Mobile Electronic Performance Support System as a Learning and Performance Solution: A Qualitative Study Examining Usage, Performance, and Attitudes

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ABSTRACT
Advanced technology innovations have contributed to the development of learning and performance solutions in both traditional and mobile workplaces. This study observed the use of the proprietary Global Positioning System (GPS) developed by Phonenav as a performance improvement solution in a mobile workplace. Thus, the study investigated the use of data assisted GPS as a performance improvement solution for delivering live instructions in a work environment, and attempted to understand its impact on users' work performances and attitudes to technology. A cross-sectional qualitative study, supported by multiple data sources, was employed. The findings of this study revealed that the use of mobile EPSS resulted in an increased work performance and work efficiency of its users. This study contributes to the field of Human Performance Technology, by facilitating an understanding of the impact of mobile EPSSs on workplace performance. It provides a useful resource for professionals and researchers in the field of Educational Technology interested in exploring the use of mobile technology for instruction delivery in mobile workplaces.

INTRODUCTION
Today's expanding mobile technological environment invites an increasingly innovative use of technology in organizational processes. According to Gayeski (2002), statistics show that modern communications technology has enabled people to become increasingly mobile. This has influenced the shift of workplace boundaries beyond traditional offices, often allowing employees more flexibility in their work schedule. Employees working remotely often find they require the use of electronic support tools. In this study a proprietary mobile global positioning system (GPS), a satellite-based guiding system, developed by Phonenav, was used as an Electronic Performance Support System (EPSS) for mobile computer specialists. The Phonenav GPS used an external satellite box to relay signals to an app on the user's cell phones through which the GPS was operated. The external box needed to be in the user's car at all times. It provided the functionality of voice and visual guidance to a location inputted by the user. To keep the participants and company names anonymous all identifiers have been replaced with pseudonyms. The technicians used the technology to perform specific work-related and non-work related tasks. This study used the GPS technology as an EPSS (Wilmore, 2006) to determine whether mobile EPSSs improve the performances of its users in the workplace, through a qualitative analysis.

An EPSS, commonly used in the workplace, provides support for its users in accomplishing and performing specific tasks, thus helping them to perform their work more efficiently (Reiser & Dempsey, 2012). EPSSs contain combinations of task structuring, knowledge, data, tools, and communication components to support four activities: learning, doing, referencing, and collaborating (Gery, 2002). Wager and McKay (2007) argued that EPSSs offer the ability to improve performance in the workplace. According to Mitchem, Fitzgerald, Miller and Hollingsead, (2013), the goal of an EPSS is to provide support that is necessary to ensure performance and learning at a moment of need in a recurrent activity. GPS technology can be incorporated into an EPSS to provide navigational assistance as Wilmore (2006) states: "An EPSS can be a global positioning system (GPS) device that identifies exactly where the user is located by tapping into GPS satellite signals" (p.13). The for-profit company Phonenav produces such technology. Its platform incorporates features such as just-in-time instructions, live streaming of visual and voice-activated directions retrieved from Phonenav's database, and other advanced features such as the ability to call businesses that appear on navigational maps, determine local fuel prices, and compare gas station locations. Phonenav's service was chosen for this study due to its highly adaptive and advanced technology.

Purpose of the Study
Clark and Estes (2008) concluded almost a decade ago that an understanding of how performance in the workplace can be enhanced is incomplete. As Nyugen (2012) has established, EPSSs are continuing to evolve with new technology. The deficiency of knowledge Clark and Estes highlighted is therefore arguably renewed

and possibly greater in the area of mobile technology to aid workplace tasks. An examination of the effectiveness of mobile technology to facilitate improved performance in the workplace is therefore long overdue. This study aimed to address this need.

The purpose of this study was to investigate how the use of a mobile EPSS, specifically Phonenav's data-assisted GPS system, affected computer technicians' work performance and attitudes toward mobile technology. It also sought to determine which elements of the GPS system had the greatest impact on improving the computer technicians' performance, as indicative of the wider impact that the use of mobile devices could have in the workplace. In order to achieve this it was important to examine the complete work environment of the participants. The Phonenav GPS platform will henceforth be referred to as the EPSS. This study examined technicians performing tasks before, while, and after using the EPSS. The following research questions were considered:

1. How do technicians use the EPSS?
2. How do technicians' performances on tasks supported by the EPSS change as a result of its use?
3. How do technicians' attitudes towards cell phone technology change as a result of using the EPSS?

This study has implications for performance specialists, through its exposition of how handheld wireless technology can affect the productivity of mobile workers as well as their attitudes toward wireless handheld technology.

LITERATURE REVIEW

The relationship between an EPSS and the field of instructional technology needs to be defined. The Association for Educational Communications and Technology (AECT) has defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources." (Reiser, 2012, p. 4). AECT goes on to state that:

> "the field of instructional design and technology… encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace." (Reiser, 2012, p. 5)

Van Tiem and Moseley (2004) have argued that:
"Instructional performance support interventions are selected when the problem is a lack of knowledge or skill. Non-instructional performance support interventions are selected to improve individual, group, or team performance, to improve processes, products, and services; to guide business plans, deliverables, results, and success measures (p. 67).

GPS is, in this context, used as a non-instructional solution. The researcher's reasoning for using GPS as an EPSS is substantiated by Tracey's (2000) assertion that instructional design "involves the design of the appropriate, affordable, easy-to-use, accessible instructional and non-instructional solutions to create intentional changes in learning and performance." (p. 389) We can consider EPSS a non-instructional solution by using the description of EPSSs provided by Barker, Schaik and Famakinwa (2007) as "computer delivered performance improvement interventions that guide and inform task completion." (p. 421) It is important to understand what we mean in this study by a mobile EPSS. Ahmed (2009) has defined it as a "focus on improving performance at the right time and in the right place in relation to a task a user performs on a mobile device." (p. i) A GPS can be used as an EPSS in this study due to the tasks given to the targeted participants are related to identifying client addresses and finding places of interest.

METHODOLOGY

This study used a descriptive methodology to investigate the participants' experiences using the EPSS, focusing on how they used it, how it altered their performance in the workplace, and how it altered their attitudes to mobile technology. Creswell (2012b) indicates that researchers should use a qualitative approach, i.e., collecting data in the subjects' environment, and data analysis, which is inductive and creates patterns for qualitative research. Participants in this study were observed over a period of one month while using the EPSS. The data sources used in this study were questionnaires, observations, log tables, a database from the EPSS, and interviews with the participants.

Sample
Creswell (1998) recommends that "no more than four cases" should be included in a case study to obtain an in-depth analysis of every case, and that "the more cases an individual studies the less the depth in any single case" (pp.76 & 63). Consequently, for this study, only three participants were chosen. Maximum variation sampling (Gall, M. D., Joyce P. Gall, 2007), a type of purposeful sampling (Creswell, 2012a), was used to identify the participants. This approach enabled an identification of important common patterns (Creswell, 2012a).

The participants were information technology (I.T.) professionals and employees of AZ Electronics (AZE), a well-known business in the United States. AZE has a division, Tech Force, that, among other capabilities, provides on-site computer maintenance and support. The researcher accessed participants through a gatekeeper: a manager at Tech Force. In this study the researcher selected at least two technicians from each hierarchical category used by AZE. These were "supervisors", "special agents", and "double agents", from highest to lowest ranking respectively. Though the intended number of participants was six, two from each category, only three candidates were willing to participate. Both the organization and participants involved in this study, were assigned pseudonyms, so as to guarantee their anonymity. In a consent form, submitted alongside a questionnaire and signed by all participants, they were instructed to use pseudonyms. The researcher guarantees that no participant used their actual names.

Procedures
This study was conducted with technicians of Tech Force, all of whom commuted daily to both individual and enterprise client sites. Technicians in each category served certain types of clients. Technicians in the double-agent category were allowed to serve individuals in their houses; special agents could serve in homes and small and medium-sized businesses; and supervisors could serve at all sites, including large businesses. The latter also supervised the technicians, as their title suggests. Tech Force provides smartphone (iOS) devices and wireless connectivity to all of its technicians. The EPSS was operated via a box installed in the technician's car, and connected via Bluetooth to Phonenav's application installed on their iOS smartphones.

The Institutional Review Board (IRB) permission was obtained from a US higher education institution. Three levels of review were provided by the institution depending on what level of interaction with human subjects would occur. They are Expedited Review, Full Board Review, and Exempt from Review. The researcher submitted the required documents as well as copies of the research instruments and consent form. The documents included general information about the research as well as disposition of the data, and documentation. It went through the institutional process and procedures for the IRB and granted permission.

Data Collection
Data was collected through a variety of means, all of which are detailed below.

Questionnaire
A questionnaire was given to each participant before the EPSS was provided to them. The questionnaire was used to evaluate the technicians' time spent completing various work-related tasks and the difficulty they attributed to each task, their cell phone experience and attitudes towards cell phone technology, and their level of skill in using mobile technology.

Observation
Two observations of each technician were performed. These were conducted to document events that occurred while the technicians used the EPSS. The record of these observations include the technicians' comments and the researcher's reaction. Observations were performed in participants' vehicles as the researcher commuted with them in order to observe them in their work environment. The first observation was conducted in the middle of the study period. The second observation took place at the end of the period. Each observation took approximately fifteen to thirty minutes.

Log Table
Participants were given a log table by the researcher at the start of the study (see Table 2) and instructed to use it throughout (Creswell, 2012a). It was used to determine how technicians used the EPSS. Participants were asked to record their reasons for using the various features of the EPSS, the date of use, the time they began performing the task and the amount of time spent on each one.

Database
The database in the EPSS stored all destinations that the participants' reached while using it. Comparing the data provided by Phonenav with the participants' log tables helped provide further clarity on how the technicians used the EPSS.

Interview
The interview sessions lasted between fifteen and thirty minutes; sufficient time to ensure that all relevant topics were discussed. The interview sessions comprised open-ended questions, such as "How has your performance of tasks changed since you began using the EPSS?" and closed questions (yes/no), such as "Do you use the EPSS to support your job performance/other activities?"

Data Analysis
Field notes were generated from the time of the first observation, conducted in the middle of the study period. Although the generation of field notes was considered the starting point of the data analysis, there was no exact point at which the analysis began or ended (Patton, 1990). A preliminary analysis provided information regarding the accuracy and relevance of the data collected.

To analyze the multiple cases, the researcher conducted a within-case analysis, followed by a cross-case analysis. As Creswell (2012a) states, "when multiple cases are chosen, a typical format is to first provide a detailed description of each case and themes within the case, called within-case analysis, followed by a thematic analysis across the cases, called a cross-case analysis, as well as assertions or an interpretation of the meaning of the case" (p. 63).

Open coding was the first phase of the within-case analysis. The researcher searched the entire dataset to find and assign codes to retrieve certain pieces of data. Searching the entire dataset involved reading each data source at least twice. This process assisted with the organization and management of the data and with the development of the description for each case (Merriam, 1998).

For the next level of the within-case analysis, the researcher constructed categories, as suggested by Merriam (1998), through a "continuous comparison of incidents, respondents' remarks, and so on, with each other" (p.179). This process was implemented throughout the analysis and writing stages. The researcher summarized each case in the form of answers to the research questions.

The cross-case analysis was initiated in this stage. The researcher compared the themes and categories that emerged from each case. This procedure assisted in identifying the categorical similarities and differences among the cases. This level of analysis, Merriam (1998) states, "can lead to categories, themes, or typology that conceptualize the data from all the cases; or it can result in building substantive theory offering an integrated framework covering multiple cases" (p. 195).

Tentative conclusions were derived from evidence of consistent results from within-case and cross-case analyses. The researcher analyzed the accuracy and reliability of the results generated, including any possible inconsistencies among them.

Credibility/Trustworthiness
According to Creswell (2012b), strategies such as triangulation and member checking are used to determine the accuracy and credibility of findings. The researcher used two types of triangulation: data triangulation and methodological triangulation. These methods were used to enhance the dependability of the data. Data triangulation was conducted through multiple cases and multiple computer technicians within Tech Force. Methodological triangulation was achieved through the questionnaires, the observations, the log tables, a database from the EPSS, and the interviews. The researcher conducted member checking by returning to participants to determine the accuracy of the recorded interviews.

Transferability
Transferability is related to issues of generalizability and was a consideration in choosing the methodology employed in this study. Merriam states that "rich, thick descriptions" enable readers to "be able to determine how closely their situations match the research situation, and hence, whether findings can be transferred" (Merriam, 1998, p. 211). The data sources in this study provide "rich, thick descriptions" to readers. Another way to address transformability is purposeful sampling (Creswell, 2012a, 1998), which is employed in this study. Purposeful sampling helps establish a connection with readers, through increasing the chances of them identifying with the participants in the study.

Analysis and Findings

In this section, the results of the three cases are presented. Each case is described and discussed. All three participants were male. The descriptions of each case were developed from the multiple data sources described above. These data sources supported each other and, in some cases (such as the database and the log tables), provided overlapping information.

First Case Analysis: John

John was in the 20-29 age group. He had been working with Tech Force for more than three years and, at the time of the study, he was working as a double agent. His educational background included a bachelor's degree.

Technician task.

As mentioned in the research questions, the tasks examined in this study included only those supported by the EPSS. John's responses to the questionnaire indicated that he mostly used the EPSS to find clients' residences, gas stations, and restaurants. John often used cell phone applications to assist him with his work. The software he used included Timebox, Schedule Sync, and messaging. John's responses to the questionnaire showed that he was a skilled user of technology and felt comfortable using cell phones. Though he rated his anxiety in using the cell phone as three on a five-point scale.

How John used the EPSS.

When John received his Bluetooth receiver and his Phonenav account password, he followed the user guide that the researcher had given him. He was able to download the software from the Phonenav website and to activate it in his mobile device. Additionally, he was able to explore and operate the EPSS without any problems. John used the EPSS to go from his house or office to clients' houses and to find gas stations, coffee shops, banks and other places on the way. With respect to going from one job to another, he explained:

> "It made it a lot easier, compared to—if I had to run to another place real fast before going to that job, my directions wouldn't be correct because it'd be from my other address - previous address - and now this one would actually be to the correct address." (John, personal communication)

John did however encounter the problem of the EPSS at times giving him incorrect directions and providing him with an intermittent service in a particular geographical area. John did use technical support function, though not for any technological assistance but to ask a representative to key in an address for him while he was driving.

While being observed, John went to visit an older customer whose address was already stored in the EPSS. He spent approximately forty seconds finding the client's address in his mobile device and then placed his device atop the cup holder in his car. He followed the directions as they were presented by the EPSS and listened to the verbal directions feature more than he looked at his cell phone.

How John's performance changed.

The EPSS helped John perform his duties more efficiently without the burden of having to navigate himself, as he explained: "I've been able to get there more efficiently now. I can just take off, leave my house, and use [the EPSS] wherever I need to" (John). The EPSS also provided alternative routes to many different places, allowing him more options for navigation. Though the EPSS provided John more accuracy when navigating between his house, office, and clients' locations, one improvement to the EPSS interface he would like to have seen was updates of the road conditions as this would have helped him plan his route more effectively.

How John's attitude changed.

John had a positive attitude toward the mobile technology from the start. He noted that the EPSS "was very good," and "made [navigation] a lot easier" (John). John even considered buying the EPSS after he participated in the study.

Table 4: John's Task Ratings

Tasks	Difficulty	Amount of Time
Finding clients' location	5	5
Finding directions	4	5
Finding gas stations	3	4
Finding restaurants	2	4

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

Second Case Analysis: George
George was also in the 20-29 age group, had worked as a special agent at Tech Force for more than three years and was also responsible for supervising other technicians. His educational background included a bachelor's degree. He was the researcher's primary contact in conducting this study.

Technician task.
George had neutral expectations of becoming more productive through using the EPSS. However, he found that using it helped him to manage his job better. George experienced the least anxiety and most comfort out of any of the participants in adopting the technology. In his questionnaire responses George indicated that, aside from finding directions to work related tasks, he mostly used the EPSS to find places for lunch (Table 5). He spent less time finding gas stations. Prior to using the EPSS George liked to utilize the cell phone applications Timebox, Schedule Sync, Internet Explorer, and Outlook to assist him with his work.

Table 5: George's Task Ratings

Tasks	Difficulty	Amount of Time
Finding gas stations	4	2
Finding driving directions	4	5
Finding places for lunch	2	4

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

How George used the EPSS.
After he received his Bluetooth receiver and Phonenav account password, George was able to download, activate, and run the EPSS on his mobile phone. In the first observation he spent approximately two minutes entering his client's address; in the second observation he spent approximately one minute performing the same action. In both observations he held the cell phone in his hand, listening to and looking at the directions presented by the EPSS unit until he reached his destination. He did not use the technical support function, and believed that no training was needed to use the EPSS.

George used the EPSS to support his tasks in both his work and personal life, stating "I didn't have any problems." (George, personal communication) He used it to go to clients' locations, restaurants, and non-work related places with his family. He used the EPSS so he did not "get lost" when going to see his clients (George).

How George's performance changed.
The EPSS helped George arrive at his clients' locations, his house or his office without becoming lost. He no longer spent time finding directions and was free of the distraction of looking at a piece of paper for directions while he was driving. He also felt that the EPSS enhanced the accuracy of the directions. The EPSS also helped him reach places that were not available on the map or for which "there is no map." (George) He considered that arriving on time to a client's location was one of the most important factors that encouraged him to use the EPSS. An improvement George suggested for the EPSS was voice recognition. This would have allowed him to enter his address by talking instead of typing. As it was he was forced to stop his car to type in addresses.

How George's attitude changed.
George's responses to the questionnaire revealed that he had a positive attitude toward technology prior to the study. He indicated that his positive attitude towards mobile technology had not changed as a result of using the EPSS, stating that "it was great" and "easy to use." (George)

Third Case Analysis: Bob
Bob also fell in the 20-29 age group and was a double agent with Tech Force. He had been working there for over three years. His educational background included a bachelor's degree.

Technician task.
The questionnaire responses indicated that Bob spent a substantial amount of time finding gas stations, places for lunch, going to the store for supplies, and calling clients (Table 6). He spent less time finding places for car maintenance. He spent a considerable amount of time calling clients, including a fair amount of time calling them to confirm their location.

Bob often used cell phone applications such as Timebox, Schedule Sync, Outlook, and STS to support him in his work. He liked using a cell phone in his work environment. Bob expected to improve his work performance through the use of the cell phone technology and was comfortable in making use of it.

Table 6: Bob's Task Ratings

Tasks	Difficulty	Amount of Time
Finding gas stations	1	4
Finding maps	4	5
Finding places for car maintenance	1	2
Finding places for lunch	1	5
Going to the store to get supplies	3	4
Calling clients	4	5
Calling clients to confirm location	3	3

Note: Difficulty was measured on a scale of 1 (easy) to 5 (very difficult)
Note: Amount of time was measured on a scale of 1 (little time) to 5 (much time)

How Bob used the EPSS.
Bob received a Bluetooth receiver and his Phonenav account password, and downloaded the software from the Phonenav website. Bob never used technical support, the device worked properly and he encountered no problems in activating it. He also successfully installed and ran the EPSS on his mobile phone. Bob described using the EPSS as a "cakewalk" and thought that there was no need for any type of training (Bob, personal communication). He liked the voice-activated feature, enabling him to listen to the device rather than look at it as he was driving. During the observation Bob spent approximately forty-five seconds entering his client's address. He also looked at and listened to the directions provided by the EPSS and followed the directions until he reached his destination. He used the EPSS to commute between his office and work assignments, stating that if his company did have access to the technology "we would use it every day." (Bob) Although the cell phone application usually ran well, Bob found that it terminated after he received a phone call. He found that restarting the application helped restore its functionality.

How Bob's performance changed.
Bob found that the EPSS helped him reach his clients with greater accuracy and saved him time in looking for directions. Furthermore he found he no longer needed to call his clients for directions. He found that it helped him correct his route if he went off course. He also found that the mobility and portability of the EPSS helped him accomplish his tasks without having to spend time looking for directions, notably including cases in which he was given an unscheduled job. Although the EPSS consistently provided Bob with the quickest route, one problem he encountered was the system "trying to force you on the toll way, so you've got to keep telling it to redirect." (Bob) He indicated that one improvement he would make to the EPSS would involve adding a feature that provided information about the quickest route with the option of avoiding toll charges.

How Bob's attitude changed.
Prior to the study Bob had a positive attitude toward technology in general and toward mobile technology in particular. Comparing his experience using the EPSS with that of the mobile technology he had been exposed to before he noted that "I've embraced it even more." (Bob) Bob was enthusiastic about his experience using the EPSS, stating that it was "awesome; it's been great. It's a great tool." (Bob) He would like to see all Tech Force technicians have access to the use of the technology as "it makes the job a lot easier." (Bob)

Cross-case analysis
After conducting a within-case analysis, a thematic analysis across the cases was employed (Creswell, 2012a). The cross-case analysis (Table 7) explored the similarities and differences among the cases which were later used to generate overarching themes. The themes that emerged from the cross-case analysis were organized into three sections: EPSS Use, Change in Task Performance, and Attitudes to Technology.

EPSS UseEase of use.
All participants found the EPSS easy to use. They were able to successfully download, activate, and run the EPSS on their mobile phones without needing technical assistance. One participant, John, called technical support but only to ask the representative to enter an address for him while he was driving. The mobility and portability of the EPSS was arguably a major factor in its ease of use.

Time.

All responses to the questionnaires indicated that the technicians had previously spent a substantial amount of time navigating to client sites prior to using the EPSS. This time was spent finding maps or finding directions via the Internet. Participants stopped checking directions or looking for maps after they acquired the EPSSs. Their only task was to enter their clients' addresses. The amount of time each participant took varied. John took between thirty to sixty seconds, George took between one to two minutes, and Bob took approximately forty seconds.

Interacting with the EPSS.

All participants successfully interacted with the EPSS and followed its directions to their respective destinations. They all used the verbal directions and the interactive map to navigate. Of the participants, only John used verbal directions more often than he looked at the device while driving. This was one of the advantages noted by Bob: "I hardly even have to look at it; I just listen to it as I'm driving and let it navigate me there." (Bob)

Tasks.

All participants used the EPSS to go from one job to another or to go to or from the office to a client site, and to reach nonscheduled jobs. They used it to perform tasks between jobs, such as finding gas stations and restaurants, and also used it in their activities outside work.

Usage encouragement.

Different motivational factors encouraged the participants to use the EPSS. George was motivated by his increased ability to be punctual. Bob was encouraged by the verbal directions feature, which enabled him to listen to and follow directions without looking at a map. John was impressed with the EPSS's large area coverage, which helped him navigate places even out of State.

Problems.

Two participants encountered problems in using the EPSS. On one occasion John received incorrect information regarding the location of his destination while the application was running on his mobile device. This happened to be due to him being in a low coverage area at the time. The application running on Bob's mobile phone suddenly stopped working abruptly and never started up again. He resumed using the application on another mobile device.

Change in Task Performance

Efficiency and accuracy.

John was the only participant that encountered a lack of reliability associated with the EPSS. The EPSS improved efficiency in all three cases: notably in helping John navigate to nonscheduled jobs, enabling George to reach clients' location on time, and absolved Bob of the need to call his clients to check their location: "I've been a lot more accurate; I haven't had to call my clients, saying, 'Hey, I'm lost!'" (George)

Mobility and portability.

The mobility and portability of the mobile EPSS meant that the participants could carry the device with ease when traveling between jobs. Having the EPSS readily available prevented all participants from getting lost.

Driving time.

Participants saved time performing tasks in two ways. Firstly they stopped checking online directions and maps: activities that had consumed more time than entering addresses into the EPSS, according to the questionnaire responses. There also seemed to be an additional safety benefit in using the EPSS as all participants indicated that they focused more on the road while driving.

Attitude to Technology

Attitude.

Tech Force employees work with technology daily, and the participants' questionnaire responses indicated that they all held positive attitudes towards technology prior to their participation in the study. This arguably influenced their positive reception of the EPSS.

Table 7: Summary - Cross-Case Analysis

Cross–Case Analysis					
Research Questions	Themes	Specification	Case 1	Case 2	Case 3
			John	George	Bob
EPSS Use	Ease of use	Download	Successful	Successful	Successful
		Activation	Successful	Successful	Successful
		Running	Yes	Yes	Yes

	Time	(Seconds)	45 (approx.)	90 (approx.)	40 (approx.)
	Interacting with the EPSS	Interactive map	Yes	Yes	Yes
		Verbal directions (VD)	Yes	Yes	Yes
		VD usage	Higher	Normal	Normal
	Tasks	Task rate (TR)	Multiple	Multiple	Multiple
		TR within each Task	Multiple	Multiple	Multiple
	Usage encouragement	Factor	Timeliness	Verbal directions	large coverage area
	Problems	Type	Hardware/Software	None	Software
		Coverage	No	Yes	Yes
Change in Task Performance	Efficiency and accuracy	Data accuracy	Yes	Yes	Yes
		Off route support	Yes	Yes	Yes
		Loss of direction	No	No	No
	Mobility and portability	Portability	Portable	Portable	Portable
		Mobility	Mobile	Mobile	Mobile
	Driving time	Additional online directions and maps needed	No	No	No
		Enabled fastest route	Yes	Yes	Yes
Attitude to Technology	Attitude	Before using EPSS	Positive	Positive	Positive
		After using EPSS	Positive	Positive	Positive

Discussion and Conclusion

In “Transforming Organizations Through Human Performance Technology” Rummler (1999) argues that, for the Human Performance Technologist, organizations are viewed as systems comprised of many channels that combine to produce products and services for end-users. In this study Tech Force, a division of AZE, acted as an adaptive system, using the EPSS as an input with which to enhance the service it could offer its clients. It did this primarily through enabling the technicians to arrive at the client sites on time, and freed the technicians of much of the logistical burden of navigating without the use of a mobile EPSS, allowing them to spend time on other tasks. Though the participants encountered problems with the technology on two occasions, the findings of this study support the idea that the use of an EPSS had an overall benefit in helping the participants to complete their work in a more reliable and timely manner. This was due to their enhanced ability to provide instruction at the moment of need without the need to print out or view instructions gathered from a web-based information provider on the internet.

The topic of mobile EPSSs and their impact on workplace performance is an underdeveloped area within the field of Human Performance (Clark & Estes, 2008). This study goes some way to addressing this gap in existing literature through investigating how mobile EPSS technology meets several performance-improvement challenges. More broadly it facilitates an understanding of how mobile devices and EPSS virtual networks can benefit workers and organizations by streamlining specific tasks, and may well point to similar benefits in other mobile work environments. A further study is needed to ascertain the long-term effects of this technology on an organizational level. Similarly, while the motivations of the technicians for using the EPSS in this study were

made clear, a further study is needed to focus specifically on what would motivate such workers to engage more with an EPSS, given that an EPSS seems to have the potential to improve work efficiency significantly. This could include an investigation into how EPSSs can continue to improve their abilities to meet the continually evolving needs of users in the mobile workplace. And lastly the potential that EPSS technology has for organizations to monitor its workforce and the impact this could have for further improvements in workforce efficiency and employee relations is a subject that requires further consideration. Taken as a whole these recommendations address how technology, to revisit Rummler, can help streamline an organization's many channels in order to improve the product it offers to its customer base.

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Appendix

Table 1:Log Table

#	Task (e.g. locate gas station or food or customer etc.)	Date	Time	Amount of time (e.g. 3h, 15m)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Day_____Date_____/_____/_____
Please fill out the log table daily. (Please print)

Table 2:Structured interview - interview questions

Do you use the EPSS to support job performance/other activities?

If yes	**If no**
1) What kind of activities do you use the EPSS to support? 2) How has your performance of tasks changed since you started using the EPSS? 3) How has the time spent performing tasks changed? 4) What are some of the factors that would influence your usage of other features in the portable EPSS? 5) What factors might encourage technicians to use the EPSS? 6) How has your attitude toward technology changed as a result of using the EPSS? 7) How did the technical support for the EPSS affect your usage (if applicable)? 8) What type of training is necessary for technicians to use the EPSS? 9) Do the EPSS functions support some of your activities? 10) What improvement would you make to the cell phone EPSS and why? 11) What type of problems have you encountered using the EPSS?	1) What were the major factors for you not using the EPSS? 2) How can the EPSS be successfully integrated into your work environment? 3) Even though you did not use the EPSS, has your attitude changed about using technology to support some of your tasks? 4) Do you think training on how to use the EPSS would help? a) If yes, what factors will be helpful to include in the training? 5) What improvements/changes would you make to the EPSS and why?

12) Please tell me about your overall experience.	

Table 3:Participant Questionnaire

General Information
Name:
Check the following:
Gender:
☐ Female ☐ Male
Age Range:
☐ 20 – 29 ☐ 30 – 39 ☐ 40 – 59 ☐ 60+
Technical Experience:
☐ Less than three years ☐ More than three years
☐ Other (please specify)
Educational Background: Indicate highest level obtained
☐ Bachelor ☐ Master ☐ Specialist ☐ Doctorate
☐ Other (please specify)
_____

What cell-phone applications, provided by your employer, do you use? Please write the application(s) you use. And rank how often you use each one. The scale ranges from 1 (rarely) to 5 (often).

Application	Rarely				Often
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

Attitudes
Please circle your response to the items. Rate aspects of the wireless handheld device (cell-phone provided by employer) on a 1 to 5 scale. NA= Not applicable 1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree

a)	I like to use a cell-phone in the work place.	NA	1	2	3	4	5
b)	I could manage my job much better if I had a cell-phone.	NA	1	2	3	4	5
c)	I feel comfortable using cell-phone technology.	NA	1	2	3	4	5
d)	There is not enough support for using cell-phone technology.	NA	1	2	3	4	5
e)	I am anxious about using cell-phone.	NA	1	2	3	4	5
f)	I would expect to be more productive by using a cell-phone.	NA	1	2	3	4	5

Tasks
Amount of Time:
Driving to your customers involves many different tasks, such as finding your customer's address and location (ex. map quest), fueling at the gas station, dealing with car problems, finding food, etc.
Please list the tasks you complete on a daily basis and estimate how much time you think other technicians spend on these tasks from 1 (little time) to 5 (much time).

Little Time	Much Time				
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

_____	1	2	3	4	5
_____	1	2	3	4	5

Difficulty:
Please rewrite the above list, then rate each item by the degree of difficulty you encounter while performing it. The scale ranges from 1 (easy) to 5 (very difficult).

Easy			Very Difficult		
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5