HYBRID/HI-TECH VEHICLES TECHNOLOGIES: AWARENESS SHIFT FROM TRADITIONAL APPLICATIONS FOR AUTO-MECHANICS

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ABSTRACT

This study was designed to determine the level of awareness of Auto-mechanics in the application of some innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles. To achieve the objectives of this study, two specific objectives and research questions were formulated to guide the investigation using a structured questionnaire developed by the researcher. Two subject experts were involved in the validation of the instrument. The reliability coefficient of 0.87 was determined using Cronbach's Alpha. A 20 - item questionnaire was administered by to 320 Auto-mechanics in the Akwa Ibom State. The data generated from this study were subjected to mean and standard deviation as the analytical tools. This study indicated the application of some innovative operating systems and as well as lack of awareness by Auto-Mechanics regarding the application of these systems particularly the modern diagnostic tools and equipment on vehicle maintenance. Based on this study finding, valid recommendations were made which included: the release of modern diagnostic tools/equipment by vehicle manufacturers to vehicle dealers and institutions, and also strong government collaborations with vocational/technical institutions in updating learners with perquisite skills.

KEYWORDS: **Applications, automobiles automobile-mechanics, hybrid/hi-tech vehicles, sensors, technologies**

INTRODUCTION

In today's tidal wave of global economic, technological, and the ever increasing complexity of automobiles, the diagnosis and repair of automobile problems is becoming an ever more burdensome task. Not only must today's vehicle auto-mechanics be familiar with the basic components of an internal combustion engine, vehicle electronics, suspension systems, and wheel components and the entire power-train, they must also be capable of utilizing computerized diagnostic and repair tools/equipment to quickly locate and correct the problems. Automobiles particularly in the third world are faced with an overwhelming variety of hybrid/hi-tech vehicles, each with different parts, systems, and features which require in-depth understanding regarding effective diagnose and repair problems. The existence of ineffective, expensive and time-consuming assessment processes coupled with a

lack of consistency in the quality of local personnel training programmes culminate into a complex and expensive qualification framework challenges. Globally, there are several sources of new knowledge leading to new technologies and products in the market. While some of the inputs to the knowledge production process originate from search and exploration efforts in research and development, other arises from learning in connection to everyday activities. The emergence of these technologies in some part of the globe, the current slow pace of adaptation, and the negative training trends are also forces challenging the increasing complexities of modern vehicle systems.

Statement of the problem:

The impact of the new technology is unavoidable in line with fast changing world. Hence, the orthodox skills have been rendered valueless based on projected demands. Clearly, skills possessed by technicians are obsolete and unnecessary because of rapid changing technology (Onyeachigbula, 2004). This has resulted in poor vehicle maintenance technology by Auto-mechanics and as well vehicles owners. It is on this basis that this study is conducted for the purpose of creating awareness for Auto-mechanics regarding the application of the innovative operating systems. Okorie (2006) mentioned that changes occasioned by technological development obviously demand a commensurate skill adjustment or shift.

Objectives of the study:

1. To determine the innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles.
2. To determine the level of awareness of Auto-Mechanics in the application of innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles

Hybrid/hi-tech vehicles: Awareness from Traditional Applications Auto-Mechanics

The automobile industry is constantly packaging new technologies, in the areas of safety driving, entertainment based on need and innovation. *The relatively long average lifespan of some vehicles culminated into current market dynamics for most passenger vehicles, and consequently complex dynamics for the deployment of sensational but advanced vehicle equipment.* These recent technologies in automobile systems are introduced through the inclusion of various communication tools and gadgets such as sensor computer-assisted-devices which have significantly resulted into remarkable advance vehicle safety and sustainability. Nison (2012) posited that both vehicle owners and technicians are aware of the changing technology and therefore it is difficult to keep it up. According to Malone (2006) this has prompted small backyard or "shade-tree technicians to become a fading image of the automobile. Some vehicles owners park their cars completely even when faults are minor due to auto-mechanics inability to diagnose faults because of the sophistication of modern automobile (Idris, 2010).

For instance, in today's emerging technology — sensors significantly provide valid recordable engine components conditions and temperatures, road signs and traffic signals, while also employing Vehicle-To-Vehicle (V2V) and Vehicle-To-Infrastructure (V2I) systems to navigate roadways, traffic and pedestrian hazards. Additionally, vehicle-to-vehicle information sharing can alert vehicles miles thus warning drivers to prepare to slow down. Furthermore some smart computerized intersections in modern automobile enhance quick applications of stoppage signs and traffic lights communication to other vehicles through sensors and integrated devices generated as data from modern hybrid/hi-tech vehicles fitted into the Electronic Control Unit (ECU). Millions of lines of computer- assisted coded units significantly control important automobile operations ranging from braking, clutch/transmission, charging, starting, fuel, lubrications, cooling, environment, to air conditioning systems.

Clearly, more than 90 percent of crashes are attributed to driving error. These have prompted automakers to create a range of safety system through these modified gadgets, alarms, and sensory devices that aid drivers for brief periods to help avoid accidents and in achieving greater efficiency during vehicle operations. In recent times, driver-assisted systems include lane departure and blind spot warnings, adaptive cruise control, automatic braking, telematics control systems and more. These development has prompted today's leading automakers in designing vehicles which automatically park themselves, brake at the sign of danger and stay in lanes without driver assistance. Interestingly, in advance countries, the V2V work by using wireless signals in sending information back and forth between cars about their location, speed and direction to ensure vehicles maintain safe from each other. Thus a study put out by the EUCAR (2010) maintained that V2V has the potential to reduce 79 percent of target vehicle crashes on the road (New York State Automobile Association 2006). Still, nearly every component in automobile ranging from ignition switch to car-tyre pressure is linked to alarms, sensors and other metering apparatus for guidance. Significantly, a collection of some car gadgets technologies is fast changing the driving technology globally. These gadgets include:

- Rear-mounted radar.
- Night vision with pedestrian detection.
- Automatic high-beam control.
- Parental control.
- GPS vehicle tracking.
- Cameras.
- Driver capability.
- In-car internet.

These exciting technologies are aimed at revolutionizing not just the automotive industry but human transportation in general. Furthermore these technologies could transform both driving and maintenance technology and also increase automotive safety dramatically thus improving safety by:

- Reducing the likelihood of collisions at intersections;
- Reducing the likelihood of forward and lateral (lane change and merge) collisions;
- Reducing the likelihood of secondary crashes;
- Reducing the likelihood of road departure crashes; and
- Providing more accurate and timely road condition alerts.

Furthermore, Driving Success (2013) indicated that examination of research challenges and an analysis of five strategic technology themes where the UK could show leadership through specialization (Driving Success, 2013). These include

1. Internal combustion engines;
2. electric machines and power electronics;
3. energy storage and energy management;
4. lightweight vehicle and power train structures; and
5. Intelligent mobility.

Significantly, the Automotive Council, UK as stated by Driving Success, (2013) listed strategic technologies which are shown in table 1. They are further broken down to integrate the innovative and creative units applicable in modern vehicles.

Table 1: Strategic technologies in hybrid/hi-tech automobiles

Roadmap	Key themes
Internal combustion engines	The roadmap defines future priorities to improve engine thermal efficiency, improvements in systems efficiency and enabling technologies. Key focus areas are: ■ Integration of combustion engines and electric machines to reduce cost and increase utility ■ Downsizing and down speeding including more sophisticated charge air/boost systems ■ Fuel injection and variable valve and actuation systems ■ Waste heat recovery to shaft power or electricity production ■ Low carbon liquid fuels
Power electronics & electric machines	Mixed technology motors such as permanent magnet switched reluctance machines as well as switched and synchronous reluctance machines are key features of the roadmap. Focus areas include improvements in: ■ Advanced lower cost control electronics ■ Conductivity in windings ■ Topology and innovative configurations ■ Thermal management & conduction
Energy storage	Significant Improvements in existing battery chemistries, achieving in excess of 400Wh/kg at a cost of less that US$250/kWh, next generation chemistries & other storage technologies Key areas for progress are: ■ Electrolytes, catalysts, decants, additives, surface modification and coatings ■ Scale up technologies to move from laboratory to prototype cells for in-field development ■ Innovative storage technologies that offer improved cost, energy density & packaging
Lightweight vehicle and power train	To meet vehicle CO2 targets, substantial vehicle weight reductions can be achieved through: ■ Migration of motorsport/aerospace technologies initially into the premium sector and ultimately into high volume vehicle manufacture ■ Advances in manufacturing/joining technologies for advanced low weight materials to achieve automotive scale and cost requirements

	■ Next generation multi-physics computer aided engineering for weight optimization ■ New vehicle topologies enabled by advanced materials
Intelligent mobility	Increased road user demand will require more intelligent & safer mobility to deliver a robust transport system. This will require improved communication, control and vehicle systems together with modal shift and demand management. Key technologies will include: ■ Advanced data processing & acquisition systems for multi-modal journey planning/optimization ■ Vehicle sensor fusion & processes for safety critical on-board software development ■ Communication systems/protocols for both vehicles and infrastructure ■ Next generation driver assistance systems and autonomous control technologies

Adapted from: Automotive Council, UK, July 2013.

Udofia (2016) had maintained that working on today's cars requires an understanding in the science and technology that govern modern and highly-sophisticated automobiles - the hi-tech/hybrid vehicles. Consequently, in some electronic parts like sensors and microprocessors which constitute the "backbone" of today's cars, there exists a high level of connectivity involving millions of lines of computer code that control important auto operations from braking to air conditioning. As technology grows in the design, production and operation of vehicles, so do concern about security and privacy priotized. Changing customer habits and expectations are causing manufacturers to rethink on how they build and sell vehicles that meet the expectations of the next generation. On this note, automakers greatly utilize various forms of software programmes on existing technology in achieving greater role in vehicle design and operations.

METHODOLOGY

The study adopted a simple survey research design. It involved the selection of views from a chosen sample through a larger population which was aimed at discovering the relative incidence, distribution and their interactions (Olaitan, Ali, Eyoh and Sowanade, 2000).

Area of study: This study was carried out in the cities of the three Senatorial Districts in Akwa Ibom State (AKS). The choice of AKS was based on the fact that significant numbers of Auto-Mechanics are not versatile in the application of some innovative operating systems of hybrid/hi-tech vehicles indicated in the literature.

Population: The population of this study consisted of 320 Auto-Mechanics in cities of the three Senatorial Districts in Akwa Ibom State as can be seen in table 1 below.

Table 1
The population frame of the Auto-Mechanics in cities of the three Senatorial Districts in Akwa Ibom State

S/no	Towns	Auto-Mechanics/Auto-Electricians
1.	Uyo	120
2.	Ikot Ekpene	80
3.	Eket	100
	Total	**320**

Sampling and sampling procedures: A Simple random sampling techniques was used to obtain a sample of 180 drawn from a population of 320.

Instrumentation for data collection: A structured questionnaire was employed for data collection. The questionnaire was developed by the researcher with sections A and B. Section A contained personal information, while section B contained 20 items formulated based on a 5 point likert-scale with response categories as Strongly Agree (AS), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD) with 5, 4, 3, 2 and 1 assigned weight respectively.

Validation of the instrument: The instrument was face validated by three Lecturers in the Department of Technical Education College of Education, Afaha Nsit with suggestions effected prior to reliability testing.

Reliability of the Instrument: The reliability of was established using the Cronbach's Alpha statistics to ascertain the internal consistency of the instrument after pilot testing in Uyo Metropolis. The pilot study involved 20 Auto-Mechanics who did not form parts of the main work.

Method of data collection: The questionnaires were administered to the respondents personally and were retrieved two weeks after administration to allow respondents adequate time to indicate their choice. A total of 180 questionnaires were received from the respondents in the same way there were administered.

Data analysis: The data generated from this study were analyzed using mean and standard deviation.

Results and discussion:

Research question one

What are the innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles?

Table 1:
Mean and standard deviation of responses innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles

S/no	Items	X	SD	Remarks
1.	Innovative operations in the suspension/steering system	4.12	1.07	Agreed
2.	Innovative operations in the braking system	4.35	0.84	Agreed
3.	Innovative operations in the oil circulatory system	4.20	1.19	Agreed
4.	Innovative operations in the cooling system	4.26	1.07	Agreed
5.	Innovative operations in the transmission system	4.05	1.01	Agreed
6.	Innovative operations in the electrical/accessories	4.71	1.62	Agreed
7.	Innovative operations in the fuel system	3.71	1.45	Agreed
8.	Innovative operations in the starting systems	4.10	1.03	Agreed
9.	Innovative operations in the ignition system	4.28	1.10	Agreed
10.	Innovative operations in the in charging system	3.66	1.27	Agreed

Field survey - 2017

Table 1 above clearly indicated that all the 10 items (systems) have their mean score above the cut-off 3.50 with least standard deviation of 0.84. Accordingly, the results showed a significant level of agreement with 3.66 as the least mean score against the critical value of 3.50. This revealed the application of the innovative operating systems in hybrid/hi-tech over traditional vehicles.

Research question two
What is the level of awareness of Auto-mechanics in the application of the innovative operating systems of hybrid/hi-tech vehicles over traditional vehicles?

Table 2:
Mean and standard deviation of responses on the level of awareness of Auto-mechanics in the application of the innovative operating systems of hybrid/hi-tech vehicles over traditional vehicles.

S/no	Items	X	SD	Remarks
11.	Hybrid/hi-tech vehicles steering/suspension system requires modern sophisticated diagnostic equipment/tools	4.39	0.96	Agreed
12.	Hybrid/hi-tech braking system requires modern sophisticated diagnostic equipment/tools	4.51	1.14	Agreed
13.	Hybrid/hi-tech oil circulatory system requires modern sophisticated diagnostic equipment/tools	4.69	0.86	Agreed
14.	Hybrid/hi-tech transmission system requires modern sophisticated diagnostic equipment/tools	4.30	1.11	Agreed
15.	Hybrid/hi-tech cooling system requires modern sophisticated diagnostic equipment/tools	4.52	0.82	Agreed
16.	Hybrid/hi-tech electrical/accessories system requires modern sophisticated diagnostic equipment/tools	4.33	1.24	Agreed
17.	Hybrid/hi-tech fuel system requires modern sophisticated diagnostic equipment/tools	4.67	0.88	Agreed
18.	Hybrid/hi-tech ignition system requires modern sophisticated diagnostic equipment/tools	4.01	0.86	Agreed
19.	Hybrid/hi-tech starting system requires modern sophisticated diagnostic equipment/tools	4.80	0.83	Agreed
20.	Hybrid/hi-tech charging system requires modern sophisticated diagnostic equipment/tools	4.59	0.85	Agreed

Field survey - 2017

All the 10 items in table 2 indicated a cut-off mark above 3.50 with the standard deviation of 0.82. Accordingly, the results showed a significant level of response with mean scores above 4.00 indicating that Auto-Mechanics lack salient technical skills in the operation of hybrid/hi-tech vehicles. The study findings indicated that, the level of awareness of Auto-Mechanics regarding the application of innovative operating systems in hybrid/hi-tech vehicles over traditional vehicles is low which requires update.

Conclusion

Based on the findings of the study, the following conclusions were drawn:
The traditional skills in vehicle operations have been faced out gradually by the integration of sensory/computer assisted devices in modern vehicles, particularly in the hybrid/hi-tech vehicles. Auto-mechanics lack the necessary technical-know-how in the proper operation the hybrid/hi-tech vehicles. Auto-mechanics lack sufficient knowledge of the spares and their concise connectivities. Awareness in the application of modern diagnostic tools/equipment by Auto-Mechanics is extremely low.

Recommendations

In line with influx of sophisticated hybrid, hi-tech and fuel-celled vehicles particularly in the developing economies, the following recommendations are made:

1. Automobile technology workshops in technical institutions should be equipped with latest tools, equipment, modern diagnostic tools/equipment and other computer-assisted/video aids.
2. Users/technicians should properly acquaint themselves with the manufacturer's provisions on safe operational modalities.
3. Conferences, workshops, and seminars should timely be arranged for knowledge update in hybrid/hi-tech and related vehicles by government, institutions and car manufacturers.
4. Instructions and educations of technicians on the dynamic nature of the auto-world should adequately constitute a package of training by vehicle manufacturers.

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