Asian Journal of Managerial Science
ISSN: 2249-6300; (P) 2583-9810 (E)
Vol.14 No.2, 2025, pp.42-52

www.crijournals.org
DOI: https://doi.org/10.70112/ajms-2025.14.2.4297

Jugaad to Smart: A Conceptual Roadmap for India's Unorganized Automotive Aftersales Ecosystem to Survive the Technological Disruption

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(Received 17 July 2025; Revised 23 September 2025; Accepted 13 October 2025; Available online 25 October 2025)

Abstract **- This study examines a critical challenge facing India's unorganized automotive aftersales sector, which comprises millions of local garages and roadside mechanics serving price-sensitive customers through affordable, accessible services. The sector faces existential threats from technological disruptions including electric vehicles that require fewer mechanical repairs, advanced driver-assistance systems demanding specialized calibration equipment, and software-defined vehicles necessitating diagnostic expertise beyond traditional mechanical skills. The study aims to develop a comprehensive theoretical framework guiding sector adaptation and survival strategies. The authors integrate five theoretical perspectives—Resource-Based View, Dynamic Capabilities Theory, Ecosystem Theory, Diffusion of Innovations Theory, and Human Capital Theory—to create a five-pillar framework addressing skill development, technology access, digital integration, policy support, and collaborative ecosystems. The proposed framework identifies interconnected adaptation strategies emphasizing coordinated action among stakeholders, including government bodies, original equipment manufacturers, and industry associations. Key recommendations include modular training programs for mechanics, subsidized access to diagnostic tools, simplified digital platforms for customer engagement, supportive regulatory frameworks, and strategic partnerships between organized and unorganized sector players. The research addresses a significant knowledge gap by providing strategic guidance for a sector employing millions while serving substantial portions of India's automotive service market. However, the framework remains purely conceptual without empirical validation with limited practical market inputs, limiting its immediate practical applicability, which needs to be done subsequently in future research work. The study contributes with theoretical foundations, while systematic methodology for integrating these five theoretical perspectives and their implementation effectiveness needs to be studied through empirical testing.**

Keywords: **Unorganized Automotive Aftersales Sector, Technological Disruptions, Theoretical Framework, Adaptation Strategies, Skill Development**

I. INTRODUCTION

The Indian passenger car aftersales service market is on the threshold of a major transformation. The arrival of advanced technologies, such as artificial intelligence, data analytics, etc., is going to revolutionize the way vehicles are serviced and maintained. However, this transformation has created a significant threat to the unorganized passenger car aftersales service businesses, which have been a dominant player in the Indian market for decades. This unorganized sector, comprising local garages and roadside mechanics, has usually catered to the needs of price-sensitive customers, who prioritize affordability over quality and reliability. However, with the increasing adoption of advanced technologies in present vehicles, the complexity of repairs and maintenance has increased significantly.

This shift towards more digitally sophisticated vehicles has created a gap between the skills and expertise of unorganized sector players and the service/repair requirements of these modern vehicles. The unorganized aftersales service sector is the backbone of India's automotive industry, particularly in the two-wheeler (2W) and passenger car (PC) segments. This sector, comprising local garages, roadside mechanics, and independent workshops, caters to a substantial portion of the market due to its affordability, accessibility, and flexibility, particularly in rural and semi-urban areas. The unorganized sector value is multidimensional and deeply rooted in the social and economic environment of India.

These workshops offer significantly lower labor costs, as lower overheads allow them to provide services at more competitive prices than organized counterparts. They are typically located within neighborhoods, offering quick turnaround times and often doorstep services or on-the-spot repairs. Many customers have long-standing relationships with their local mechanics, built on personal trust and familiarity. They are often more adaptable to immediate customer needs and less bound by rigid scheduling or standardized procedures. They have a deep understanding of local driving conditions, common vehicle issues in the region, and availability of parts. Even though they lack formal training for new technologies, traditional mechanics possess strong practical problem-solving skills for mechanical issues. Despite these advantages, the unorganized sector grapples with challenges such as lack of standardized practices, inconsistent quality, limited access to genuine spare parts, and, most importantly, a significant

technological deficit. Existing studies highlight these structural issues but often fall short of providing rough insights into specific strategies for technological adaptation within this informal ecosystem. The magnitude of this problem can be verified through various established industry articles.

II. THE IMMINENT TECHNOLOGICAL DISRUPTION IN AUTOMOTIVE AFTERSALES SERVICES

The global automotive aftermarket is experiencing extraordinary technological disruption, fundamentally altering maintenance requirements and service delivery models. These changes are driven primarily by:

A. Electric Vehicles (EVs)

The shift from Internal Combustion Engine (ICE) vehicles to EVs drastically changes maintenance needs. EVs have significantly fewer moving parts, leading to reduced mechanical wear and lower routine maintenance frequency.

B. Battery Management Systems (BMS) & High Voltage Systems

These require specialized knowledge, diagnostic tools, and safety protocols for handling high-voltage batteries, motors, and power electronics. Repair involves software diagnostics and module-level component replacement rather than traditional mechanical fixes.

C. *Software-Defined Vehicles*

EVs are heavily dependent on software for performance optimization, charging, and diagnostics, requiring over-the-air (OTA) updates and advanced software troubleshooting.

D. *Advanced Driver-Assistance Systems (ADAS)*

Modern vehicles are equipped with an increasing number of sensors (cameras, radar, ultrasonic, LiDAR) that power features like adaptive cruise control, lane-keeping assist, and automatic emergency braking.

E. Precision Calibration

Any damage or even minor displacement of sensors (during a windscreen replacement or body repair) necessitates precise calibration using highly specialized and manufacturer-specific equipment. This is a complex and costly process requiring expert technicians.

The union of electric vehicles, advanced driver-assistance systems, universal connectivity, and digital customer interfaces signifies an exceptional wave of disruption for the automotive service industry. While these technologies promise enhanced safety, efficiency, and convenience for vehicle owners, they simultaneously impose a steep learning curve and major investment requirements on service providers. Workshops must change from a purely mechanical focus to a hybrid model that covers electrical engineering, software diagnostics, data analytics, and digital customer engagement. Those businesses that invest in cutting-edge equipment and continuous training, develop sophisticated digital platforms, and adopt a culture of transparency and professionalism will prosper, while those who cling to traditional methods will be reduced to as good as non-existent. Thus, these forthcoming technological disruptions are a major challenge to the unorganized aftersales service business.

III. LITERATURE REVIEW

The rapid technological evolution within the global automotive industry presents a complex challenge, particularly for the aftersales service sector. While many studies focus on Original Equipment Manufacturers (OEMs) and large organized service chains, the adaptation and survival of the unorganized aftersales sector, especially in developing economies like India, remain a critical yet underexplored area. This literature review examines the existing knowledge concerning the Indian automotive aftersales sector, the global technological disruptions impacting the aftermarket, and relevant theoretical frameworks for adaptation and identifies significant gaps in the research.

Wernerfelt (1984) suggests that firms derive competitive advantage by harnessing valuable resources, a foundational statement later formalized in Barney's (1991) VRIN framework—emphasizing resources that are valuable, rare, inimitable, and non-substitutable. Peteraf (1993) combines these arguments, highlighting resource heterogeneity and imperfect mobility as central to sustained competitive advantage. Contemporary works extend RBV's scope, with Srivastava et al. (2001) analyzing intangible assets and Baxter & Matear (2004) focusing on knowledge resources. Fernandez et al. (2000) review RBV's limitations, advocating its hybridization with the knowledge-based view to explain modern organizational adaptation. Sandner & Block (2011) explore resource arrangement in entrepreneurial contexts, further cementing RBV's relevance in dynamic markets. Sharma, P., & Gupta, A. (2023) investigate the long-term customer loyalty towards India's unorganized automotive workshops, emphasizing the role of interpersonal trust, perceived affordability, and geographic proximity.

Using a qualitative approach, the researchers highlight that while service standardization is lacking, the personalized, unorganized relationships and perceived honesty of local mechanics form a strong competitive advantage, crucial for any future adaptation strategy. This research highlights the core "resource" from an RBV perspective that unorganized players must leverage. Teece, Pisano, & Shuen (1997) define dynamic capabilities as a firm's capacity to adapt resources and competencies to rapidly changing

environments. Eisenhardt & Martin (2000) expand this scope, depicting dynamic capabilities as "organizational and strategic routines" that underpin new resource configuration, arguing for their contingent nature according to market dynamism. Helfat et al. (2007) examine how firms sense, seize, and transform, with Galvin et al. (2014) providing empirical evidence of dynamic capabilities' role in strategic alliances. Kapoor (2020) reviews measurement challenges, while Albort-Morant et al. (2018) apply dynamic capability frameworks to innovation ecosystems. Moore (1993) introduces business ecosystems as dynamic networks defined by the coevolution of economic actors, outlining competitive "community" formation. Iansiti & Levien (2004) refine the analogy, describing keystone, dominant, and niche roles that shape ecosystem health.

Adner (2017) reconceptualizes ecosystem boundaries, while Gawer & Cusumano (2014) explore platform leadership. Recent studies, such as Shou et al. (2022), focus on digital and innovation ecosystems. Das, A., & Verma, K. (2022) analyze the emergence of digital aggregator platforms (e.g., GoMechanic) in the Indian automotive aftersales sector from an ecosystem theory perspective. It discusses how these platforms attempt to bridge the gap between unorganized workshops and digitally savvy consumers, offering standardization and lead generation. While acknowledging the potential for formalization and efficiency gains, the study also highlights challenges related to quality control and commission structures, suggesting a complex relationship within the evolving ecosystem. Rogers (2003) refines his model of innovation adoption with five adopter categories and the S-curve of diffusion. Parisot (1995) extends Rogers' theory to technology adoption in educational contexts, while Dearing (2009) applies the framework to public health innovation.

Medlin (2001) reviews the theory's use in agricultural extension, and Barker (2004) explores cultural determinants of diffusion. Mishra, R., & Patel, V. (2021) use the Diffusion of Innovations Theory to investigate the slow adoption rate of even basic digital diagnostic tools among informal mechanics in rural India. Findings suggest that high initial cost, complexity, perceived lack of immediate relative advantage for older vehicle fleets, and limited opportunities for trialability are significant disincentives. The study recommends subsidized access, hands-on demonstrations, and peer-led training to accelerate adoption. Schultz (1961) proposes education and skill development as major forms of capital investment, foundational to economic productivity. Becker (1964) expands on this, arguing for quantifiable returns to human capital.

Heckman (2006) analyzes the role of early childhood investments, while Mincer (1974) examines schooling and labor market outcomes. The World Bank's Human Capital Project (2025) tracks human development metrics globally. Roy, D., & Chatterjee, S. (2023) highlight the existing skill gaps among Indian automotive technicians concerning EV maintenance, specifically high-voltage systems, battery diagnostics, and power electronics. Using the human capital theory, the researchers argue that without significant investment in reskilling and upskilling programs, a severe shortage of qualified EV technicians in the unorganized sector will emerge, posing a threat to the overall EV adoption ecosystem. Prakash, A., & Devi, P. (2023) assess the digital readiness of small, unorganized automotive workshops in India, focusing on their adoption of online booking, digital payments, and customer relationship management tools.

The findings reveal a significant gap in digital literacy and infrastructure but also a willingness to adopt simple, user-friendly solutions. This highlights the Diffusion of Innovations perspective, thereby focusing on the need for highly compatible and low-complexity digital tools. Mohanty, S., & Basu, P. (2021) review various government schemes and initiatives aimed at skill development in India's automotive sector. While acknowledging programs for formal vocational training, the researchers highlight the limited reach and support for the largely unorganized workforce. They recommend more decentralized, affordable, and industry-partnered training models, reinforcing the human capital theory's call for strategic investment in workforce capabilities.

Hart's (1973) seminal ethnography establishes the informal sector's role in urban West African economies, while De Soto (1989) provides a framework for understanding informality as an engine of entrepreneurship in developing countries. Recent literature, such as Portes & Sassen-Koob (1987), explores informality in the context of migration and global restructuring. Raijman (2001) investigates entrepreneurial strategies in informal markets. Li, J., & Chen, H. (2020). A comparative case study from a similar developing economy (China) examines how informal auto repair shops have adapted to increasing vehicle complexity and urbanization. It identifies strategies like specialization (e.g., in electronics), forming informal networks for knowledge sharing, and migrating to aggregator platforms. While not directly India-focused, it provides valuable insights into the dynamic capabilities and ecosystem integration observed in similar informal sectors.

IV. RESEARCH GAP

While the general impact of technological disruption on the automotive service industry is well documented, there is a significant gap in the research done in identifying, evaluating, and proposing specific, actionable, and survival strategies tailored for India's unorganized automotive aftersales sector. Despite its critical role, there's hardly any comprehensive theoretical framework guiding how India's unorganized aftersales sector should adapt and survive these disruptions. This gap includes a lack of in-depth understanding and realistic models. Some of them are:

1. Lack of innovative financial mechanisms (e.g., microfinancing, leasing of equipment, etc.) that enable

small, unorganized workshops to quickly acquire the necessary new tools and technologies at an affordable cost.
2. Significant gap in understanding effective, scalable, and affordable training methodologies suitable for the unorganized Indian mechanic. Need to explore innovative delivery models, peer-to-peer learning, modular certifications, and industry-academia collaborations specifically designed for this informal workforce.
3. Lack of digital integration. Need to develop or promote user-friendly, affordable digital platforms and tools specifically designed for the unorganized sector to facilitate online presence, booking, payments, and basic data utilization, bridging the existing digital divide. Exploration of successful models (e.g., aggregator platforms like GoMechanic) can help formalize, standardize, and connect unorganized workshops without undermining their local advantages.
4. Lack of research focusing on specific policy recommendations and government intervention models to safeguard livelihoods and facilitate a just transition for this large informal workforce.

Addressing these research gaps is highly important for ensuring the sustainable livelihood of millions employed in India's unorganized automotive aftersales sector and also for maintaining a robust service ecosystem, especially for the rapidly increasing fleet of advanced vehicles.

V. RESEARCH PROBLEM

From the gaps identified above, the research problem in question is, "How can India's largely unorganized automotive aftersales service sector effectively adapt and survive the impending technological disruptions driven by EVs, ADAS, connected vehicles & telematics, and the digitization of customer interfaces," given their natural constraints of—

1. high cost of specialized EV diagnostic tools, ADAS calibration equipment, and proprietary software subscriptions;
2. requirement of expertise in high-voltage electrical systems, advanced electronics, software diagnostics, and data analytics, with limited access to formal, affordable, and relevant training;
3. challenges in digital integration due to varying levels of digital literacy, internet access, and financial resources;
4. Implement standardized processes and ensure quality control.

VI. OBJECTIVES OF THE STUDY

Following are the research objectives:

1. To analyze the role of government bodies, automotive OEMs, and industry associations in providing support, incentives, and regulatory frameworks to facilitate the transition and survival of the unorganized aftersales sector.
2. To propose a comprehensive roadmap or framework outlining practical steps and policy recommendations for India's unorganized automotive aftersales sector to sustainably adapt and survive the ongoing technological disruptions.

VII. METHODOLOGY

Though this comprehensive study is based on secondary data sources, specific stakeholder categories like workshop owners, mechanics, OEM representatives, and policymakers were consulted through informal methods to a limited extent to validate these secondary sources. However, no organized and formal structure of these interactions, like interviews, surveys, focus groups, etc., was conducted, as data collection through primary data sources was not the base of this study.

VIII. CONCEPTUAL FRAMEWORK

While the "what" of technological disruption is clear, the "how" for India's unorganized aftersales sector remains largely an unexplored territory in academic literature. This highlights the critical need for a specific theoretical framework or an integrated approach that combines elements of resource-based view, dynamic capabilities, ecosystem theory, diffusion of innovations, and human capital theory. However, these need to be applied strictly to the unique socio-economic and technological situation of India's unorganized automotive aftersales market. Such a framework would provide a robust foundation for identifying practical adaptation and survival strategies.

A. Theoretical Concepts

To understand how India's unorganised aftersales sector can adapt and survive, the following various theoretical concepts which offer a valuable structure, needs to be understood.

B. Resource-Based View (RBV)

This theory suggests that a firm's sustained competitive advantage comes from its valuable, rare, unmatched, and non-interchangeable resources and capabilities. For the unorganised sector, traditional "resources" include:

1. *Trust and Personal Relationships* – Long-standing customer loyalty.
2. *Affordability* – Competitive pricing due to low overheads.
3. *Local Presence and Accessibility* – Convenient neighbourhood locations.
4. *Practical Experience* – Deep hands-on mechanical troubleshooting skills.

RBV suggests that while these traditional resources are valuable, they may become less unique or interchangeable as new technologies reduce mechanical repair frequency. The key lies in how the unorganised sector can leverage these existing resources (e.g., using trust to transition customers to new services) while simultaneously developing new, technologically relevant capabilities (e.g., diagnostic software proficiency, EV battery repair skills).

C. Dynamic Capabilities Theory

Building on RBV, this theory focuses on the business's ability to sense, seize, and reconfigure its resources and competencies to adapt to rapidly changing environments. For the unorganised sector:

1. Sensing: How do these workshops identify and interpret signals of technological change? (increasing EV sales, ADAS features in incoming vehicles, changing customer demands) This involves market scanning, learning from OEMs/organised players, and understanding regulatory shifts.
2. Seizing: Once sensed, how do they mobilise resources to grasp new opportunities? This could involve investing in new tools, seeking training, or making partnerships. The challenge here is prominently on getting capital and structured information.
3. Reconfiguring: How do they transform their existing processes, skill sets, and business models to integrate new technologies? This implies a shift from mechanical to diagnostic-heavy work, adopting digital tools, and altering their service offerings.

This theory highlights the need for continuous learning and organisational agility, which is particularly difficult in highly informal settings of the unorganised sector.

D. Ecosystem Theory

This perspective views the automotive industry not as a linear supply chain but as an interconnected network of organisations, technologies, and stakeholders. The unorganised aftersales sector is one of the most important components of this broader automotive ecosystem. Ecosystem theory suggests that adaptation is not solely an internal organisational effort but also depends on how effectively these workshops integrate and collaborate with other players, such as:

1. OEMs and Tier-1 Suppliers: For access to genuine parts, diagnostic tools, and technical information for newer technologies.
2. Technology Providers: For software, diagnostic solutions, and digital platforms.
3. Training Institutions: For formal skill development.
4. Aggregators and Platforms: As intermediaries that can connect unorganised players to customers and digital resources.

The theory emphasises the importance of shared value creation and interoperability within the network. For the unorganised sector, adopting such collaboration and reducing competitive friction with organised players is very important for survival.

E. Diffusion of Innovations Theory

This theory explains how, why, and at what rate new ideas and technology spread through cultures. It identifies key attributes influencing adoption:

1. *Relative Advantage:* How much better is the new technology/practice than the old one? (Faster diagnostics, more accurate repairs).
2. *Compatibility:* How consistent is it with existing values, experiences, and needs? (Does it fit their current business model, or is it too disruptive?).
3. *Complexity:* How difficult is it to understand and use? (Highly complex EV/ADAS systems can be a major barrier).
4. *Trial-ability:* Can it be experimented with, on a limited basis? (Affordable modular training, shared equipment access).
5. *Observability:* Are the results of the innovation visible to others? (Seeing peers successfully adopt new tech can encourage others).

Applying this theory helps understand the barriers and facilitators to technology adoption within the unorganised sector, emphasising the need for innovations that are perceived as less complex, more compatible, and offering clear advantages.

F. Human Capital Theory

This theory suggests that investments in human knowledge, skills, and abilities (human capital) lead to increased productivity and economic value. For the unorganised automotive aftersales sector, where labour is a primary resource, the importance of human capital development is of greatest importance.

1. Upskilling: Investing in training mechanics in EV technology, ADAS calibration, and software diagnostics directly enhances their human capital.
2. Education and Certification: Formal education and industry-recognised certifications can boost credibility and access to advanced work.
3. Retention: Ensuring that skilled mechanics remain within the sector rather than migrating to organised players or other industries.

This theory emphasises that technology adoption cannot happen without a corresponding investment in the skills of the people who will implement and manage that technology.

Based on the above, we propose a multi-pillar theoretical framework designed to guide the adaptation and ensure the survival of India's unorganised automotive aftersales

ecosystem. It moves beyond identifying problems, recognising the sector's unique constraints in capital, skills, and formal organisation. The framework is built on the understanding that survival centres on leveraging existing strengths (trust, affordability, transparency) while proactively developing new capabilities through a supportive and collaborative ecosystem. Apart from these, alternative theoretical perspectives and critical literature need to be studied and this framework further refined.

TABLE I THEORETICAL SYNTHESIS TABLE

Theory	Foundational Work(s)	Core Contribution	Recent Adaptations / Extensions	Key Reference(s)
RBV	Wernerfelt (1984); Barney (1991); Peteraf (1993)	VRIN, resource heterogeneity	Intangible assets, hybrid models, knowledge assets	Peteraf, M.A. (1993). SMJ, 14(3), 179-191.
Dynamic Capabilities	Teece *et al*. (1997); Eisenhardt & Martin (2000)	Resource adaptation, routines	Measurement, empirical studies, ecosystems	Teece, D.J. *et al.* (1997). SMJ, 18(7), 509-533.
Ecosystem	Moore (1993); Iansiti & Levien (2004)	Business networks, coevolution	Digital, innovation, platform ecosystems	Moore, J.F. (1993). HBR, 71(3), 75-86.
Diffusion of Innovations	Rogers (2003)	Adoption curve, multi-context	Tech, health, education, social innovation	Rogers, E.M. (2003). Diffusion of Innovations, 5th ed.
Human Capital	Schultz (1961); Becker (1964)	Education, skill, productivity	Returns to education, health, global indices	Becker, G.S. (1964). Human Capital, Univ. Chicago Press.
Informal Sector	Hart (1973); De Soto (1989)	Informality, entrepreneurship	Migration, globalisation, urban resilience	De Soto, H. (1989). The Other Path, Harper & Row.

IX. PROPOSED FRAMEWORK

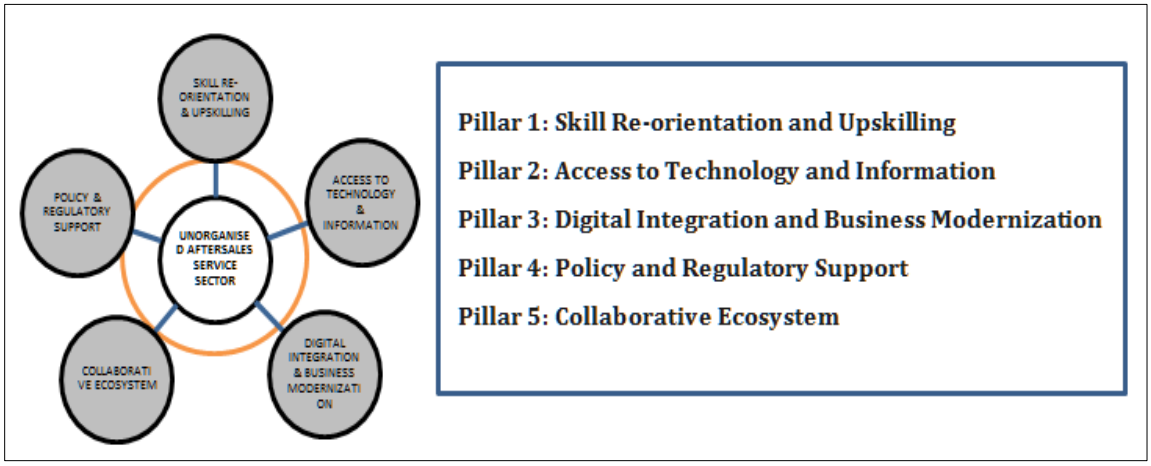

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Fig.1 Conceptual Diagram of the Proposed Framework

Our proposed framework is structured around five interconnected pillars, each addressing a critical dimension of adaptation. These pillars represent areas where concentrated efforts from various stakeholders can enable a smooth and sustainable transition for the unorganized sector. Greater insights can be obtained by creating a theoretical synthesis matrix identifying areas of convergence, divergence, and complementarity among these five theories.

A. Pillar 1: Skill Re-orientation and Upskilling

The foundational challenge for the unorganized sector lies in its deeply entrenched mechanical skill base, which is increasingly inadequate for the demands of new-age vehicles. This pillar focuses on bridging the formidable gap from mechanical to electrical, electronic, and software competencies.

1. Modular, Practical Training Programs: Trainings must be designed specifically for the existing workforce, many of whom may have low formal literacy. Programs should be modular, allowing mechanics to learn at their own pace, and heavily emphasize hands-on experience. Instead of lengthy classroom sessions, short, intensive

workshops focused on practical applications would be more effective.
2. Certification & Recognition: Formalizing skills through industry-recognized certifications (ASDC, NSDC, or OEM-backed programs) is essential. These certifications would not only authenticate their new competencies but also enhance credibility, attract new customers, and allow access to more complex repairs.
3. Emphasis on Foundational Digital Literacy: The ability to use smartphones for diagnostic apps, online platforms, and digital payments is no longer a luxury but a necessity. Trainings must incorporate basic computer and smartphone usage, internet navigation, and understanding of simple digital interfaces.

B. Pillar 2: Access to Technology and Information

The advanced nature of modern vehicles necessitates sophisticated tools and comprehensive technical information, which are often expensive and difficult for unorganized workshops to acquire. This pillar focuses on enabling accurate diagnosis and repair.

1. Affordable Diagnostic Tools: The prohibitive cost of multi-brand scanners, ADAS calibration equipment, and battery testers is a major barrier. Solutions must include subsidized access programs, microfinancing options specifically for tool acquisition, or the establishment of shared facility centers where multiple workshops can collectively invest in and utilize high-cost equipment on a pay-per-use model.
2. “Right to Repair” Implementation: Policy machineries are important to ensure that manufacturers share essential service manuals, wiring diagrams, diagnostic software updates, and technical bulletins with independent repair shops at fair and reasonable costs. This levels the playing field and ensures that unorganized workshops are not locked out of servicing new vehicles due to lack of information.
3. Genuine Parts Availability: Access to genuine or quality equivalent spare parts for new technologies (EV components, ADAS sensors) is vital. Mechanisms to ensure accessible and affordable supply chains for these specialized parts, through partnerships with component manufacturers or authorized distributors, are necessary.
4. Online Technical Repositories: Creation of accessible digital platforms (web-based or app-based) for technical data, repair procedures, wiring diagrams, and software updates for various vehicle models. These repositories need to be user-friendly and available in vernacular languages to maximize utility for the unorganized sector.

C. Pillar 3: Digital Integration and Business Modernisation

The shift towards digital customer interfaces and data-driven operations is unavoidable. This pillar focuses on leveraging digital tools for operational efficiency and enhanced customer engagement within the unorganized sector.

1. Simplified Digital Platforms: Development of user-friendly mobile applications for workshops to manage bookings, create digital job cards, generate transparent billing, and communicate directly with customers. These apps should be built in, require minimal data entry, and potentially support voice commands for ease of use.
2. Online Marketplaces/Aggregators: Platforms that connect customers directly to unorganized workshops can significantly enhance visibility and customer acquisition. These platforms should focus on promoting transparency (standardized pricing for common services, customer reviews, etc.) while allowing workshops to maintain their independence and brand.
3. Digital Payment Adoption: Encouraging the widespread adoption of cashless transactions (UPI, mobile wallets, etc.) for seamless and secure payments, reducing reliance on cash and improving financial record-keeping.
4. Basic Online Presence/Marketing: Assisting workshops in establishing a simple yet effective digital footprint, such as a Google My Business listing, basic social media presence, or profiles on local service directories, to improve discoverability and attract digitally savvy customers.

D. Pillar 4: Policy and Regulatory Support

Government and regulatory bodies play a central role in creating an enabling environment for the unorganized sector's transition. This pillar emphasizes supportive policies that formalize, incentivize, and regulate the sector without stifling its unique advantages.

1. Simplified Licensing and Registration: A streamlined and accessible process for unorganized workshops to register and obtain licenses. This validation can provide access to financial aid, training programs, and greater legal protection while also allowing for better data collection on the sector.
2. Financial Incentives: Targeted subsidies, low-interest loans, and grants specifically designed for technology upgrades (EV charging infrastructure, diagnostic equipment) and skill development programs for unorganized workshops. This direct financial support can significantly reduce the initial capital burden.
3. Quality Standards and Consumer Protection: Developing practical and achievable quality standards for EV and ADAS services within the unorganized sector. These standards should be accompanied by a clear certification process and a consumer protection mechanism that builds trust in certified unorganized workshops while also ensuring accountability.
4. Infrastructure Support: Potential for government- or private sector-led establishment of common facility centers or technology hubs in clusters of unorganized workshops. These centers could provide shared access to expensive tools, technical libraries, and training facilities.

E. Pillar 5: Collaborative Ecosystem

No single entity can drive this transformation alone. This pillar stresses the importance of adopting active partnerships and collaborations among various stakeholders within the broader automotive ecosystem.

1. OEM-Unorganized Sector Partnerships: Original Equipment Manufacturers can collaborate with independent workshops for specific services (out-of-warranty repairs for certain components), supply of genuine parts at competitive prices, or even basic training modules. This could involve recognizing certified unorganized workshops as satellite service points for specific repairs.
2. Dealer-Unorganized Sector Partnerships: Authorized dealerships could partner with local unorganized workshops, referring out-of-warranty mechanical work that they might not prioritize, supplying genuine parts, or offering access to specialized tools and training (e.g., for ADAS calibration where dealers have the equipment).
3. Skill Development Bodies & Industry Associations: Organizations like ASDC, ACMA (Automotive Component Manufacturers Association), and local mechanic associations must play an active and long-drawn-out role in curriculum development, standardized training delivery, and certification. They need to advocate for the needs of the unorganized sector.
4. Technology Providers: Companies developing diagnostic tools, software, and digital platforms should actively engage with the unorganized market to create solutions that are not only technologically advanced but also affordable, user-friendly, and compatible with their operational realities.
5. Digital Aggregators/Start-ups: These platforms can act as key facilitators, standardizing operations, providing market access, and sometimes even facilitating access to training and financing for unorganized workshops, thereby accelerating their integration into the digital economy.

This integrated framework offers foundational insights for India's unorganized automotive aftersales ecosystem. By simultaneously addressing skill development, technology access, digital integration, policy support, and fostering a collaborative environment, this framework aims to transform an endangered sector into a robust and important component of India's evolving mobility landscape, ensuring both economic viability and quality service delivery for future vehicles.

X. INTERDEPENDENCIES AND DYNAMICS OF THE FRAMEWORK

The proposed five-pillar theoretical framework for the survival of India's unorganized automotive aftersales ecosystem is not a collection of isolated strategies but a tightly interwoven system. Each pillar influences and is influenced by the others, creating a complex yet synergistic structure. Understanding these interdependencies is important for effective implementation and for ensuring the holistic transformation of the sector. The strength of this framework lies in the synergistic interplay between its components.

A. Skill Re-orientation (Pillar 1) & Access to Technology & Information (Pillar 2)

1. Skill reorientation is fundamentally dependent on access to the same technologies and information it intends to teach. Mechanics cannot be effectively trained in EV diagnostics (Pillar 1) without hands-on access to affordable diagnostic tools, EV components, and technical manuals (Pillar 2). On the other hand, simply providing advanced tools without the necessary skills makes them useless.
2. As mechanics acquire new skills, they are better prepared to understand and utilize complex diagnostic tools and interpret technical data. This increased proficiency then drives demand for better access to up-to-date technology and information.

B. Digital Integration (Pillar 3) & Skill Re-orientation (Pillar 1) / Access to Technology & Information (Pillar 2)

1. The success of simplified digital platforms (Pillar 3) depends on the foundational digital literacy emphasized in Pillar 1. Mechanics need to be comfortable with smartphones and basic computing to use booking apps, digital job cards, and online technical repositories.
2. Digital platforms can provide data (common faults, service history) for training programs on identifying emerging skill needs (Pillar 1) and data regarding the most frequently required types of diagnostic tools (Pillar 2).
3. Online technical repositories (Pillar 2) become truly effective only when integrated into digital platforms (Pillar 3) that mechanics can easily access on their devices.

C. Policy and Regulatory Support (Pillar 4) as an Enabler

1. Policy support is of prime importance. Financial incentives (subsidies, low-interest loans) directly facilitate the acquisition of expensive diagnostic tools (Pillar 2) and enable workshops to invest in training programs (Pillar 1) for their staff. Without this support, the financial barriers for the unorganized sector are challenging.
2. The implementation of “Right to Repair” legislation is a direct policy mechanism that ensures independent workshops have equitable access to the technical information and software updates, which are important for servicing modern vehicles.

3. Simplified licensing and registration (Pillar 4) can encourage workshops to validate, which in turn makes them eligible for government-backed digital integration initiatives (Pillar 3) and financial support.
4. Policy-driven quality standards not only protect consumers but also create a framework for certification that can be developed and enforced through collaboration with industry associations (Pillar 5).

D. Collaborative Ecosystem (Pillar 5) as the Central Integrator

1. Skill development bodies and industry associations (Pillar 5) are important for designing, delivering, and certifying the modular training programs. OEM and dealer partnerships (Pillar 5) can provide expertise, training infrastructure, and access to proprietary knowledge.
2. Partnerships between technology providers (Pillar 5) and the unorganized sector can lead to the development of affordable diagnostic tools. Common facility centers (Pillar 4) require collaborative efforts (Pillar 5) for setup and management.
3. Digital aggregators and start-ups (Pillar 5) are the primary drivers for creating and promoting the simplified digital platforms needed for business modernization. Their success depends on the willingness of unorganized workshops to collaborate & adopt.
4. Industry associations and other stakeholders within the collaborative ecosystem (Pillar 5) are essential for advocating for the necessary policy and regulatory support (Pillar 4) from the government. They represent the collective voice of the sector.

E. Example of Interdependence of the Framework Pillars

Imagine an unorganized mechanic wanting to service an EV. They need expertise in high-voltage systems (Pillar 1). To gain these skills, they require access to practical training (Pillar 1) and potentially affordable diagnostic tools (Pillar 2). The affordability of these tools might come from financial incentives (Pillar 4) provided by the government. The training itself might be delivered by a skill development body (Pillar 5) in partnership with an OEM (Pillar 5) and facilitated by a simplified digital platform (Pillar 3) for booking the course and accessing materials. Once trained and equipped, the mechanic can then use a digital booking app (Pillar 3) to attract EV customers, further cementing their role within the collaborative ecosystem (Pillar 5).

XI. SIGNIFICANCE OF THE STUDY

This study is important for the academic industry, as it contributes to the literature on informal economies, technological adoption in traditional sectors, and flexibility of strategies. It aims to provide insights to policymakers, skill development bodies, manufacturers, multi-brand workshops, and the unorganized players themselves. Also, importantly, it reports livelihood concerns of the vast workforce and ensures affordable service access for a large population.

XII. DISCUSSION

Despite its comprehensive nature, implementing this framework will face significant hurdles like resistance to change, new funding and investment, scalability and reach, quality control and standardization, data privacy and security, OEM and organized sector buy-in, sustainability of aggregator models, and technological obsolescence.

1. The unorganized sector is categorized by traditional practices and a strong reliance on unspoken knowledge. There can be natural resistance to adopting new technologies, changing established work routines, or reinforcing operations due to fear of the unknown, perceived complexity, or loss of autonomy.
2. While policy support is proposed, securing adequate and sustained funding for massive skill reorientation, subsidized tool access, and infrastructure development will be a huge challenge. The scale of the unorganized sector requires substantial financial commitment from government, industry, and private players.
3. Reaching millions of geographically dispersed workshops, especially in remote areas, with standardized training and technology access presents a logistical nightmare. Developing delivery models that are effective across diverse regional backgrounds, language barriers, and literacy levels is a complex challenge.
4. Ensuring consistent quality of service and adherence to standards across a highly fragmented and informal sector will be difficult. Monitoring compliance and building consumer trust in newly certified workshops requires robust mechanisms.
5. As digital integration increases, managing customer data and ensuring cybersecurity for smaller, less tech-savvy workshops becomes a concern.
6. Convincing OEMs and large organized players to genuinely collaborate and share resources/information with the unorganized sector, which they traditionally view as competition, will require strong incentives, rules & regulations, and policy mandates.
7. While digital aggregators offer a path to modernization, their long-term business models and their impact on the profitability and independence of individual workshops need careful monitoring to ensure mutual benefit.
8. The pace of automotive technological change is rapid. Any solutions provided (e.g., diagnostic tools) have a risk of becoming obsolete quickly, necessitating continuous updates and further investment.

Overcoming these challenges requires a multi-stakeholder approach characterized by long-term commitment, flexible strategies, and a deep understanding of the unique dynamics of India's unorganized aftersales ecosystem.

XIII. CONCLUSION

The automotive aftersales sector faces intense disruption from EVs, ADAS, and digitized customer interfaces, posing an existential threat to India's unorganized repair ecosystem. This study concludes that the unorganized sector's survival hinges on a comprehensive, multi-dimensional approach, rather than isolated adjustments. A proposed five-pillar theoretical framework guides this transition: skill reorientation & upskilling, access to technology & information, digital integration & business modernization, policy & regulatory support, and a collaborative ecosystem. This framework acknowledges the unorganized sector's financial, educational, and structural constraints, emphasizing the deep interdependencies among the pillars (e.g., skill development needs access to tools; technology adoption requires financial incentives, etc.). A shared ecosystem acts as a central integrator, encouraging collaboration among OEMs, training bodies, technology providers, and government entities. Despite implementation challenges like resistance to change, funding, scalability, and quality control, this framework addresses a crucial research gap on how resource-constrained informal sectors can adapt to significant technological shifts. Empowering the unorganized sector through this framework is important for securing millions of livelihoods, ensuring affordable and quality vehicle maintenance, and supporting India's mobility goals. Its decline would have severe social and economic implications, particularly in rural and semi-urban areas. Investment in training and upskilling is highly important to soften these impacts. In conclusion, the future of the unorganized passenger car aftersales service business is uncertain and challenging, as it will depend on its ability to adapt and evolve in response to the challenges and opportunities presented by advanced technologies. As customers become increasingly sensitive and demanding, the unorganized sector will need to prioritise quality, reliability, and innovation to remain relevant and competitive in the period of advanced technologies. The framework provides a guiding structure, but its success will ultimately depend on the political will, industry collaboration, and the adaptive capacity of the mechanics themselves.

XIV. FUTURE SCOPE FOR RESEARCH

Much can be done in this sector, as it is the most neglected part of the industry in India. Below are some of the future research scopes of work.

1. A survey can be conducted to assess the current state and preparedness of India's unorganized automotive aftersales sector in terms of the proposed five pillars: existing skills, technological infrastructure, financial capacity, awareness regarding the forthcoming technological disruptions, and specific challenges faced by unorganized workshops related to acquiring specialized tools and equipment, upskilling their workforce, integrating digital platforms for customer interaction, etc.
2. Exploratory research can be done to evaluate innovative financial models and collaborative frameworks (e.g., micro-financing schemes, equipment leasing, cooperative procurement, aggregator models, or shared service centers) that enable unorganized workshops to invest in necessary technology and training tailored for them, focusing on practical hands-on training that enhances operational efficiency, customer reach, and transparency, considering their varying levels of digital literacy and infrastructure.
3. Greater insights can be obtained by creating a theoretical synthesis matrix identifying areas of convergence, divergence, and complementarity among these five theories.
4. The feasibility of adding additional theoretical concepts like networking theory, etc., needs to be studied and added, if required.

XV. DEFINITIONS

“unorganized” (lack of formal structure), “informal” (outside regulatory framework), “traditional” (established practices), “jugaad” (frugal innovation), “dynamic capabilities” (sensing, seizing, and reconfiguring abilities), and “ecosystem theory” (interdependent value creation networks).

All the Authors declare that they have no conflicts of interest.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Use of Artificial Intelligence (AI)-Assisted Technology for Manuscript Preparation

The authors confirm that no AI-assisted technologies were used in the preparation or writing of the manuscript, and no images were altered using AI.

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