Information Technology artifacts for increasing customers' savings: An example of design science in the car industry

Research-in-Progress
General Track

Goikoetxea, Javier, Universidad de Deusto, Bilbao, Spain, javier.goikoetxea@opendeusto.es
Ortiz de Guinea, Ana, Universidad de Deusto, Bilbao, Spain, ana.ortizdeguinea@deusto.es

Abstract

The effective design of technology could facilitate customers' savings. For example, an Information Technology (IT) artifact focusing on car maintenance and ad hoc services could generate improvements and savings to the car driver. Addressing the lack of IT artifacts aimed at providing savings around car maintenance, and the business opportunity such gap provides, this research-in-progress' objective is to create an IT artifact that will monitor and analyze vehicle data to discover when it is necessary to offer solutions to detected needs while embedding persuasive design principles to influence drivers' car maintenance/service behaviors with the goal of saving money to vehicle owners. To do so, this research-in-progress will employ the Design Science Research (DSR) methodology in order to rigorously build and evaluate the IT artifact. Thus, following the DSR methodology, the impact of the IT artifact on drivers' spending on car maintenance as well as the offerings conversion ratio will be analyzed. This research contributes to the literature by answering calls for research on collection vehicle data for new services and on new business models evolution in the car market.

Key Words: *Artifact, Design science, Persuasive design, Car services & savings*

1. Introduction

Within the scientific field of management, the subfield of Information Systems (IS) or Management Information Systems (MIS) research, aims to "study the effective design, delivery and usage of Information Systems in organizations" (Keen, 1980, p. 12). Two paradigms characterize IS research: behavioral science (BS) and design science (DS) (Hevner et al., 2004). The former, BS, studies and analyzes the impact of IS on human and/or organizational behavior, while the latter, DS, creates and evaluates IT [Information Technology] artifacts to solve human and/or organizational problems (Hevner et al., 2004). While BS in IS has been criticized for being overly academic and practically irrelevant (Benbasat & Zmud, 1999), DS addresses this perceived lack of professional relevance since it is fundamentally a "pragmatic research paradigm that calls for the creation of innovative artifacts to solve real-world problems" (Hevner & Chatterjee, 2001, p. 9).Thus, DS has been used in both management and IS to solve diverse and practically relevant problems such as the development of organizational strategy (Holloway et al., 2016) or the implementation of gamified applications to influence employees' pro environmental behaviors at work (Oppong-Tawiah et al., 2018).

This research, thus, falls within the DS paradigm in IS research. More specifically, its overall objective is to create an Information Technology (IT) artifact that will monitor and analyze vehicle data to discover when it is necessary to offer solutions to detected needs, will embed persuasive design principles to influence drivers' car maintenance behaviors, and will measure its impact on drivers' vehicle maintenance economy and acceptance of such offered solutions. The creation of such IT artifact addresses both a gap in the scientific literature regarding Car Maintenance & Services Management (CMSM) and a practical relevant problem in terms of drivers' economy.

The scientific literature on CMSM explains what vehicle parameters can be monitored in order to anticipate what the vehicle will need (such as oil change, for example) (Dhall & Solanki, 2007). This literature determines the value of vehicle information in the context of facilitating the overhaul and repair of a vehicle through diagnostic systems (Resetar, 2016). However, this literature does not explain real time checks of car status along with real time offers of car services with discounts that translate in direct savings for drivers). Thus, different authors have stated that it is necessary to deepen the analysis of the type of service that, thanks to new technologies, can be offered to drivers in real time (e.g., He et al. 2014), and the management of an automation calls (direct automatic call to a driver when the vehicle needs a service, normally calculated by time or mileage) to the revision or maintenance of a vehicle (Lin et al., 2009). In summary, new business/services' use cases with car data are still evolving (Dhall & Solanki, 2017) and according to several authors, IT artifacts to improve car maintenance should be studied and developed (Toledo & Shiftan, 2016; Fournier et al., 2011).

At the same time, it is important to note that the introduction of an IT artifact does not assure its acceptance and use by potential users (Lapointe & Rivard, 2005), even more when such IT artifact implies a change in the driver's habitual behaviors. In this regard, research in psychology has long studied persuasion in order to foster behavioral change (Gerald & Burgoon, 1978; Cialdini R., 1984; Albarracin D., et al., 2018). Taking this literature as a starting point, Fogg (2003) points out that there are machines that influence or can influence people's ability to react. He indicates that there are 3 elements that condition the reaction of a person. The first one is the motivation that a person has to do or not something (Fogg, 2003). The second element is the ability or skill with which s/he counts to carry out a purpose (Fogg, 2003). Finally, the third is the trigger or the action by which purpose is set in motion (Fogg, 2003). These three elements in conjunction with the system design (color, image, sound,) the people/person attitude (people need, interest, people personality and context) and the IT artifact (computer) could determine behavior and we can try to modify the behavior through persuasion (Fogg, 2003).

Oinas-Kukkonen and Harjumaa (2009, p. 486) define persuasive system as a "computerized software or information system designed to change attitudes or behavior (or both) without using coercion or deception". Thus, building upon psychological research on human persuasion, a set of persuasive design principles have been developed that can be embedded into IT artifacts in order to persuade users to engage in the target behavior (Fogg, 2003). The main idea thus, is to embed key persuasive design principles into our IT artifact to influence drivers' purchasing behavior of car maintenance services in order to materialize economic savings for the drivers.

The intended materialization of drivers' economic savings in car maintenance services is the practical relevant problem that this research addresses. According to a recent industry study (PWC, 2018), it is expected that current vehicles will have longer use by the year 2030 taking into account that 20% less vehicles will be sold. As a result, vehicles will have to withstand higher mileage contextualized on lower demand for new vehicles. If vehicles are going to have more use, the opportunity of gathering and analyzing vehicle information remotely to manage cars' service needs appears as a business opportunity. Taking into consideration that the average salary in Spain is €1,640 gross per month (Agencia Tributaria, 2018) savings in vehicle service can have a major impact on the population. For instance, 65% of respondents in a survey are willing to share their vehicle's data if they make a save in return (Telefonica, 2014). Further, 44% of the participants in the same survey believe that technology will give them greater control, for example, over the price they pay for the maintenance and repairs of their vehicle. Thus, the cost of vehicle repair and maintenance appears to be influencing people's focus on car's aftermarket.

In summary, this research addresses the inexistence in the literature of an IT artifact that captures and analyzes car's information in real time using the persuasive design principles along with DSR to reduce the impact of the monetary consumption he/she makes in his/her vehicle, annually.

As a result, we would like to answer to the following questions: Would persuasion design principles be effective engaging drivers in cost car driving behaviors? How would the use of a persuasive IT artifact impact drivers' economy?

To answer these research questions, this research will follow a Design Science Research (DSR) methodology oriented to the creation of successful artifacts (Peffers et al., 2007). DSR is a methodology based on the development of an applicable artifact rather than on the creation on a theory (Peffers, Tuunanen & Niehaves, 2018).

2. Literature Review

As we have pointed out in the previous section, the literature review focuses on two research areas. On the one hand, we will review the literature on Car Maintenance & Services Management (CMSM). On the other hand, we have to consider the literature on persuasive systems design in order to understand how IT artifacts can help to persuade a person.

2.1. IT Artifacts for the Car / CMSM (*Car Maintenance & Service Management*)

The literature on car IT artifacts can be organized into five main areas: location, behavior, data-security, mobility and services & maintenance. The first area of research, location, mainly focuses on studying different driving information (e.g. Chen et al., 2015) and information around car mobility (Datta et al., 2016). This is done through multiple car sensors, such as accelerometers and gyroscopes that provide data and GPS (geospatial position system) that provide position (Johnson & Trivedi, 2011). The most common approach for collecting car data comes from car mobility and location events (Datta et al., 2016; Ranacher et al., 2016). There are authors that have studied how to collect and control car data just to analyze mobility.

In the second category we have reviewed the personalized driver risk to individualized insurance policies (Gerpott et al., 2013). Up till recently the insurance premiums' prices have been based on a priori risk, without taking into account the drivers' actual information (Parry, 2005). Thanks to existing technology, vehicle data can be captured to characterize the driver and evaluate his/her risk behavior, thus adapting the insurance premium to the real risk (Handel, 2013).

In the third category we have included literature concerning collecting car information in the context of how this may affect users in a framework in which the autonomous and connected car can be part of the mobility of our cities (Petit & Shladover, 2015).

In the fourth category we have reviewed everything related to new mobility ways (carsharing, motorsharing and so on). Thus, this literature has studied the impact of technology from the point of view of solving some of the challenges posed today in our cities due to the increase in the transport of cargo and people (He at al., 2014). It is true that the challenge of the new mobility can lead to new business models (Jittrapirom et al., 2017) whose results are part of alternative transport models (e.g., carsharing, bikesharing, motorsharing, etc.). Furthermore, this literature also focuses on cars' environmental impact (Berchicci & Vergragt, 2002; Cohen & Kietzmann, 2014). Finally, other authors within this category analyze both opportunities for sustainable mobility and barriers (Berchicci & Vergragt, 2002).

The fifth category is related to Car Maintenance and Service Management (CMSM). This literature focuses on measuring some parameters of the car, just from a point of view of activity control (Amouzegar & Patel, 2013). The main focus is on car maintenance control trough radiofrequency systems installed on roads.

2.2. Persuasive technology design

As explained before, this research-in-progress aims to design an IT artifact that attempts to modify drivers' behaviors on car service. Persuasion, based on psychological literature, is defined as "the process by which a person's attitudes or behavior are, without duress, influenced by communications from other people" (Encyclopedia Britannica, 2015).

According to Fogg (2003, p. 15), we can define persuasion "as the attempt to change attitudes or behaviors or both". Fogg further explains that the:

"Networked and mobile technology could allow commercial offers to be made at the moment people have a need and can act on the offers, or safe driving could be promoted while the driver is on the road, as part of an in-car system. Intervening at the right time and place via networked, mobile technology increases the chances of getting results." (Fogg, 2003, p. 183).

This is exactly that we want to study in this research-in-progress. That is, we want to mix the ability to collect data from a vehicle with the study of how we can use these data to make life easier for the driver in terms of saving money over car needs. The technology allows us to collect data, interact with the user, and try to persuade him/her to follow a specific path of action.

In this research in progress, we are designing an artifact that would persuade an individual to follow a path of action (Intille, 2004) thanks to an economic incentive over different options of car maintenance and real time needs (e.g., discounts vehicle servicing such as fuel, tires, parking, annual insurance, etc.). This commercial proposal can be influenced by factors such as the design of the IT artifact and the state in which the person is (Fogg, 2003) (eg: interest, state of mind, happy,…).

Persuasion is an ordinary activity element. Persuasion is believed to occur when an attitude and its corresponding behavior changes (Pappas et al., 2017). A person's attitudes and behavior are also affected by other factors (e.g., verbal threats, physical coercion, one's physiological state), thus affecting persuasion (Oinas-Kukkonen & Harjumaa, 2009). Oinas-Kukkonen & Harjumaa (2009) propose 4 persuasive categories:

- **Primary Task:** The design principles in this category support the carrying out of the user's primary task. This category is related to reduction, tunneling, tailoring, personalization, self-monitoring, simulation and rehearsal.
- **Dialogue:** This category is related to implementing computer-human dialogue support that helps users to achieve their goals. This principle includes praise, reward, reminders, suggestion, similarity, liking, and social role.

- **System Credibility:** This category approach us to the credibility. So, the more credible the more persuasive. This category consists of trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability.
- **Social Support**: This category describes how to design the system to try to motivate users by leveraging social influence. Into this category of design principles, we can find social facilitation social comparison, normative influence, social learning, cooperation, competition and recognition.

Additionally, Fogg (2003, p. 187) introduces *"the Kairos Factor"*. According to this factor, we can present a message at the right moment to increase the potential to persuade thanks to a mobile device (i.e., the IT artifact) (Fogg, 2003, p. 188).

In this research in progress, there are several principles that we believe, a priori, should be embedded into the design of the IT artifact for it to be effective in changing drivers' behaviors in order to save money in car maintenance services:

- **Principle of Self-Monitoring**: Provide a system that helps users track their own performance or status supporting them in achieving goals in a less tedious way. In our case, the driver will receive full information of their savings through an APP to check savings account.
- **Principle of Personalization**: Provide personalized discounts. Drivers will receive push notification messages (QR codes) through the IT artifact that can be presented on the suggested places (shops) to have rebates and discounts.
- **Principle of Suggestion**: Provide general advice on targeted behaviors. Application for driver with real time solutions to CMSM with savings.
- **Principle of Kairos**: Mobile devices are ideally suited to offering suggestions at opportune moments. The IT artifact will show to driver products and services depending on the needs and circumstances at the right moment. Soikkeli (2015) introduces as well the importance of time and space in which we can impact a user through his/her smartphone since, as he says, we can persuade more customers in real time.

Foog (2003, p. 32) states that a persuasive technology tool is an interactive product designed to change attitudes by making desires outcomes easier to achieve. In this way, people who authorize the use of the artifact are biased to accept offers (Nooraishya & Mohamad, 2018).

3. Methodology

In order to fulfill our research in progress objective, we will employ Design Science Research (DSR). DSR is a methodology based on the development of an applicable artifact rather than on the creation of a theory (Peffers, Tuunanen & Niehaves, 2018). Science allows us to better understand how the world works and we can design artifacts to improve human capabilities to understand that world (Baskerville et al., 2018). Thus, DSR is defined as the design and investigation of artifacts in context (Peffers et al., 2007). More precisely, DSR is used when we want to try to solve or improve a problem that we have identified, through the process of creating a system/product that will serve to answer the questions we are asking ourselves (Hevner et al., 2004).

Design science research (DSR) requires the creation of an innovative IT artifact for a special problem domain (Peffers et al., 2007). The DSR paradigm aims to establish rigorous ground rules for knowledge contributions around building and evaluating IT artifacts (Hevner et al., 2004).

Our IT artifact identifies what is needed in real time and recommends options for each case with the final aim of saving money. We will approach the development and implementation of our IT artifact in six activities identified by Peffers et al. (2007) for DSR:

- Motivation and Problem identification: The first step in our design process concerns the identification of the problem and its motivation (Oppong-Tawiah et al., 2018). The identified problem is about drivers spending a lot on car services. The objective is to address this issue through the development of an IT artifact. Despite calls for research on this topic (e.g. Reininger et al., 2015; Toledo & Shiftan, 2016; Jittrapirom et al, 2017), this type of IT artifact does not exist currently in the literature. To develop the IT artifact, we focus on persuasion in order to influence drivers' decisions around car service needs. Apart for this, the artifact also proposes maintenance before a problem occurs so that prevention can take place.

- Objectives for a solution: In this step, we will identify the key persuasive design principles to embed into the IT artifact (Fogg, 2003; Oinas-Kukkonen & Harjumaa 2009). In our case, the persuasive principles that apply to this research are the following, because:
    - Principle of Self-Monitoring: Provide a system that helps users track their own performance. In our case, the driver will receive full information through the IT artifact on their spending.
    - Principle of Personalization: Provide personalized discounts. The driver will receive push notification messages with savings included through Quick Response codes (QR Codes) from the IT artifact.
    - Principle of Suggestion: Provide general advice on targeted behaviors. Application for drivers with real time solutions to CMSM. This is just a general information, but not personalized proposals.
    - Principle of Kairos: Mobile devices are ideally suited to offering suggestions at opportune moments. The IT artifact will show to the driver products and services depending on his/her circumstances at the right moment.

- Design & Development of the artifact: Our approach for resolving the practical problem consists on creating an artifact to collect real time data and to use those data to try to influence the driver to safe money in real time around car maintenance services. According to Peffers (2007), a design research artifact can be any designed object in which a research contribution is embedded in the design. Our IT artifact will be design by using 3 elements:
    - The OBD-II device (On Board Diagnostic). This device is an existing system for processing and transmitting on-board signals (Dhall & Solanki, 2017).
    - The Platform, that is a high-performance computer system, equipped with redundancy characteristics, to allow the provision of the service without temporary interruptions.
    - A mobile application (APP) that allows the driver to manage the system/service himself, from its activation to its deactivation, including its configuration, the subscription of new value-added services and some data visualization. It also includes the saving money real time offers for car management.

- Demonstration: In this section we have to demonstrate that the use of the artifact indeed solves one or more instances of the target the problem (Peffers et al., 2007). The OBD system, as part of our IT artifact (formed by the OBD, the platform, and the mobile application), will be extensively adapted to use by the car industry and his ecosystem. Our basic premise is that drivers using our developed IT artifact will be able to reduce the annual cost around their cars. To test this premise, drivers' annual costs will be measured at two different points in time. First, drivers will answer a quantitative survey before the adoption of our IT artifact where they will be asked about a) the money they spend annually on car maintenance and car expenses (e.g. parking, gas, washing, insurance, etc.) b) the number of kilometers traveled in the past year, and c) their satisfaction with their current car maintenance spending. Second, the same data will be collected sometime after they start using our IT artifact. That is, the money spent and number of kilometers traveled since the adoption of the IT artifact will be gathered automatically through the IT artifact, and a quantitative survey will capture drivers' satisfaction with current spending with the IT artifact. These data will serve to calculate their spending per km and satisfaction before and after the use of the IT artifact. Thus, this evaluation will take a quasi-experimental form with a one-group pretest-posttest design (Shadish, Cook & Campbell, 2002). That is, the pre adoption gathered data on spending per km and satisfaction will be statistically contrasted with the post adoption gathered data on spending per km to see whether there is a statistical significant reduction on spending per km and a statistical significant increase in satisfaction after the adoption of the IT artifact.

- Evaluation: The evaluation provides feedback on the research process (Venable, 2014). We are going to use the Venable evaluation framework in this research. We are going to evaluate whether the IT artifact with the embedded design principles is effective in procuring savings in car maintenance to drivers. In DSR there are many types of evaluation (Venable et al., 2014). According to Venable et al., (2014), there are six different (but related) purposes and goals of the evaluation activity in DSR. Due our objectives, we will focus on these four:
  - How well designed the artifact is: Our artifact is based on tree elements (device, platform and mobile application). We will analyze the fulfill the technical criteria (if the system collect information, if the system send information, if the platform management data,…).
  - Control the quality of the outcomes knowledge: We will test whether our artifacts solve our needs.
  - Artifact functionality, performance and usability: These 3 terms will be used to evaluate our artifact. As mentioned in the demonstration point, we will compare the functionality, performance and usability before the artifact and after.
  - Discerning why our artifact work or not: We will analyze why our artifact works or doesn't work. In other words, we are going to evaluate if the artifact system help drivers to obtain savings or not.

  Venable et al (2014) explain that there are 4 steps for evaluating a DSR project:
  - To explicate the goals of the evaluation: There are four competing goals in DSR evaluation: *Rigor, uncertainty and risk reduction, ethics, efficiency.*
  - To choose the evaluation strategy: Following Venable et al., (2014), there are 4 options of DSR evaluation strategy: Quick & Simple, Human Risks & Effectiveness, Technical Risk & Efficacy and finally Purely Technical Artefact. At this stage of the research we consider that the four of them are applicable to our strategy evaluation.
  - To determine the properties to evaluate: We are going to evaluate yearly discount per driver and the voucher conversion ratio.
  - To design the individual evaluation episode: In this section, we will analyze the constraints in the environment and contextual day factors (time, people, budget, weather, type of cars,…).

- Communication:
  We have to communicate the problem and its importance, the artifact's utility and novelty and the rigor of its design to the research and practice communities (Petters et al., 2007). We have to direct our communication efforts to both the academic (academic journals and conferences) and the professional communities (presentations to professional audiences). The OBD system only is being used by different automotive industry players and the author of this Research is a regular speaker explaining the economic benefits that the implementation of a program of this type has for companies and drivers.

4. Conclusions

The objective of this research in progress is to design and build an IT artifact that will persuade drivers to change their behavior around car maintenance in order to allow them to save money. This research in progress contributes to the academy by explaining and analyzing how an embedded artifact can help to reduce vehicle service costs. Our approach to design IT artifacts for saving purposes can also be applied to other areas such home supplies (electricity, heating, water,…) and personal expenses (hotels restaurants, trips,…) to mention only two options. Design Science could be an effective way of reducing costs in different areas and this could be the starting point for these future studies.

References

Agencia Tributaria. España. (2018)

Albarracin D, Sunderrajan A, Lohmann S, Chan S, Jiang D. (2018) *The psychology of attitudes, motivation and persuasion*. The handbook of attitudes. New York: Routledge; 2018;1-5

Amouzegar, F., & Patel, A., (2013) *Vehicle Maintenance Notification System Using RFID Technology*. International Journal of computer theory and engineering. Vol 5. Nº 2

Baskerville, R., Baiyere, A., Gregor, S., Herner, A., & Rossi, M., (2018). Journal of the Association for information systems 19 (5), 358-376.

Benbasat, I., & Zmud, R. W., (1999) *Empirical research in information systems: The practice of relevance.* Mis Quarterly Vol. 23. Nº1, pp. 3-16 March. Issues and opinions.

Berchicci, L., Vergragt, P., (2002) *Assessing the potential of new artifacts for sustainable mobility systems: The Mitka case Design for sustainability program, Industrial Design Engineering.* WIT Press. Southampton.

Chen, S,-H., Pan, J.-S,, & Lu, K., (2015) *Driving Behavior Analysis Based on Vehicle OBD Information and AdaBoost Algorithms.* Proceedings of the international multiconference of engineers and computer scientists 2015. Vol I, IMECS 2015, Hong Kong.

Cialdini RB (1984) *The psychology of persuasion*. Executive Book review.

Cohen, B., Kietzmann, J., (2014) *Ride on! Mobility Business Models for the Sharing Economy*. Organization & Environment. Vol 27 (3) 279-296. SAGE Publications.

Datta, S. K., Ferreira Da Costa, R. P., Härri, J., & Bonnet, C., (2016) *Integrating Connected Vehicles in Internet of Things Ecosystems: Challenges and Solutions.* Communications systems department. EURECOM. Biot. France.

Dhall, R., & Solanki, V. (2017) *An IoT Based Predictive Connected Car Maintenance Approach.* International Journal Of Interactive Multimedia And Artificial Intelligence, Vol 4, Nº 3.

Encyclopedia Britannica (2015): https://www.britannica.com/science/persuasion-psychology

Fogg, B.J., (2003). *Persuasive Technology. Using Computers to Change What We Think and do*. San Francisco, CA: Morgan Faufmann Publisher Inc.

Fogg, B.J., (2009). *Creating Persuasive Technologies: An Eight-Step Design Process.* Persuasive Technology Lab Stanford University captology.stanford.edu

Fournier G., Hinderer H., Schmid D., Seign R. & Baumann M. (2011). *The new mobility paradigm: Transformation of value chain and business models.* Enterprise and work. Innovation Studies, 8, IET, PP. 9 – 40.

Gerald R. Miller & Michael Burgoon (1978) *Persuasion Research: Review and Commentary,* Annals of the International Communication Association, 2:1, 29-47.

Gerpott, T.J., Berg, S., (2013) *Explaining customer's willingness to use mobile network-based pay-as-you-drive insurances.* International Journal of Mobile Communications. Volume: 11. Issue: 5. Pages: 485-512

Handel, Benjamin R. (2013). *Adverse Selection and Inertia in Health Insurance Markets: When Nudging Hurts.* American Economic Review, 103 (7): 2643-82.

He, W., Yan G., & Xu, L.S., (2014) *Developing Vehicular Data Cloud Services in the IoT Environment.* IEEE Transactions on Industrial Informatics. Volume: 10, Issue: 2. Pages: 1587 – 1595.

Herver, A., & Chatterjee, S,. (2001) *Design Research in Information Systems. Theory and Practice.* Integrated series in information systems. 22. Springer.

Hevner A. R. & S. Chatterjee S. (2010). *Design research in information systems: Theory and practice*. Springer Science & Business Media.

Hevner A.R., March, S.T., Park, J., & Ram (2004) *Design Science in information Systems research*. MIS Quarterly, 28 (1), 75 – 105.

Holloway, S. S., van Eijnatten, F. M., Romme, A. G. L., & Demerouti, E. (2016). *Developing actionable knowledge on value crafting: A design science approach*. Journal of Business Research, 69(5), 1639–1643.

Intille S.S. (2004). *Ubiquitous computing technology for just-in-time motivation of behavior change*. The MIT home of the future consortium. Cambridge, MA – USA.

Jittrapirom, P., Caiati, V., Feneri, A-M., Ebrahimigharehbaghi, S., Alonso-Gonzalez, M.J., & Narayan, J., (2017*) Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes and Key Challenges*. This article is part of the Issues "Smart Cities-Infrastructure and Information". Cogitatio. Creative Commons Attribution 4.0. Urban Planning, Volume 2, Issue 2, Pages 13-25.

Johnson, D. A., & Trivedi, M.M., (2011*) Driving Style Recognition Using a Smartphone as a Sensor Platform*. 14th International IEEE Conference on Intelligent Transportation Systems. Washington.

Keen, P. (1980). *Information systems and organizational Change*. Center for information systems research. Massachusetts Institute of Technology. Cambridge Massachusetts.

Lapointe, L. & Rivard, Suzanne (2005). *A multilevel model of resistance to Information Technology Implementation.* MIS Quarterly, Vol 29 – 3 pp 461 – 491 . September 2015

Lin, J., Chen, S-C., Shih, Y-T., & Chen, S-H., (2009) *A study on Remote On-Line Diagnostic System for vehicles by integrating the Technology of OBD, GPS and 3G. Word Academic of Science, Engineering and Technology.* International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol 3, Nº8.

Nooraishya W., Nazlena, M., (2018). *A Study on Persuasive Technologies: The Relationship between User Emotions, Trust and Persuasion.* International Journal of Interactive Multimedia and Artificial Intelligence. www.researchgate.net/publication/323373067.

Oinas-Kukonen, H. &, Harjumaa, M., (2009*). Persuasive Systems Design: Key Issues, Process Model and System Features.* Communication of the Association for Information Systems. Volume 24 - Article 28.

Oppong-Tawiah, Webster, Staples, Cameron, Ortiz de Guinea, Hung (2018). *Developing a gamified mobile application to encourage sustainable energy use in the office. Journal of Business Research*. Published by Elsevier Inc.

Parry, I. W., (2005) *Is Pay-As-You-Drive insurance a better way to reduce Gasoline than Gasoline Taxes?* The American Economic Review. 95, 2. ProQuest Central.

Peffers, k., Tuunamen, T., & Niehaves, B., (2018). *Design science research genres: Introduction to the special issue on exemplars and criteria for applicable design science research.* European Journal of Information Systems. 27 (2), 129 – 139.

Peffers, K., Tuunamen,T., Rothenberger, M. & Chatterjee, S. (2007). *A design science research methodology for information systems research. Journal of Management information systems*. Vol 24, Nº3, pp 45 – 77

Petit, J., & Shladover, S. E., (2015) *Potential Cyberattacks on Automated Vehicles*. IEEE Transactions on intelligent transportation systems, Vl: 16, Nº 2. 1524-9050.

PriceWaterhouseCoopers. (2018) *Five trends transforming the automotive industry*.

Ranacher, P., Brunauer, R., Van der Spek, S., & Reich, S., (2016) *what is an Appropriate Temporal Sampling Rate to Record Floating Car Data with a GPS?* International Journal of Geo-Information. ISPRS Int. J. Geo-Inf. 2016, 5(1), 1.

Reininger, M., Zhuang, Y., & Cappos, J., (2015). *A First look at vehicle data collection via smartphone sensors*. IEEE. Sensor Applications Symposium (SAS).

Resetar, M. (2016) *Innovative Approach to Vehicle Diagnostics.* UDC 629.054 Essay. FSB

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston, MA, US: Houghton, Mifflin and Company.

Soikkeli, T., (2015) *Comparison of context-aware predictive modeling approaches: Semantic place in inferring mobile user behavior.* International Journal of Pervasive computing and communications. Vol. 11 Issue: 3, pp.323-346

Telefónica Connected Car Digital Report. 2014. Telefónica S.A.

Toledo G.,& Shiftan, Y., (2016). *Can feedback from in-vehicle data recorders improve driver behavior and reduce fuel consumption?*. Transportation Research Part A. 94 – 204.

Venable, J., Pries-Heje, J., & Baskerville, R. (2014). FEDS: *A Framework for evaluation in Design Science Research. Research Essay.* European Journal of Information Systems. 1-13