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Utilizing the Internet of Things in the Public Sector

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ABSTRACT

This study investigated the utility of the internet of things in the public sector and the factors influencing the satisfaction of its users. The study followed two directions: The first investigated managers' perceptions and their satisfaction with using sensors for tracking vehicles. The second direction investigated drivers' satisfaction with the system used. Results collected from 20 interviews conducted with managers revealed that cost reduction and more control over drivers' behaviors are the contributions expected from the system. They reported the dissatisfaction of drivers based on violation of their privacy, inequity of implementation, and the low awareness of its utility. Surveys collected from drivers supported the role of trust and privacy but failed to support the role of usefulness. The qualitative and quantitative nature of this research revealed valuable insights and concluded to important recommendations and future work.

KEYWORDS

IoT, Jordan, Public Management, Satisfaction, Tracking System, Vehicle Tracking

1. INTRODUCTION

Governments around the world are striving to improve their operations and reduce their service cost. One of the new trends is the implementation of new technologies into the administrative and operational systems. To achieve such goals, governments are using wireless systems to track vehicles and control expenses. Such systems bring efficiency, effectiveness and reduced costs. Still, employees, managers and executives, might perceive them differently. While many governments have made substantial progress in adopting the concept of Internet of Things (IoT) in a form of tracking systems (Wet-News, 2019), Jordanian government started to use it just recently. One of the most important tracking systems used is the vehicle tracking system (VTS), which uses different technologies such as sensors, RFID (Radio Frequency Identification), GPS (geographical positioning system), or LBS (Location Based System) to track fleets and objects.

The vehicle tracking system utilizes many types of electronic devices, where they are similar in their tracking functions but different in the characteristics and mechanisms of action (Mukhtar, 2015). Major classifications focused on passive vs. active systems. The passive system saves the

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location of information in an internal storage, where it is accessed when the vehicle is available at sight. The active system can transmit the location of information in real time (Kamel, 2015), where the location and information of vehicle are tracked and managed instantly. Finally, the hardware needed to provide real-time functionality includes receivers, sensors and chips, and is operated by a software that manages both the system and the communication network (Radinski & Mileva, 2015).

Public sector institutions are implementing Wireless Tracking Systems (WTS) to improve their operations and enhance the control over their vehicles. They anticipate cost reductions and substantial improvements in vehicle fleet management (VFM). Still, different stakeholders have different perceptions regarding the utilization of such systems. Top management perceives WTSs as strategic systems that add value and reduce cost. On the other hand, employees perceive such systems as invading their privacy and causing health problems. Such contradictory perspectives call for more investigation by research to understand the adoption of such systems.

This study explored the application of IoT (in the form of WTS) in Water Authority of Jordan, where a multi-method approach was followed. The study pursued two research questions. First, a set of structured interviews (survey and open questions) were conducted to explore managers' perspectives on the area. Second, drivers filled a survey to probe their perspectives on the topic. Both instruments were based on a solid literature review to assimilate the factors that will influence the satisfaction with such systems.

RQ1: What are the perceptions of managers regarding the use of IoT (in the form of vehicles' tracking system) in WAJ?

RQ2: What are the perceptions of drivers regarding the use of IoT (in the form of vehicles' tracking system) in WAJ?

The following section depicts the literature review, where a sub-section on IoT and tracking system is reported. The second sub-section included the related studies that cover the following variables: perceived usefulness, privacy, and trust and their influence on satisfaction when using vehicles' tracking systems. Finally, a subsection on the tracking systems in WAJ is covered. The next few sections include research method details, data collection, data analysis and discussion, conclusions, implications, and future work.

2. LITERATURE REVIEW

2.1 Internet of Things and Tracking Systems

'IoT is defined as *"Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts*" (Atzori, Iera, & Morabito, 2010). The applications related to the Internet of Things (IoT) concept are systems that utilize interconnected computer devices and data processing systems that use digital sensors to transfer data over an Internet network without requiring human intervention (Pokorni, 2019). The IoT environment is basically a collection of devices that are connected together like sensors or mobile phones. When these devices are connected through an automated system, they can collect information, and send through an Internet connection to a system that can analyze it and take the necessary action in order to assist a person with a specific task.

IoT consists of six elements: 1) *Identification,* which enables to name or match the services requested to a specific demand. 2) *Sensing*, where the data from the related objects is gathered within the same network range and is sent to a database, or a cloud for analysis in order to take accurate actions on specific services. 3) *Communication*, where various objects connect to convey a message. 4) *Computation*, which is done through computing units and software applications. 5) *Services*, which

consists of four major categories. And Finally, 6) *Semantics*, which refers to the ability of extracting smart knowledge from diverse machines to deliver the required services (Mi et al., 2018). One of the new elements that increase the complexity of the adoption of IoT i cloud computing, where critical issue like building trust and the ultimate security and privacy related to the control over public data will arise (Prasad & Bhavsar, 2020).

Many technologies have caused the evolvement of the term IoT such as machine learning, embedded systems and real-time analytics, which among many other disciplines empowered the IoT. The main power of IoT is its significant impact on many of our daily activities in both personal and work practices, where it connects many sensors to the system at any time, from anywhere, and with any media (Atzori, Iera, & Morabito, 2010). The IoT is an era that shapes the future, where the things in our daily lives will be armed with microprocessors, which will allow them all to communicate with one another and with the users. The IoT purpose is to make the Internet even more immersive and pervasive. In addition, several applications will be established to enable easier access to the IoT interface with a diversity of devices like house appliances, surveillance cameras, monitoring sensors, and vehicles, in order to address new needs and new services to individuals, companies, and public sector institutions (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014).

The IoT intersects with many other applications like smart grids, traffic management, house automation, and mobile healthcare (Muneer, Fati, & Fuddah, 2020). IoT adds value to many areas of work and can acquire and sustain competitive advantage (Wortmann & Flüchter, 2015). Additionally, IoT is creating a new disruptive era along with the cloud computing technology, where it enables a wider number of applications to be utilized and built (Botta, De Donato, Persico, & Pescapé, 2016). On the other hand, building the IoT architecture is a challenging task, mainly due to the very large variety of devices, computer networking, and services that may be involved in such a system (Zanella et al., 2014). Additionally, a number or serious concerns regarding the growth and threats of IoT that may be encountered, are raised, especially in terms of privacy and security. Research asserted the difficulty of maintaining security when more mobile devices are utilized in the IoT architecture (Hashemi & Aliee, 2019).

Tracking technology is one form of IoT, where it is made possible by the integration of three technologies: database technologies like geographic information system (GIS), navigational technologies like global positioning system (GPS), and communication technology like general packet radio service (GPRS) (Aloquili et al., 2009; Al-Bayari & Sadoun, 2005). The tracking technologies can work together like GPS and RFID (IoT sensors); the RFID reader equipped with a GPS can write the location of reader into the tag along with read time (Want, 2004).

GPS navigation device is a device that calculates geographical position related information (i.e. location position latitude, longitude and altitude information), and time related information. It captures such information accurately in all conditions of weather and from anywhere on or near the Earth (Aloquili et al., 2009; Al-Bayari & Sadoun, 2005; Kathirvel et al., 2015). Such technology can be more efficient and effective in outdoors settings (Mukhtar, 2015). The main purpose of GPS systems is to identify the position of the persons or objects and/or as an input to a more comprehensive system function.

Many companies deploy such technology to maintain vehicles' fleets, where they use tracking devices to monitor the behavior and reliability of employees. It enables companies to save cost based on location analysis, reduce their operational costs, improve their efficiency, improve safety, improve environmental quality, and respond better in emergency times (Coffed, 2014). Safety was a major concern when exploring the adoption of IoT (Tarabasz & Poddar, 2019). Hollis (2012) reported other uses in traffic control and criminal law enforcement. Table 1 list various uses and applications of GPS systems and their corresponding literature resources. The following sections demonstrate what the literature reported in relation to the major issues that arise when using such technology.

Table 1. Summary of IoT uses and applications in transportation

IoT uses and applications in traffic	Source
• Avoid traffic congestion and accident and save time	Chen & Chen (2011)
• To notify authorities or carriers when a truck has entered a restricted area or deviated from an intended route • Make a sure that the shipments remain on their allowed or intended route; they also monitor the driver and the truck location, which potentially infringing on both the driver and the carrier privacy.	Fries et al. (2012)
• For data analysis • Transportation • Automotive considerations	Wood et al. (2014)
• Offensive and defensive purposes by military	Kaplan, Loyer & Daniels (2013)
• Murder investigations • Drug investigation • Robbery investigation • Public corruption • Hostage situation • Probation violations	Ganz (2005)
• Determine location anywhere on the Earth	Kathirvel et al. (2015)
• Critical capabilities to a civil and commercial user's position • Steering to destination • Software tourism attraction and guidance around the city	Kathirvel et al. (2015); Aloquili et al., (2009); Al-Bayari & Sadoun (2005); Coffed (2014); Mukhtar (2015).
• Track the accurate geographic locations of criminal suspects	Bankston & Soltani (2014).
• Mining, civil safety response, farming,, surveying and package delivery	Coffed (2014)
• Oversee the vehicle status (i.e. temperature, fuel and door status). • Provides precise and reliable information about the work amount by all employees	Al-Bayari & Sadoun (2005)
• Stop the vehicles if stolen • Containing longitude, latitude and speed information to the vehicle owner or location can also be tracked using internet through Google maps	Singh et al. (2015)
• Monitor the behavior and reliability of employee	Kaplan, Loyer & Daniels (2013)

2.2 Related Work

Adopting IoT goes through four stages process: low expectation, trust building, behavior change, and minimal use. Such process is characterized by being users-centric and require government to adopt their designs to user's preferences (Cho, Lee & Lee, 2019). Park and Kim (2014) introduced a new integrated model to analyze drivers' acceptance of a car navigation system. The study conducted interviews and explored psychological factors related to navigation system usability. The model identified locational accuracy and perceived processing speed of car navigation systems as key psychological constructs. Data was collected via an online survey from 1,181 drivers and statistically analyzed using SEM, where results indicated that the proposed research model predicts drivers' acceptance. The authors concluded that satisfaction plays a moderate role.

Costa (2012) conducted a comparative study between three alternatives that determine the value of the consumed fuel by drivers in Massachusetts. Results indicated that using such technology contributes to reducing fuel consumptions and provides additional features such as congestion pricing. Still, the challenges of using such technology are related to capital and operational costs, privacy, fuel efficiency, and security concerns.

Finally, in a Jordanian context, RFID technology was explored by Abu-Shanab and Yamin (2014) in a public library context, where the authors concluded to the importance of users' beliefs in the benefits of RFID technology in controlling and managing library operations. Finally, significant differences between managers and employees' perspectives were reported. Later Ganapathi and Abu-Shanab (2019) replicated the study in Qatar, where they explored employees' perceptions in this regard in the library of Qatar University and Qatar National Library. Results concluded that shelf management of resources, perceived RFID contributions, and workplace efficiency were the top rated dimensions pertaining to the use of RFID. Customer satisfaction was the most influential factor that encouraged libraries to use such technology.

Research that investigated the satisfaction of using IoT and tracking systems is rare. In Jordan, only few studies explored such technology based on its rare use by public sector (i.e. the previous example of Abu-Shanab & Yamin, 2014). One of WAJ (Water Authority of Jordan) goals from using tracking systems was reducing the fuel consumption based on tracking drivers and gaining their commitment to their scheduled tasks. Drivers satisfaction is not the major objective of WAJ executives, they aim for cost reduction and better control. The following sections will add to the literature review by exploring research related to privacy, usefulness, trust and satisfaction.

2.2.1 Privacy

Salman, Saad and Ali (2013) asserted the role of tracking systems in leading humans to what to do and how to behave (good or bad behavior). Thus, a number of ethical issues arise when the collected information is recorded and transmitted to a third party (Fries et al., 2012). Privacy is the first major ethical issue, where it becomes more serious, where tracking technologies make it easier to abuse or invade people's privacy (Khalifa et al., 2012). Privacy is defined as "*respecting individual's right to have information with an appropriate protection level*" (Fang, 2002). Other definitions of privacy focus on the humans' right to seclude themselves, or data about themselves, and/or selectively express themselves. Privacy is the right of the people to be secured in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by affirmation, and particularly describing the place to be searched, and the persons or things to be seized (www.law.cornell.edu).

It is important to apprehend that the boundaries of what is considered private/public differ among individuals or cultures. A common overlap exists between privacy, security, and confidentiality (Al-Jamal & Abu-Shanab, 2018). The authors assert that governments are confused between privacy and transparency, where they claim the right of opening their records to the public (open government initiatives). Privacy is a well-researched item with respect to technology adoption within the Jordanian context (Al-Jamal & Abu-Shanab, 2015a & 2015b & 2018). A study in Germany reported a negative association between privacy and adoption intentions, where such result confirms the legitimate users' concerns regarding privacy when using IoT applications (Wunderlich et al., 2019).

Radio Frequency Identification (RFID) introduction adds a new dimension to the debate over privacy as it enables businesses to track products after the purchase point. However, RFID does not violate privacy any more than credit card and bar code use (Ganz, 2005). The tradeoff facing governments and individuals when implementing tracking technology is threatening individuals' liberty for the sake of fighting terrorism or public corruption. When considering privacy, we need to consider security, where governments need to fully protect such networks from tampering (Chin, Callaghan & Ben Allouch, 2019; Abdul-Ghani & Konstantas, 2019).

Another dimension that is disputed in research is tracking. Some researchers and books claim that tracking is a violation of human rights. Many consider tracking a dimension of privacy (to be left alone and not to be followed). Monitoring sensors-equipped vehicles significantly raises privacy concerns. The system will capture vehicle movement and thus can relate that to the driver. Such traces of location might detect sensitive places visited by the drivers, from which, for example, political affiliation, medical conditions and potential involvement in traffic accidents or traffic violations could

be inferred (Hoh et al., 2012). Finally, Bankston and Soltani (2014) distinguish between short term tracking for traffic management and long-term recording of drivers and vehicles details. They proclaim that society can tolerate the first practice, but the second is a clear violation of people's privacy.

H1: Privacy will positively influence users' satisfaction with IoT implementation.

2.2.2 Perceived Usefulness

When exploring the factors affecting the use of technology, many famous theories are reported in the literature. One of the most commonly used and yet yielded robust results is the Technology Acceptance Model (TAM). Based on the Theory of Reason Action (TRA), the TAM was first proposed by Fred Davis (1989), but was modified by the same author (and many other authors), and more than one time. The basic most commonly used version of TAM included three major variables: Perceived usefulness and perceived ease of use as independent variables and behavioral intentions as dependent variable. This study is based on a non-voluntary use of technology and employees don't demonstrate any high level skill need to use the tracking system. Thus, the only variable surviving from the TAM is perceived usefulness (PU).

Previous studies concluded that PU has a significant impact on technology acceptance. In the context of IoT-wearable devices research, studies supported the role of PU (or performance expectancy) in influencing adoption decision (Kao et al., 2019; Tarabasz & Poddar, 2019). They also indicated that satisfaction is significantly associated with PU (Park & Kim, 2014). PU, like most technology adoption variables, varies from one technology to another (technology specific). In this study, we will measure PU using the following dimensions: productivity, effectiveness, efficiency, better control, and job functionality related needs. The research framework assumes that PU will have a significant relationship with the driver's satisfaction about the use of tracking technology (which is used to track their vehicles).

H2: Perceived usefulness will positively influence users' satisfaction with IoT implementation.

2.2.3 Trust

Trust is "*the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor'* (Mayer et al., 1995, p. 713). Research on trust indicated significant result for the influence of trust on technology adoption (especially in e-government area) and decomposed trust into two major indicators: trust in government and trust in technology (Abu-Shanab, 2014). Such fragmentation is crucial for this study as it builds the argument that defines the relationship between employees (drivers in this case) and the government (The WAJ representatives) and the technology (tracking system and IoT).

People are not willing to share their information with others. Still, many will sacrifice such right for the sake of enjoying a social media account (Rose, 2012). The author cites the story of Facebook, where the application depends on people's freedom to give more information for the sake of enjoying the interaction. Still, even with public sector perspective, citizens need some assurance that their data is protected to trust their government (Chin et al., 2019). Trust is balanced with the amount of control users master in the process, where research emphasized the role of control in building trust (Falcone & Sapienza, 2020).

H3: Trusts will positively influence users' satisfaction with IoT implementation.

2.2.4 Satisfaction

Job satisfaction is the collection of beliefs and feelings that people have about their current jobs. It reflects the extent to which people get gratification and the sense of fulfillment that is derived from

their job (Tong et al., 2015). User's satisfaction is a crucial factor for the continual use of technology and for the success or failure of WTS projects. It is important to understand the main challenge facing Jordanians when using a certain technology. It is also equally important to understand the antecedents of satisfaction so governments realize employees buy in for such technology. Dissatisfaction among customers who use WTS might occur because of technological failure which results into a negative perception of the functional quality of the service. Dissatisfaction might also arise from technology design problems or service design problems (Alawneh, Al-Refai & Batiha, 2013).

2.3 Water Authority of Jordan (WAJ)

Water Authority of Jordan (WAJ) was established in 1983 under the temporary law, and was directly linked to the Prime Minister of the Ministry of Water and Irrigation (MWI). (www.waj.gov.jo). The ministry is concerned with utilizing the water sources in Jordan and to reduce the gap between supply and demand through the development of water sources. It focuses on finding new sources, reducing water losses, and increasing awareness of the efficient water consumption. The ministry also manages the sewage sector in Jordan and the reuse of the treated output for irrigation purposes. Jordan suffers from water shortage, which prompted the Jordanian governments to give the water sector the highest priority.

WAJ in particular is responsible for supplying water as well as wastewater service management. The following are the set of task managed: Scan water sources and manage water use, develop plans and policies related to water use, Manage public and private wells and the exploration process, handle projects related to its functions, and conduct research and studies related to water and wastewater sectors (www.waj.gov.jo).

The MWI followed the government's lead in transforming some services to be offered electronically. Such step responds to the primary goals of Jordan's e-government project, which aims to develop, improve and speed up government services and better serve citizens. The Minister of Water and Irrigation proclaimed that the use of technology would enable them to face many challenges. Based on that, MWI transformed some services in areas like administration and operational areas. He added that the electronic transformation plan implemented since 2016 has accomplished a lot, where he claimed that the ministry provided full support to E-government initiatives.

Al-Yarmouk Water Company is a limited liability company, founded in 1997 by the Ministry of WMI/WAJ/ and formed a special agreement for such purpose. The purpose of such agreement is to provide and manage water services in the four provinces in Northern Jordan (Irbid, Ajlun, Jerash and Mafraq). They started using GPS in 2012 by establishing a contract between WAJ with Sama Company for communication and programs. This study will target its required samples only in the Northern part of the country and specifically under the jurisdictions of Al-Yarmouk Water Company (www.ar.pmu.gov.jo).

3. RESEARCH METHOD

Based on our previous literature review, a research model was proposed to better understand the factors influencing employees' satisfaction regarding the use of IoT (tracking systems). This study used the tracking system as a surrogate for IoT, where it is the only application related to IoT. The research model hypothesized that perceived trust, perceived usefulness, and perceived privacy are major factors predicting the level of satisfaction with the system. Figure 1 depicts the research model and the assigned hypotheses. Table 2 also lists the four variables used and the definition adopted for each variable.

This research followed a multi method approach, where it utilized two sources of data. First, a survey covering the issues related to employees' perceptions regarding the research model components. Second, a set of interviews to understand managers' perspectives. The second direction of this study was to probe managers' opinions regarding the issues related to the use of tracking technology for

Figure 1. Proposed research model

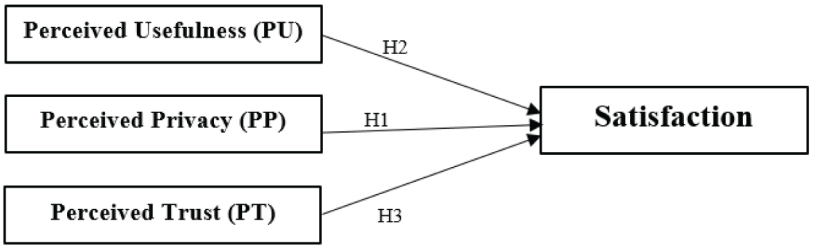

Table 2. Variables definitions

Variable name	Variable definition	Reference
Satisfaction (S)	Collection of beliefs and feelings people have about a job; it reflects the extent to which people get gratification and the sense of fulfillment that is derived from their job.	Tong et al., (2015)
Perceived Usefulness (PU)	to which extent a person believes that using a specific system will enhance her or his job performance	Sentosa & Mat, (2012); Zhou (2008)
Perceived Privacy (PP)	Respecting individual's right to have information with an appropriate protection level	Fang (2002)
Perceived Trust (PT)	The willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor	Abu-Shanab (2014; Mayer et al., (1995)

fleet control. This step included few open questions to understand the issues related to the study and overcome the small sample size. The following sections elaborate more on the instruments used and the sampling process.

3.1 Research Instrument

This study adopted two instruments. The first instrument covered the items used for measuring employees' perceptions of the four variables included in the research model. Table 13 in the Appendix depicts the items short descriptions and the source in the literature. The items were modified to fit with the specific purpose of this study as none of the reviewed literature explored the adoption of tracking technology. The survey included a description of the study and its purpose, then a section that included two demographic questions (age, and experience). Gender was not included in the survey because the researchers expected that none of the drivers is a female.

The survey included 8 items for measuring perceived usefulness, 4 items for measuring perceived privacy, 6 items for measuring perceived trust, and 4 items for measuring satisfaction. The instrument items were translated to Arabic language from its original sources using a short backward translation process (Brislin, 1976), where one expert from academia translated the items to Arabic, another expert translated back the items to English, and the researchers compared the two versions and finalized the text used. Using Arabic language surveys yields more reliable results as Arabic is the language of Jordanians and most drivers cannot speak other languages fluently (Abu-Shanab & Md Nor, 2013).

The second instrument included the same introduction and a list of items that addressed the utility of tracking system and its use in WAJ domain. The demographic section in the second survey included age, experience, education, and the managerial position. Again, gender was not a major demographic factor based on the majority of managers who were males. The instrument included 19

items regarding the utility of tracking system and its use by WAJ. Finally, the instrument included 5 open ended questions. Both surveys used a 5-point Likert scale with 1 representing a total disagreement and 5 representing a total agreement.

3.2 Sampling Process

Based on the research questions of this study, two samples were targeted. The first sample included 100 drivers, where few surveys did not report their age and experience. Table 3 shows the demographic distribution of drivers' sample. The second sample included 20 managers, where our focus on the Northern provinces limited our selection and our sampling process. Table 4 reports all the demographic details collected for the second sample. The sample distribution with respect to position was as follows (with their frequencies): Water Network Management (3), Human Resource (2), Director of the Directorate (4), Water subscriptions (1), Sewage Network Management (1), Procurement (1), Control and Inspection (1), Vehicle Maintenance & Operation (2), Commercial Rep. (1), Stations and Wells (1), Control and Public Services (1), Finance (1), and Information Technology (1).

4. DATA ANALYSIS AND DISCUSSION

This section will report the results of the two tests implemented. The first section and second will cover the managers' survey results and discussion of the open ended questions. The third section will explore the drivers' survey results.

4.1 Managers' Survey Results

The first step in analysis is to explore managers' opinions regarding the 19 items related to the utility of tracking system use. Descriptive analysis was applied and the item means and detailed frequencies were estimated. Table 14 in the Appendix lists the results generated. The 19 questions represent the indicators that measure the utility achieved from using tracking systems for tracking AL-Yarmouk vehicles. The weighted frequency distribution was calculated using the sum of product of each scale level (from 1-5) by the frequency associated with it (example: Q19 = (3*1)+(4*2)+(6*3)+(5*4)+(2*5)=58.) In social sciences, it is a common practice to consider the following classification scheme when using a 5-point Likert scale: 1-2.333 as low, 2.333-3.666 as moderate, and 3.666-5 as high mean.

Table 3. Drivers' sample demographics (Total sample = 100)

Age	Freq.	%	Experience	Freq.	%
Less than 25	8	8%	1-5 years	15	15%
25-35 years	36	36%	6-10 years	23	23%
35-45 years	27	27%	11-15 years	24	24%
More than 45	24	24%	More than15 years	29	29%
Not reported	5	5%	Not reported	9	9%

Table 4. Managers' sample demographics (total sample = 20)

Experience	Freq.	%	Education	Freq.	%
5-10 years	5	25	Diploma	3	15
10-15 years	6	30	Bachelor	15	75
> 15 years	9	45	Master	2	10

Results indicated that more than 50% of items yielded high perceptions, while all the others are moderate. Q1, Q2 andQ3 have the highest values, which indicates that managers see the system is very useful and its major contribution is drivers' commitment and increased control over operations. On the other hand, Q13, Q18 and Q19 have the lowest values. Q13 indicates that the system cannot determine the set of locations the driver visited during work hours. Regarding Q18, it seems that managers did not think there is a strong relationship between drivers' job satisfaction with the system. Finally, Q19 shows that managers did not highly believe that the system achieved its intended objectives.

4.2 Open Questions

Based on the exploratory and descriptive nature of the study, the second part of interview included a set of open-ended questions to give managers the freedom to bring in their input regarding the contribution of GPS systems. The five questions are the following:

Q1: What are the main purposes achieved from using tracking system?
Q2: What is the main problem faced in using tracking system?
Q3: Mention additional options that tracking system can provide other than the ones used by WAJ?
Q4: Do you think the drivers are satisfied from using tracking system? Why?
Q5: What are the reasons that influence the driver's satisfaction or dissatisfaction?

The authors analyzed the collected text for each question. The five questions used in the interview were analyzed manually by counting how many times a specific statement is repeated in the answer for all 20 managers. Such classification represented a simple grounded theory implementation. We calculated then the percent of frequency based on the total statements counted for all managers. Such method means that the total frequencies are not conclusive to 20 only (number of managers), but might exceeded in some cases if a manager gave more answers. Following are five tables that list the five questions (embedded in their title) and the frequency distribution estimated for each (Tables 5-9).

Managers think that the main purpose achieved from using tracking system is the adherence to the required path (34.48%). Although it was the most frequent among answers, they have indicated implicitly that it led to achieving other goals like reducing oil consumptions and decreasing vehicles repair expenses (Table 5). Finally, linking the results of this table and Q19 in Table 14 in the Appendix shows that managers believe that the system did not pay back its intended benefits, but showed varying performance achievements across the use spectrum.

Since its first year of inception, managers indicated that most of the problems faced are technical problems. Managers explained that in some areas the network coverage is bad, so it may lead to providing incorrect data and missing segments. A poorly defined work area borders, lack of privacy,

Table 5. What are the main purposes achieved from using tracking system?

Answers	Freq.	%
Adherence to the required path	10	34.5%
Reduce oil consumption	7	24.3%
Increase control	4	13.7%
Improved performance	4	13.7%
Speed completion of tasks	2	6.9%
Decrease vehicle's repair expenses	2	6.9%
Total	29	100%

lack of interaction with repair & support team and problems with the system provider are the lowest percentages (Table 6).

The objective of the question in Table 7 is to know to what extent managers are aware of the wide tracking system benefits. Most of managers did not know if the system provides options other than the used ones (55%). Based on the IT manager, two-way communication is the next step that WAJ will provide. For dismantling vehicles, the system is in an inactive mode and applied only to heavy vehicles. Such policy is based on savings in fuel consumptions. In addition, stopping vehicles may cause traffic jams and accidents. The gap between the IT manager's plans and the reported percentages calls for an awareness campaign and a training program that will increase system functionalities' utilization and improve performance.

Tracking systems may help decision makers to become aware about other option. When decision makers were asked about drivers' satisfaction with tracking system, 68% said No, and 32% answered Yes (sum of percentages in Table 8 for yes/no). Which indicates that drivers are not satisfied with the implementation of such systems. It indicated that even if they did not like being tracked, driver's desire of using vehicles for personal purposes are the major reason leading to driver's dissatisfaction. Two responses included an answer of "Yes or No" at the same time, as the managers could not decide if drivers are satisfied or not. Finally, the rank of reason behind dissatisfaction are shown in Table 8 (from highest to lowest) and they are: do not like to be monitored, using vehicles for personal matters, system is not beneficial, awareness level, and equity issues.

Table 6. What are the main problems faced in using tracking system?

Answers	Freq.	%
Technical problem	9	43%
Driver's resistance	3	14%
There's no problem	3	14%
I don't know	2	10%
Drivers are not aware of the work area borders	1	4.75%
Lack of privacy	1	4.75%
Lack of interaction with repair & support team	1	4.75%
Problems with system provider	1	4.75%
Total	21	100%

Table 7. Mention additional options that tracking system can provide other than the ones used by WAJ?

Answers	Freq.	%
They don't know	11	55%
Interaction with drivers (two way communication)	3	15%
Stop out, off track or stolen vehicles	2	10%
Understand tracking system importance, but don't know what particular options can do	2	10%
Directing in traffic jams & select the best route	1	5%
Current system is appropriate	1	5%
Total	20	100%

Table 8. Do you think the drivers are satisfied from using tracking system? Why?

Answers	Freq.	%
(Yes) Preserves their rights	6	27.3%
(No) Don't like being monitored/tracked	5	22.7%
(No) The desire of using vehicles for personal purposes	5	22.7%
(No) The system is not beneficial	2	9.1%
(No) Not aware about the system importance	2	9.1%
(No) No equity in enforcement	1	4.6%
(Yes) Sincerity and self-commitment	1	4.6%
Total	22	100%

On the other hand, managers' perceptions regarding why drivers would be satisfied is the equity again. They perceive that the tracking system preserve their rights and empower good drivers. The second mentioned reason is sincerity and commitment, where drivers are perceived by managers to be committed. Table 9 shows such responses.

Managers declared that applying this system, to monitor drivers and record irregularities (but overlooking managers' behavior), make drivers feel the system is unfair. The system is designed to track WAJ vehicles regardless of the driver (manager or not). The presence of a rewarding system that rewards drivers who are committed to their track is very important to reinforce their satisfaction.

4.3 Drivers' Survey Results

The second survey targeted drivers working in the four Northern provinces in Jordan. The drivers responded to 100 surveys. The first test on drivers' survey was to estimate the mean of the four variables included in the research model. The mean estimate will be used as a surrogate of the variables, where it is the mean of the items included in the survey measuring the variable. Table 10 represents the results of the mean estimation.

Results shown in Table 10 indicates moderate perceptions regarding all of the variables. The highest mean estimated relates to the perceived usefulness of tracking system, while the lowest mean relates to the satisfaction variable. Such moderate levels indicate the utility of the system, but not to the expectations of drivers, where they are not extremely satisfied with the system. Still, the standard deviations represent a consensus among drivers regarding such evaluation.

Table 9. What are the reasons that influence drivers' satisfaction or dissatisfaction?

Answers	Freq.	%
Equity in enforcement	6	26%
Reward & punishment system	6	26%
Awareness (drivers know about the importance and advantages of system)	4	17%
Driver intention of use	2	9%
Consider Drivers needs	2	9%
Having no ideas	2	9%
Trust between employee & the Company	1	4%
Total	23	100%

Table 10. Variable estimated means

Variable	No. of items	Min	Max	Mean	Std. Dev.	Cronbach's alpha
Perceived Usefulness	8	1.38	5.00	3.4513	0.8195	0.799
Perceived Privacy	4	1.00	5.00	3.0817	0.9165	0.681
Perceived Trust	5	1.40	4.60	3.3600	0.8904	0.733
Satisfaction	4	1.00	4.75	3.0225	0.9861	0.776

The second step in analysis is to test for the reliability of the variables, where Cronbach's alpha is a suitable measure for estimating the internal consistency of items included in any variable. Results indicated acceptable levels of reliability, where any value above 0.6 is considered acceptable. On the other hand, the recommended values need to exceed 0.8 (Hair et al., 1998). The reason for such low reliability is the collection of items used, where we started our study with a newly developed instrument collected from many articles. Such first trial makes the reliability of instrument not highly consistent.

The second step is to see if the selection of the variables included in the model is suitable. Such argument can be supported by estimating the bivariate correlations between each two variables included in the model. Table 11 depicts the Pearson's correlations matrix. The results shown in Table 11 indicates a significant bivariate relationship between satisfaction and perceived privacy and trust. On the other hand, and contradictory to most previous research, perceived usefulness did not show a significant relationship with satisfaction. The correlations between the three independent variables were all significant but not to a degree to present a multicollinearity issue (if correlations are more than 0.85, then a multicollinearity issue is reported (Hair et al., 1998)).

To test the research model, multiple regression is used. Multiple regression technique is a robust statistical technique used when the research model includes multiple independent variables and one dependent variable. The test used an enter scheme, where all independent variables were entered (even though PU did not show a significant correlation).

Results indicated a significant model, with an $R^2 = 0.317$ (adjusted $R^2 = 0.295$). Such result represent an explanation in the variance of satisfaction equal to 31.7%. Table 12 represents the regression coefficient table.

As expected, two independent variables were significant predictors of drivers' satisfaction with using tracking systems. Such result supports hypotheses 1 and 3. On the other hand, result did not support hypothesis 3, which relates to the relationship between perceived usefulness and satisfaction.

Table 11. Pearson's correlation matrix

Variables	PU	PP	PT	S
Perceived Usefulness (PU)	1			
Perceived Privacy (PP)	0.209*	1		
Perceived Trust (PT)	0.212*	.260**	1	
Satisfaction	0.154	0.465**	0.427**	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 12. Regression coefficient table

Predictor Variables	Unstand. Coeff.		Stand. Coeff.	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.525	0.464		1.132	0.261
Perceived Usefulness	0.007	0.105	0.006	0.067	0.947
Perceived Privacy	0.407	0.095	0.379	4.275	0.000
Perceived Trust	0.362	0.098	0.327	3.692	0.000

Dependent Variable: Satisfaction

5. CONCLUSION AND FUTURE WORK

This study tried to answer two research questions that explored the influence of tracking system's use in Water Authority of Jordan on the satisfaction of employees and managers. The study adopted two directions for answering the research questions. First, the researchers developed a research model, which consisted of two ethical issues (privacy and trust) and adopted perceived usefulness from TAM to predict drivers' satisfaction with tracking system use in WAJ. An Arabic survey consisting of 22 items measuring the four variables was used. To test the proposed model, multiple regression technique yielded surprising results, where PU was not a significant predictor of satisfaction and PP and PT were significant predictors in the model. Results related to privacy and trust are aligned with previous research (Abu-Shanab, 2014; Alawneh, Al-Refai & Batiha, 2013). On the contrary, PU contradicted with previous research supporting its role in predicting technology adoption literature (Park & Kim, 2014). The coefficient of determination R^2 is 0.317 which means that model has explained 31.7% of the variance in satisfaction. Considering the small sample size, such explanation power is considered acceptable (0.8 as per Cohen et al., 2003).

The second direction followed by the research method was to conduct a set of structured interviews to explore the utility of using tracking systems. The interviews targeted managers to explore their perceptions regarding the system and driver's satisfaction levels. The results indicated that the system has many utilities, the most important ones are reducing the expenses of oil consumption and vehicles maintenance. Such perception is confirmed by comparing the reports of WAJ for previous periods. The other benefit reported is the increase in control over drivers' behavior. Despite that, managers believe that drivers are not satisfied with the system. Reasons mentioned were the motivation and equity of implementation, which might increase their satisfaction if handled carefully. Finally, it seems that drivers' awareness of the system and its benefits was reported as an important factor that affects satisfaction (in line with the work of Verdegem & Verleye, 2009; Alawneh, Al-Refai & Batiha, 2013).

Carefully inspecting the results, we notice that trust is a significant predictor of satisfaction, but it was not stressed enough in the interview synopses. The quantitative analysis of the model indicated a moderate level on all variables (trust and satisfaction), while the qualitative analysis indicated such issue (reported by managers in the interviews). The synopses also indicate the reasons behind such level of satisfaction. This may help us in identifying more variables to use in future research.

The general impression of managers is that the drivers are not satisfied because it restricts their movement and they do not like to be monitored. Managers suggested solutions to better satisfy them such as increasing their awareness of the system's utilities, motivation, equity and justice in implementation, and adding new features to the system to facilitate their work.

5.1 Contributions and Implications

This is one of the few studies that dealt with satisfaction and the utility of using tracking system at government or private sector in Jordan. IoT is a new topic that is not implemented in Jordan, and how

about being researched. Jordan is trying to use ICT to improve operations and help in bridging the gap and fight corruption (Abu-Shanab et al. 2013). Interview style helps in understanding the research problem and formulating a sound empirical research method. The newly developed instrument (in Arabic) is commended for building a foundation for researchers to use such instruments for future research. The two instruments used helped in building a research model with an acceptable explanatory power based on the small sample size.

The results provided important insights to the factors that influence managers' perceptions regarding the utility of tracking systems, the role of PU and its insignificant influence from drivers' perceptions, and the importance of trust and privacy above PU when probing drivers' opinions and interest.

Government officials need to look carefully into the results of this study and address drivers' feedback to gain their satisfaction and improve their performance. Protecting privacy, building trust, committing to fair processes in implementation, putting a suitable rewards system, and raising awareness about the system and its utility for all government, managers, and drivers are all important factors that positively affect the satisfaction of users. Previous research proposed more work on control for building trust and raising awareness regarding privacy and security issues (Falcone & Sapienza, 2020; Abdul-Ghani & Konstantas, 2019). In addition, increasing control over drivers, driver's commitment to the right path and reducing expenses of oil consumptions and maintenance of cars, are all very important achievements and gains from using tracking systems.

5.2 Limitations and Future Work

This study suffered from few limitations. First, the low educational level of drivers limited their understanding of the questionnaire items. In addition, drivers lack the needed level of awareness about the system utility for them, where they were concerned about their behavioral violations and personal interest. Second, the equity issues (based on the deactivation of tracking system on manager's cars) might have inflected hostile behavior against the system and might affected results when responding to the survey. Third, the small sample size (based on availability) also yielded insignificant results that are not aligned with the literature. Such issue is caused by the small population/sample open for research. The study covered four districts in the northern part, which is a substantial size. Also, the technology is employed by Al-Yarmouk company and not in the south of Jordan (owned by the government). Finally, the newly developed instrument might have influenced the results.

It is important for researchers to extend such study and replicate our empirical test on drivers' perceptions. Governments need to explore employees' satisfaction (all categories) and try to raise awareness regarding the diverse benefits of implemented systems. Finally, a parallel policy need to be enforced to cover issues of privacy, trust, reward system and equity between all categories of employees.

Despite its insignificance, it is better not to drop usefulness from future research. More studies of the impact of usefulness on satisfaction, will either support the findings of this study, or solidify the findings. Finally, WAJ recently contracted with AL-Manaseer Company and applied magnetics cards for controlling oil consumption; thus, this study can be replicated on this new technology with extended variables to explore the satisfaction and utility of this technology.

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APPENDIX

Table 13. Survey short item descriptions

Perceived Usefulness Items	Source
Q1: Using GPS systems improves my productivity Q2: Using GPS makes it easier for me to determine/access required location Q3: Using GPS enhances my effectiveness	Mahadeo (2009)
Q4: Using GPS provides greater control over my work. Q5: The electronic mail system addresses my job-related needs Q6: Tracking with GPS will help me do the job faster Q7: Using electronic mail reduces the time I spend to determine required location Q8: GPS provides adequate support when vehicle brakes down	Davis (1989); Labay & Anderson (2006)
Perceived Privacy Items	**Source**
Q1: WAJ does not provide my personal information to others without my consent Q2: WAJ ensures the confidentiality of my personal information Q3: WAJ will never misuse my personal information Q4: WAJ has adequate technological standards and tools to ensure that the data I send cannot be modified by unauthorized people Q5: WAJ adheres to personal data protection laws Q6: WAJ only collects users' personal data that are necessary for its operations	Alawneh et al. (2013)
Perceived Trust Items	**Source**
Q1: I trust that GPS provides the right location and correct information	Mahadeo (2009)
Q2: I feel confident that technological advances make it safe for me to use GPS Q3: I feel assured that the system can protect me from any problems with information systems	Li et al. (2008)
Q4: I have confidence in the technology used by the government Q5: The government have sufficient and trusted experience and resources	Johnson et al. (2008)
Q6: I trust that company and their benefits has the highest priorities at WAJ	Khasawneh et al. (2013)
Satisfaction Items	**Source**
Q1: I have positive experience with using GPS Q2: GPS satisfies my needs by providing the necessary functionalities	Alawneh et al. (2013)
Q3: My interaction with the GPS is clear and understandable Q4: GPS has no Health risks	Park & Kim (2014) Suggested by researcher

Table 14. Closed questions results

#	Question	Frequencies					*Σ Freq.	Mean
		1	2	3	4	5		
1	Tracking with GPS is useful				12	8	88	4.4
2	GPS improved driver's performance & made them more committed			2	11	7	86	4.3
3	GPS Increased control over work			2	11	7	84	4.2
4	GPS Reduced time needed to determine required positions		2	6	4	8	78	3.9
5	GPS helped drivers accomplish their tasks quickly		1	6	8	5	78	3.9
6	GPS allowed officials to interact with drivers and give them directions	2	2	2	10	4	72	3.6
7	GPS helped select the best track and avoid traffic jams	3	2	6	7	2	63	3.15
8	GPS sends notifications when vehicles crash or in jam to provide support	4	2	2	9	3	65	3.25
9	The management do not abuse driver's location	1	2	10	7	1	68	3.4
10	Al-Yarmouk management save driver's information		1	5	9	5	78	3.9
11	Al-Yarmouk management provides security requirements such as firewalls		1	7	9	3	74	3.7
12	Al-Yarmouk company applies privacy policies & laws		1	7	10	2	73	3.65
13	GPS identifies the visited places which are associated with work only	7	2	1	7	4	*58*	*2.9*
14	GPS provided accurate information	1	2	1	9	7	79	3.95
15	GPS runs continuously and will not disrupt the work	1	1	3	10	4	75	3.75
16	The information system used is reliable & suitable	1	2	4	8	5	74	3.7
17	Al-Yarmouk water have enough experience with information systems	1	1	1	11	6	80	4
18	Driver's job satisfaction influence their satisfaction about tracking them	2	5	4	8	1	*60*	*3*
19	Al-Yarmouk water achieved all predetermined objectives of using GPS	3	4	6	5	2	*58*	*2.9*

*The sum is the result of frequency value multiplied by the rate of Likert scale associated with it

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