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Optimization of Auto-Repair Practice in Benin City, Edo State, Nigeria through Evidence-Based Strategies

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Abstract **Original Research Article**

This study was designed to optimize auto-repair practice in Benin City by assessing the already existing maintenance methods, identifying the major challenges confronting technicians, spare-parts dealers, car owners, and proposing evidence-based strategies for improving the expected efficiency and reliability. A descriptive survey design supported by a mixed-method approach was adopted for the effective and resourceful conduct of the research problem. Structured questionnaires containing Likert-scale, multiple-choice and dichotomous items were purposively administered to 200 respondents comprising 100 auto technicians/workshop owners, 35 spare-parts dealers, and 65 car owners. A total of 174 valid responses were obtained. This represents 87.0% response rate. Data were analyzed with Microsoft Excel and SPSS, combining descriptive statistics with the Z-test for proportions, at the 0.05 significance level, to test five formulated hypotheses. Results showed that workshop land tenure is overwhelmingly informal with only 4.5% of technicians owning their premises. While capacity for servicing modern vehicles remained weak, as only 24.7% of workshops had specialized tools and 29.2% had diagnostic equipment. Hypothesis testing confirmed workshop facility availability (Z = 6.678), technical training (Z = 6.890), and spare-parts availability/accessibility (Z = 6.337) each significantly influenced repair efficiency, quality, and speed respectively. Customer satisfaction was driven principally by proximity to spare-parts markets (Z = 3.641) rather than by workshop type or technician competence alone. Most decisively, technicians (74.2%-78.7%) and spare-parts dealers (76.7%-86.7%) showed statistically significant preference for relocating to a centralized mechanic village over scattered workshop locations (Z = 2.921-5.406). The study concludes that auto-repair practice in Benin City, Edo State, Nigeria is only moderately effective, constrained by facility inadequacy, a training-adequacy gap, and dependence on spare-parts proximity.

Keywords: auto-repair practice; mechanic village; vehicle maintenance; workshop optimization; spare parts.

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1. Introduction

The automobile use in Nigeria has grown rapidly becoming integral part of the economic and social life of the citizens (Ukonze*et*, 2020). With cities was critically pinned to Benin City relying heavily on road transport for the movement of both goods and people. Vehicles deteriorate over time through friction, heat, vibration and road irregularities. The vehicles were often got spoilt due to the high level of bad poor roads,

overloading and irregular maintenance by the users. Maintenance is therefore essential for safety and reliability automobile vehicles and becomes more urgent as vehicle numbers grow day by day in our society (Thompson, 2022). Nigerian vehicle maintenance, however, remains largely informal and reactive. Owners often service their vehicles only after a fault occurs which often compounded by counterfeit parts and the near-absence of certified technicians (Fajimi*et,* 2024). There are parts of the conditions that constrain the effective auto-repair practice in some growing cities such as Benin City in Nigeria (Idowu, 2023).

Modern vehicles repairs are currently increasingly relying on electronic and computerized systems as a result of rising in technical demands that are beyond the experience-based diagnosis of local approaches (Hossain *et al.,* 2024; Denton, 2020). Many technicians are still relying on informally acquired mentor-based knowledge and skill that often lead to misdiagnosis and prolonged downtime. Local workshop practices often lack the expected and effective diagnostic scanners and similar equipment procedures that are often needed for the repair of automobile vehicles in our society (Oluwaseyi and Sunday, 2020). Many also operate without adequate shelter or drainage (Baidoo and Odum-Awuakye, 2015). The continued importation of used ('Tokunbo') vehicles that currently dominate the national fleet adds further to the diagnostic burden (Ayetor*e,* 2021). Weak regulation and counterfeit spare parts compound these inefficiencies.

The informal, artisan-based repair sub-sector often sustains most of the Nigeria's ageing fleet in the absence of formal service infrastructure (Afolabi, 2020). Optimization in this context extends beyond workflow improvement to the strategic application of management, technology and human-resource capability (Song, 2021). Standardization raises productivity elsewhere and shared diagnostic centers can help in the resource-constrained workshops in order to absorb the cost of modern tools (Suhaib, 2024). The existing studies have shown concentrations on formal, well-equipped workshops and leaving limited evidence on how such strategies can be effectively applied within the informal clusters of typical Nigerian cities. This study addresses such gap by assessing the existing maintenance practices in Benin City, Edo State, Nigeria; using evidence-based strategies for improving the expected efficiency and reliability in order to determine the major challenges affecting them, and analyzing the statistical relationship between workshop/spare-parts factors and vehicle reliability.

2. Research Methodologies

This practice led research problem was conducted based on effective selection of notable and acceptable evideance-based research methodologies in five hypotheses were tested: workshop-facility availability (H1), technical training (H2) and spare-parts availability/accessibility (H4) each significantly influence repair efficiency, quality or speed; customer satisfaction is significantly affected by workshop type, service quality and proximity to spare parts (H3); and technicians prefer relocating to a centralized mechanic village over scattered locations (H5).

A descriptive survey design with a dominant-quantitative mixed-method approach was adopted (Creswell and Creswell, 2018), using structured questionnaires (multiple-choice, dichotomous and five-point Likert items) supplemented by a few open-ended items. The study was conducted in Benin City, Edo State, Southern part of Nigeria (Eghomwanre and Akharame, 2025), chosen for its concentration of formal and informal workshops and growing vehicular activity. The target population and sample comprised 200 respondents in three categories (Table 1) shows this evidences clearly: 100 technicians/workshop owners, 35 spare-parts dealers and 65 car owners. A purposive sampling technique was used, as no formal register of workshops or dealers exists for this informal sector; respondents were sampled from functioning workshops, recognized spare-parts markets and recently serviced vehicle owners across the metropolis.

Table 1: Target Population and Sample by Respondent Category

Respondent Category	Population/Sample	% of Sample
Auto Technicians / Workshop Owners	100	50.0
Spare-Parts Dealers	35	17.5
Car Owners / Vehicle Users	65	32.5
Total	200	100.0

Source: Field survey, 2026.

A structured questionnaire in three stakeholder-specifications were made but comparably cored versions that covered demographics of the research scope; workshop land, facilities and equipment in the areas of technical training, spare-parts availability, repair efficiency, customer satisfaction and preference for a mechanic village. Likert items were scored 1–5 with a mean ≥ 3.00 was interpreted as agreement. Content validity was established through expert review by academic staff of the Department of Mechanical Engineering, Federal University of Technology, Akure, Nigeria (FUTA) and reliability through a pilot survey showing acceptable internal consistency. On-the-spot questionnaires were self-administered with oral interpretation for respondents unable to read or write, improving completeness and contributing to the high response rate.

Data were analyzed in Excel and SPSS using descriptive statistics and the Z-test for a single population proportion (α = 0.05, one-tailed), testing whether the proportion endorsing a statement significantly exceeded a neutral benchmark of p_0 = 0.50. For a Likert-scale item, the sample proportion was computed as the combined share of respondents who selected "Strongly Agree" or "Agree"; for a dichotomous (Yes/No) item, the sample proportion was the share of respondents who selected "Yes". The test statistic used is presented in Equation 1 (Frank and Althoen, 1994).

$$Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \quad (1)$$

where: Z is the calculated Z-test statistic for the test of a single proportion; $\hat{p} = \frac{x}{n}$ is the sample proportion of respondents endorsing the statement;p_0 is the hypothesized population proportion under the null hypothesis, taken as 0.50; x is the number of observed "successes" (i.e., respondents who selected Strongly Agree/Agree or Yes); and n is the total number of valid respondents for that item (Frank and Althoen, 1994).

At the 0.05 level of significance, the critical value for a one-tailed test is $Z_{critical}$ = 1.645, corresponding to the point beyond which only 5% of the area under the standard normal distribution curve lies, as derived in Equations 2 to 4:

$$P(Z \geq Z_\alpha) = 0.05 \quad (2)$$

$$P(Z < Z_\alpha) = 1 - 0.05 \quad (3)$$

$$P(Z < Z_\alpha) = 0.95 \rightarrow Z_\alpha = Z_{critical} = 1.645 \quad (4)$$

3. Results and Discussion

A total of 200 questionnaires were administered, 174 were validly completed (87.0% response rate): 89 technicians/workshop owners (51.1%), 55 car owners (31.6%) and 30 spare-parts dealers (17.2%) (Figure 1). The sector remained male-dominated among technicians and dealers, while car ownership was more gender-balanced (Figure 2). Education skewed toward little or no formal schooling, most pronounced among technicians, while few respondents held tertiary qualifications (Figure 3). Technicians were

nonetheless experienced: 46.1% had over ten years in the trade.

Fig. 1: Distribution of Respondents by Category (N = 174)

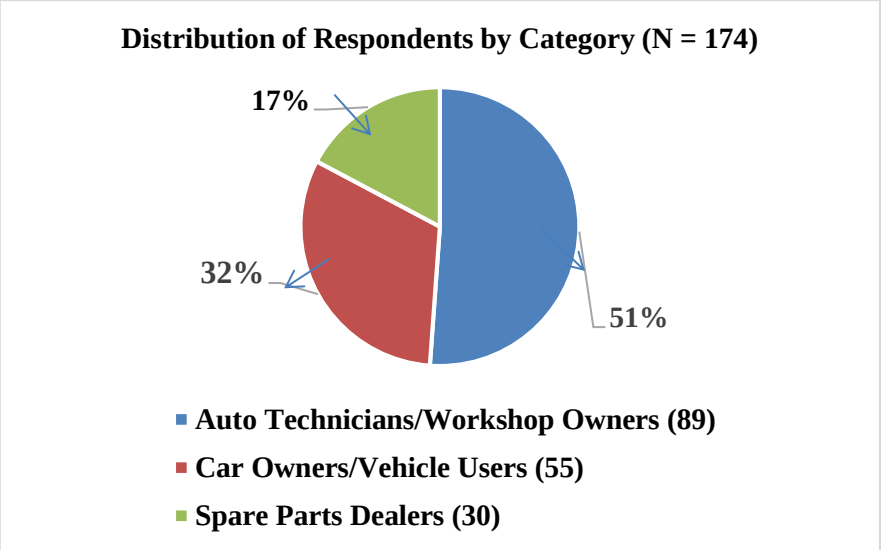


Fig. 2: Gender Distribution of Respondents by Category

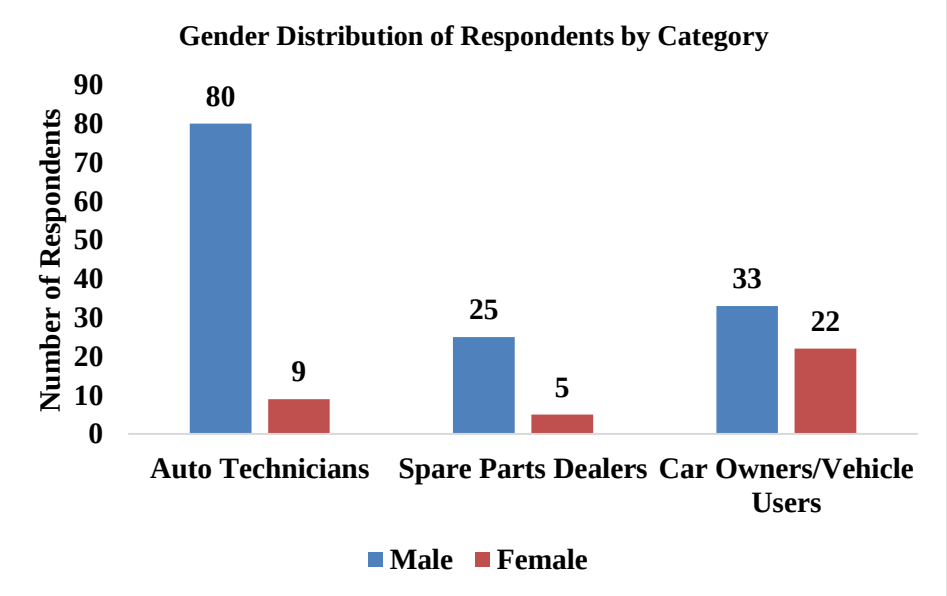
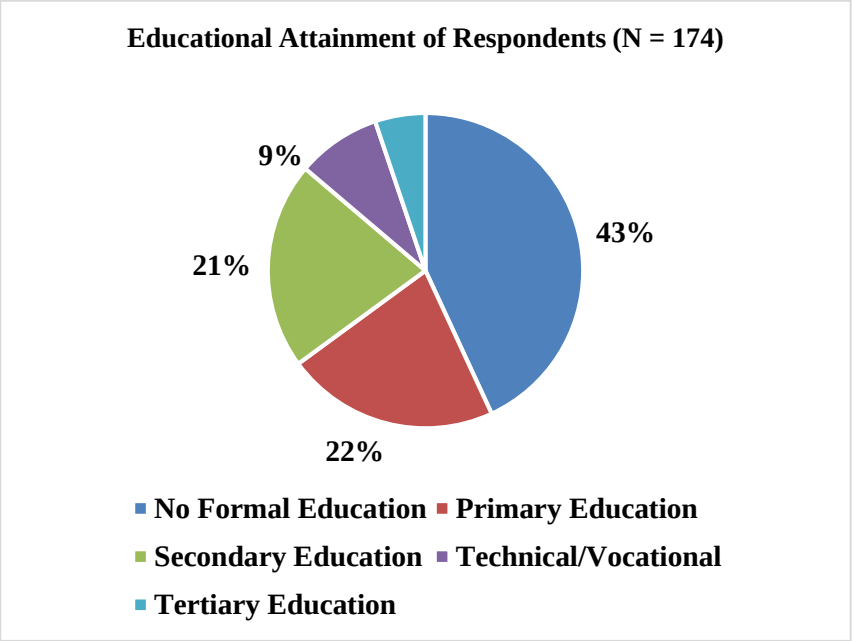


Fig. 3: Educational Attainment of Respondents (N = 174)



3.1 Current Workshop Practices

Land tenure was overwhelmingly informal: only 4.5% of technicians owned their workshop land, 73.0% rented and 22.5% leased. Basic infrastructure was moderately available (inspection pit 85.4%, hand tools 83.1%), but modern-vehicle capacity was weak: specialized tools (24.7%) and diagnostic equipment (29.2%) were scarce, as were adequate space (23.6%) and reliable electricity (30.3%) (Table 2); 85.4% of technicians agreed tool/equipment shortages cause delays.

Tab. 2: Availability of Key Workshop Facilities and Equipment (Technicians, n = 89)

Facility / Indicator	Yes (%)	No (%)
Functional inspection pit	85.4	14.6
Basic hand tools	83.1	16.9
Vehicle lift/jack stands	66.3	33.7
Access to diagnostic equipment	29.2	70.8
Specialized tools for modern vehicles	24.7	75.3
Adequate workshop space	23.6	76.4
Reliable electricity supply	30.3	69.7
Mechanic village would improve efficiency	78.7	21.3
Willing to relocate to a mechanic village	74.2	25.8

Source: Field survey, 2026.

Technicians rated their own practical experience highly (mean = 4.02) and identified high setup and tool-acquisition costs (means of 4.11 and 4.17) as dominant constraints. Dealers reported favourable stocking capacity (76.7% commonly stock demanded parts; 0.0% reported logistics challenges) and strong support for a mechanic village (86.7% agreement). Car owners rated distance to spare-parts markets affecting repair speed as the highest-scoring item across the entire survey (mean = 4.45; 92.7% agreement), and 74.5% rated their vehicles reliable after repair (Table 3).

Table 3: Selected Likert-Scale Findings by Respondent Group

Statement	Group (n)	Mean
Collaboration with technicians improves outcomes	Technicians (89)	4.22
High cost prevents acquiring needed tools	Technicians (89)	4.17
Willing to collaborate more closely with technicians	Dealers (30)	4.47
Distance to spare-parts markets affects repair speed	Car Owners (55)	4.45
The cost of repairs is reasonable	Car Owners (55)	3.20

Source: Field survey, 2026. Mean ≥ 3.00 = Agree.

3.2 Hypothesis Testing

Table 4 summarizes the Z-test outcomes. Workshop-facility availability significantly influenced repair efficiency (Z = 2.438–6.678), and training significantly affected repair quality/speed (Z = 6.890), though only 53.9% of technicians felt their own training personally adequate, a training-adequacy gap. Of the three factors under H3, only proximity to spare parts was significant (Z = 3.641); workshop type and service quality were not, so H03 was only partially rejected. Spare-parts availability significantly affected repair time/efficiency (Z = 6.337 distance; Z = 2.921 dealer stock). Most decisively, both technicians (74.2–78.7%) and dealers (76.7–86.7%) significantly preferred a centralized mechanic village (Z = 2.921–5.406), the clearest and most actionable finding of the study.

Table 4: Summary of Hypothesis Testing (Z-test, α = 0.05, Zcrit = 1.645)

Hypothesis	Z-calc. (range)	Decision
H_1: Workshop facilities – repair efficiency	2.438–6.678	Reject H01; accept H_{11}
H_2: Technical training – quality/speed	6.890	Reject H02; accept H_{12}
H_3: Type, quality, proximity – satisfaction	0.135–3.641	Partial (proximity only)
H_4: Spare-parts availability – time/efficiency	2.921–6.337	Reject H04; accept H_{14}
H_5: Mechanic-village preference	2.921–5.406	Reject H05; accept H_{15}

Source: Field survey, 2026. Significance level = 0.05; Zcritical (one-tailed) = 1.645.

Technicians display strong self-rated competence in customer communication and collaboration, yet the sector is constrained by informal land tenure, weak specialized-tool and diagnostic capacity, inadequate space, and unreliable electricity consistent with reports that modern-vehicle complexity has outpaced tooling and training among Nigerian technicians (Hossain *et al.*, 2024; Muoghalu and Ahmad, 2024). Tool/equipment inadequacy and high setup costs were statistically significant constraints, whereas customer switching behaviour and dealers' logistics challenges were not, suggesting intervention priority should target cost and tooling support rather than transport logistics.

Hypotheses One and Four were strongly supported: facility availability significantly influences repair efficiency, and spare-parts accessibility especially distance to markets significantly affects repair time and efficiency, corroborating the view that proximity between repair and parts-supply functions is central to workshop efficiency (Juehling*et al.*, 2010; Kihwili and Mwisila, 2025). Hypothesis Two confirmed training significantly affects repair quality and speed, though a sizeable minority of technicians felt their own training fell short, pointing to a precise vocational-training target. Hypothesis Three was only partially supported: for car owners, proximity to reliable parts mattered more to satisfaction than workshop condition or technician competence. Most decisively, Hypothesis Five was strongly supported across technicians and dealers alike, echoing calls elsewhere for shared diagnostic centres and cooperative-ownership models through which resource-constrained workshops can absorb the cost of modern equipment and training (Suhail*et al.*, 2024; Antoniolli*et al.*, 2017).

4. Conclusion

Auto-repair practice in Benin City, Edo State, Nigeria is only moderately effective with technicians that show genuine practical skill. But the sector is held back by informal land tenure, weak modern-vehicle servicing capacity, inadequate space with off and on electricity and heavily dependence on spare-parts proximity. At $\alpha = 0.05$, workshop facility availability, technical training and spare-parts availability/accessibility each significantly affect repair efficiency, quality and speed, while customer satisfaction is driven mainly by ease of spare-parts access. Most decisively, technicians and dealers alike expressed strong, statistically significant support for relocating to a centralized mechanic village a finding that, together with existing informal clustering, provides an empirically grounded case for a planned, centralized, mechanic-village-based model for optimizing auto-repair practice in Benin City.

A phased integrated mechanic-village management framework is recommended, comprising government land allocation, shared infrastructure, structured technical training and certification, a spare-parts coordination hub, a regulatory and quality-assurance regime, and standardized service-management practices, as an empirically grounded strategy for optimizing auto-repair practice in Benin City and comparable Nigerian secondary cities.

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