufacturers in China to drive down costs. As Charlie Paglee, CEO of Brannan Auto, put it in 2014, "An entire stamped steel body for an electric vehicle can now be tooled up for less than $1 million USD, which is incredibly cheap and unheard of in the automobile industry outside China."[44]

Despite low selling prices, the industry has proven profitable according to a 2016 report.[45] If sustained, this will continue to provide the much-needed capital for motivated LSEV makers, allowing for investments in research and development, and upgradation of their manufacturing processes and technologies in order to move upmarket. However, preserving the cost advantage, while attempting to move upmarket, is a delicate balancing act. Further sustainability hinges on two conditions:

1. LSEV manufacturers are able to make improvements to manufacturing processes and scale their production while preserving their cost advantage. In addition to increasing the volume of production, building cars that appeal to more demanding customers will inevitably increase their cost structure. LSEV manufacturers will need to continue innovating in order to find cost-effective ways to improve their offerings.
2. LSEV manufacturers are able to improve their battery and motor technologies while preserving their cost advantage. The transition to lithium-ion batteries or other storage mechanisms with a higher energy density, and the shift to more powerful motors, will inevitably increase the vehicle cost. If they manage to successfully incorporate such innovations into their vehicles while maintaining their cost advantage, they should continue to be profitable as they march upmarket.

A Promising Start

In just a decade, what was once a niche product is now well on its way to becoming commonplace in rural Chinese communities.[46] In Shandong province, often regarded as the pilot province of LSEVs, more than 600,000 units were sold in 2016 according to the International Energy Agency's *Global EV Outlook 2017* report. To fully appreciate that magnitude, consider that fewer than 160,000 battery and plug-in hybrid electric vehicles were sold in the U.S. during the same year.[47]

Undoubtedly, the growth potential for LSEVs in China is immense—over half a billion Chinese lived in rural areas in 2016.[48] Yet opportunity for growth extends beyond such pockets. LSEVs are rapidly expanding into new markets and gaining traction in larger cities such as Beijing and Shanghai.[49]

As LSEVs steadily ingrain themselves into the Chinese landscape, manufacturers are building upon their early success by making gradual improvements to their models. High-end models are no longer competing with motorcycles; they are now competing with low-end versions of traditional EVs. While LSEVs may not achieve mainstream adoption until they meet certain safety and quality thresholds, one thing is clear: LSEVs are off to a promising start.

IMPLICATIONS AND RECOMMENDATIONS

LSEVs in China are decidedly on a disruptive trajectory. By primarily providing low-end, low-cost options to nonconsumers, LSEVs have established a solid foothold to conceivably work their way up China's passenger vehicle market. But, is China the foothold for a much more expansive disruption across developing markets, and eventually into developed markets? Alternatively, could LSEVs take root elsewhere? What does this mean for automakers globally?

In short, automakers that dismiss the disruptive potential of LSEVs risk being left in the dust. By engaging in sustaining innovations, traditional automakers may feel a false sense of security that they are indeed leveraging electric powertrain technology to capture growth and protect their business from disruptive entrants. However, by failing to reimagine their business models and launch the electric powertrain technology in low-end applications, they are effectively taking a back seat while others redefine the automotive industry.

Given the disruptive trajectory of LSEVs, how can incumbent automakers capitalize on this opportunity and ensure that they remain competitive in the long run? Alternatively, how can entrants maximize their odds of succeeding in the electric vehicle market?

Incumbent automakers and entrants racing to win in EVs should not shy away from targeting nonconsumers with low-end offerings. As discussed earlier, these consumers will happily embrace low-end models since they are infinitely better than their only other alternative—no car at all. Given that there are nonconsumers across the globe, the question is: where should automakers get their start?

1. Target nonconsumption in China

Though the rules of the game are already being defined by existing LSEV players, there is still room for growth in China. Foreign automakers may also benefit from an impending change in regulation. In the past, they have had to partner with Chinese enterprises in order to conduct business in China; however, the government plans to lift foreign ownership restrictions for electric vehicle manufacturers in 2018.[50]

Learning from Minimills: Play the Long Game

Although LSEVs in China may currently be targeted at the consumers that traditional automakers are content to ignore, it would be a mistake to disregard the threat that LSEVs may pose to global markets in the decades to come. Like the minimills and countless other disruptors we have analyzed, motivated LSEV makers appear to be in the automotive market for the long haul.

When minimills entered the steel market in the mid-1960s, integrated steel manufacturers underestimated them and their powerful motivation to move upmarket. By the time the integrated mills acknowledged minimills as a threat, the game was largely over. It took nearly 25 years for the minimills to fire up their sheet steel factories—the most profitable segment in the steel industry—but the result was the same. Lacking the foresight to see how minimills could transform their industry, many integrated mills were eventually driven into bankruptcy. This phenomenon has played out time and time again across industries, including the automotive sector.

This announcement, coupled with the impending regulations on LSEVs, should provide better visibility on the path forward to addressing nonconsumption in China. However, the regulations on LSEVs may also come with increased benchmarks; unlike their predecessors, future manufacturers of LSEVs will likely have to adhere to certain basic safety and quality thresholds.[51]

2. Selectively explore other developing markets

As Professor Clayton Christensen has noted: In business strategy, the new game begins before the old game is over. In the context of LSEVs, this means that even before disruption in China completely plays itself out, automakers can catch another wave of disruption in other developing markets. Markets such as India, Vietnam, and Indonesia all have motorization rates that are lower than the global average.[52] Where there are pockets of nonconsumers, there are opportunities for disruptors—incumbents and entrants alike—to capture growth. Forward-thinking companies can take the lead and selectively explore such developing markets.

In addition to capturing the growth offered by nonconsumption, there is a distinct advantage in forging business models that are targeted at nonconsumption or the least-demanding consumers in developing countries. These business models can be profitably applied in more markets than those built in developed nations.[53]

Regardless of where automakers get their start, the key to rolling out such a strategy will be to start small. Before committing further resources, the intention must be to learn and test assumptions about the market and the firm's business model.[54] Then, as they refine their strategy, automakers can gradually launch better cars that can meet the needs of more demanding consumers in developing and developed markets.

3. A note for incumbents: Aim for autonomy

Almost always, the business model of a company's core business is attuned to seamlessly execute sustaining innovations. Incumbents—automakers included—cannot afford to distract their attention from the core business that allows them to continue their operations and meet short-term growth and profit targets. Thus, the resource allocation process, which acts as a filter to apportion resources such as capital and employees, will almost always prioritize sustaining innovations, which promise well-defined markets with a tangible revenue potential. This means that, despite the best intentions of the organization's leadership, the business model of the established business will almost certainly starve any potentially disruptive venture of the necessary resources. This helps explain why efforts from incumbent automakers to launch offerings at lower price points, such as the Renault TWIZY and GM Baojun E100,[55] may fail to reach their full potential.

To mitigate this challenge, the Theory of Disruptive Innovation prescribes that incumbents ensconce the new venture in an autonomous business unit that is empowered with an unfettered charter to explore disruptive opportunities.[56] With this particular setup, the core business can continue to execute its deliberate, sustaining innovation strategy, while the autonomous business unit focuses on building the new growth engine.

Closing Thoughts

Industry transformation is already underway in China—and that's a good thing. By primarily targeting nonconsumers, LSEV makers are further democratizing the car, and enabling hundreds of thousands of people who previously could not afford one to enjoy its benefits, while simultaneously creating jobs and revving up the economy.[57] Furthermore, by leveraging electric powertrain technology, LSEV manufacturers are positioning themselves to reduce their carbon footprint down the line, provided they are responsible in how they manage the battery supply chain, among other sustainability measures. The Chinese government, too, has a role to play in steering the country towards renewable energy sources.

The question is whether automakers will follow the lead of LSEV manufacturers and capitalize on the next wave of growth, or ignore the threat and pave the way for their own disruption.

NOTES

1. Petit, S. (2017, October 17). World vehicle population rose 4.6% in 2016. Retrieved from: http://subscribers.wardsintelligence.com/analysis/world-vehicle-population-rose-46-2016

2. Yang, Z., & Bandivadekar, A. (2017). 2017 Global Update: Light-duty vehicle greenhouse gas and fuel economy standards (Rep.). Retrieved from: https://www.theicct.org/sites/default/files/publications/2017-Global-LDV-Standards-Update_ICCT-Report_23062017_vF.pdf

3. Sylvers, E., & Stoll, J. D. (2017, July 26). U.K. to ban sale of diesel, gasoline vehicles by 2040. *The Wall Street Journal*. Retrieved from: https://www.wsj.com/articles/u-k-to-ban-sale-of-diesel-gasoline-vehicles-by-2040-1501062680

4. Yang, Z., & Bandivadekar, A. (2017). 2017 Global Update: Light-duty vehicle greenhouse gas and fuel economy standards (Rep.). Retrieved from: https://www.theicct.org/sites/default/files/publications/2017-Global-LDV-Standards-Update_ICCT-Report_23062017_vF.pdf

5. Plungis, J. (2018, February 22). The race to improve fuel economy. *Consumer Reports*. Retrieved from: https://www.consumerreports.org/fuel-economy-efficiency/the-race-to-improve-fuel-economy//

6. Chediak, M. (2017, December 05). The latest bull case for electric cars: The cheapest batteries ever. *Bloomberg*. Retrieved from: https://www.bloomberg.com/news/articles/2017-12-05/latest-bull-case-for-electric-cars-the-cheapest-batteries-ever

7. The scope of this paper is limited to passenger light-duty vehicles (PLDVs).

8. Alternative Fuels Data Center. Emissions from hybrid and plug-In electric vehicles. (n.d.). Retrieved from: https://www.afdc.energy.gov/vehicles/electric_emissions.php

9. Lienert, P. (2018, January 15). Global carmakers to invest at least $90 billion in electric vehicles. *Reuters*. Retrieved from: https://www.reuters.com/article/us-autoshow-detroit-electric/global-carmakers-to-invest-at-least-90-billion-in-electric-vehicles-idUSKBN1F42NW

10. Please refer to *The Innovator's Solution* by Clayton M. Christensen for a more detailed account of the disruption unleashed by minimills.

11. Harshaw, A. (2015, April 15). From mini-mills to alternative materials, competitive threats create a challenging landscape. Retrieved from: http://usa.arcelormittal.com/news-and-media/blog/2015/apr/04-15-2015

12. DeBord, M. (2014, October 10). Morgan Stanley: Tesla is bigger than electric cars. *Business Insider*. Retrieved from http://www.businessinsider.com/morgan-stanley-tesla-is-bigger-than-electric-cars-2014-10/

13. About Tesla. (n.d.). Retrieved from: https://www.tesla.com/about

14. Higgins, T. (2017, January 20). Tesla boosts range of all-electric Model S to 335 miles. *The Wall Street Journal*. Retrieved from: https://www.wsj.com/articles/tesla-boosts-range-of-all-electric-model-s-to-335-miles-1484946718

15. Wayland, M. (2017, July 25). GM launching over-the-air updates 'before 2020,' Barra says. Retrieved from: http://www.autonews.com/article/20170725/OEM06/170729843/barra-ota-2020

Markus, F. (2017, February 07). 2017 Tesla Model S P100D first test: A new record ~ 0-60 MPH in 2.28 seconds! *Motor Trend*. Retrieved from http://www.motortrend.com/cars/tesla/model-s/2017/2017-tesla-model-s-p100d-first-test-review/

16. Voelk, T. (2018, March 06). Porsche positions itself against Tesla, on the road and beside it. *The New York Times*. Retrieved from: https://www.nytimes.com/2018/03/06/business/porsche-mission-e-tesla.html?login=smartlock&auth=loginsmartlock

17. Loveday, S. (2018, June 2). 8 cheapest electric vehicles for sale in the U.S. Retrieved from: https://insideevs.com/8-cheapest-bevs/

Trotter, C. (2018, June 12). 2018 Tesla Model 3 review. *U.S. News & World Report*. Retrieved from https://cars.usnews.com/cars-trucks/tesla/model-3

18. Statista. New vehicle average selling price in the United States from 2007 to 2017 (in 1,000 U.S. dollars). (n.d.). Retrieved from: https://www.statista.com/statistics/274927/new-vehicle-average-selling-price-in-the-united-states/

19. Truett, R. (2016, November 14). Hyundai plans long-range Ioniq. *Automotive News*. Retrieved from: http://www.autonews.com/article/20161114/OEM03/311149967/hyundai-plans-long-range-ioniq

20. Since EVs are expected to have less maintenance requirements, dealerships may lose out on their service revenue. This may impact their motivation to sell EVs but this issue is beyond the scope of this paper.

21. International Energy Agency. Global EV Outlook 2018 (Rep.). (2018). Retrieved from: https://www.connaissancedesenergies.org/sites/default/files/pdf-actualites/globalevoutlook2018.pdf

22. Wang, H., & Kimble, C. (2012). The low speed electric vehicle—China's unique sustainable automotive technology? *Sustainable Automotive Technologies 2012*, 207-214. doi:10.1007/978-3-642-24145-1_27

23. Kimble, C., & Wang, H. (2013). China's new energy vehicles: Value and innovation. *Journal of Business Strategy, 34*(2), 13-20. doi:10.1108/02756661311310413

24. Porcari, A. (2016, April 12). It's time to expose the billion dollar hidden asset of Kandi Technologies, China's innovative #1 pure electric vehicle developer. Retrieved from: https://www.hvst.com/posts/its-time-to-expose-the-billion-dollar-hidden-asset-of-kandi-technologies-chinas-innovative-1-pure-electric-vehicle-developer-EdnTOBL2

25. China low-speed electric vehicle industry report, 2018-2022. (2018, March). Retrieved from: https://www.researchandmarkets.com/reports/4516286/china-low-speed-electric-vehicle-industry-report

26. Wang, H., & Kimble, C. (2012). The low speed electric vehicle—China's unique sustainable automotive technology? *Sustainable Automotive Technologies 2012*, 207-214. doi:10.1007/978-3-642-24145-1_27

27. Yan, H. (2017, February 27). New rules set to govern low-speed electric vehicles and tackle questions of safety. China Daily. Retrieved from: http://www.chinadaily.com.cn/business/motoring/2017-02/27/content_28359457.htm

28. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

29. Howell, S., Lee, H., & Heal, A. (2014, May). Leapfrogging or stalling out? Electric vehicles in China (Rep.). Retrieved from: https://www.belfercenter.org/publication/leapfrogging-or-stalling-out-electric-vehicles-china

Shen, Q., Feng, K., & Zhang, X. (2015). Divergent technological strategies among leading electric vehicle firms in China: Multiplicity of institutional logics and responses of firms. *Science and Public Policy*, *43*(4), 492-504. doi:https://doi.org/10.1093/scipol/scv056

In certain cases, the local governments have offered support to LSEV makers. For instance, Shandong Provincial Government extended some support to Shifeng Group.

30. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

31. International Energy Agency. Global EV Outlook 2018 (Rep.). (2018). Retrieved from: https://www.connaissancedesenergies.org/sites/default/files/pdf-actualites/globalevoutlook2018.pdf

32. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

33. Yan, F., & Wills, K. (2012, April 19). Mini electric cars fill gap in China as official EVs sputter. *Reuters*. Retrieved from: https://www.reuters.com/article/us-china-mini-ev-idUSBRE83I0CZ20120419

34. Yan, H. (2017, February 27). New rules set to govern low-speed electric vehicles and tackle questions of safety. China Daily. Retrieved from: http://www.chinadaily.com.cn/business/motoring/2017-02/27/content_28359457.htm

Paglee, C. (2014, July 25). A window into China's low-speed electric vehicle revolution. Autoblog. Retrieved from: https://www.autoblog.com/2014/07/25/a-window-into-chinas-low-speed-electric-vehicle-revolution/

Ou, S., Lin, Z., Wu, Z., Zheng, J., Lyu, R., Przesmitzki, S., & He, X. (2017, January). A study of China's explosive growth in the plug-in electric vehicle market (Rep.). Retrieved from: https://info.ornl.gov/sites/publications/files/Pub72210.pdf

Oak Ridge National Laboratory's report gives a price range of $4,623 to $10,787 USD for LSEVs.

35. Yan, F., & Wills, K. (2012, April 19). Mini electric cars fill gap in China as official EVs sputter. *Reuters*. Retrieved from: https://www.reuters.com/article/us-china-mini-ev-idUSBRE83I0CZ20120419

36. Ou, S., Lin, Z., Wu, Z., Zheng, J., Lyu, R., Przesmitzki, S., & He, X. (2017, January). A study of China's explosive growth in the plug-in electric vehicle market (Rep.). Retrieved from: https://info.ornl.gov/sites/publications/files/Pub72210.pdf

37. Ou, S., Lin, Z., Wu, Z., Zheng, J., Lyu, R., Przesmitzki, S., & He, X. (2017, January). A study of China's explosive growth in the plug-in electric vehicle market (Rep.). Retrieved from: https://info.ornl.gov/sites/publications/files/Pub72210.pdf

38. Paglee, C. (2014, July 25). A window into China's low-speed electric vehicle revolution. Autoblog. Retrieved from: https://www.autoblog.com/2014/07/25/a-window-into-chinas-low-speed-electric-vehicle-revolution/

39. Undercoffler, D. (2017, June 26). Body on frame vs. unibody: Pros and cons. *Automotive News*. Retrieved from: http://www.autonews.com/article/20170626/OEM01/170629864/body-on-frame-vs.-unibody:-pros-and – cons

40. Paglee, C. (2014, July 25). A window into China's low-speed electric vehicle revolution. Autoblog. Retrieved from: https://www.autoblog.com/2014/07/25/a-window-into-chinas-low-speed-electric-vehicle-revolution/

41. Ou, S., Lin, Z., Wu, Z., Zheng, J., Lyu, R., Przesmitzki, S., & He, X. (2017, January). A study of China's explosive growth in the plug-in electric vehicle market (Rep.). Retrieved from: https://info.ornl.gov/sites/publications/files/Pub72210.pdf

42. American Automotive Policy Council. State of the U.S. automotive industry (Rep.). (2017, October). Retrieved from: http://www.americanautocouncil.org/sites/aapc2016/files/2017 Economic Contribution Report.pdf

43. Yan, F., & Wills, K. (2012, April 19). Mini electric cars fill gap in China as official EVs sputter. *Reuters*. Retrieved from: https://www.reuters.com/article/us-china-mini-ev-idUSBRE83I0CZ20120419

This paper compares the cost of Shifeng Group's automotive plant with that of a typical automotive plant in the U.S. in 2017 solely to show that LSEV manufacturers are not afraid of breaking the status quo in order to make affordable cars for rural Chinese consumers. Surely, inflation needs to be factored in. Aspects such as quality of cars, plant capacity, land costs, etc., also need to be factored in. These are beyond the scope of this paper. (Exchange rate used for conversion: 1 USD = 6.6 Chinese yuan.)

44. Paglee, C. (2014, July 25). A window into China's low-speed electric vehicle revolution. Autoblog. Retrieved from: https://www.autoblog.com/2014/07/25/a-window-into-chinas-low-speed-electric-vehicle-revolution/

45. China Low-speed Electric Vehicle (LSEV) Industry Report, 2016-2020. (2016, November 09). Retrieved from: https://www.prnewswire.com/news-releases/china-low-speed-electric-vehiclelsev-industry-report-2016-2020-300360308.html

46. Yan, H. (2017, February 27). New rules set to govern low-speed electric vehicles and tackle questions of safety. China Daily. Retrieved from: http://www.chinadaily.com.cn/business/motoring/2017-02/27/content_28359457.htm

47. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

48. Statista. Urban and rural population of China from 2006 to 2016 (in million inhabitants). (n.d.). Retrieved from: https://www.statista.com/statistics/278566/urban-and-rural-population-of-china/

49. International Energy Agency. Global EV Outlook 2016 (Rep.). (2016). Retrieved from: https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf

50. Shirouzu, N., & Jourdan, A. (2018, April 17). China to open auto market as trade tensions simmer. *Reuters*. Retrieved from: https://www.reuters.com/article/us-china-autos-regulation/china-to-open-auto-market-as-trade-tensions-si mmer-idUSKBN1HO0YA

51. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

52. International Organization of Motor Vehicle Manufacturers. Vehicles in use. (n.d.). Retrieved from: http://www.oica.net/category/vehicles-in-use/

With motorization rates well below the average motorization rate for all countries in 2015, developing markets such as India, Vietnam, and Indonesia have a lot of room for growth. The motorization rate includes both passenger cars and commercial vehicles.

53. Hart, S. L., & Christensen, C. M. (2002, October 15). The great leap: driving innovation from the base of the pyramid. *MIT Sloan Management Review*. Retrieved from: https://sloanreview.mit.edu/article/the-great-leap-driving-innovation-from-the-base-of-the-pyramid/

54. McGrath, R. G., & MacMillan, I. (1995, July/August). Discovery-driven planning. *Harvard Business Review*. Retrieved from: https://hbr.org/1995/07/discovery-driven-planning

Discovery-driven planning is a powerful tool while exploring Disruptive Innovation.

55. Baojun E100 is manufactured by the joint venture between GM China, SAIC Motor Corporation Limited, and Liuzhou Wuling Motors Co Limited.

56. Analysis of dominant incumbents that have successfully caught subsequent waves of disruption shows a common thread: almost always, the incumbents created a separate business unit to target Disruptive Innovation. For example, IBM, which was a dominant player in the mainframe industry, successfully competed in the minicomputer as well as personal computer industry by creating a separate business unit during each wave of disruption. For more details, refer to *The Innovator's Solution*.

57. International Energy Agency. Global EV Outlook 2017 (Rep.). (2017). Retrieved from: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

About the Christensen Institute

The Clayton Christensen Institute for Disruptive Innovation is a nonprofit, nonpartisan think tank dedicated to improving the world through Disruptive Innovation. Founded on the theories of Harvard professor Clayton M. Christensen, the Institute offers a unique framework for understanding many of society's most pressing problems. Its mission is ambitious but clear: work to shape and elevate the conversation surrounding these issues through rigorous research and public outreach.

About Tata Consultancy Services (TCS)

Tata Consultancy Services is an IT services, consulting and business solutions organization that partners with many of the world's largest businesses in their transformation journeys. TCS offers a consulting-led, Cognitive powered, integrated portfolio of IT, Business & Technology Services, and engineering. This is delivered through its unique Location Independent Agile delivery model, recognized as a benchmark of excellence in software development. A part of the Tata group, India's largest multinational business group, TCS has over 394,000 of the world's best-trained consultants in 46 countries. The company generated consolidated revenues of US $19.09 billion for year ended March 31, 2018 and is listed on the BSE (formerly Bombay Stock Exchange) and the NSE (National Stock Exchange) in India. For more information, visit www.tcs.com.

About the Author

Chandrasekar Iyer is a visiting research fellow at the Clayton Christensen Institute from Tata Consultancy Services (TCS). Chandrasekar researches the future of manufacturing with a primary focus on automotive, industrial machinery, and aerospace subsectors. At TCS, he worked as a business consultant for two years, focusing on business process management and technology solutions for sales, marketing, and after-sales functions.


CHRISTENSEN
INSTITUTE


TATA
TATA CONSULTANCY SERVICES