The Future of Mobility – on the Cusp of the Electrification Revolution

The Mobility Ecosystem Powered by Blockchain

Ronak Doshi, Vice President

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Foreword

In a Business 4.0™ world, leading organizations are leveraging ecosystems to innovate around stated and unstated needs of customers and important challenges faced by humanity at large. Ecosystems can be especially useful in driving the adoption of electric vehicles. Our economy and society need to replace the gasoline powertrain with an electric one. However, a scarcity of charging infrastructure will slow down the speed of adoption by hampering customer experience. Without a ubiquitous charging infrastructure, consumers will hesitate to replace gasoline vehicles due to range anxiety. Yet, for individual organizations, building this infrastructure on their own is fraught with risks owing to the uncertainty around the rate of electric vehicle adoption. In addition, changing models of personal mobility and potential arrival of autonomy create further challenges for automotive OEMs. It is in this context that ecosystem models can help to bring together different organizations to share risk, develop the charging infrastructure more quickly, and deliver frictionless experience for consumers.

In parallel to the renewed focus on e-mobility, the increased traction of blockchain technology across industries provides an opportunity to design ecosystems that are more open, modular, and interoperable compared to existing ecosystems. With blockchain technology as a key building block, we can look forward to ecosystems with equal distribution of influence among different entities, efficient business processes among partners, and transparent governance models. Most importantly, the open design and transparency will lead to better alignment among stakeholders moving toward a common goal of ensuring the market success of electric cars.

With the goal of providing an impetus to the adoption of electric vehicles and a superior customer experience, Everest Group has released research on the challenges key stakeholders face in creating the market for electric vehicles. The research also presents a roadmap to develop an electric vehicle ecosystem in India and the US and explains how a blockchain-powered ecosystem strategy can be utilized across different markets. TCS is pleased to share this research, as we believe that this research will motivate stakeholders in the automotive value chain, and other relevant organizations, to work together to address society’s need for electric vehicles.

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Executive summary

The future of mobility is being defined by a digital-enabled convergence of themes such as autonomous driving, connected vehicles, electrification, and shared mobility. Developments in electric vehicles (EVs) and environmental concerns are leading to change: in 2018, EV sales reached a record high of over two million units.

While challenges to EV adoption remain, EV industry participants are attempting to address high comparative product price, lack of charging infrastructure, lack of efficient engines, and battery-related challenges. Vehicle manufacturers – or Original Equipment Manufacturers (OEMs), Battery Technology Suppliers (BTS), Infrastructure Providers (IP), governments and regulators, and System Integrators (SI) are among the key industry players attempting to drive adoption. However, the siloed nature of these organizations’ investments results in slower and lower impact on EV adoption. There is significant potential benefit in industry-wide collaboration among EV ecosystem players to create exponential impact from their individual investments that maximizes value for end customers, ecosystem players, and the environment at large.

Everest Group conducted a study with 59 automotive industry leaders responsible for EV across OEMs, BTSs, IPs, government and regulatory bodies, and SIs to explore the challenges in building an EV ecosystem and understand ways to overcome the challenges for scaled EV adoption in India and the United States. The two countries reflect stark differences in EV adoption.

This study provides a roadmap to develop an EV ecosystem in India and the US and explores how a blockchain platform-based ecosystem strategy could be adopted in markets across the spectrum of EV adoption maturity. We explore the “4T” features of trust & security, transparency & auditability, traceability & automation, and transaction & automation that blockchain technology can enable for the EV ecosystem. Both EV and blockchain technology have moved beyond the initial hype; now is the time to explore the opportunities they present.

Key findings

- The future of mobility hinges on the ability of EV industry participants to collaborate on the principle of building an ecosystem centered around creating exponential customer value
- A structured approach to curating, onboarding, and ongoing management of EV ecosystem participants is essential for successful collaboration. This approach includes:
  - Identifying key entities to build an EV ecosystem
  - Curating participants for a minimum viable ecosystem
  - Defining a shared governance structure
  - Modeling incentives to build a scalable and sustainable ecosystem
- A platform-thinking approach would allow the ecosystem to scale in a sustainable, agile, and programmatic way that creates a favorable environment for players to participate and build robust offerings for end customers. Blockchain technology promises to provide the transparency and trust required to drive such an ecosystem
- Ecosystem players need to invest in building capability to develop and manage a next-generation technology platform that will enable ecosystem governance and encourage EV adoption at scale
“Demand incentives can help in the short term. But, in the next five to six years, the expected reduction in battery prices and the simultaneous increase in the cost of internal combustion engine vehicles due to stringent emission regulations could help EVs offer an inherent operating cost benefit and make them sustainable even in the absence of incentives.”

- Shailesh Chandra, President, Electric Mobility Business and Corporate Strategy, Tata Motors

**Current state of electric vehicle adoption**

**Everest Group take**

Successful EV adoption in India hinges on the ability to build cost-effective mass market mobility solutions. The Indian government policy to encourage EV adoption is being complemented by consortia building efforts of ride-sharing organizations to tackle last-mile connectivity for urban transportation. This bottom-of-the-pyramid approach in India is starkly different from the personal-vehicle owned movement for EV adoption in the US. While both markets face the same set of EV adoption challenges – high cost of EV, range anxiety, and lack of e-mobility infrastructure – there are stark differences in their approach to solve these challenges.

**Current state of EV adoption in India**

The goal of the Indian government’s ambitious National Electric Mobility Mission Plan is to electrify the entire mobility ecosystem by 2030, with 15% of all vehicles in the country to be electric. Faster Adoption and Manufacturing of Electric Vehicles in India (also known as FAME India), launched in 2015, was one of the major initiatives of this mission. To further drive continuous focus on EV adoption, the Indian government announced the FAME 2 scheme in 2019, with a planned investment of INR 100 billion.

Current drivers of EV adoption in India are public transport and last-mile connectivity powered by three wheelers. A key growth driver of four-wheeler EV adoption is likely to be procurement for government offices, and sales of electric buses will also be driven by government procurement to drive electrification of public transport in India.

In the private sector, major ride-sharing operators – such as Ola and Uber – are investing in the Indian EV market and are likely to drive growth in the electric four-wheeler segment. Food delivery operators are likely to propel growth in the electric two-wheeler segment. Adoption of privately-owned four-wheelers and two-wheelers is expected to reach an inflection point in five to six years as battery technology and charging infrastructure improves and overcomes the challenge of high cost of EV and range anxiety among individual customers.

Finally, Panasonic’s May 2019 announcement that it intends to invest INR 7 billion in 25 Indian cities to install 100,000 EV charging stations by 2024 will help to drive adoption. Exhibit 1 shows past and anticipated EV sales in India, by vehicle category.

**EXHIBIT 1**

EV sales in India across segments and expected growth

Source: Everest Group (2020)
Today, more than 200,000 electric cars can be found on roads across the country as almost every manufacturer sells them. But, like other new vehicle technologies, Americans don’t have the full story and that could be causing the gap between interest and action.”

— Greg Brannon, AAA’s Director of Automotive Engineering

Current state of EV adoption in the US

The EV market in the US has grown through consumer-led, government-supported adoption. In 2018, over 361 thousand EVs were sold in the US, an 81% growth over 2017; all told, more than a million EVs have been sold in the US. Contrary to the Indian market, adoption is largely four-wheeler private cars, with Tesla leading the EV sales chart. Transportation is the largest and fastest growing contributor to emissions; given the global spotlight on climate change, EV adoption is likely to increase significantly, particularly as it still accounts for only 1 percent of total cars sold in the country. Traditional OEMs are also driving adoption; not wanting to be left behind in the development of EVs, many are investing in EV R&D and manufacturing.

EXHIBIT 2

EV sales in the US and expected growth

Source: Everest Group (2020)

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1,59,139</td>
<td>33.2%</td>
</tr>
<tr>
<td>2017</td>
<td>1,99,826</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>3,61,307</td>
<td>8,89,785</td>
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<tr>
<td>2022E</td>
<td></td>
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</table>

**Drivers for EV adoption**

<table>
<thead>
<tr>
<th>India</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on public commuting with fleet-led play</td>
<td>People-led government supported adoption curve</td>
</tr>
<tr>
<td>Driven by the government announcement of electrification of transportation by 2030</td>
<td>Focus on private vehicles</td>
</tr>
</tbody>
</table>

**Investments in EV (examples)**

<table>
<thead>
<tr>
<th>India</th>
<th>US</th>
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<tbody>
<tr>
<td>Mahindra and Mahindra partnered with Uber to deploy EVs across several Indian cities</td>
<td>EV startups have raised more than US$2 billion in the US in 2018, a huge increase over the US$650 million raised in 2017</td>
</tr>
<tr>
<td>Ola aims to put over one million electric vehicles on the road by 2021 and has partnered with Mahindra &amp; Mahindra. Their target for 2018-2019 is to place over 10,000 e-rickshaws and electric auto-rickshaws on the road</td>
<td>Audi is partnering with Amazon and Electrify America to deliver its first all-electric SUV to U.S. market. Audi has also partnered with utility service Arcadia Power</td>
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**Government support**

<table>
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<tr>
<th>India</th>
<th>US</th>
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<tr>
<td>As per Faster Adoption and Manufacturing of (Hybrid &amp;) Electric Vehicles II (FAMEII) scheme, government will invest INR 5,500 crores (~ USD 784 million) in the next five years</td>
<td>In 2008, U.S. government made available PEV tax credits of $2,500 to $7,500 per vehicle, which have since been extended</td>
</tr>
<tr>
<td>Energy Efficiency Services Limited (EESL) plans to procure 10,000 EV units</td>
<td>Department of Energy’s (DOE’s) partnered with employers to providing employees with access to charging stations which can helped increase the number of charging stations; nearly 7,500 stations were planned or installed</td>
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Key challenges to EV adoption

While there have been multiple initiatives across India and the US to drive EV adoption, some fundamental challenges need to be addressed to drive scaled adoption.

- Anxiety over EV range remains the biggest barrier to widespread adoption. Consumers demand the same driving experience as the combustion engine vehicle offers, including long range and short charging/filling times. Battery energy density is crucial to enabling those capabilities.
- The current cost of EV ownership is high relative to traditional vehicles for the same quality and experience, driven mainly by the higher price of currently available battery technology. Some of the Indian and US government efforts that incentivize EV customers may help to drive adoption. Manufacturers are predicting cost parity by 2025 as battery technology evolves and as a result of efficiencies throughout the EV manufacturing value chain.
- Limited charging station availability is a major adoption challenge for both India and US consumers. The challenge is more pronounced in India given the lack of an organized parking infrastructure. India had about 425 publicly available EV charging points at the end of 2018. By 2022, government and private efforts are expected to boost that number to an estimated 2,800 charging points. Though a significant increase, the total number of charging points will remain low, posing a significant challenge.
- Limited availability of viable and cheap financing to support low-earning traditional auto rickshaw (three-wheeler) drivers is another hindrance to EV adoption. India had about 425 publicly available electric vehicle charging points at the end of 2018. By 2022, government and private efforts are expected to boost that to an estimated 2,800 charging points. This is a very low number and will continue to be a significant challenge.

EXHIBIT 3

Key challenges to EV adoption

Source: Everest Group (2020)

"We see charging installation as a very important business."

– Pat Bigatel, Director of Amazon Home Services
“Using Tata Motors’ in-house capabilities, coupled with Tata Group companies’ expertise and ongoing collaboration with other ecosystem players, we intend to offer a comprehensive range of electric vehicles and other ecosystem solutions to break the barriers to adoption. We have already developed cars, buses, and last-mile commercial vehicles, and plan a strong product portfolio.”

- Shailesh Chandra, President, Electric Mobility Business & Corporate

“We’re at the point where the vehicle is a context, a moving extended smartphone that you sit in, that has the potential to provide in-car experiences, driven by making sense of data”

- Andy Moore, Designer at Fjord

THE FUTURE OF MOBILITY – ON THE CUSP OF THE ELECTRIFICATION REVOLUTION

EXHIBIT 4

The power of collaboration – the necessity for an EV ecosystem

Everest Group take

The rise of industry 4.0 technologies and shifts in consumer needs and business models are pushing enterprises to an “ecosystem-first” mandate across all industries. The focus on creating exponential customer value by orchestrating the entire customer journey is driving adoption of new technologies and business models. The future of mobility hinges on the ability of EV industry participants to collaborate on this principle of building an ecosystem centered around creating exponential customer value.

Driving EV adoption is complex, as it includes products and services and must address rapidly evolving demand for innovation, sustainability, and bundling of services. Due to rapidly expanding scope of services in the consumer’s mobility journey and delinking of these services from the product decision, makes it difficult for a single organization alone to provide a full suite of mobility solutions. Even a traditional two- or three-company partnership will not be enough to create the customer experience conducive to adoption at scale and speed. Further, the friction in collaboration among entities drive up costs and aggregators attempting to bring entities together are not able to provide consistent experience to customers. The impact of investments by EV industry participants has been low and slow given the siloed nature of their approach. A consumer-focused, ecosystem-based approach is necessary to achieve the full potential of the future of mobility.

Of the many challenges to EV adoption, the lack of charging infrastructure is the most pressing. This challenge is aggravated by the lack of interoperability of charging infrastructures and limited incentives for utility providers to invest. Furthermore, customer anxiety is increased by the lack of planning and design of the charging infrastructure network. The situation is a vicious cycle: the high cost of establishing a charging infrastructure and the current low adoption of EVs disincentivizes charger investment, but the lack of charging infrastructure is slowing EV adoption. However, this situation presents a unique collaboration opportunity for players in the EV industry to pool their monies to create investment and to solve the industry challenges of high infrastructure cost, interoperability issues, high cost of charging, and ease of access.
We are seeing a few industry initiatives for ecosystem collaboration:

- Automakers, electricity providers, charging network companies, policymakers, and non-profits launched an organization in California called Veloz, with the aim of marketing EVs to a wider audience.

- Volkswagen established Electrify America to promote EV adoption. It announced US$200 million investment plan in California to build fast-charging capabilities within metro areas, where most EV drivers are expected to charge, and is also supporting charging station for regional routes and highway networks.

- SmartE, an aggregator of three-wheeler vehicles in Gurgaon, India, has partnered with Delhi Metro Rail Corporation (DMRC) to provide last-mile connectivity at metro stations.

However, a sustainable ecosystem requires a robust governance and incentive structure to enable new entrants to innovate and offer additional services for a seamless mobility experience for customers.

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**EXHIBIT 5**

EV ecosystem curation survey results

Source: Everest Group (2020)

80% of leaders from the EV industry surveyed believes that the key factor driving participants to an electric vehicle ecosystem is the potential synergy achieved from cost savings that result from collaboration compared to competition/siloed adoption.

85% of the respondents believe that by 2025, the electric vehicle technology will be largely democratized to allow for ground-up innovation by new market entrants due to the reduction in R&D expenses as an entry barrier.
Challenges in building a sustainable EV ecosystem

**Everest Group take**

EV industry participants understand the need for a sustainable EV ecosystem to drive EV adoption and create more value for the end-users. There are potential roadblocks in building an EV ecosystem such as sharing of the economic benefits, pooled nature of initial investments to setup an ecosystem, and managing governance among others. The construct of an ideal EV ecosystem requires participants to have a shared view of the transactions, economic incentives, and governance approach for a network of participants. This requires a technology that enables transparency, shared view to records, customer data protection, and a mechanism for automated enforcement of incentives and governance structure. The unique characteristic of the ideal EV ecosystem are like an enterprise blockchain-based network that allows participants to share a common view of transactions on a private permissioned database and enforces governance mechanisms through smart contracts.

The EV ecosystem has the potential to enable ground-up innovation, driving EV adoption and enabling customer experience that extends beyond core mobility services. EV industry leaders also realize there are several challenges to build a sustainable EV ecosystem:

**EXHIBIT 6**

EV ecosystem curation survey results – challenges to build an EV ecosystem

| Source: Everest Group (2020) |

- **60%** of leaders in EV industry believe that the greatest challenge to adopting and scaling an ecosystem for electric vehicles is the disproportionate share of economic incentives/benefits by one/few participant(s)

- **60%** of survey respondents see participant attrition (e.g., a different OEM poaching a battery supplier to its ecosystem with exclusive rights) as one of the greatest threats to an existing EV ecosystem

- **43%** of leaders believe the threat to an existing ecosystem is over-scaling in which numerous participants dilute the economic incentives for incumbents

For the ecosystem to overcome these challenges, it needs to define a governance structure that not only eases barriers to entry for new participants, but effectively integrates them and fairly aligns incentives for all participants. The idea is to create so much benefit from working as a group as to disincentivize providing those services on their own.
EV ecosystem curation strategy

**Everest Group take**
A structured approach to curating, onboarding, and ongoing management of the EV ecosystem is essential for a successful collaboration approach. The key steps for creating and ecosystem for the EV industry participants are outlined below.
1. Identify key entities necessary to build an EV ecosystem
2. Curate participants for a minimum viable ecosystem
3. Define a shared governance structure
4. Model incentives to build a scalable and sustainable ecosystem

**1. Identify key entities for the ecosystem**
There are two approaches to identify the key entities in the EV ecosystem. The first approach maps the customer EV touchpoints using a design-thinking principle of customer journey mapping. In this approach, the enterprise builds a map of every entity (both internal and external) that touches EV user.

An alternative data-centric approach identifies key entities by answering the following questions:
- Who are the data producers?
- Who are the data owners?
- Who are the data processors?
- Who are the data regulators?

The answers to the above questions identify the relevant participants that are delivering services to EV users. As both experience and data are critical to an EV ecosystem, enterprises can apply a combination of the two. The benefit of the hybrid methodology is that it identifies a wide array of participants, allowing for network effects and value-add possibilities for both the customers of, and participants in, the network.

**EXHIBIT 7**
Description of network participants for an EV use case

Source: Everest Group (2020)
2. Build the minimum viable ecosystem

Once the potential participants are identified, the enterprise needs to build a minimum viable ecosystem that can be used to demonstrate proof-of-value to customers.

A clear articulation of the roles of the key participant segments in an EV ecosystem helps identify the features of an ideal candidate for each segment.

EXHIBIT 8

Key participants in an EV ecosystem

Source: Everest Group (2020)

a. **Vehicle manufacturer – OEM**: Traditionally, OEMs focus solely on maximizing the market for their products. However, for an OEM to participate in the EV ecosystem, it needs to operate in a collaboration model and play a key role in building industry standards. OEMs currently investing in open technologies and interoperable solutions with a focus on building a community around the open technologies are ideal partners to build the minimum viable ecosystem.

b. **Battery Technology Supplier (BTS)**: The evolution of battery technology must consider a wide variety of dimensions, including cost, performance, safety, life span, and specific energy and power. There is a trade-off among these dimensions, each of which impact the aggregated performance of an EV. For an EV ecosystem, the ideal BTS would invest in developing battery technology to overcome the core challenges to EV adoption such as the high price of EV and range anxiety. It is also be important that the BTS to be equally focused on ensuring a battery disposal system to limit the environmental hazard of the used batteries by working collaboratively with the ecosystem.
c. **Infrastructure Provider (IP):** The deployment of a charging infrastructure requires significant investment, yet it is difficult to incentivize players to invest in a market that is not seeing adoption in the near term. The ideal plan is the development of an IP ecosystem within the broader EV ecosystem, which requires a combination of multiple players (a charging points provider, power network providers, electricity producers, parking space providers, retail outlets, P2P charging infrastructure, real estate companies, etc.) all offering consumers cost-effective services, convenience, and a richer experience. It follows a virtuous investment cycle, where in the pooling of investments from multiple players will improve the charging infrastructure and drive EV adoption. As a result, more players will join the ecosystem to reduce the required per participant investment as well as to drive down cost for customers.

EXHIBIT 9
EV ecosystem curation survey results – characteristics of key participants of the EV ecosystem

Source: Everest Group (2020)

EXHIBIT 10
EV ecosystem curation survey results – role of blockchain technology

Source: Everest Group (2020)

As per Everest Group survey, 79% of system integrator respondents believe that blockchain can enable the creation and self-governing sustenance of such ecosystems for EVs.

d. **System Integrator (SI):** The SI is a vital ecosystem player because it leverages next-generation technology and provides the platform that can help to orchestrate the EV ecosystem. The underpinning technology for such a platform should be able to drive a shared governance model and incentive for participants, both old and new, that amplifies the benefits of the network. Everest Group research indicates that 79% of respondents believe that blockchain can enable the creation of, and self-governance for, an EV ecosystem. Thus, the SI of choice for a minimum viable ecosystem should have a mature blockchain practice and the vision to develop blockchain technology further with focused investments. Because the necessary platform capabilities would cut across multiple technologies and businesses, the best targets would be large SIs with next-generation technologies talent. They should be equally capable of managing the platform and making necessary changes as and when business demands. While the responsibility of managing the platform lies with SIs, blockchain technology would ensure that governance of the platform remains decentralized.
e. **Government and regulators:** Government and regulators are core players, as they can influence other stakeholders to join/expand the ecosystem. The role of government in facilitating EV adoption is not limited to providing tax credits and incentives to end-users and businesses. As the EV ecosystem scales, it will be imperative for government to drive standards across the EV ecosystem. The government also has an important role in channeling investments from utilities and addressing the need for an EV charging infrastructure. Respondents to our survey also believe that there is a significant need for government to clearly articulate policies for battery manufacturing and disposal in accordance with environmental regulations. Finally, the government will have a significant role in redefining trade policies and agreements as EV adoption rises and oil dependence declines.

**EXHIBIT 11**

**EV ecosystem curation survey results – role of government and regulators**

Source: Everest Group (2020)

To build a minimum viable ecosystem, potential participants need to be classified as core, context, and value-add depending upon their role.

- **Core:** Participants that offer the products/services that are essential to delivering the basic services and orchestrating customer experience.
- **Context:** Players that ensure the experience consistency as the network would scale in terms of transaction volume and number of customers. They would expand the scope of the ecosystem beyond the basic experiences.
- **Value-add:** Participants that provide peripheral, value-add services. Value-add partners are critical in driving network effects to scale ecosystems and provide additional value for customers.

The core, context, and value-add classification will vary based on the situation.

In the case of an EV charging ecosystem, the core participants would be the EV charging infrastructure provider, the charging station space providers (such as parking lots and malls), the payment services provider, the technology platform provider, regulators, and...
EV OEMs. These core participants would demonstrate the proof-of-value to a customer looking for a seamless, on-demand EV charging experience. As the ecosystem scales, context participants such as ride-sharing firms, vehicle service centers, and battery technology suppliers will join the ecosystem enabling the number of transactions and number/type of customers to increase. Value-add players such as insurers, loyalty & rewards providers, vehicle dealers, vehicle service centers, towing services, technology (map services, search engines, etc.), and social media firms will offer peripheral services that generate more business value for the overall ecosystem and enhanced experiences and add value for the customers.

EXHIBIT 12
Electric vehicle charging ecosystem
Source: Everest Group (2020)

EXHIBIT 13
Everest Group EV ecosystem curation survey results – governance and incentive design
Source: Everest Group (2020)

54% of EV industry leaders believe that ecosystems should be designed such that core participants cannot exert a hierarchy of influence and control on other participants.

81% of the respondents believe that ecosystems should be designed such that the network expands and sustains itself on its own without one (or few) participants acting as checkpoint(s).
3. Creating an ecosystem of ecosystems to drive infinite potential

The EV charging ecosystem is only one of the services ecosystems that can be defined within the EV landscape. However, the vision of complete vehicle electrification requires other ecosystems to evolve and the ability to leverage each other’s capabilities to ensure a seamless experience for customers. Exhibit 14 depicts some of the other EV ecosystems, such as EV ride sharing services, EV leasing services, and battery swapping services. As the exhibit indicates, some of the participants remain common across several ecosystems with technology platform orchestrating the broader ecosystem.

The core and context services will change places depending on the ecosystem. Every experience requires a unique set of core services, which changes in the definition of what is core and/or context. The value-add services that can be designed on top of these experience ecosystems can provide infinite potential to create and capture customer value.

EXHIBIT 14

Ecosystem of ecosystems governed by the technology platform

Source: Everest Group (2020)
The examples below demonstrate the ability of an ecosystem of ecosystems not only to overcome some of the key challenges facing customer adoption of EV, but also to offer lifestyle solutions that enrich customer experience.

As the EV ecosystem scales, the potential to create exponential customer value increases. It also provides an opportunity for the EV participants to simplify the customer’s experiences by being an orchestrator for all their lifestyle needs. For example, a customer’s visit to a shopping mall for groceries could be influenced by the presence of charging station.
These two examples demonstrate the potential impact of the EV ecosystem on customer lifestyles well beyond simply their vehicle of choice. Two examples of ecosystem participants actively engaging EV owners are:

- Marriott International has installed more than 2,500 EV charging stations at its locations around the globe
- PluginIndia is enabling businesses/resorts/vacation homes to set up EV charging stations and is appealing to home owners and businesses to set up community charging stations and open them to for EV owners

3. Define a shared governance structure

The ecosystem needs a shared governance structure to ensure its scalability and sustainability. Shared governance is built on the principles of trust, transparency, openness, and a decision-making framework that considers the best interests of the customers. A multi-party network is likely to have significant difficulty achieving these goals. Managing an EV ecosystem of ecosystems is complex and requires a platform-led governance structure; blockchain technology enables an ecosystem with distributed governance by designing and implementing the controls through smart contract technology that automates governance processes and eliminates fraud and abuse.

For the EV charging use case, shared governance principles would need to support the change management efforts required across organizations to drive customer adoption of EV ecosystem services. Effective governance design includes studying the local environment, country regulations, and customer demand characteristics for each region.

For example, an EV charging ecosystem in India would require a governance structure to foster bottom-of-the-pyramid innovation as the early EV adopters are passenger vehicles (e.g., three-wheelers) for short distance commutes in large cities. The governance of shared public infrastructures will be a key design principle. On the other hand, adoption of EVs is driven by consumer vehicles in the US and hence governance principles that focus on private vehicle ownership and customer convenience would be key.

4. Model incentives for network participants

One of the biggest challenges to scaling the ecosystem is incentivizing new participants to join the ecosystem. A fair and transparent incentive mechanism not only helps attract newer participants but also builds trust with customers. As the number of participants in an ecosystem increases, we see an exponential rise in the customer adoption of the services offered by the ecosystem participants followed by plateauing as customer adoption saturates. This expansion of the number of participants is very similar to the “network effects” seen for social media platforms. At the same time as adoption increases, cost per transaction for basic services will decline. These combined events increase value for the ecosystem participants as the network scales and customer adoption and transaction volumes rise.

Just like most networks, fair pricing of services can be achieved by participants bidding with offers for customers and the services they would like to provide and customer selecting the offer by participants that aligns to their budget, preferences, and ratings/reviews by other fellow customers. For the EV charging use case, ecosystem participants can drive efficiency and innovation in their processes and thereby reducing the cost for each participant through collaboration efforts. It lowers the investment for a single organization run
EXHIBIT 17

Network effect of ecosystem in driving down cost of transaction

Source: Everest Group (2020)

centralized effort to drive EV adoption and the build-out of the entire network. Lower cost to serve customers allows participants to pass some of these benefits to the customer, which further incentivizes adoption. Each participant can focus on its core offerings and collaborate with other partners to ensure customer receives a seamless experience. Participation in the EV ecosystem will allow participants to gain from the brand-value, consumer trust, and services that other participants bring to the network. It allows participants to create new business models and partnerships to serve customers better and grow their business. As network effect kicks in, multiple services create its own ecosystems within the ecosystem, creating infinite value potential in theory.

An example of this is bundling the sale of EV with the charging station services. The bundled services allow OEM and BTS to leverage each other’s brand to gain customer trust while it also enables customers to have a one stop shop experience. As ecosystem matures, it allows to build new and innovative products and services on top of the core services. For example, a shopping mall or a retail store can offer charging stations in its parking space, which becomes their source of differentiator attracting more customers for their retail business.

The EV ecosystem needs a transparent incentive mechanism as well as a methodology to enforce rules on how benefits are shared among participants without any discrimination. We explore how blockchain technology could support these design principles for the EV ecosystem.
Role of blockchain technology in EV ecosystem curation

Both EV and blockchain technology have moved beyond the initial hype. Blockchain technology enables the creation of distributed networks and governance enabled through cryptography-backed consensus mechanisms. Thus, trust in the network is enabled through blockchain consensus mechanism instead of relying on a centralized entity. Blockchain-powered smart contracts convert networks to ecosystems by codifying governance and incentive mechanisms. The immutable nature of blockchain technology combined with controlled transparency that a permissioned blockchain enables, will help the ecosystem to audit and manage itself. The rise of enterprise-grade blockchain platforms has given enterprises the trust in technology to launch strategic initiatives on blockchain. An ideal EV ecosystem will require these elements (the “4T” features) enabled by blockchain technology.

**EXHIBIT 18**

Blockchain “4T” features of Trust, Transparency, Traceability, and Transaction immutability

**Source:** Everest Group (2020)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Implications for EV ecosystem:</th>
</tr>
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</table>
| Trust and security       | Blockchain drives trust and security in transactions between multiple parties through its consensus mechanisms backed by cryptographic algorithms | - Multi-party network needs inherent trust and security features  
- Enterprises will benefits from a permissioned ledger that allows for control over data privacy and security  |
| Transparency and auditability | Blockchain offers transparency and auditability through its distributed ledger structure, offering users/regulators complete audit trail | - Governance of the network is enabled by the auditable nature of blockchain transactions  
- All participants can have a view into the incentives structure of the ecosystem to ensure there is fair and transparent allocation of economic incentives  |
| Traceability and insights | Blockchain strengthens traceability by creating a shared view of the database and allowing to plug an analytics layer on the blockchain | - Consumers can trace charging infrastructures in their location as well as support their decision via insights provided on top of the blockchain data on best-available offers and already set preferences  
- Participants can analyze their performance and align their offerings to user needs  |
| Transaction and automation | Blockchain is streamlining processes by removing intermediaries, resulting in smooth transaction as well as enforcing rules via smart contracts | - The complex governance structure will be automatically enforced via smart contracts to reduce administrative efforts and costs for the network  
- The automation also allows for finality of transaction and thus providing a secured record of every completed activity  |
“Today mobility is heavily centralized with overly complex service layers that create waste and often offer a sub optimal product to consumers — blockchain has the potential to unravel this market. There are three ways where I see blockchain impacting mobility. Firstly, creating a network of non centrally and fractionally owned, shared access vehicles. Secondly, the management of this network through a tokenized marketplace for a trusted community to carry out maintenance and movement tasks. Finally, creating a trust network for consumers to access shared vehicles using a verified digital identity.”

– Chris Kirby, founder of Tomorrow’s Journey

While blockchain technology is a viable solution for developing such a platform, several other next-generation technologies would need to be incorporated to be able to drive scalability and sustainability. The platform would need to future-proof by provisioning for the combinatorial effects of these technologies.

An assessment of 320+ blockchain projects by Everest Group shows that enterprises use a combination of technologies in their blockchain projects to deliver enhanced stakeholder value. IoT and cybersecurity are the top two next-generation technology initiatives that are being leveraged to drive blockchain initiatives. Supply-chain and trade finance blockchain use cases are witnessing a combination of cloud, data security, and IoT to enhance the efficiency of the process as well as deliver better experience to the participants. Data using GSP-enabled devices as well as temperature monitoring sensors around the goods being transported are recorded in a distributed ledger hosted on cloud. This data allows to enforce smart security contracts as well as gain insights into the quality of product during the supply-chain. As blockchain technology as well as the varied use cases mature, we expect the industry to deploy analytics technologies as well as cognitive components on the distributed ledger data to derive insights for business process efficiency and enhanced customer experience. For the EV ecosystem, rise of autonomous vehicles and use of edge computing will create unique sources of data from vehicle telemetry that can be key inputs for the blockchain platform. This is in addition to the user, participant, and third-party data that the ecosystem could utilize. The ecosystem participants post gaining consumer consent can use this data to provide targeted offers and improve the overall customer experience. OEMs, BTS, and charging infrastructure providers will be able to understand friction points in the customer vehicle by analyzing this data on blockchain and solve issues around interoperability, standards incompatibility, and any other product performance issues.

The ecosystem will need the highest standards of security and compliance to ensure consumer data protection and eliminate data abuses. As the EV ecosystem grows in terms of data volume and variety, the participants are expected to use machine learning components to build prediction engines that can build pro-active offerings for customers and find ways to create more value for all stakeholders.
A platform-based approach to scale EV ecosystem

Implementing and scaling an EV ecosystem requires significant change management activities and a reimagining of business processes and operating models. A platform-based approach allows the ecosystem to scale in a sustainable, agile, and programmatic way that creates a favorable environment for players to participate and build robust offerings, while balancing demand and supply in the ecosystem.

The platform-thinking approach to EV ecosystem orchestration will help the industry move beyond a siloed view of product/services and align to customer experience. It also pushes the organizational boundaries to create a shared approach to value creation by moving beyond a siloed view of product/services and align it to customer experience outcomes.

The technology platform needs to be open source, interoperable, cloud-based, secured, AI-enabled, and have an architecture that is microservices-based and API-enabled for easy integration and customizations.

- **Open source, interoperable, cloud-based, secured, AI-enabled, and having an architecture that is microservices-based and API-enabled for easy integration and customizations**

- **Marketplace model to allow customers to choose the relevant offerings/apps. The modular nature of the platform will spur innovation in the ecosystem and allow ease of adoption of newer technologies as they are available and right-fit for the use case**

- **The platform should allow customers to control their access to data and should be compliant with industry regulations**

- **Change management (reimagination of business processes & operating models) and orchestration capabilities of the platform pushes the organizational boundaries to create a shared approach to value creation by moving beyond a siloed view of product/services and align it to customer experience outcomes**

The platform should allow customers to control access to their data and should be compliant with industry regulations. A platform-based approach will allow participants to create apps for customers in a marketplace model and drive innovation in offerings. The modular nature of the platform should allow ease of adoption of newer technologies as they are available and right-fit for the use case.
Appendix – survey details

EXHIBIT 21
Split of respondents across India and U.S.
Source: Everest Group EV ecosystem curation survey

EXHIBIT 22
Split of respondents across industries
Source: Everest Group EV ecosystem curation survey

EXHIBIT 23
Split of respondents as per their designation
Source: Everest Group EV ecosystem curation survey
About Everest Group

Everest Group is a consulting and research firm focused on strategic IT, business services, and sourcing. We are trusted advisors to senior executives of leading enterprises, providers, and investors. Our firm helps clients improve operational and financial performance through a hands-on process that supports them in making well-informed decisions that deliver high-impact results and achieve sustained value. Our insight and guidance empower clients to improve organizational efficiency, effectiveness, agility, and responsiveness. What sets Everest Group apart is the integration of deep sourcing knowledge, problem-solving skills and original research. Details and in-depth content are available at www.everestgrp.com.

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