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Observational Research and Automotive Industry

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I. Introduction

Observation has an extensive history based on ethnographic research. Nowadays, to study people behavior & performance in their instinctive environment, Observational research provides understanding about the different things from their perspective. This process requires considerable time with the possibility of assuming various role plays with the intention to seek more comprehensive know-how of the target group (Baker, 2006, p.171). Observational data have been neglected by researchers due to inconvenient and non-reliable ways to collect them and then build them into costly & time-consuming research theories. Marketing research is more inclined to the realities of daily consumption, and extensive research is required to capture those moments of reality (Belk, 2005, p.128). Authorities are spending many funds in transportation and traffic safety research. Over the last years, in densely populated countries there is growth in the number of cars which create problem to confront drivers. Consequently, scientific and observational research on road-use behavior has become an important issue concerning road accidents and to diversify driving experience (Michon, 1969, p.297).

In the recent years, there is an increase in the use of an explorative type of research methods to estimate vehicle's driving behavior. One of the way to conduct this kind of study is by using instrumented vehicles. It helps in evaluation of different aspects of driver's reaction & behavior (Helander,1976, p.271). Some of the pre-crash measures include advanced driver assistance system, safety features of self-driven cars, and designing of infrastructure, driver training & policy making which requires a reasonable understanding of driver's behavior. Thus, naturalistic driving (ND) has developed as an important source of data with favorable ecological validity. ND allows not only immediate assessment of driver's behavior but also give relevant information about road infrastructure and pre-crash safety actions (Bärgman, 2015). Presently, some intense research has been carried out globally by different scholars and researchers particularly those involved in direct observational research of globalizing industries like electronics, motor vehicles, etc. (Sturgeon,2008, p.301).

The motive of this chapter is to find out the benefits that automotive industry can relish from observational research. Today, it is inevitable to develop an integrated strategy towards sustainability by focusing on strengths & strategic plans of the company. First, I will start an introduction of the observational research, its definition, different types, and pros & cons. It

is then followed by the Retail industry example, one of the leading industry where observations are done. Furthermore, I will majorly focus on Automotive Industry and the extensive use of the observational research to estimate the driver or consumer behavior. Finally, I will draw a conclusion whether this ethnographic and explorative research that include observation could profit Auto Industry in the future.

II. Observational Research

Sharp (2003, p.1590) defines observation as observation as noticing of human behavioral patterns, objects, and actions in a systematic way to obtain information about the event. Information is obtained directly through witnessing the people behavior of interest, instead of consulting secondary evidence for example reports or diary records. It helps researchers to see what consumer do in real, rather than what they say they do. In this section, the paper examines the different types, advantages and disadvantages of observational research for market researchers and practitioners.

2.1 Major Types

1. Structured Observation – In this systematic technique, researcher engages in clear formulated rules for the observation and recording of the consumer's action. These rules are necessary to follow, and observers should make sure what they are looking for and how they will record behavior. Subsequently, each participant who is part of the observational research for a given period (Bryan, 2012, p.272). This approach reduces the possibility observer bias and increases the reliability of the data (Sharp, 2003, p.1591).

2. Unstructured Observation – This method does not involve proper observation schedule like in structured observation for the recording of behavior. Instead, the main idea is to record as much as detail as possible with the aim of developing narrative account (Bryan, 2012, p.273). It is ideal approach when the problem is not defined properly as it offers flexibility and monitors all aspects of the situation (Sharp, 2003, p.1591).

3. Participant Observation – This technique is best-known and mainly linked with qualitative research that involves the relatively extended engagement of the observer in a social setting e.g. groups or organizations. This help to produce the meanings they attribute to their behavior and environment (Bryan, 2012, p.273).

4. Simple & Contrived Observation – Observer has no influence over the situation being observed in simple observation. On the contrary, in contrived observation, the observer actively alters the situation to find the effects of interference (Bryan, 2012, p.273).

Currently, Observational research provides a limited role in commercial and academic research as it requires modern tools & techniques. By the time, there has been a slight improvement in technology and certain methods such as Video surveillance. It is still not the mainstream option due to expensive and time-consuming nature (Sharp, 2003, p.1590).

2.2 Pros & Cons

Pros

Human observation is an old approach followed by anthropologists, and now it is used to conduct market research. The uniqueness of this method is that subjects are unaware that they are being studied. It helps to record their natural behavior giving the researcher insights into actual, not reported or pretended behavior. As previously stated, in this research there is no chance for recall errors. People are not asked about their preferences or actions on the spot. Instead, they are observed while they are engaged in the particular activity. Researchers can obtain accurate information and with less cost involved for example in-store traffic observation rather than do a survey (Burns, 2014, p.122).

Cons

The limitation of the observational research is that there are the only small number of subjects considered and usually under special circumstances. It leads to subjective interpretation which is required to describe observed behavior and eventually researcher refers to his conclusions to be uncertain. Moreover, another drawback of observation some of the characteristics of the subject such as motivation, intention, and attitude cannot be noticed. Researchers must be worried about the issue of accuracy of those who were observed if they represent all the consumers in the target group (Burns, 2014, p.122).

III. Example: Consumer Retail

In this section, the paper inspects the use of observation in Retail sector. I used this example to give an overview so to understand the aspects of observational research more distinctly. The Retail industry is one of the few marketing industries where observational research has been systematically used to notice real-time consumer reaction and their buying behavior. Researchers understand patterns of consumer purchase from direct observation to alter the

shopping experience. Observational research has important methodological issues that are taken into consideration i.e. use of mechanical devices such as video camera or personal observation. Some rare cases like, capturing children's behavior is done by video surveillance. However, people marketing related behavior can be observed with an ease and their no need for participants (Sharp, 2003, p.1592). Retail marketers commonly use this strategy to gather marketing intelligence about their competitors. Also, they estimate the behavior of their employees at the store by hiring the service of mystery shoppers. These are the people who pose as consumers, but in actual, they are trained observers. Importantly, all these activities and researches are conducted in an ethical way referring to Market Research Association (MRA) code of ethics (Burns, 2014, p.122). According to (Sharp, 2003, p.1592), A study was conducted for alcohol beverage industry where researchers made multiple investigations to discover broad consumer behavior and their selection criteria. This research included in-depth interviews, focus groups (questionnaire/survey) and observations of shoppers. The key issues examined are listed below in Table 1.

Table 1: *Key issues examined*

Brand Choice	Store Navigation	Marketing issues
No. of brands measured	Areas in store arrived & time spent	Proportion of brands on special occasions
Time spent to pick brand	Shelf, fridge and floor stock usage	Use of advertising material
Avg. No. of units bought		Role of promotional activities for sales

Source: Sharp, 2003, p.1592

The results show the variation between different research approach i.e. interviews and observation. In general, the findings came through claimed behavior and the data obtained from the consumers. For instance, during interviews users affirmed that they regularly read product labeling and took more time in-store to look out for products. In contrary, with observational findings that showed that less 10% customers spent time on reading labels on packaging. Likewise, shoppers took less time to enter the market, make decisions, shop and leave. Therefore, the methodology that used claimed behavior (Interviews) tend to

produce the results that can be exaggerated and area complex. Whereas observational research provides a broader picture of behavioral patterns, which are easy to understand (Sharp, 2003, p.1593).

IV. Observation in an Automobile

Driving is one of the common activity that is performed almost daily by ordinary people. Also, car accidents are the primary cause of human errors that need to be taken into consideration. Since 2011 car crash statistics are rising. Understanding the features of driver's behavior which lead to crashes will contribute to improving the road safety through significant advancement in vehicle, roadway design and technology such as Intelligent and sustainable transport. Earlier, Researchers used traditional methods like interview and survey to study car driving behaviors and its effect on safety. The results from these conventional methods were too subjective. Sometimes it may not show the accurate answer from respondent's point of view because these methods are biased towards researchers who design self-reported questionnaires. Currently, use of the observation research has given much clearer outcomes with the collection of naturalistic data (Ariffin, 2014, p.314). In this section of the paper, the various techniques used in observing driving behavior are discussed. The motive of this chapter is to provide practical information about the Observational research concerning Automobile.

4.1 Instrumented Vehicles

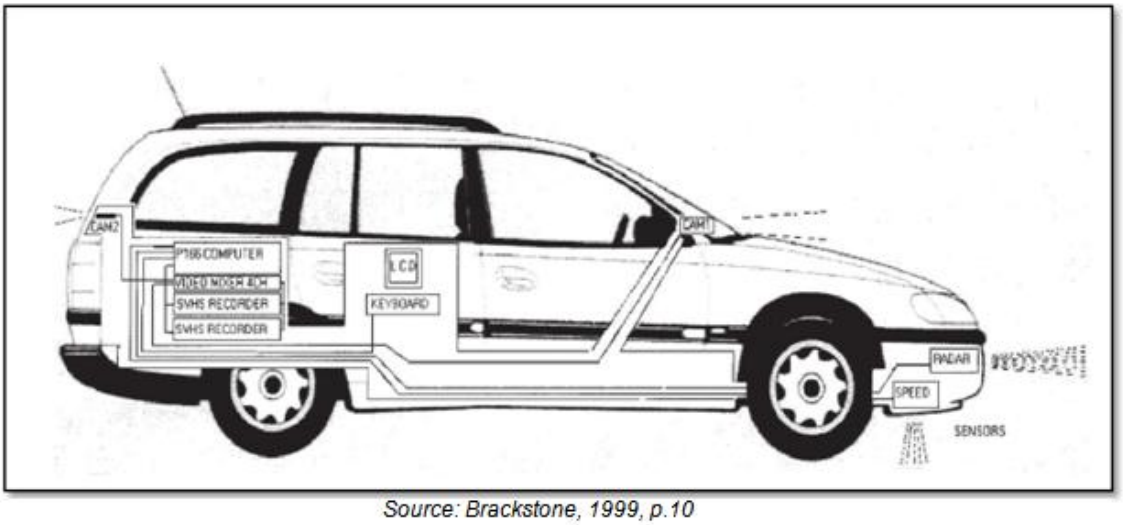
In a comprehensive study of the vehicle environment, there is a demand to analyze a large number of variables concurrently. To enhance this research a fully instrumented car (IC) was developed for the experimentation of the human behavior (Helander, 1976, p.271). Instrumented Cars (IC) have been used by researchers at large scale in various application to study driver's behavior. In 2002, a study was conducted in the UK to comprehend car following behavior in a highway domain using an IC. Moreover, several other well-known car naturalistic studies are carried out in the US by using IC. This help researcher to record is synchronized and unobtrusive behavior of the drivers. There are several limitations of IC according to the previous investigation. First, management of data is recorded through the various acquisition of sources which utilizes an independent system like video recording and software for playback or recording. Second, the power supply for the system causes the EC that drains much of battery used in a particular car. This lead to the problem such as a vehicle is not able to start at many times and loss of statistics due to obstruction in data
collection process. Thus, Data acquisition system needs more input devices to accustom different data types (Ariffin, 2014, p.315).

In figure 1 below, it shows different elements of IC that was assembled at the transportation research center at Southampton. It was equipped with sensors and was designed to analyze and collect data on highway traffic (Brackstone, 1999, p.10). These elements are explained briefly to give a synopsis about the functioning of each device.

Optical Speedometer

It is a primary feature which records following data output depend on ground speed. It also allows relative measurements collected by different external sensors that can be translated into quantifiable data. The accuracy of measurement is imperative to form the base for the calculation of acceleration. Lastly, to complete the analysis use of an interferometric device that varies according to the road surface (Brackstone, 1999, p.10).

Figure 1: *Elements of Instrumented Car*



Source: Brackstone, 1999, p.10

Radar Rangefinder

It is the second element capable of determining the distance traveled, relative car speed and some immediately adjacent vehicles. This unit is also used by Jaguar in the UK in the past years in its experiment not only with collision avoidance but also smart cruise control systems. This unit produces different beams which cover 3-degree view of the field both

horizontally and vertically. It monitors the behavior of vehicles in adjacent lanes and also gives information on the range (Brackstone, 1999, p.10).

Video-Audio Monitoring System

The other sensors provide a considerable amount of dynamic data, but there is still a necessity to maintain a visual record of each activity. It gives the clear macroscopic picture that is superficial to the driver. Additionally, a secondary feature allows recording audio tracks of the driver to add comments and feedback from subjective tests. The vehicle has been armed with two video cameras, one rear facing at the edge of rear windscreen and one in the front facing towards driver on the dashboard. It allows maximizing flexibility both regarding field view and physical size for e.g. drivers hand and eye movement. After recording, the output is then routed with the help of preview screen on a PC controller. All the recordings comprise of an overlaid time image synchronized with the controller (Brackstone, 1999, p.11).

Driver and Operator Input

It allows easy identification of individual events and actions. There is a trigger that has been installed which is used by the operator to place markers within the data management files (Brackstone, 1999, p.11).

Data Processing

With the number of sensors and data logging, databases can be maintained easily in less time. Nevertheless, adequate measures must be taken to make sure not only smooth handling but also efficient maintenance of the database. Furthermore, to extract relevant results number of activities need to be performed like aggregating and filtering of data, making pictures of precise locations, and vehicle speed (Brackstone, 1999, p.11).

Together, all these developments provide actual information on driver strategy and behavior. It also estimates usage, drive distance, preferable route and individual decisions that are made during bad weather and high traffic. Previous insights on vehicle usage relied on traditional methods like a questionnaire. These were completed by different individuals with different defective memory and perception. The new electronic process must be well-adjusted against the privacy issues of the driver and other members who are observed (Jermeland, 2002, p.293).

4.2 Naturalistic Driving

Approaches to studying driver behavior

In literature, there are several ways to study fundamentals of driving behavior on traffic safety. It helps researchers to estimate driver behaviors that especially those who end up in crashes. First, experimental studies of the subject in most situations aim to build casual relationships (driver behavior & crash). This controlled

approach uses driving simulators and track testing experiments which required prior studying of driver's nature and scenario. The second method is based on traditional data collection (Interview & surveys) and then analyze them on scene and in-depth investigation. These data include variables that report car kinematics which is saved through reconstruction of various material like tire tracks, vehicle deformations, etc. This collected data is then used as input for studies to evaluate vehicle kinematics during accidents. Lastly, in the recent years, the third approach to naturalistic driving (ND) has been developed. It has appeared as a valuable tool for observing and understanding the dynamics of driving behavior in the real traffic situation. The data is obtained unobtrusively through sensors, GPS, radar, Video camera, recorder and includes information about the driver and his surrounding traffic environment (Bärgman, 2015, p.1).

Concept

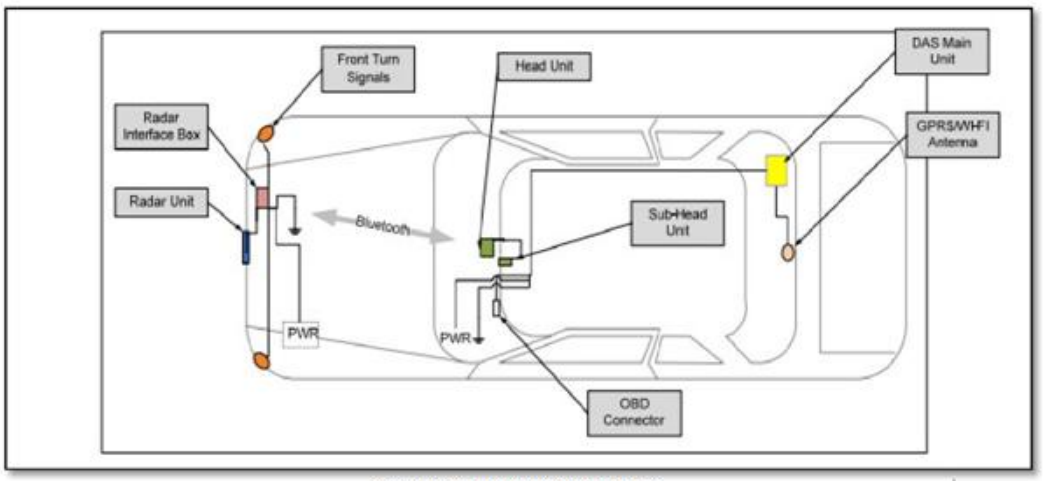
The Naturalistic Driving (ND) is a research technique founded by Virginia Tech Transportation Institute (VTTI) in the US. It was made with the perspective to overcome limitations of the other traditional methods. In ND, contestants drive their cars which are mounted with unobtrusive Data Acquisition system (DAS) that records their driving behavior, roads and its surroundings (Regan, 2012, p.2). Naturalistic Driving (ND) also commonly known as naturalistic observations is an innovative approach amid already existing traffic research technique. It is a study undertaken to give insights about driver's behavior during daily road trips using recording their details, the car, and the surroundings through inconspicuous data collection equipment and without tentative control. In prior studies in the US and Europe, this approach has shown its potential to understand substantially the process leading to car crashes. The subjects owned cars are armed with devices to monitor numerous aspects of driving behavior. It includes major elements like acceleration, speed, road positioning of the car, eye & head movement of the driver and traffic densities, time headway and weather conditions of the natural environment. This technique has been

equipped with passenger cars, trucks, and motorbikes. It helps to observe and then analyze the different aspects related to the rider, vehicle, road and traffic id different situations (UDRIVE, 2016).

Data Acquisition System (DAS)

(Campbell, 2012, p.32) The in-vehicle data acquisition system (DAS) is a unit that receives and stores data from forward radar, all video camera, accelerator meters, positioning system and onboard computer vision algorithms. In figure 2 below, it can be noticed the schematic view of DAS.

Figure 2: *DAS schematic view*



Source: Campbell, 2012, p.32

The information from the DAS is collected continuously while the participant's car is observing. Installation takes around 3 hours wherein the main computer records the relevant data on a detachable hard drive that is replaced after usage usually every 4-6 months. The front radar interconnects wirelessly to the central computer. Additionally, the main unit consists of acceleration meter, an alcohol sensor, and four cameras are fitted away from driver's view in a head unit and to the right of rear view mirror. The DAS also records data from the vehicle which is connected to the on-board diagnostics port. These camera pictures are combined in one frame and compressed to have an efficient storage. However, there is also a fifth camera which shows images of passengers which are blurred so that they cannot get recognized. Likewise, DAS also has machine vision algorithm to determine the driver's head movement. Eventually, the encrypted data is then transferred through the high-speed network for final processing, quality check, and control (Campbell, 2012, p.32).

Supremacy

There are several advantages of ND if compare with other traditional methods. Firstly, ND has a huge degree of control over the different variables that could affect driving behavior, for example, the breadth of the road can be altered rationally, being other factors remain unchanged whereas the controlled methods are conducted in a setup environment. For instance, driving simulators or test circuits resulting in slow and complicated transfer of the results to real traffic. Secondly, In ND, the behavior and factors that lead to an accident are observed directly (SWOV, 2010, p.2). However, the main disadvantage of ND approach is that researchers need to take proper care if they want to make causal relationships because ND uses observation without interfering model (Bärgman, 2015, p.2).

V. Results & Discussion

Instrumented Vehicles (IV) can provide plenty of data for planning which can use in both short & long run by multiple agencies for different purposes. Today, these research efforts are applied to car safety and pricing value in several countries. IV also plays a crucial role in managing advanced traffic systems by giving a possible image of overall operations & control of the vehicle. Nonetheless, the data from IV is valuably used in designing of car interiors according to driver preferences. These type of decisions will be reinforced by IV data which includes a selection of messages like routing and design strategies. The data will be crucial for the development and assessment of different car concepts including strategic decision making for transportation (Guensler, 2002, p.3).

(Elliott, 2016, p.2) The development of self-driven cars has encouraged the need to forecast human driving behavior to enable interaction between autonomous and human-driven vehicles. In transportation figures, it is a new domain of research to bring improvement in artificial intelligence and manufacturing of self-driven cars. Since 2009, these cars have been tested on roads. Moreover, for the probable future, the biggest obstacle of self-driven cars is that these cars need to interact with human driven cars. Human drivers do not talk about their plans to other people. Thus, the ability to arrange driverless cars in future will severely depend on the advancement of an upright prediction model of human driving behavior. Without any doubt, it seems to be a complex task to build a forecast model to

address the utmost human behavior. Researchers focusing on a preliminary prototype based on a single driving behavior i.e. whether the human driver would halt at a crossing before taking a left turn. Observers used naturalistic driving (ND) study to develop this prediction model because it includes the collection of data from cars as they are piloted on authentic highways. The data such as vehicle speed, brake application and distance traveled is then collected by method of data acquisition system (DAS) which is fitted on research vehicle. It leads to future research and development of managing self-driven cars that should try to accustom the analogy of stopping behavior on the human driver the (Elliott, 2016, p.3).

Numerous studies have shown prediction models of operating speed which are based on spot speed data accumulated by radar, pavement sensors, etc. Sometimes, this collection method gives invalid assumptions to researchers due to the constant speed on flat roads and fluctuation in acceleration on curves. Then, Global positioning system (GPS) is used in an instrumented vehicle (IV) to examine driver behavior regarding speed choice and acceleration performances to improve operating speed model. If concerning driver's behavior, Instrumented vehicles and naturalistic driving study approach show several results like constant driving speed and car handling (Galante, 2014, p.61).

VI. Conclusion

The mass implementation of observational research is a reality, and it has been strengthened over the period due to an upsurge in technology and sustainability. Observation is a complex, challenging and creative process that leads to the production of novel and valuable results. Furthermore, it is crucial because it plays a vital role in Automotive Industry, Transportation and communication as it helps to develop pioneering ideas to solve the critical problems like car accidents. Researchers assume that observational studies are implemented and have more limitations currently. Mainly, in the automotive industry where the customer prefers good designed interiors and mileage of the car. In summary, it can be stated that auto industry is a huge and concentrated market which is operated majorly by various experimentation and researchers to estimate consumer behavior. However, there are some similarities when compared to additional research methods for instance need for planning, literature review and determination about the study and location of the observations. The usage of these several data collection techniques makes observation more realistic approach that gives researchers to have better insights

into driver behavior. The several outcomes of observational research can be noticed through this paper that will help automotive industry in the future management and making of new concept cars. Firstly, Observational research has already triggered the development of autonomous vehicles. Researchers are always trying to predict human driving behavior to enable the interaction among driverless and human driven cars.

Secondly, Instrumented Vehicles (IV) gives the qualitative analysis that can be performed on large scale of behavioral procedures. These results help traffic operations to understand driving behavior which is essential for further assessment and control of Information systems. Lastly, Naturalistic Driving (ND) is a modern research approach and has a great potential to match other existing methods for data collection on the performance of the driver in any situation. It will lead to the gathering of data that can support countermeasure development.

Word Count – 3938

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