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FACTORS THAT FACILITATE OR HINDER FUEL-SAVING INITIATIVES AND TECHNOLOGY

December 2015

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AND TECHNOLOGY**

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MASTER OF BUSINESS ADMINISTRATION

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Encouraged by opportunities to optimize both new and existing company assets, FedEx sought both qualitative solutions in routing tactics and opportunities provided by new technology. FedEx leveraged the power of their people to make responsible energy use a corporate professional standard without compromising the core mission of on-time delivery. The ability to ingrain constructive changes into an everyday activity fostered belief in the changes and promoted the acceptance of technical solutions that supported organizational initiatives.

This case study offers insight into how organizations can extract value by combining technology and existing corporate social elements. A key concept for success that was observed in this FedEx case study was maintaining a keen awareness of corporate objectives while exerting control over the pace of any changes introduced.

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LIST OF ACRONYMS AND ABBREVIATIONS

E ² O	Expeditionary Energy Office
GCR	Global Citizenship Report
OR	Operations Research
PSM	Proactive Systems Management
ROI	Return on Investment
RPS	Roadway Package Systems
TAM	Technology Acceptance Model
TCO	Total Cost of Ownership
TRA	Theory of Reasoned Action

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—Kurt Noack

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—Dave Henton

I. INTRODUCTION

Energy use has become a routine societal concern. Individuals have become mindful of costs associated with fuel consumption for each mile driven on the road. Fuel-use anxieties extend beyond the common household and can be encountered across various populations of vehicle operators. This sentiment is true for militaries as well, including the Marine Corps: “On 13 August 2009, the Commandant of the Marine Corps (CMC) declared energy a top priority for the USMC [United States Marine Corps]” (Marine Corps Expeditionary Energy Office, 2011). That same year, the USMC Expeditionary Energy Office (E²O) was created to lead the charge in optimizing the Marine Corps expeditionary capabilities. E²O was tasked to “analyze, develop, and direct the Marine Corps energy strategy” (Marine Corps E²O, 2011) with the express purpose of elevating capabilities and functions through more efficient energy use.

The Marine Corps has actively sought ways to improve its operational reach through the responsible use of fuel. Previous research has indicated that there is a need to study logistics-based organizations (such as FedEx) from a multi-disciplinary perspective that includes technology adoption, strategic communication, and planning (Salem & Gallenson, 2014). This study focuses on fuel-savings technology and the implementation and acceptance of initiatives. A key element of this study involves technology that can be used in the oversight of fuel usage and conservation efforts of vehicle fleets. Beyond the availability of technology in the form of telematics to meter and monitor fleet vehicles, the study intends to explore the human factors that influence the use and adoption of fuel-savings technology and initiatives.

The volatility of fuel prices over the past decade has created the potential for disruptions in service and operating cost increases for entities that operate fleets of vehicles. Additionally, society has collectively focused more attention on environmental sustainability issues. The fuel efficiency for vehicles of both private companies and militaries has been constrained by the makeup of the fleet at any given point of time. This has limited the ability of those organizations with vehicle fleets to implement quick

changes or to accommodate for fluctuations in a potentially volatile oil market. Time, resources, and devotion are required to develop initiatives and acquire fuel-efficient technologies. Barriers to new technology go beyond the additional financial cost, as often there are social barriers to overcome by the users of new systems.

A. PURPOSE AND CORPORATE CASE STUDY

The purpose of this investigation is rooted in fuel-efficiency initiatives for commercial vehicle fleets. The intention is to look into the elements common to fleets of vehicles and identify the factors that either facilitate or hinder the agenda of implementing fuel-saving technology. Once identified, this report explores the role of these factors in employing fuel-efficiency technology.

We originally set out to investigate the adoption and acceptance of fuel-saving technologies in commercial vehicle fleets. Our interest was the perception of individual actors from various perspectives throughout the company. More specifically, if the technology were in the vehicles for use, how might this change the behavior of the drivers? For example, would individuals use the technology to adjust their driving habits if a visible gauge in the vehicle provided real-time data of how their driving style on the fuel efficiency being achieved?

We elected to focus on a single corporate entity for a case study exploration. Ultimately, we chose FedEx as the corporation for the study. It was immediately apparent—with the company’s mission statement focusing on on-time, reliable delivery—that the company went to great lengths to avoid any “distractions” to the drivers. This also meant that the strategy for fuel efficiency revolved around minimizing things the driver needed to observe and think about while driving. The result was a heavy emphasis on engineering fuel savings into the vehicles from a maintenance side.

B. RESEARCH BACKGROUND

With interviews and other research indicating an engineering focus on fuel efficiency with few, if any, incentives for efficiency gained from behavior, we amended the investigation to examine the factors that facilitate or inhibit the implementation of

fuel-efficient technology. This is not to say there was no attention given to fuel efficiency from an operations perspective. FedEx did appear to cultivate a culture of responsible fuel use and would investigate outliers of fuel use from normal patterns.

A number of factors were investigated for potential correlations to fuel-saving initiatives. The factors were generalized as either motivating factors or barriers regarding their influence on company initiatives or the introduction of new technologies. Factors can fall into a wide spectrum of both cultural aspects and characteristics of technology.

Motivating factors would be those tied to business success. These factors would be driven by the desire to improve the business's bottom line; the incentive to invest in technology with the promise of savings through a return on the investment. Gains tied to motivating factors include both competitive advantages in the corporate world and potential market appeal, such as the use of hybrid or electric vehicles to appeal to larger cultural values. Efficiency improvements through automation can also serve as a motivating factor, such as potential fuel savings from smoother vehicle acceleration rates controlled by onboard computers.

Barriers, or aspects that hinder fuel savings, can be as general as a resistance to change or specific limitations being experienced. The return on investment associated with new technologies may come with risks that pose challenges to anticipated gains. Risks may be tied to compatibility issues with existing systems or support infrastructures. Other risks may hinge on requirements needed, such as the duty cycle capabilities of electric vehicles compared to traditional fossil fuels.

The intent of this investigation was to link both motivating factors and barriers to corporate fuel-saving strategies in managing a fleet of vehicles. This case study observed a willingness to try new tactics and technologies by FedEx while keeping control of the balance between progressiveness and the acceptance of risk. We saw that changes were introduced on a scale that allowed FedEx to deal with the surprises that came with change. When it came to technical innovation, the company strove to match the best fit for using new technologies with where to best use existing assets with older technologies. A fundamental element of the corporate strategy observed was to maintain a focus on the

company's core mission. FedEx made a conscious effort to save fuel without making fuel savings their mission.

II. LITERATURE REVIEW

The United States Marine Corps Expeditionary Energy Office (E²O) is seeking organizational change and exploring the role of new technologies in supporting needed change. The Marine Corps has recognized an increased dependence on fossil fuels to support vehicle operations and has sought after both behavioral and technological changes to combat this (Amos, 2012). The amplified dependence on fuel introduces additional costs to missions and added personnel risks with more individuals needed to provide fuel support. The United States Marine Corps has outlined this concern in their 2012 Expeditionary Energy Strategy and Implementation Plan; the passages in the plan echo the constraining impact of fuel requirements:

Our fuel requirement limits our range and freedom of maneuver from the sea and on land. It constrains our tactical options for executing missions in complex battlespaces, across long distances, and against hybrid threats. Tethered to fuel, we have lost speed. (Marine Corps E²O, 2011, p. 9)

The Department of Defense (DOD), as a whole, has recognized the reliance on fuel as both a challenge and a risk. As a result, the DOD Office of Operational Energy Plans and Programs has identified the need for institutional change (Schwartz, Blakeley, & O'Rourke, 2012).

Even the most promising change encounters resistance; Kieran Mathieson (1991) made this point concerning efforts to predict user intentions with information systems. Mathieson pointed out that “information systems have the potential to improve organizational performance, but only if they are actually used” and that “systems that are not used cannot be effective, no matter what their technical merits” (Mathieson, 1991, p. 173). This notion can be applied to initiatives and new technologies introduced into organizations. Technology has contributed immensely to modern businesses increasing productivity, profitability, and more when it comes to the business's bottom line (Ozer & Yilmaz, 2011). With these advantages came challenges regarding the business role of technical innovations, which created a need for research. As a result, there has been a

wide range of research and numerous theories dedicated to the behavior dimensions surrounding the use of technology.

Research has explored ways of predicting the use of a new system based on individual intentions and how one's attitude might contribute to those intentions (Alotaibi & Wald, 2013). Technology implementation and the associated changes have been the focus of a great deal of research, with a significant foundation in the Theory of Reasoned Action (TRA) first presented by Fishbein and Ajzen. The two researchers, Fishbein and Ajzen, are credited with having "placed a compelling and coherent structure on the field of attitudes, which was in relative disarray before their work" (Sheppard, Hartwick, & Warshaw, 1988). We began our literature review with TRA and explored its contribution to the Technology Acceptance Model (TAM), credited to Fred Davis, to predict user acceptance of technology based on the factors of perceived usefulness and perceived ease of use (Dillon & Morris, 1996). Davis deliberately chose TRA as the foundation to build upon for his TAM construct (Davis, 1986). We also looked to the socio-technical theory for how various stakeholders within an organization respond to the introduction of the technology. A key tenet of the socio-technical theory framework is that technology, or its capability, has little significance in determining whether people use it (Dillon & Morris, 1996). Socio-technical theory argues that the social dynamics and internal relationships relating to holistic job satisfaction generally act with the greatest influence on the willingness to use a technology.

At the core of our investigation was the question of how individuals in an organization responded to corporate initiatives regarding fuel efficiency. Rooted in the assumption that technology is available to help support the initiatives was the question of the employee response in terms of how they might put any technology to use if it is introduced into the company's repertoire. The analysis uses theories that seek to collaborate on available technologies and the predicted behavioral responses of human actors. Target theories include the Theory of Reasoned Action (TRA), three variations of the Technology Acceptance Model (TAM), and socio-technical theory. Each theory has been presented in its own segment in this chapter, with a short synopsis of its origins and

a description of the theory. The theories have been individually critiqued for virtues and fallibility. Lastly, we discuss the validity of each theory as applied to this case study.

A. THEORY OF REASONED ACTION

The Theory of Reasoned Action (TRA) provided the root construct for the origins of the Technology Acceptance Model which is discussed at a later point. TRA was first introduced by Fishbein and Ajzen (1975) as an explanation linking user attitudes and subjective norms with actual observed behaviors with regard to the use of newly introduced systems. TRA was a generalized theory to predict voluntary behavior and focused “on the determinants and performance of a single behavior” (Sheppard et al., 1988, p. 326). The model was “not anchored to any given belief set (Dillon & Morris, 1996, p. 9), but rather that the intention to perform a behavior was “influenced jointly by the individual’s attitude and subjective norms” (Dillon & Morris, 1996, p. 9). The subjective norms in the construct are referring to “the person’s perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein & Ajzen, 1975, p. 302)

The basis of TRA is that both the attitude about a given behavior and the perceived normative beliefs directly contribute to an individual’s behavioral intentions. The attitudes relate back to individual beliefs and the normative beliefs come from the subjective expectations of others. The beliefs of an individual inherently reinforce that person’s attitudes. The distinction between normative beliefs and that of the individual is the implication of consequences for behavioral choices imposed by the normative expectations (Davis, 1986). The convergence of these two factors is based on the premise that people are rational when making use of surrounding information available to them (Kollmus & Agyeman, 2002). The model asserts that attitudes and social pressures together influence one’s behavioral intentions, which shape the actions exhibited. In short, one’s behavioral intentions are reasoned by weighing personal beliefs against what other’s expectations may be. Both factors provide an influence on behavior and neither stands alone to determine behavioral choices made by individuals.

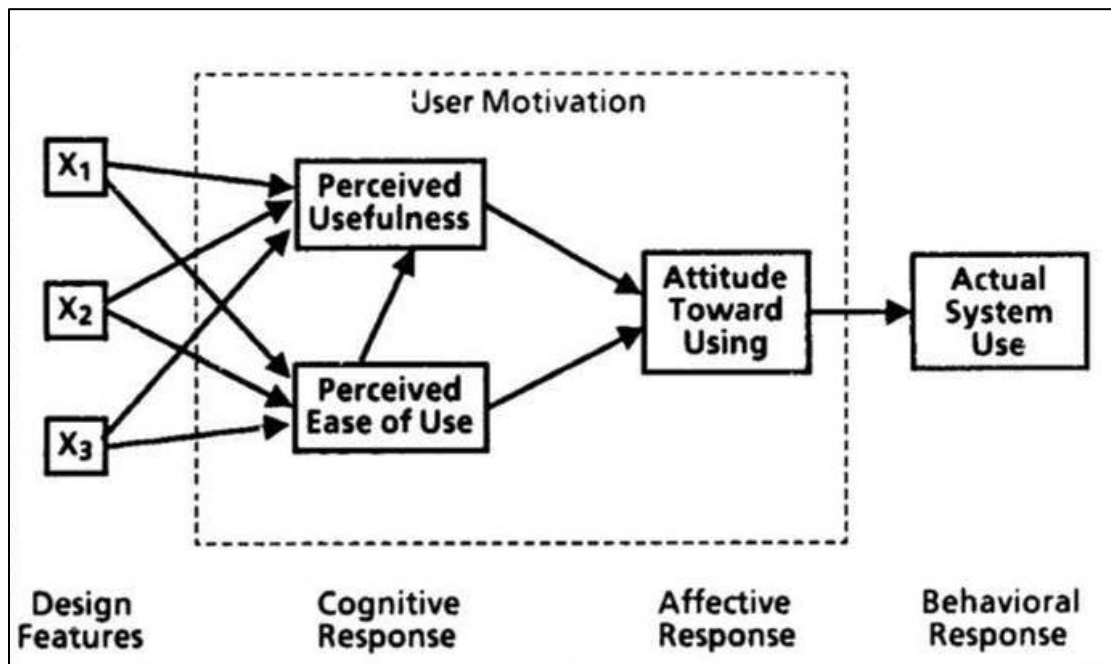
TRA is characterized by its simplicity, which leads to a theory that is insufficient to forecasting complex reasoning behind behavioral decision-making. Sheppard et al. (1988, p. 326) point out that there are “factors beyond [an] individual’s voluntary control [that] fall outside the boundary conditions established for the model.” It also stands to reason that an individual’s perception of the normative expectation is inherently biased from the start, as it would be derived from subjective interpretations of social cues. The ability to consider beliefs and attitudes held by an individual as well as belief in the appropriateness of a behavior was the basis of TRA. Accounting for the perceived subjective norms provided a basis of reasoning for the individual to take into consideration when deliberating over intended behaviors. The merit of TRA was in providing a distinction between internal beliefs and the external pressures to conform in a conceptual framework to show a shared causal relationship to the intentions of an individual actor. Fishbein and Ajzen (1975) were critical of the assumptions forced upon investigators using the framework which they provided. The authors concluded that “the assumption that changes in beliefs about the consequences of performing the behavior will lead to change in attitude toward that behavior may not have been supported in this particular study” (Fishbein & Ajzen, 1975, p. 520). Regardless of the authors’ condemning assessment of their own study, the conceptual framework provided by Fishbein and Ajzen led to the pioneering of future theories attempting to provide practical models for predicting outcomes when rational behaviors are influenced by highly subjective human factors.

B. TECHNOLOGY ACCEPTANCE MODEL

Fred Davis Jr. (1986) used the construct of TRA to form the Technology Acceptance Model. Davis argued that a potential user’s attitude was a function of perceived usefulness and perceived ease of use (Davis, 1986). His premise was that design features, which are external variables, influence both perceived usefulness and perceived ease of use. In Figure 1, provided by Davis (1986), notice that the perceived ease of use is also considered to be a factor that influences perceived usefulness. These factors combined to influence the attitude toward using a given system. The TAM

construct presents this influence as a correlation of design features to the attitude of a potential user when it comes to using a new technology. The actual system use was the result of a linear relationship being expressed from the potential user's attitude. Figure 1 reflects the application of the TAM construct as it is intended to apply to the individual actor.

Figure 1. Technology Acceptance Model (TAM) Construct



Source: Davis, F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation, Massachusetts Institute of Technology). Retrieved from <http://dspace.mit.edu/handle/1721.1/15192>

It is important to acknowledge that Davis's (1986) assertion of TAM's relevance is specific to predicting the acceptance of technology by an individual. His claims are not being applied to the use of a particular technology by a wide audience. This distinction is pertinent to this study in that the acceptance under examination is that of a corporation as the actor responding to available technology. The question of acceptance is being directed at two parallels. The first parallel is the corporation's decision to accept a given technology for use in fleet vehicles. The second parallel is the behavior of individual users. In the case of fleet vehicles, users fall across a wide spectrum of the company's

personnel, from the executives looking at reports down to individual drivers and mechanics working hands-on with individual vehicles.

While TAM most prevalently applied to individual users, the culmination of “acceptance” by individuals translates to the more widespread use, or “adoption,” of a given technology. For the purposes of this writing, the distinction is as follows. *Acceptance* is the intent to use; the attitude derived from one’s assessment of both the usefulness and ease of use. It is the individual actor recognizing that use of the given technology is suitable for the given task and intending to use it as such. *Adoption* implies the widespread use across a population of potential users.

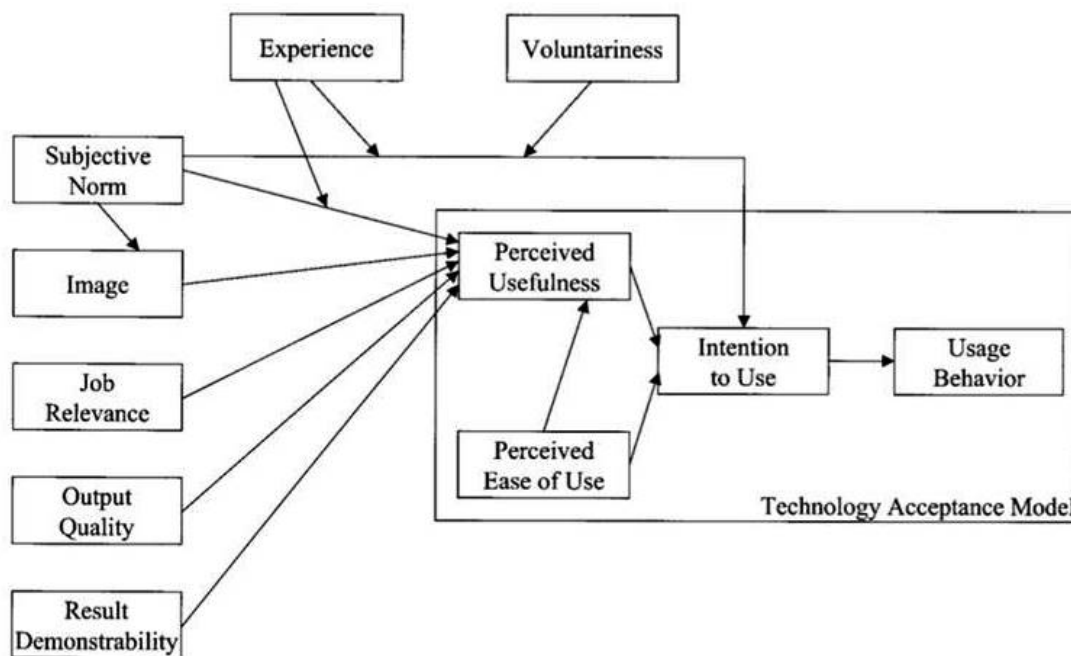
A term that occasionally gets lumped into the discussion referencing acceptance and adoption is the term *use*; the academic conversation of *use* signifies the distinction of intended use versus actual use when being applied as part of theory-associating behaviors to technology. An example of this would be utilizing the GPS navigation feature in a car simply as a speedometer to measure the car’s speed. It was intended to help the driver navigate a route to a destination with turn-by-turn directions, but the driver might rely on it to monitor the car’s speed. Therefore, the device is doing what it is expected to do, but the driver is using the device differently than its original intended use. Additionally, the car is provided with a speedometer using internal measurements to provide the information; therefore, the speed being displayed by the GPS navigation unit is redundant. With *use* defined as how the driver is using the technology, the action of the driver’s preference to read the GPS display instead of the car’s speedometer can be directly applied to TAM. The driver’s act of using the GPS as a speedometer is a culmination of the intent to use following a positive assessment of both usefulness and ease of use.

1. Evolution of TAM

The construct of TAM has evolved over time. A criticism shared by both TRA and the initial construct of TAM was the simplicity of each. Venkatesh and Davis acknowledged this need to expand on the construct of TAM. The authors found that “perceived usefulness has consistently been a strong determinant of usage intentions,

with standardized regression coefficients typically around 0.6” (Venkatesh & Davis, 2000). Recognizing the need for a deeper understanding behind the determinants of perceived usefulness, Technology Acceptance Model 2 (TAM2) has an extended construct leading into perceived usefulness. More specifically, the aim of TAM2 was to “include additional key determinants of TAM’s perceived usefulness and usage intention constructs, and to understand how the effects of these determinants change with increasing user experience over time with the target system” (Venkatesh & Davis, 2000, p. 188). Figure 2 shows the additional determinants as injects into the original TAM model; the determinants feed heavily into the perceived usefulness for individual users of technology.

Figure 2. Technology Acceptance Model 2 (TAM2) Construct

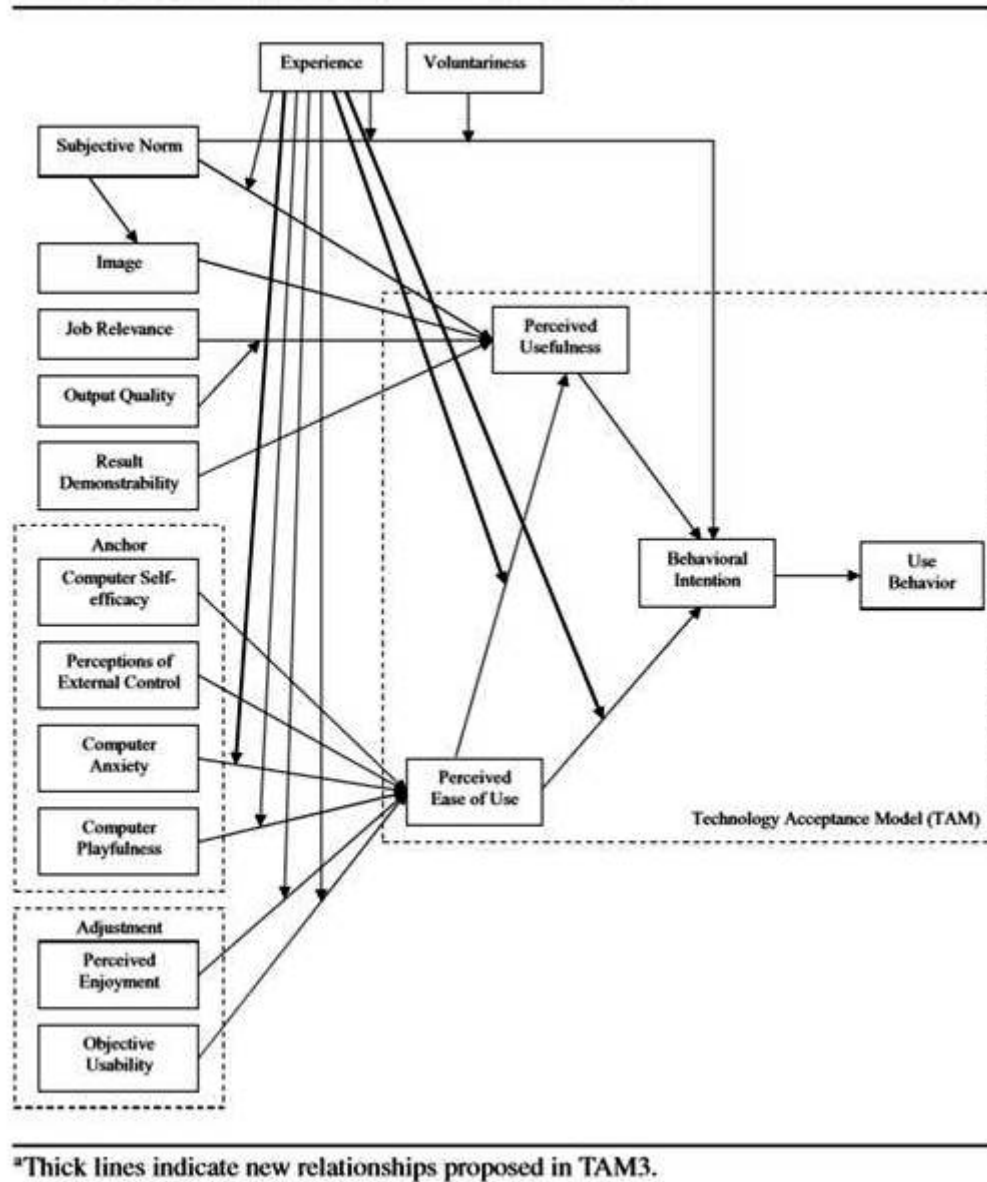


Source: Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science* 46(2):186–204. doi:10.1287/mnsc.46.2.186.11926

The body of work extending the construct of TAM continued to grow after TAM2. Venkatesh and Bala (2008) demonstrated the recognition of additional

determinants that feed into perceived ease of use. TAM2 had focused solely on the addition of determinants that influenced perceived usefulness. The additional determinants provided in the Technology Acceptance Model 3 (TAM3) are shown in Figure 3. These added determinants to the construct have been distinguished into two fields. One field of determinants are identified as anchor determinants that affect less-experienced users to a greater degree (Venkatesh & Bala, 2008). The other field of determinants added to the construct in TAM3 are labeled as adjustment determinants, the impact of which would be expected to correspond to one's level of experience with the technology (Venkatesh & Bala, 2008).

Figure 3. Technology Acceptance Model 3 (TAM3) Construct



Source: Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273–312.

C. SOCIO-TECHNICAL THEORY

The socio-technical theory originated years before the contemporary age of computer technology. This theory had its roots in the social dynamics tied to the introduction of industrial advances in the pursuit of efficiency. The notion of the socio-

technical theory is an attempt to explain how optimizing the efficiency of tasks performed by groups of individuals is interlocked with the social dynamics of the group.

1. Background of Socio-Technical Theory

The premise behind the socio-technical theory is that true optimization is not solely reliant on advances in technology, but rather the most optimal solutions account for social aspects when applying the technical advances. The theory has its genesis in action research projects conducted by the Tavistock Institute in post-World War II British coal mines (Trist, 1981). At that time, coal was the primary source of fuel, and a cheap, plentiful supply of coal was essential to the reconstruction efforts. Productivity in England's recently nationalized coal mines was not keeping pace with the increase of technological innovations. The Tavistock Institute's fellows endeavored to understand the disconnect between worker and machine. They ultimately introduced a concept that would not only bridge the divide, but provide critical insights into how to better leverage technology and social systems to simultaneously improve working conditions and productivity.

One of the Institute's key findings was that when workers were introduced to higher levels of specialized mechanization in the mines, it entailed a change from working in groups to working on specific one-man-task roles, coupled with the addition of another layer of supervision that was more external and coercive (Trist, 1981). This change in organizational structure and job specification was devised to accommodate the changes in technology (mechanization) and did not take into account any human factors. This approach frequently resulted in diminished productivity and worker morale.

2. Key Principles of Socio-Technical Theory

The resultant theory proposed a paradigm from which to view organizational structure and systems. Changes in technology should not be considered without first considering the impact it will have on people, as well as the various predictable and unpredictable ways in which people may utilize that technology. To create an organization that is adept at incorporating and growing with new technology, the socio-

technical theory suggests a number of principles that an organization should follow. Some of the principles that Trist endorses are to view the whole of the group's functional activities as a work system which, in turn, makes up a basic unit of measurement, as opposed to viewing a single job function as a unit of measure. Correspondingly, the work group was now the focal point of attention as was their ability to regulate themselves internally, free from a detached, bureaucratic, and top-heavy management scheme.

According to the Tavistock Institute (Trist, 1981), the enumerated principles are as follows:

- Work systems instead of a singular job focus
- Work groups as a focal point
- Increased internal regulation of groups
- Redundancy of functions; vice redundancy of parts (Jaques, 1956)
- Valuing the discretionary aspects rather than prescribed aspects of work roles (Emery, 1967)
- People are complementary to machines, not mere extensions of them

The socio-technical theory increases variety for the individual worker and the organization, whereas a bureaucratic style of management leads to a smaller, but more specialized, variety of skills in each worker. To an extent, the Institute's findings were pointing to informal organizational systems that were in place prior to the advent of mechanized industry, when smaller groups of workers had more autonomy and the responsibility to work and organize themselves in a productive manner.

3. Socio-Technical Theory Levels of Analysis

According to Trist (1981), socio-technical studies should be carried out at three broad levels, beginning at the micro level and graduating to the macro level. Each of these levels is interrelated. The three levels are (1) primary works systems, (2) whole organization systems, and (3) macrosocial systems (Trist, 1981).

Primary works systems are those systems of concern at the micro level of analysis. They are generally a group, or small groups, of specialized and support personnel, management, and associated equipment and facilities. They are characterized as having a recognized purpose that unifies the people and activities (Trist, 1981). Some of the Tavistock Institute's key findings with regards to the individual within the primary work system were that individuals have different motivating factors, those factors change over time, and perhaps most importantly, that workers are more inclined to commit themselves to the concepts of joint optimization if they have evidence that the company has made a long-term commitment to optimization. This effect is amplified if the worker feels that the "norms and values of the wider society are also changing in the direction of the new paradigm" (Trist, 1981, p. 44).

Within socio-technical theory, a whole organization system is concerned with viewing the individual as a system unto themselves within a larger work system. Individuals are not specialists with narrow training that may be soon obsolete, but part of a larger system of parts that share redundancies, similar to a biological system. From this perspective, a new paradigm emerged that viewed the worker as an internally self-regulated resource that could be developed to utilize a broad skill set within a group setting, which would lead to joint optimization between worker and technology, increased commitment to and collaboration within the organization, as well as higher levels of innovation. The old paradigm viewed the worker as a somewhat disposable, task-oriented specialist that had to be closely supervised and monitored (Trist, 1981). Collaboration and innovation was not expected or desired.

D. CONCLUSION

Improving energy efficiency is a critical goal for the United States Marine Corps. Not just a matter of cost, the efficient use of fuel can reduce the number of dangerous convoys the Marines have to make (Salem & Gallenson, 2014) and is in keeping with the ethos of the USMC's expeditionary nature. Fuel usage has increased exponentially over the last decade of operation, which is most likely unsustainable (Ciarcia, 2013). The E²O is seeking ways in which to more effectively use fuel with its ground fleet. The

exploration of fuel-saving technologies is a critical endeavor, as is the willingness of Marines to adopt fuel-saving technologies and initiatives. Adopting new technologies, fostering a culture of innovation, and willingness to implement fuel-efficiency goals is critical to the Marines and may prove a vital component of their ability to remain the premier expeditionary force in the world.

In this section, we reviewed two theories of technology acceptance, along with the broader theory of socio-technical systems. The Theory of Reasoned Action was the precursor to TAM, and it helps to explain the factors of personal attitudes and subjective norms as influencers in the observed behaviors of individual decision-making. TAM expanded upon these concepts and applied them to an individual's willingness to accept a new technology. According to the theory, ease of use and perceived usefulness are the two basic components on which most individuals decide whether or not they will use a specific piece of technology. The socio-technical theory helps to explain the relationship of man and machine, and it provides a construct in which workers will most effectively utilize technology based on the social constructs and structure of the workplace. Together, these three theories provided a foundation and framework for this study. Codes relating to adoption, acceptance, and social factors were derived from the academic literature. These codes and the analytic process from which themes and larger concepts were developed are explained in subsequent chapters.

During the course of this exploration, the notion of TAM was applicable to how FedEx first introduced computerized methods of efficiency. A noteworthy instance is provided in the findings section, as shared by one interview participant who shared the story of the first transitions from paper maps to computerized maps (Interview FE07, August 27, 2015). This example included deliberate steps to convey both ease of use, with only minimal changes introduced from traditional paper maps, and the usefulness of additional capabilities provided by digital maps. Usefulness in the form of improvements to routing efficiency were presented in a controlled manner to avoid radical changes that might undermine the attitudes of managers and couriers regarding the computerized maps. In some instances, technology could be automated with the individual choice of accepting changes significantly reduced. For example, performance changes in fuel

efficiency that could be engineered into newly acquired vehicles might alter how the vehicle responds, as was the case with slowed acceleration rates (Interview, FE02, July 2, 2015), without providing an option to the driver or a grace period to accept it for either its ease of use or usefulness.

Based on observations during the FedEx case study, the importance of social dynamics, which was a key notion applied by the socio-technical theory of acceptance, held true. When actions were voluntary as opposed to being dictated by automation and outside the control of individuals, the company's internal network of social relationships impacted the acceptance of changes being introduced. The innovations or transformations that were best received were those that could be conveyed as worthwhile to the widest audience within the organization.

III. METHODOLOGY

The root question of this case study was as follows: If a technology that promotes fuel savings is available and installed in a vehicle, will people use it? Through this research, we sought to gain an understanding of individual behaviors surrounding corporate initiatives and new technology implementation in the interest of consuming less fuel. The premise for this research was the organizational interest in lowering fuel consumption for two primary reasons. The first reason was to achieve cost savings by using less fuel. The second was the extended operational reach, meaning to go further in distance or duration using the same amount of fuel. Simply stated, if an organization could accomplish the same objective while using less fuel, the two corresponding benefits would be decreased cost to perform a set objective and the ability to go beyond that objective with the same resources previously used. When applied to the United States Marine Corps, these benefits would translate to a combination of options that include transporting less fuel from the outset of a mission and being out on the mission longer.

A. RESEARCH DESIGN AND DATA SOURCES

The research design for this project was a single qualitative case study of a commercial organization that operates a fleet of ground vehicles. FedEx was chosen because it is an organization whose mission relies heavily on ground vehicles, which translates to fuel as a major cost concern for the company. The study initially focused primarily on FedEx Express's ground fleet of vehicles, but it expanded into FedEx Express's large fleet of airplanes. This was because FedEx has implemented a number of insightful fuel-savings initiatives in both their ground and aviation fleets. FedEx has implemented efforts to reduce fuel costs and has adopted technology to complement these initiatives. Through this case study, we analyzed both historical and recent practices with the goal of identifying specific elements that led to fuel savings through successful internal initiatives and the introduction of new technologies.

Oral interviews were a primary data source for capturing the human perceptions. The interviews were conducted with both authors and a faculty research assistant present. With the permission of the participants, the interviews were recorded to audio files and later transcribed into a document with participant names removed to maintain anonymity. This preserved the responses word-for-word, which allowed for continued analysis. If any individual elected to participate in an oral interview under the condition that it was not recorded, notes were taken by both authors and the faculty research assistant. To maintain anonymity throughout the case study, participant names were replaced with a notion in the format of “FE##”; all quotations used for analysis are referenced in this manner.

Our research gathered data about FedEx fuel-saving initiatives in a general sense, which consisted of program goals, implementation strategies, acceptance of the programs within the organization, and the perceived successes or failures experienced. The interviews provided additional context to the written literature and amplifying information. With the exception of one interview participant, each person had been employed by FedEx for many years and provided some oral history of technology progression they had witnessed during their time with the company. This helped to understand the distinction between the employees as technology users and the gains promised or implied from a strictly technical perspective.

The intent of interviews was to gain perspectives from personnel undertaking different roles in the company’s operation. Interview questioning utilized a bank of initial probing questions of a general nature about fuel-conservation efforts within the FedEx Corporation. Based on responses to the initial probing questions during interviews, follow-on questions were derived from the themes observed.

B. CASE STUDY

The case study pursued specific actions taken by FedEx to reduce fuel consumption and internal perceptions of those actions. The concept of actions taken included the use of technology and efforts by FedEx to manage the behaviors of individuals that tied to fuel consumption. Data sources reviewed included FedEx

corporate literature and articles about FedEx initiatives promulgated by sources both internal and external to the company. Two key document sources were the company's formal annual reports and the FedEx Global Citizenship Report (GCR). In addition to written materials, anonymous interviews were conducted with FedEx employees. Nine interviews were conducted over the phone using a bank of open-ended questions to allow for individuals to share individual perspectives from their positions within the company. The individuals available for interview consisted of regional managers, executives, and vice president level decision-makers.

C. CODING DATA

The transcripts became the primary focus of data analysis. The steps used for analysis of the transcripts started with coding the responses into relevant categories based on the academic literature and insights gleaned from interviews. The codes used are provided in Table 6 located in the Appendix. One example code, unnecessary idling, might indicate company concerns about idling engines and fuel consumed. The root cause of an idling vehicle may be habits or practices of individual drivers, or it may be something that can be controlled by technology design. In the air cargo mode of transportation, standard procedures such as pre-flight routines might be a factor that falls under unnecessary idling. The coding of data and the supporting context in which terms were used was how the case study sought to identify specific concerns of FedEx and how the company chose to respond to these concerns. The coded responses were categorized, looking for common concepts that came up during the interviews. These concepts were later grouped into primary themes observed. The findings presented in this study come from the translation of the themes that emerged during analysis of the data.

In addition to the coding efforts, which originated with a focus on the use and adoption of new technology, emerging data during the interviews consistently led to discussions of change management. The methodology during this case study was adjusted to account for a relationship between the social dimension and fuel-efficiency initiatives of the company that was evident and could not be ignored. The coding list for analysis of

interview data was expanded to allow for indicators corresponding to the social aspects of change management.

The case study results included an association between technical innovation efforts and change management concepts, which may have significant value to other entities that operate fleets of ground vehicles and/or aircraft. Specifically, we intend for this research to benefit the United States Marine Corps on how to best implement fuel-savings technology and initiatives based on lessons learned from FedEx.

IV. ANALYSIS

In this chapter, we investigate the factors that facilitate or hinder the implementation of fuel-saving technologies and initiatives in commercial vehicle fleets by conducting a case study analysis of FedEx's fuel-savings technologies and fuel-savings initiatives. The analysis consisted of reviewing the interview responses of each participant for insight into FedEx's efforts in fuel conservation and the role that their corporate culture has on fuel use. The forum of open-ended questions allowed each interviewee to demonstrate what was significant, distinct, or otherwise noteworthy from their personal perspective. The context of transcripts and notes were correlated to a coding scheme to look for trends or other connections related to fuel and energy use. The derived conclusions indicated that the company is focused on optimizing the use of new and existing meter and monitoring technologies and fostering social dimensions that would support the desired change. The corporation's goal of optimizing technology and supporting social dimensions for change is all in support of the organization's core mission.

The following section begins with a brief history of the company, since controlling fuel costs has been vital to FedEx since its inception. We explore the company's objective, identity, and ethos, and we explain the causal relationship to implementing fuel-savings measures. Next, we discuss an overview of the corporate structure since the organization has created individual operating companies to promote various fuel and non-fuel related efficiencies. We provide a brief overview of these individual operating companies to give insight into the operations of the corporation and to provide some context to the operating areas this case study primarily focused on. We then look at the factors that spurred the company to seek changes in its fleet of vehicles and operating procedures. Finally, we analyze the ground and air fleets and detail changes that have been instituted to promote fuel savings. Unsurprisingly, the company has experienced both success and setbacks and has provided us with a number of lessons

learned in the process of this investigation that should benefit the United States Marine Corps.

A. THE CASE OF FEDEX

FedEx was born from a term paper written by Fred Smith at Yale. He envisioned an all-in-one, point-to-point, origin-to-destination carrier that would provide quick and efficient delivery. To Fred Smith, this entailed managing and owning the fleet of aircraft, ground vehicles, and operations centers to manage the packages from origin to destination (FedEx Corporation, 2015). By the year 2000, FedEx had become a recognized leader in the package delivery business. The company's FY 2000 annual report chronicles the achievement of approximately \$18.2 billion in revenue (FedEx Corporation, 2000). That same year, then-named parent company FDX became "FedEx Corporation" and began another major phase of expansion that incorporated a number of smaller operating companies under its corporate umbrella. Today, FedEx's fleet of aircraft is the world's largest all-cargo air fleet and includes multiple Boeing and Airbus airframes. Owning the aircraft and a majority of the vehicles empowered FedEx to implement fuel-savings initiatives that may have been stymied had they not been under the direct control of a single enterprise.

From interviews and corporate literature, we discovered some basic principles that underlie FedEx's identity and ethos and influence the company's ability to implement fuel-savings technologies and initiatives. The corporate notion of the Purple Promise, best paraphrased in their FY14 GCR, states, "In everything we do, we are committed to moving possibilities forward for our customers every day, and doing so in a safe, ethical and sustainable way" (FedEx Corporation, 2014b, p. 7). This is the foundation of the company's "people-service-profits" ethos. One interviewee explained that "FedEx believes in the principle that if you take care of your employees, they will provide outstanding customer service, which will lead to profits" (Interview FE05, August 13, 2015).

The following subsections explore the concepts of objective, identity, and ethos at FedEx. A basic understanding of these strategic management concepts helps explain how

FedEx implemented various fuel-savings technologies and initiatives, as well as provides some insights into the institutional reasons as to why some technologies and initiatives were not readily accepted. Furthermore, a basic understanding of these topics will help the Marines understand the similarities and differences within their organization. This, in turn, will help them draw parallels in which they can adopt similar technologies or initiatives that may ultimately result in more responsible fuel usage.

1. Objective

Clearly, like any business, profit is ultimately the bottom line. No business can continue to operate in the long term without consistently generating revenue and turning a profit. Multiple senior managers conveyed to us that they were keenly aware that if FedEx was not able to provide reliable on-time delivery at a reasonable cost, then someone else would (Interview FE01, June 16, 2015). While profitability is what ultimately allows a business to survive, it is not necessarily its core mission or purpose. Arguably, Fred Smith did not set out simply to become wealthy and famous. Instead, he saw a need and developed an enterprise to fill the need. His now well-known term paper from Yale outlined “a system to accommodate urgent, time-sensitive shipments such as medicine, computer parts, and electronics; he receives an average grade” (FedEx Corporation, 2015). This idea better defines the identity of FedEx and what they do. Multiple interviewees indicated that FedEx is a mission-oriented business. On-time delivery is the ultimate goal. Of concern was that fuel usage has not been at the forefront of the typical employee’s or manager’s thinking. While some employees focused on optimizing fuel usage (which we discuss in a following subsection), the majority of employees focused on safe, efficient delivery. Now, FedEx seeks to make responsible fuel usage an integral part of its short- and long-term objectives. We discuss how FedEx integrated this concept into their objective throughout the company. Like the Marines, who often have the viewpoint that “effectiveness trumps efficiency and energy conservation is a nuisance” (Salem & Gallenson, 2014), FedEx had similar difficulties when attempting to make responsible fuel usage part of its overall objective. This

analysis and its findings further explore how FedEx implemented fuel savings technologies and initiatives that helped make fuel savings part of their objective.

FedEx's 21st-century objective is continued success of its reliable, on-time delivery model with a strong focus on sustainability and global citizenship (FedEx Corporation, 2014b). Inherent in FedEx's global citizenship and sustainability efforts is reducing fuel usage. Reducing fuel usage simultaneously controls costs and reduces emissions (FedEx Corporation, 2014b). Unstable and/or high fuel costs can erode the company's profitability and endanger its mission. Therefore, FedEx has incorporated fuel-savings goals into its objective and developed a corporate identity and ethos that has further helped the company reduce fuel usage.

2. Identity

FedEx has become synonymous with reliable, overnight, on-time delivery. This has, to a large extent, defined who they are and how they see themselves (Interview FE01, June 16, 2015). Being conscientious users of fuel and seeking ways to save fuel was not necessarily part of the overall FedEx identity to many employees. Similarly, Marines view themselves as expeditionary warriors and do not necessarily build their identity around conscientious fuel use. The primary identities of both organizations have served them well and made them leaders in their field. FedEx ultimately fostered a change in attitude toward fuel efficiency as a value-added proposition. Likewise, the Marines could gain from understanding what technologies and initiatives FedEx incorporated, and how they did it. Similar to many FedEx employees prior to being exposed to fuel-savings initiatives, many Marines do not view fuel-savings concerns as part of what they do. Previous research indicates Marines feel, amongst other things, that there is an abundance of fuel, that change is synonymous with bureaucracy, and that more work and operational effectiveness trumps efficiency (Salem & Gallenson, 2014)

The identity of FedEx, as portrayed by multiple senior managers, is one in which excellence is pursued in all aspects and at all levels of the company. This ties into accepting fuel-savings technologies and initiatives as being the right thing to do, both for the bottom line of the company and the greater good. Additionally, multiple interviewees

believed that outstanding service and high levels of customer satisfaction were another critical factor of FedEx's success. They referenced the FedEx "Purple Promise," which is the unifying vision for FedEx wherein each employee will make every FedEx experience outstanding (Interview FE05, August 13, 2015). FedEx is able to make this promise a reality, in part, because of its high level of employee satisfaction. "Everyone is bleeding purple . . . and there's a strong sense of loyalty as evidenced by the large number of people that have 30 years of experience [within the company]" (Interview FE05, August 13, 2015). FedEx has also developed a strong and relatively loyal customer base for the type of service it provides. It has established a reputation as a reliable and ethical business to many of its customers. The notion of the "golden package" was conveyed to us by multiple interviewees. The golden package concept is one in which each employee involved in the transportation of the package at any point is asked to treat each package as if it has something of vital importance to the customer, and absolutely must arrive to its destination on time. Additionally, "the company has embraced principles which align with military values, such as teamwork, that lead to an esprit de corps within the company" (Interview FE05, August 13, 2015). FedEx has effectively leveraged their cultural identity of teamwork and excellence in order to implement fuel-savings measures while maintaining a mission-first mentality, which we detail in subsequent sections.

3. Ethos

FedEx's people-service-profits ethos includes cultivating a sense of community. Beginning in 2008, FedEx added a GCR as part of its annual informational package broadcast to stakeholders of the company. Included in the GCR is a section dedicated exclusively to the company's efficiency in terms of emissions from the fuel consumed and its environmental impact. FedEx used the 2008 report to announce its commitment to fuel efficiency for benefits that extended beyond the company's direct interests. Congruently, the company has been diligent in developing streamlined and efficient processes that encourage buy-in and ownership from its employees. FedEx has stated a commitment to not only improve their own operations, but to contribute innovations to the industry as a whole.

FedEx plays an important role in how the world is connected. Yet the commercial transportation industry has no single solution for reducing its environmental footprint. FedEx is committed to operating and innovating in new ways that can help our business as well as our industry. (FedEx Corporation, 2008b, p. 8)

4. FedEx Corporate Structure

Since fuel usage plays such a major role in FedEx's ability to achieve its mission, remain profitable, and deliver on its ethos, this study gives some consideration to how its corporate structure has been developed around those markers. FedEx has created four service groups that function as independent companies. It utilizes this portfolio of companies to develop the most efficient solution to supply chain issues, and it leverages them to develop fuel-savings efficiencies (FedEx Corporation, 2015). FedEx refers to its network of independent operating companies as a collaborative portfolio of solutions, each of which can be fine-tuned to deliver optimal performance in its area of focus (FedEx Corporation, 2015). The four service groups are FedEx Express, FedEx Ground, FedEx Services, and FedEx Freight. Table 1 provides an overview of each operating company. This structure was developed to allow the individual companies to "operate independently yet compete collectively" (FedEx Corporation, 2015), and it has influenced the development and implementation of various fuel-saving technologies and initiatives.

Table 1. Operating Company Overview

Company	Service Description	Number of Employees	Fleet Size
	<i>"The largest express transportation company in the world."</i>	160,000	<u>Surface Vehicles:</u> 47,000 <u>Aircraft:</u> 630
	<i>"Cost-effective, small-package shipping."</i>	53,000	<u>Surface vehicles:</u> 32,000
	<i>"Priority and economical less-than-truckload freight."</i>	33,000	<u>Trucks:</u> 14,500
	<i>"Technology and services customized for your business needs."</i>	31,000	N/A

Source: FedEx Corporation. (2014c). *FedEx Corporation brochure: What does FedEx deliver?* Memphis, TN: Author. Retrieved from http://about.van.fedex.com/wp-content/uploads/2015/01/Corporate-Brochure_Feb2014.pdf

a. Overview of FedEx Express

This study's primary focus was on the fuel-savings technologies and initiatives instituted at FedEx Express. All interviews and most of the corporate literature reviewed focused on the FedEx Express operating company. Essentially, FedEx Express is the original Federal Express, and all of the other operating companies grew from the original Federal Express. Of all the operating companies, FedEx Express probably best represents the core of a company, as a whole.

The focus of FedEx Express is on quick and reliable small package (under 150 lbs.) delivery. Its cornerstone capability is time-definite shipping, such as same-day, overnight, or similar delivery options based on customer needs. FedEx Express is the largest operating company within the corporation in terms of employees, overall fleet size, and revenue. In FY15, FedEx Express revenues were \$27.2 billion, which accounted for approximately 57% of FedEx Corporation's total FY15 revenues of \$47.5 billion

(FedEx Corporation, 2014a). FedEx Express is in the “overnight delivery business” and is the global arm of the enterprise (Interview FE01, June 16, 2015).

5. Impetus for Change: Unstable Fuel Prices

Utilizing technology to understand and control fuel costs has been a survival issue for FedEx since the company’s inception. In the early 1970s FedEx used a proprietary three-model planning system. This system included an origin-destination model, an automated flight schedule, and a financial planning model. Arguably, the origin-destination system was the most important and unique system that FedEx developed. Centered on Fred Smith’s original business concept, the system was based on a hub and spoke model that the company developed based on a single hub and the optimal cities that it could most efficiently service. City selection was based on factors such as population, employment, and business needs (Mason, McKenney, Carlson, & Copeland, 1997). FedEx’s automated flight scheduling program was unique in that it did not simply show flight schedules and gate arrivals. The system, termed FLY, was a comprehensive gate-to-gate simulation based on FedEx’s fleet of aircraft and potential airports it could service. The system accounted for “the operating characteristics of the aircraft, loading times, unloading times, prevailing winds, flying times, and such other factors as air traffic control delay times, taxi delay times, and instrument approach times” (Mason et al., 1997). During the 1973 OPEC oil embargo when fuel was being rationed, FedEx utilized these technologies to calculate the company’s anticipated fuel usage and was able to successfully lobby Congress to receive a fuel allocation. These actions probably saved the entire company from bankruptcy while it was still in its infancy (Mason et al., 1997). This experience was one of the factors that ingrained the principle of applying technology to solve fuel usage problems at FedEx.

In 2004, skyrocketing fuel prices forced FedEx, and many other businesses, to take a more serious look at their fuel consumption. In June 2005, FedEx missed Wall Street earnings expectations, which caused its stock to tumble. This induced a major ripple effect through the entire sector, which then spilled out into the wider market (Martinez, 2005). FedEx cited rising oil prices as the primary reason for missing earnings

expectations. It is no coincidence that most of FedEx's current fuel-savings metrics and goals use 2005 as a baseline.

Unsurprisingly, the 2008 financial crisis and resulting major economic recession negatively impacted FedEx's profits. In addition to reduced demand, more consumers were willing to wait longer for their products to arrive. Next day delivery was simply not as important to consumers during the peak of the recession (Interview FE02, July 2, 2015). Persistent high fuel prices coupled with a troubled economy further enforced the need to control fuel costs. The chairman's letter in the 2008 annual report cited the need for major cost-savings measures in light of the challenging economic environment, noting that "FedEx has survived three previous oil crises" (FedEx Corporation, 2008a).

In addition to the profitability challenges associated with unstable fuel prices and a weakened economy, FedEx has recognized the need to adopt sustainable business practices to bolster its corporate reputation. FedEx Chairman Fred Smith, in his 2014 GCR, stated, "FedEx believes our commitment to global citizenship underpins our long-term growth and profitability" (FedEx Corporation, 2014b). Furthermore, FedEx strategy considers what it terms "global citizenship" to be key to its long-term competitive advantage and has identified business objectives that overlap with critical social issues (FedEx Corporation, 2014b). Increased fuel efficiency across their fleets is one example where the reductions in cost and toxic emissions simultaneously achieve a business objective and address a social issue.

6. FedEx Express's Fleet of Vehicles

FedEx's primary mission is reliable, on-time delivery of items to and from customers around the globe (Interview FE01, June 16, 2015). As a business that relies on a fleet of vehicles, fuel is a significant cost driver and managing fuel costs is a fundamental element in their ability to remain profitable. Unstable fuel prices and the ability to mitigate fluctuations in fuel costs can have significant long-term impacts on the success of companies like FedEx, whose core mission is directly tied to the movement of cargo by both ground and air. The FedEx Express ground fleet has successfully implemented a number of fuel-savings initiatives that are discussed in this section. The

Fuel Sense program, also discussed in this section, focused primarily on their large aviation fleet. Developing a culture of environmental sustainability that entails fuel usage reductions has become a fundamental element of the larger corporate identity.

a. *FedEx Express's Ground Fleet*

This subsection of the analysis focuses on the FedEx fleet of ground vehicles and the fuel-savings technologies and initiatives the company has implemented within that fleet. The corporate culture (objective, identity, and ethos), the corporate structure, and the aforementioned impetus for change have played a part in shaping the company's basic framework for acquiring, maintaining and fueling its vehicles. These same factors of culture, structure, and a need for fuel efficiency also laid a foundation for FedEx to explore fuel-saving technologies and new vehicle designs and to include alternatives to fossil fuels.

(1) Life Cycle Costs

Most of the costs associated with a fleet of ground vehicles come from one of three cost categories: acquisition costs, maintenance costs, or fuel costs (Interview FE01, June 16, 2015). Due in part to the size, usage patterns, and vehicle lifespan expectancies of its fleet, FedEx developed a robust methodology in which to approach these costs. The FedEx Express fleet of ground vehicles is the second largest in the United States (Interview FE01, June 16, 2015), and 80% of the vehicles in this ground fleet are panel vans (Interview FE02, July 2, 2015). Even though fuel tends to be the biggest cost driver for their fleet over the long run, there is interplay between the three major cost drivers (Interview FE01, June 16, 2015). For example, well-maintained vehicles tend to be more fuel efficient and will be able to stay on the road longer, affecting both fuel costs and the acquisition cycle. The acquisition of new vehicles must take into account future maintenance requirements, fuel-efficiency goals, and the feasibility of installing telematics if they do not come as standard options on the vehicle. We take a more in-depth look at these factors in the following subsections.

When looking at opportunities to achieve fuel and other operational savings, it is important to look at the full life cycle of the vehicles. In general, costs for the first seven years are associated with depreciation, maintenance, and fuel (Interview FE01, June 16, 2015). It is at this time that monitoring the vehicle's health, courier driving habits, and the mechanical efficiency of the vehicles is of vital importance. All these factors impact fuel efficiency. FedEx's fleet of ground vehicles has a 7–10 year average lifespan, but some vehicles are kept for upwards of 20 years (Interview FE02, July 2, 2015). As the vehicle ages and depreciation (acquisition) expenses are no longer a factor the two main cost drivers of maintenance and fuel become an even bigger part of the equation (Interview FE01, June 16, 2015). Vehicle replacement decisions and the associated timelines are primarily based on a cost-benefit analysis basis to determine whether it makes sense to keep or replace vehicles. These decisions are usually made for groups of vehicles based on an in-depth analysis that considers various factors, including model-year and mileage. Finally, vehicles are scrapped when the maintenance and fuel costs outweigh the acquisition costs associated with replacement. The importance of taking into account the full life cycle costs of acquisition, maintenance, and fuel is clear.

(2) Acquisition Costs

When discussing these three factors, multiple senior managers conveyed to us that acquisition strategy and cost should not be overlooked when considering how to implement fuel-savings technologies and initiatives. Since the typical lifespan of a FedEx vehicle is seven years and in some cases can go upwards of 20 years, the type of vehicle acquired for the fleet has a significant impact in what the company will have to work with in regard to implementing telematics during the lifespan of those vehicles. Replacing large swaths of usable vehicles at one time to acquire more fuel efficient ones is generally not a feasible solution for many reasons. FedEx Express acquires approximately 3000 new vehicles annually, and acquisition managers typically look out about five years to try and predict needs and the types of new delivery vehicles that will be available (Interview FE02, July 2, 2015). Their decisions are primarily based on payload capacity, fuel efficiency in miles per gallon, years of anticipated service, and purchase price. There are a myriad of other factors that come into play though. As one senior manager stated, "You

will always be surprised by something you didn't think of" (Interview FE02, July 2, 2015). Market factors can also cause significant changes to their business outlook, which translates into the need to acquire different types of vehicles than had previously been anticipated. For example, the 2008 financial crisis changed consumer behavior to a significant extent. Customers were more willing to use less expensive ground shipping options and wait a few days for their packages to arrive as opposed to paying a premium for next day service. This caused FedEx to re-evaluate the amount and types of vehicles they had planned to acquire. A broader change in the market is what one FedEx employee referred to as the "Amazon effect" (Interview FE02, July 2, 2015), which is characterized by the expansion of online retailers coupled with the surge of demand for lightweight personal electronics that has created a change in the amount and type of items being shipped through companies like FedEx. The average size and weight of a package has decreased over the last five years, and subsequently FedEx has been induced to look at changes in their trucks (Interview FE02, July 2, 2015). Everything from vehicle size, payload, and engine type is continuously reviewed to determine if they are being as efficient as possible for each route.

Due to significant acquisition and replacement costs of such a large fleet, efficient use of existing vehicles and technologies is an important part of FedEx's strategy. FedEx Express deliberately minimizes the retrofitting of old vehicles with new technology, and instead utilizes newer technology as they acquire new vehicles. These newer technologies impact a broad range of operations, which in turn impacts fuel usage. FedEx recognizes how a comprehensive approach to fleet and asset management can impact their mission. Some of their innovations include dynamic route planning, aggressive maintenance plans, and optimization of its vehicle inventory based on mileage bands.

(3) Maintenance Costs

The maintenance cost driver influences both the acquisition effort and fuel-savings measures and should also be considered when formulating overall fuel savings goals. FedEx managers have taken significant strides toward identifying trends associated with maintenance and performance, which influences fuel usage. One manager stated

“We understand the cost associated with each type of truck and each mileage band” (Interview FE01, June 16, 2015). A mileage band refers to the number of miles a vehicle has been driven and the various vehicle characteristics associated with those bands. For example, when a certain type of vehicle reaches 80,000 miles it may be likely to experience a 2% reduction in fuel efficiency or be prone to having transmission issues. Furthermore, an in-depth understanding of their vehicles, which begins in the acquisition phase, lends itself to being able to better implement fuel-savings technologies within the vehicles. One interviewee asserted the importance of connecting the role of the vehicle to its impact on energy use, “Understanding energy consumption really is a science; you must evaluate what a vehicle needs to do” (Interview FE01, June 16, 2015). While management makes broad decisions about vehicle life spans, individual technicians (mechanics) have significant sway in determining whether smaller groups of vehicles, or even individual vehicles, should be kept in service.

Multiple senior managers talked about how FedEx’s approach to route planning and their “right truck, right route” philosophy are an important part of efficient asset management. “We always match the right equipment with the right engine and the right fuel type on every profiled route. It has been a huge gain for us” (Interview FE01, June 16, 2015). In general, older trucks are shifted to lower mileage routes, which maximizes their lifespan and reduces overall fuel consumption by simply not driving the less fuel-efficient vehicles as much. FedEx has determined that every truck operates differently at specific mileage ranges throughout its life and that it is important to account for these differences. For instance, understanding the cost and performance characteristics associated with each type of truck at each mileage band allows them to streamline maintenance and achieve higher levels of fuel savings (Interview FE01, June 16, 2015). A simple example of this concept is substituting smaller vehicles for a route that typically requires a larger vehicle when they are experiencing less volume than usual, or using older trucks in a dense urban environment in which the truck only drives a few miles and only makes a few stops. This is a simple concept, but the complexity lies in implementing it on a large scale in a dynamic and time-constrained environment. The “right truck, right route” philosophy demonstrates FedEx’s integrated approach to fuel savings. Telematics

are used to help manage assets as opposed to a more simplistic approach that might only entail the application of telematic devices or driver training. Fuel-savings technologies and initiatives are not viewed from a single lens at FedEx.

(4) Technology Selection

When it comes to implementing new fuel savings technology within its ground fleet, one message that was conveyed to us was, “Don’t let better get in the way” (Interview FE01, June 16, 2015). If a business is constantly waiting for a new capability or the next version of some technology to provide that much anticipated breakthrough, it may very well miss the opportunity to use capable, existing technology in an effective manner to achieve fuel savings. In a conversation that compared vehicle innovations to the progressive release of new iPhones, the interviewee stated that “Technology changes so fast that you are always chasing the technology. You just have to bite the bullet, make a decision, and go with something. Maximize the value and have an exit strategy to upgrade to the next technology” (Interview FE01, June 16, 2015). In the past, there were more significant technological and cost barriers that hindered FedEx’s ability to adopt new technology. At this time, however, given the advancements in cellular digital communications, widespread availability of telematic devices, and analytic software tools, FedEx has determined that the cost of adding telematics and related components to new vehicles is a rational decision based on a cost benefit analysis (Interview FE01, June 16, 2015 and Interview FE03, July 6, 2015). For example, FedEx Express has implemented what it calls a Proactive Systems Management (PSM) that manages things like the rate of acceleration, shift points in the transmission, idling time, distance and speed of the vehicle in reverse, and so forth. As stated during one interview, “Telematics and related technology has become very appealing to us and it’s very reliable. It’s something that we can do now and achieve results, very significant results” (Interview FE03, July 6, 2015). The various standard features and telematics capabilities and devices in many modern vehicles provide tangible fuel savings and maintenance and performance benefits, and they tend to improve the overall safety of the vehicle. Furthermore, it’s important to note that FedEx does not view telematics as simple driver-monitoring

technology. Telematics are viewed from a broad perspective and take into account not only driver behavior, but multiple other cost and safety factors:

When we say telematics, it is a little broader than just the simple vehicle telematics used, which is the sensors and so on, the driver behavior telematics. There's things like the communication module, a tax module that calculates fuel tax, which varies from state to state, so we measure that per tax ... and customizable data feeds we can analyze at various levels (individual vehicle and driver, or batches). So, there are multiple feeds from these systems. (Interview FE01, June 16, 2015)

(5) Vendor Selection

Emerging technological developments and vendor relations also play a role in implementing fuel-savings technologies and should not be overlooked. This can be particularly true for large organizations that have the potential to influence these areas. FedEx actively participates in the research and development of various fuel-savings technologies and alternate fuel vehicles, but it does so with an air of caution. While it actively seeks to support promising new developments and startup companies, ultimately FedEx is not in the business of sustaining those types of endeavors. FedEx managers expressed to us that they objectively evaluate the promises offered by new technologies and vendors while speculating whether those technologies will be viable and whether the vendors will be around in the long term to support their product (Interview FE03, July 6, 2015). Furthermore, rolling out a new technology to a large fleet is a challenge. Some advice we received regarding interactions with vehicle manufacturers was that fuel economy must be explicitly included in the requirements list and will be one of the primary metrics used to evaluate their product. One executive we interviewed said, "They can choose to make something efficient or inefficient. Manufacturers do not automatically default to efficient, by the way. They automatically default to profitable" (Interview FE01, June 16, 2015).

In summary, FedEx combined optimization of their existing assets with the integration of new technology. They identified three major cost factors associated with fleet vehicles over their lifetime of operations and have formulated a successful approach

to maximize their fleet's value while controlling acquisition, maintenance, and fuel costs. There is interplay between the acquisition, maintenance, and fuel costs, and no single cost factor can be addressed effectively without at least considering the others. The availability of proven fuel-savings technology inherent in the design of new vehicles has helped FedEx to implement new telematics and data analysis tools and more easily. The ability to more easily and effectively implement these technologies is a relatively recent development. Additionally, FedEx has conducted serious inquiries into the viability of hybrid, electric, and virtually all other known alternative fuel vehicle designs for their ground fleet (Interview FE02, July 2, 2015). FedEx was forced to scale back its original fleet replacement plan since alternate fuel vehicles still cannot meet the duty cycle requirements of most routes. Additionally, a lack of infrastructure exists to support most alternate fuel vehicles, and the cost benefit analysis still does not bear out. However, the company is slowly adopting alternate fuel vehicles as they are deemed viable. The company's fleet of vehicles has been increasing in diversity, both with a mix of newer and older models of the traditional panel truck design, and with different sizes and types of courier vehicles. This diversity brought with it more variation with which to incorporate FedEx's optimization strategy of "right truck, right route." All of the aforementioned factors have contributed to significant fuel savings for the company. Some of the fuel-savings metrics and statistics are reviewed in the subsection that details the success of FedEx's fuel-savings initiatives.

b. FedEx Express's Aviation Fleet

FedEx's fleet of aircraft is the world's largest all-cargo air fleet, and aviation fuel is a major cost (FedEx Corporation, 2014a). Subsequently, most of FedEx's fuel savings initiatives focused on their aviation fleet via a multi-faceted program they termed Fuel Sense (FedEx Corporation, 2014b). FedEx did not necessarily implement new technologies into its aircraft fleet, but instead focused on process improvements that led to significant fuel savings. We believe that the analysis of FedEx's successful Fuel Sense program provides valuable insight into broader change management initiatives which contain inherent truths that should carry over to other organizations, like the Marines.

Multiple interviewees pointed to the similarity between FedEx and military culture wherein teamwork and mission accomplishment were highly vaunted ideological values (Interview FE09, September 3, 2015; Interview FE05, August 13, 2015). Furthermore, through the course of this study it has become clear that the simple application of telematics in fleet ground vehicles was not how FedEx approached its massive fuel savings goals.

Based upon the previously explained impetus for change at FedEx and the company's global citizenship ideals, Fuel Sense was developed to reduce fuel usage and change the way in which employees viewed fuel usage. Broadly speaking, Fuel Sense is an "enterprise-wide, purpose-driven narrative, and within that, we unpack it depending on the project and who we are talking to" (Interview FE09, September 3, 2015). In other words, the Fuel Sense program encompassed large organizational shifts accomplished mostly by individual employee actions, large and small. The net effect of those individual behavior changes has led to a significant reduction in the company's aviation fuel usage (Interview FE08, September 3, 2015). Fuel Sense was implemented in a way that tapped into the teamwork virtue of the culture while being careful not to interfere with the mission, and was approached as a value added prospect. A view expressed during one interview shared the following insight in tying company initiatives to the organizational culture:

It's really then about adding on to that existing narrative, adding on to that existing culture ... that not only are you helping to deliver this package, but by the way, every time you make a decision, you are delivering more than just that package. So immediately it becomes more purpose driven ... in the sense that really what I am doing is having an [impact] across the world. (Interview FE09, September 3, 2015)

Fuel Sense is geared more toward motivating and empowering employees to make differences that have a broad impact on the company and the environment. A more detailed conceptual analysis of the lessons learned from the analysis of the Fuel Sense program is offered in the data coding and analysis subsection of this chapter, and in the findings section.

7. Setbacks in Fuel-Savings Initiatives

In this section we review the setbacks that FedEx experienced while implementing various fuel-savings technologies and initiatives. We do this to gain some object lessons of how successful companies respond to and overcome challenges. FedEx has had to overcome challenges with its ground and aviation fleet—challenges that have been both technological and social in nature. Some of the obstacles we identified in our interviews were that FedEx often waited for the next best thing and, in a sense, sought perfection. They were also sometimes swayed by the prospect of new technologies and failed to make rational business decisions based on a prudent cost-benefit analysis. Lastly, they did not adequately consider infrastructure challenges when planning their aggressive electric vehicle fleet plan. This section provides some detail of those setbacks, whereas the findings section provides, in part, a more in-depth analysis of how these challenges were overcome.

a. Do Not Seek Perfection

Some senior managers expressed that the company was often slow to implement fuel-savings telematics technology in its ground fleet, even when it was technologically feasible and made sense in terms of cost-benefit analysis. With regard to implementing telematics, one senior manager revealed some of the lessons they had learned over the importance of timely implementation of technology: “One of the things that we tended to do was wait for the next best thing” (Interview FE01, June 16, 2015). Using the iPhone as an example, this manager illustrated that some people buy every new version that comes out, while others are constantly waiting for the next best thing and do not act. The suggestion of “Don’t let better get in the way” was born from this setback (Interview FE01, June 16, 2015). Additionally, this should be a rational business decision—not one solely based on what technology is available, but on what the business requires.

b. Implement Based on a Cost-Benefit Analysis

FedEx was initially aggressive in efforts to implement alternative fuel vehicles and had a pioneering fleet replacement plan in place by 2003; however, their plan to

replace their fleet of vehicles with electric, hybrid, and other types of alternative fuel vehicles were too ambitious. The infrastructure and tax relief benefits they had planned for did not materialize as envisioned, resulting in the need to scale back the acquisition of alternate fuel vehicles. The company explored almost every option that was technologically feasible, but nothing ultimately made sense from a cost-benefit analysis when compared to fossil fuel vehicles (Interview FE02, July 2, 2015).

Even though the company has aggressively partnered with hybrid vehicle manufacturers to develop trucks that will meet FedEx's requirements, they have not yet been able to replace most of their fleet with hybrid or electrics. They have tested hybrid, electric, compressed natural gas, and even turbine-powered vehicles (Interview FE02, July 2, 2015). As early as 2003, the company was looking to replace all of its medium-duty trucks with hybrid or electric vehicles as part of a 10-year plan (FedEx Newsroom (2003). To date, they are still purchasing fuel-efficient non-hybrid vehicles while continuing to push for better hybrid and electric vehicles. For FedEx, the most cost-efficient solution is still fossil fuels. One viewpoint expressed anxieties specific to electric and hybrid vehicles being developed; "Cost benefit analysis doesn't support electric or hybrid vehicles at this time; they do not have the endurance and cannot support the 'duty cycle' of delivery requirements" (Interview FE02, July 2, 2015). Additionally, there are concerns that the electric battery is essentially hazardous waste and must be dealt with at the end of its useful life (Interview FE02, July 2, 2015).

c. Consider Infrastructure Costs

Multiple senior managers pointed out that there is insufficient infrastructure support for fleets of electric vehicles. Even in confined scenarios, such as airport ground support vehicles, adequate infrastructure and sources of electricity must be in place. Additionally, there must be contingency plans to deal with power failures. The managers indicated that a proper, robust infrastructure to support electric fleets of ground support equipment was rare, but they have seen some success and significant advancements at airports in support of all-electric ground support vehicles (Interview FE01, June 16,

2015). FedEx is still looking to the future in hopes of embracing more electric and hybrid vehicles, as explained by Fred Smith, chairman and CEO:

Battery technology is such that you cannot make a case for battery only vehicles on an ROI basis unless the price of diesel gets up into the \$4.50–\$5.00 a gallon category, but the simplicity of electric propulsion for commercial vehicles, the high start and stop, is inarguably better than ICE [internal combustion engine] because 93% of the power produced goes to the propulsive power rather than the loss and heat in the transmission and so forth in the vehicles. So we strongly believe that over time, for short haul, light duty commercial vehicles, all electric will be very compelling as the next generation of batteries comes out with more battery density. (Securing America’s Future Energy, 2013)

Initially, the Fuel Sense program was met with much skepticism and pushback. The program was targeted at FedEx Express’s aviation fleet due to the sheer amount of fuel used by their large aviation fleet. One FedEx senior manager stated that “the initial launch of Fuel Sense failed miserably. [You] can only ask pilots to change minimal things since they are process oriented” (Interview FE08, September 3, 2015). Pilots did not want to consider changing established processes and behaviors. Ground support employees, whose primary mission is typically the loading and unloading of vehicles and aircraft, tend to be mission focused. They conveyed to managers that any perceived additional tasking would take away from their ability to meet their mission objectives, such as loading cargo within a specified time. Both pilots and ground crew indicated that changes to established procedures could have a negative impact on safety. In a sense, FedEx was a victim of its own successful business, safety processes, and employee dedication. Employees were hesitant to stray from the tried and true approach. Senior managers had to go back to the drawing board and formulate a new approach.

It is important to note that FedEx experienced some significant setbacks. Even a company as large and successful as FedEx that also operates one of the most efficient fleets of ground and air vehicles in the world had to learn from its mistakes. Additionally, the problem of how to best implement measures to reduce fuel consumption are not one dimensional. While the Fuel Sense program did not encompass FedEx’s fleet of ground vehicles, the company did roll out aggressive fuel-efficiency goals enterprise-wide. FedEx Express’s ground vehicle fleet operators and managers resisted in a manner

similar to their counterparts on the aviation side of the business. Said one interviewee, “Fuel savings goals were not readily adopted within FedEx Express’s non-aviation branches” (Interview FE05, August 13, 2015).

Employees were not necessarily opposed to the notion of saving fuel or caring for the environment; they were, however, heavily focused on mission performance and safety. Fuel costs and emissions were a concern, but they had not been elevated to the level of importance to garner the reaction and results that the new business environment and unstable fuel prices were deemed to require.

8. Success of Fuel-Savings Initiatives

Despite some initial setbacks, FedEx has realized significant successes with its fuel-savings initiatives and changes. These successes were substantiated by observed metrics discussed in the following paragraphs and during the course of interviews conducted for this case study. Many of the factors that facilitated the success are detailed in the following sub-section and the findings section. This section details some of the successes via specific performance metrics which bear evidence of the company’s overall success with regards to reducing its fuel consumption.

According to the 2014 GCR, the FedEx Express fleet of ground vehicles has improved its vehicle fuel efficiency by 29.5% since 2005. The original goal was 20% by the year 2020 using 2005 as the baseline year. Having exceeded that original goal, a new goal of 30% improvement in fuel efficiency by 2020 was instated. FedEx plans to revisit this goal again in light of their more recent success (FedEx Corporation, 2014b).

According to the 2014 GCR, the FedEx Express aviation fleet has reduced its aircraft emissions by 21.4% since 2005. The goal is a 30% reduction in emissions by the year 2020 using 2005 as the baseline year. The report translated these percentages into significant numbers relating to fuel and emissions; “Through Fuel Sense initiatives, FedEx Express has saved 100 million gallons of jet fuel and avoided more than 976,000 metric tons of carbon emissions” (FedEx Corporation, 2014b). Since 2007, Fuel Sense

initiatives have “collectively saved the company more than 330 million gallons of jet fuel, the equivalent of 500 Olympic-size swimming pools” (FedEx Corporation, 2014b).

Additionally, although FedEx has not expanded its fleet of alternate fuel vehicles as rapidly as originally intended, it has substantially increased the number of various alternate fuel vehicles. In FY14 FedEx had 397 hybrid vehicles, 404 electric vehicles, 132 compressed or liquefied natural gas vehicles, 69 propane vehicles, 40 hydrogen vehicles, and 6 hybrid hydraulic vehicles (FedEx Corporation, 2014b). In total, the fleet has expanded to 1048 alternate fuel vehicles.

B. DATA CODING AND ANALYSIS

This section further analyzes the transcripts and notes derived from the eight hours and forty-nine minutes of interview recordings, along with manual notes from interviews that were not recorded, to look for key concepts in FedEx’s approach to fuel-saving initiatives. From the aforementioned data sources, phrases and significant quotes were extracted and coded into categories listed in Appendix A. Table 2 illustrates a sample from Appendix A. The sample shows a breakout of five codes as they were applied to driving behaviors that would directly correlate to fuel efficiency. For example, the behavior of unnecessary idling is consuming fuel without contributing to mission accomplishment.

Table 2. Example Excerpt from Coding Scheme

ROOT CODE CATEGORY	CODE SUB-CATEGORY	APPLIED CODES	CODE DESCRIPTION
Behaviors			
	Driving Behaviors		
		Unnecessary idling	Idling when it is not necessary for mission accomplishment
		Speeding	Going over company/state speed limits
		Harsh driving	Such as fast acceleration, hard breaking
		Inattention	Operating a vehicle not attending to the activity
		Inefficient running	Operating a vehicle when not fully loaded

As indicated in the methodology section, this case study sought to derive and understand corporate concerns and associated actions by applying the codes listed in Appendix A to data gleaned from academic and corporate literature and personal interviews with FedEx employees. We discovered trends in how FedEx identified progressive changes that would be applicable to their mission, as well as the development of a proactive approach to change that recognized the role of social elements in the company's overall agenda. Information gleaned from the literature and data from the coded interviews was compiled and grouped together under a relevant coding construct that was derived from significant concepts identified in the academic literature review. Additional codes were added as new information was discovered throughout the interview process. The coding categories were used as a guide to help group the data into coherent and rational subsets of data from which we could analyze it. The compiled lists of similar quotes are listed on the right-hand columns of Table 3, Table 4, and Table 5.

From these sources of compiled and similar data, logical themes emerged. These themes are contained in the middle column of the tables and correspond to the group of quotes to the right of the outlined themes. We then grouped relevant, similar themes derived from the compiled data of grouped quotes and themes into a single comprehensive concept. A total of three concepts emerged from the process of coding and grouping quotes and themes. The concepts are described in the caption at the bottom

of Table 3, Table 4, and Table 5; the three tables correspond to the three concepts that emerged. Each concept corresponds to all of the themes and quotes outlined in the two columns of data to the right of each concept. Each concept was derived from multiple relevant themes, and each theme was derived from multiple relevant supporting quotes. A further description and analysis of each concept and its related themes, along with supporting quotes, are detailed in the findings section.

Table 3. Concept 1: Identifying the Need for Change and Determining the Value of Change

Themes	Compiled Quotes
By applying business modeling to existing conditions, FedEx determined the most economical and efficient use of its current fleet, i.e., “Right Truck, Right Route.” Utilize the existing technologies and infrastructure to make the best decisions possible, use the best technology available in the most intelligent manner possible, and have a plan to phase in and out of those technologies.	“Our asset management tries to fit the right asset at the right route and ensures that the duty cycles and the drive cycles are optimized to actually improve our fuel costs” (Interview FE03, July 6, 2015).
	“Sure, but the real [magic] if you will, is taking the data and turning it into information...you have a series of algorithms you can put it into information. So the data itself could be all kinds of aberrations there, but its knowledge” (Interview FE01, June 16, 2015).
	“We always match the right equipment with the right engine and the right fuel type on every profiled route. It has been a huge gain for us. In general, old trucks are shifted to low mileage routes.” (Interview FE03, July 6, 2015).
	“Don’t let better get in the way” (Interview FE01, June 16, 2015) (Apply existing technologies and don’t constantly wait for the next best thing to come out. I.e., iPhones) Also, have an exit strategy.
	Cover as many of the known variables as possible. “Don’t have a simple $A+B=C$ because it will be wrong” (Interview FE02, July 2, 2015).
An analysis of total cost of ownership (TCO) reveals that fuel costs are the most significant of the three major costs (acquisition, maintenance, fuel). There is an art and science to managing those factors to maximize vehicle life, efficiency and costs.	“You know, at the end of the day, when you are looking at the total cost of ownership of a fleet, fuel economy—fuel—is always been the big driver” (Interview FE01, June 16, 2015).
	“[Initially, for total cost] you have depreciation, maintenance, and fuel and it [TCO] is very high. It comes down as depreciation reduces. Then...becomes a maintenance discussion. ...depreciation free years...just looking at maintenance and fuel, so we watch that curve.” (Interview FE01, June 16, 2015).
New technological capabilities are making it easier to apply technology to the problem. Wireless communications and availability of telematics and data analysis software are more ubiquitous. Many new vehicles	Cost benefit analysis does not take you off fossil fuel use. Paraphrased from both Interview FE02, July 2, 2015 and Interview FE03, July 6, 2015.
	...simplicity of electric propulsion for commercial vehicles, the high start and stop, is inarguably better than ICE [internal combustion engine] because its 93% of the power produced goes to the propulsive power rather than the loss and heat in the transmission and so forth in

Themes	Compiled Quotes
have telematic and data transfer capability as standard features. Fuel savings and safety are engineered into the vehicle, not necessarily a driver training or use of telematics at the driver level.	the vehicles. ...electric will be very compelling as the next generation of batteries comes out with more battery density.” (Securing America’s Future Energy, 2013, December 3)
	[Electric vehicles] cannot support the <i>duty cycle</i> of delivery requirements. For example, a route may be 15 or 150 miles, but can have 50 stops, the AC might be running, there are individual driver driving patterns. ... there are also issues with electric and hybrid battery disposal. Now you are dealing with a type of toxic waste when you have to deal with scrapping the vehicle (IRT battery disposal). Paraphrased from Interview FE02, July 2, 2015.
	“...today’s modern vehicles and ground support equipment have the capability to have onboard computers, multiple onboard computers in some cases, as many as four. ...sensors are already on the equipment as opposed to yesteryear when you had to invest in having sensors actually put on the vehicle” (Interview FE01, June 16, 2015).
	“We call it PSM, Proactive Systems Management... they control the acceleration rate, acceleration,... the shift points on the transmission just to optimize that vehicle to actively provide the highest possible fuel efficiency. ...now they’re merging them with safety features. You know, we use all of them. It has become very appealing to us that it’s very reliable. It’s something that we can do now and achieve results, very significant results” (Interview FE03, July 6, 2015).

FedEx identified the need for changes and improvements in some of the company’s processes to increase fuel efficiency. Some changes could be implemented with new technology. Some improvements could be made by changing how they used existing technology and vehicles.

Table 4. Concept 2: Social Dimension, Identifying the Importance of Strategic Communications and Campaigns

Themes	Compiled Quotes
FedEx is a professional organization with teams of dedicated employees at all levels. Appealing to professionalism and loyalty was instrumental to implementing change. There must be an emotional connection to the value of the work being conducted. It’s not “just” a job.	Fed Ex has “professional drivers and this is the way professional drivers behave” (FE07-08, September 2, 2015).
	“Emotion works because people want to be identified by GROUPS - being part of the crowd! This is what we do here.... if you want to be part of who we are, you need to do this” (Interview FE08, September 3, 2015)
	“It’s all about representing FedEx. Yes. Everybody is bleeding purple as they say” (Interview FE05, August 13, 2015).
A “deep understanding” of the culture and the need for change is essential. It is not a quick solution and it is not simply an initiative that will be forgotten about after the next trend comes along. It is a	“Culture change requires tenacity, grit, and vision to stay on track. Need a number of people to drive it. Goes slowly so need a lot of persistence to achieve it. Some is intentional and some is not. Need to be smart about the intentional changes you are looking for” (Interview FE08-09-10, September 3, 2015.)
	“We have training programs...two of them. The one is called

Themes	Compiled Quotes
deep and abiding change that must be ingrained into the culture of the business at all levels. It is now part of how they conduct business and how they conduct themselves. It is part of the shared value system and inextricably tied to the successful completion of their primary mission.	practices, which is targeted towards the managers. Then the other piece is methods; that is targeted towards couriers. ...Now the challenge is getting folks—you know, how to you ingrain that in everyday activity? So you know, you got a manager that is just the way they are going to have that done and they are going to coach their folks and they are going to hold them accountable to doing that and you will see that happening. Then if you have one that don't really push that or hold them accountable, you kind of see a little lax around that and you don't see those good methods or practices happening and then you see that manifest into later leave building [route start times], more service failures, more miles on road, more hours on road, those kind of things. So it's directly relatable" (FE07-08, September 2, 2015). "...the really difficult part is, which is all part of this culture change, is to maintain that improvement" (Interview FE08-09-10, September 3, 2015) "Leadership is necessary on sustainability issues relevant to the organization and to society. We have to be leading in areas that are relevant and germane to what we do each day because if we don't, who will?" (Tennessee Energy Education Initiative, 2013).
Belief follows behavior. By changing behaviors in a manner that is not overly intrusive, cumbersome, or seen in a negative light, change can be deeply implemented at many levels. If, by getting an employee to engage in a positive behavior, management can help that employee to see the value of that behavior to the greater good, a fundamental transformation of perceived value of the behavior may ensue.	"...that belief follows behavior. So if you get people to behave in a certain way, then they recognize, they identify and recognize that behavior as being different than it was in the past and then they create a belief around that. If I am behaving in a certain way, if I am saving fuel because I load the airplanes with an specific CG, then that must mean that I care about the environment because that aligns with my behaviors, so that has got that resonance where it all fits together" (Interview FE08-09-10, September 3, 2015). How to obtain goal of moving load 1% aft of center of gravity (CG). "[employee response]'well, what do you want us to do? Get the flight ready on time OR load the CG at the center?' The answer was both. It's we want you to take advantage of those opportunities whenever they are there; and whenever there is no opportunity, that's fine. Your primary mission is to make sure that the flight is safely loaded; and the multiple opportunities we have to move that CG aft, any percent aft counts. So whatever you can do to move it aft counts. In just three weeks, after probably answering I want to say close to 35 to 40 emails on questions about how the program works, we have been able to move the CG 2.5% aft... still not aft of center, but it is 2.5% from where we started" (Interview FE08-09-10, September 3, 2015).

FedEx recognized elements of the social dimension that could facilitate or hinder change initiatives, including lessons learned from early attempts.

Table 5. Concept 3: Adding Value without Compromising the Mission

Themes	Compiled Quotes
FedEx prioritizes the reliable, on-time delivery of packages, which is directly tied to its existence and should not be compromised. For effective change, need to show the possibility of change without disrupting operations and the “same, but different” concept applies. “Quick wins” are important to show the value of the change and to make believers of the employees who must embrace and “be” the change. Target the change goals to the right audience. Appealed to employees in all roles; encouraged realistic goals.	“FedEx sells certainty” (Interview FE01, June 16, 2015).
	“People, service profits” (Interview FE05, August 13, 2015).
	“You want to affect hearts and minds and you want to change the culture, you want to save on energy, but you still have to deliver packages on time. You sell reliability” (Interview FE08-09-10, September 3, 2015).
	Found that if you can break fear of change, can achieve great things. Paraphrased from FE07 & 11, October 16, 2015.
One of the first steps is to show the possibility of change without disrupting existing operations. Same, but different concept applies. It is important to get “quick wins” and show the value of the change. Make believers of the employees who must embrace and “be” the change. Target the change goals to the right audience. Appealed to employees in all roles, encouraged realistic goals within their scope	Example: Paper maps changed to digital for routing purposes; same map, but on a computer to get over hump of resistance. Same, but different... *Paraphrased (Interview FE07 PT2, August 20, 2015).
	“Basis of change management is quick wins to show change is working” (Interview FE07-08, September 2, 2015).
	“We have training programs that there is two of them. The one is called practices, which is targeted towards the managers. Then the other piece is methods; that is targeted towards couriers... Now the challenge is getting folks, you know, how do you ingrain that in everyday activity?” (Interview FE08-09-10, September 3, 2015).
	What do you truly control? RANGE OF CONTROL “if you set metrics/measures/requirements that the person does NOT have control of, you will get frustration instead of results, AND lose focus” (Interview FE07-08, September 2, 2015).
Show the difference that one person can make. Tie this into the larger goal and emphasize the importance of one person, one task, one “something.” Be careful to <i>not</i> tie to monetary incentives. There may be a major monetary factor, but tying a dollar amount to rewarding individuals may act as a disincentive. Also, not everyone can contribute in the same way, so it is important to not alienate some roles. Keep it a team effort. Right incentives, right training.	[That is where the 1% arose] “Everybody can contribute. We have heard frustration from front line, feeling like they couldn’t have an impact. So we asked them to just save one drop of fuel. So our mantra is “One person, One action, One drop.” That’s the reason why we are sticking with this theme, this theme of one. Because everybody is just one” (Interview FE07-08, September 2, 2015).
	“we are shying away from the money part because we can’t give money to some of our groups of employees because they can’t be financially rewarded for jet fuel savings...Talking more about the equivalencies and impact and that emotional connection because of impact. So we are relating it to savings to the business, how many miles we can drive our courier vans for free, those kinds of things” (Interview FE08-09-10, September 3, 2015).
	“Another thing that is interesting, if you have read the book “Drive”, knowledge workers are actually disincentivized by giving them a reward; and perform worse when you dangle a financial carrot out in front of them” (Interview FE08-09-10, September 3, 2015).

FedEx aligned the desired changes and social dimensions to work in parallel to achieve the company’s goals without compromising its primary mission of on-time delivery.

C. CONCLUSION

This section detailed the myriad of conceptual changes that FedEx Express effected in order to achieve the results the company needed. We reviewed the factors of objective, identity, and ethos; the corporate structure; the need for change due to unstable fuel costs; and some of the setbacks and successes FedEx experienced. The final section compiled meaningful quotes from the personal interviews we conducted and organized them into logical themes and concepts derived from the concepts gleaned from the academic literature. Ultimately, there was no single best approach or technology that achieved those results. Instead, FedEx experienced success by taking a holistic approach to the problem of fuel savings by taking into consideration their existing fleet, proven existing technology, the promise of newer technologies, and the power of harnessing their employee base with change management initiatives encompassed in the Fuel Sense program.

V. FINDINGS AND RECOMMENDATIONS

This case study analyzing the fuel conservation efforts of a commercial vehicle fleet began with two assumptions. The first assumption was that corporations operating large fleets of vehicles, such as FedEx, were aggressively implementing fuel-saving telematic technologies into their vehicle fleets, similar to the options offered in personal vehicles today. These technologies often involve a driver-vehicle interaction of some sort. The second assumption was that there would be a technology adoption challenge for the company regarding the use of the aforementioned telematics. That is, the vehicle operator would not be inclined to use the telematics or would look for ways to sidestep them. The original research question was this: “If there is a telematic tool or informative display in the vehicle that the driver can utilize or interact with to improve fuel efficiency, are commercial vehicle drivers using them effectively, or at all? If not, how do companies overcome resistance to utilizing this technology?”

These assumptions were based on knowledge of technology currently available in personal vehicles, in which a driver can access immediate feedback about fuel economy based on driving style. An initial review of corporate literature and current technological trends with regards to fuel efficiency steered the study in that general direction. Additionally, information gleaned from initial interviews with FedEx employees indicated a significant interest in utilizing fuel-savings technology within their vehicle fleets. However, interview sources repeatedly signaled that FedEx considered any sort of telematic device that the driver interacts with as a distraction that could negatively impact safety and mission performance. Instead, fuel-saving telematics were incorporated into the vehicle, either by FedEx or the manufacturer, in such a way that the driver did not directly interact with that technology while operating the vehicle. A prime example is the maximum acceleration rate of a vehicle being rigidly controlled by an onboard computer that is part of the vehicle’s design.

This modification of our initial assumptions changed the perspective and starting point of what this case study could provide for insight. The question of what might

facilitate or hinder corporate fuel-efficiency initiatives evolved from how individual users might respond to specific technologies into something broader. In this section we review three key findings gleaned from the data coding and analysis outlined in the previous section. We then provide recommendations to the Marines based on these findings.

A. FINDING 1: IDENTIFY THE NEED FOR CHANGE AND DETERMINE THE VALUE OF THE CHANGE

FedEx identified the need for changes and improvements in some of their processes to increase fuel efficiency. Some changes could be implemented with new technology, but many improvements could be made by changing how they used existing technology and vehicles. Table 1 in the analysis section shows the data that contributed to this concept. The following subsections bear out the details of this concept.

1. Utilize Existing Technology and Processes

One method FedEx used to determine the most efficient use of its current fleet was to apply the principles of Operations Research (OR) to its business model. Specifically, FedEx's philosophy of using the right truck on the right route based on the previously mentioned mileage band and dynamic routing analysis helped the company to most effectively manage their existing assets, technology, and process to achieve fuel savings. A FedEx executive noted significant fuel savings gained by where FedEx places existing assets; "We match the right asset with the right route and ensure that the duty cycles and the drive cycles are optimized to actually improve our fuel costs" (Interview FE03, July 6, 2015). So, FedEx utilizes existing technologies and infrastructure to make the best decisions possible with what is available, seeks to use the best technology available in the most intelligent manner possible, and has a plan to phase those technologies into their operations as well as a plan to phase them out. The right truck, right route philosophy encompasses a wide spectrum of variables to include matching payload capacity to projected volumes of specific routes and assigning older vehicles that achieve lower miles per gallon performance onto routes that are concentrated geographically with fewer miles to travel.

2. Conduct a TCO and ROI Analysis of Existing and Developing Technology

An analysis of total cost of ownership (TCO) reveals that fuel costs are the most significant of the three major costs identified by FedEx—acquisition, maintenance, and fuel (Interview FE01, June 16, 2015). There is an art and science to managing those three factors to maximize vehicle life, efficiency, and costs. Initially depreciation costs are high, but as the vehicle ages and depreciation is reduced or eliminated, the focus shifts toward maintenance and fuel. At this latter point, decisions tend to be based largely upon maintenance costs of keeping that vehicle on the road. As shared by one executive, “When the curve starts to hockey stick [due to maintenance costs], ideally you would want to get to it [and potentially replace the vehicle] before it does the big giant flip at the end where it starts climbing sky high again” (Interview FE01, June 16, 2015).

Even though fuel costs are the single largest driver of three identified major costs, the return on investment of hybrid and electric vehicles does not make financial sense at this time for the majority of operating areas. There is, however, significant potential for new types of vehicles if and when infrastructure can support and the duty cycle (or mission) of new vehicles aligns with mission requirements. As one interviewee stated, “Cost-benefit analysis does not take you off fossil fuel use at this time” (Interview FE02, July 2, 2015).

3. Ease of Use of New Technology and New Capabilities

During the literature review, we observed the foundational determinants in TAM were the perceptions of both ease of use and usefulness. These two determinants remained at the core of subsequent evolutions of the TAM model. The case study of FedEx validated these determinants. At the heart of the company’s desires to introduce new technologies was the motivation of anticipated returns on the investments of innovation.

New technological capabilities are making it easier to apply technology to the problem of managing fuel costs. Wireless communications and the more ubiquitous

availability of telematics and data analysis software make it easier to implement. Many new ground vehicles have telematics and data transfer capability as standard features. In the recent past, the cost of things like telematic sensors, labor, and cellular transmission were prohibitive. Referencing the affordability of these newer capabilities, an interviewee stated “Today, the cost is marginal; it’s no longer a huge expense” (Interview FE01, June 16, 2015). Additionally, many fuel-savings technologies and safety features are engineered into standard vehicles. FedEx focuses on safe driving habits, but it does not focus on training drivers to operate the vehicle in a fuel-efficient manner. The fuel-saving technology is either built into the vehicle or can be engineered into the vehicle, and the driver does not need to be tasked with the concern of driving in a fuel efficient manner. During one interview, an executive described how the standard availability in newer vehicles has been a factor that has facilitated the ability to monitor vehicle performance; “Modern vehicles have the capability to have onboard computers. The sensors are already on the equipment as opposed to yesteryear when you had to invest in installing sensors on the vehicle” (Interview FE01, June 16, 2015). Multiple senior managers conveyed to us that one design goal is a simple interior cab design that is free from anything that may distract the driver. Distracted driving was a major concern from the maintenance and design aspect. Much of the information gleaned from the sensors is analyzed by the managers at various levels. Drivers do not see the data unless there is a need for some sort of managerial intervention. Regional managers tend to focus on driving habits and anomalies with individual vehicles while higher-level managers look for broader maintenance and fuel usage trends. One view shared by an executive emphasized that it was not as much the raw information, but the story that the data provided.

The real magic, if you will, is taking the data and turning it into information You have a series of algorithms that transform it into information. The data itself could have all kinds of aberrations, but knowledge can be gleaned from it. (Interview FE01, June 16, 2015)

B. FINDING 2: SOCIAL DIMENSIONS MATTER: IDENTIFYING THE IMPORTANCE OF STRATEGIC COMMUNICATIONS AND CAMPAIGNS

FedEx identified and understood the importance of strategic communications and campaigns, recognizing the elements of the social dimension that could facilitate or hinder change initiatives, including lessons learned from previous setbacks. Table 2 in the analysis section contains data that shows the connections between the corporate social fabric and communication within the company. Researchers Nardon and Aten (2012) identified this same tie-in while studying communications in business settings using virtual worlds.

Organizations seeking to implement novel and emerging technologies should have an understanding of employees' perceptions of how and to what purpose a technology will be used prior to implementation efforts (Nardon and Aten, 2012). Data analysis substantiated the expectations of innovation based on the socio-technical theory. The same principles presented in the literature pertaining to the socio-technical theory could be mapped to observations in the data from FedEx.

1. Professional Organizations, Professional Employees, Emotional Connections

FedEx is a professional organization with teams of dedicated employees at all levels. Appealing to this professionalism and loyalty was instrumental to implementing change. There must be an emotional connection to the value of the work being conducted. In other words, working at FedEx is not merely a job, and couriers aren't merely delivering boxes. By tapping into this positive emotional connection that employees have with the company, FedEx was able to create a sphere of influence wherein groups of people connected to and then actually fostered the company's change management initiatives (Fuel Sense) from every level. As stated by one interviewee, "Emotion works because people want to be identified by groups—being part of the crowd. This is what we do here and if you want to be part of who we are, you need to do this" (Interview FE08, September 3, 2015).

2. Importance of Deep Change

A deep understanding of both the existing culture and the true value of the desired change is essential. There is rarely a quick solution when deep and abiding change is needed. Change cannot simply be an initiative that may be forgotten after the next trend or concern rears its head. The change must be ingrained into the culture of the business at all levels. It must become part of their objective, identity, and ethos, which will foster change in how employees—as groups and as individuals—conduct business as well as the manner in how they conduct themselves. The desired change becomes part of the shared value system and should be inextricably tied to the successful completion of their primary mission. Executives stated that change was not easy, “Culture change requires tenacity, grit, and vision to stay on track and you need a number of people to drive it. It goes slowly so persistence is essential” (Interview FE10, September 3, 2015). Furthermore, part of the challenge is to ingrain the change into everyday activity. For example, when regional managers do not hold couriers responsible for their choices, it may result in more miles and hours on the road, or to more service failures.

3. Belief Follows Behavior

At first glance the notion that belief follows behavior is counterintuitive, and by many measures it is. Arguably, most people act in a manner that coincides with and is guided by their beliefs. However, FedEx has found that by changing behaviors in a manner that is neither intrusive, cumbersome, nor seen in an overtly negative light, a change in belief can be formed around those new behaviors. That new belief then reinforces the desired behavior. For example, if by getting an employee to engage in a positive behavior, management can help that employee to see the value of that behavior to the greater good, a fundamental transformation of perceived value of the behavior may ensue. This transition of behaviors to beliefs was described in the following way:

If you get people to behave in a certain way, then they identify and recognize that behavior as being different than it was in the past; and then they create a belief around that. For example if I am behaving in a certain way, if I am saving fuel because I load the airplanes [in a certain manner], then that must mean that I care about the environment because that aligns

with my behaviors. So, that has got that resonance where it all fits together. (Interview FE09, September 3, 2015)

Senior managers conveyed to us that front line personnel often felt they were being asked to make decisions that pitted performance against fuel-savings goals, or safety against fuel-savings goals (Interview FE08-9-10, September 3, 2015). For example, one specific goal of the Fuel Sense program was to ask specific aircraft cargo loading personnel to move the load in the aircraft 1% aft of the center of gravity. Placing the load 1% aft of center was determined to be the ideal load scenario that was most conducive to helping the jet to fly in a more fuel-efficient manner. From their analyses the cargo loads typically sat about 3% forward of the center of gravity. When implementing this goal, managers would be presented with questions that could be considered a false dichotomy of sorts. In one scenario, an employee asked a manager something like, “Do you want me to get the flight ready on time or load the cargo 1% aft of the center of gravity?” The manager’s response reinforced the notion that the overriding primary mission was to safely load the plane on time; however, if there was an opportunity to move the load aft by any amount whatsoever then to please take the opportunity to do so. If the opportunity simply did not present itself, then that was absolutely fine (Interview FE08, September 3, 2015). Although the ultimate goal was to move the load 1% aft of center, the expectation that was conveyed to frontline employees was that any progress made toward moving the load toward that goal, no matter how small, was considered a success. By the end of the week one employee was able to change his average load from 3% forward of aft to only 2% forward of aft with no impact to schedule or safety, and that small improvement was noted and celebrated by management. By clearly conveying the reasons for the change and giving employees an opportunity to make even a small positive change without any repercussions for not doing so, they were able to tap into a culture where employees voluntarily chose to do what was best for the company and the environment. Furthermore, other employees became interested in this new goal and sought ways to achieve it on their own. Senior management shared a recent win in changing the center of gravity of cargo being loaded onto airplanes:

In just three weeks, after probably answering 35 to 40 emails on questions about how the program works, we have been able to move the CG 2.5% aft. Yes, still not aft of center, but it is 2.5% from where we started. (Interview FE08-9-10, September 3, 2015)

C. FINDING 3: ADDING VALUE WITHOUT COMPROMISING THE MISSION

FedEx has been relatively successful at identifying the right process and implementing it successfully. It has aligned the desired changes and social dimensions to work parallel to achieving the company's goals without compromising the primary mission of on-time delivery. Table 3 in the analysis section contains examples found in the data of deliberate steps used by FedEx to achieve desired changes within the company.

1. Mission First Priority: Do Not Let Initiatives Become the Mission

There is a clear mission first priority at FedEx. Without the ability to reliably deliver on-time packages, there would be no business at all. Multiple senior managers explicitly acknowledged the business reality that if they are unable to remain competitive by making on-time deliveries in a cost-efficient manner they will lose business to someone who can, and it is not inconceivable that they could go out of business entirely. One manager said, "FedEx sells certainty" (Interview FE01, June 16, 2015). Therefore, it is critical that they implement needed changes to improve fuel-efficiency goals without disrupting the core business. This same sentiment was expressed in other interviews as well, "We had to implement change without impacting savings or service" (Interview FE07, FE08, September 3, 2015). While implementing fuel savings technology and initiatives was crucial to their continued success, it never became the overriding mission. Safety of operations and on-time delivery could not be comprised. Fuel-savings goals were always viewed as a value-added proposition.

2. Initiating Change without Disruption: First Steps

One of the first steps FedEx managers took was to show the possibility of change without disrupting existing operations by using a same, but different approach. For

example, when implementing electronic maps in earlier years, there was pushback from drivers who were used to paper maps. FedEx was able to smooth the transition by showing drivers that electronic maps were essentially the same thing, but in a different format with added features. The developers intentionally retained the general representation of the paper maps. Hence, the same-but-different notion. This type of mentality was carried forward when implementing future changes. By consistently demonstrating the positive attributes of change as a demonstrable improvement, the company was able to facilitate acceptance. This notion validates the perceived usefulness element of the TAM construct discussed in the literature review section.

Timing of the change is another critical aspect of acceptance. Another important concept relayed to us was the notion of getting a quick win to demonstrate the feasibility and positive value of the change. For example, by demonstrating to their drivers that FedEx's dynamic route planning model can save both time and hassle, the couriers came to appreciate and subsequently accept new technologies (Interview FE07, August 27, 2015). Conversely, in regards to the timing of subsequent changes, in order to avoid resistance when trying to implement a follow-on change, organizations must be careful not to let the newly established change become the status quo. It's human nature for many people to get comfortable with something and then become entrenched in that mode of operation. One senior manager referred to this rate of change as the "Goldilocks method" (Interview FE07, August 27, 2015). That is, the rate of change should deliberately not be too fast or too slow, but just right (Interview FE07, August 27, 2015). Attempting to implement change too quickly often increases the likelihood of resistance and failure. Going too slowly increases the likelihood of employees becoming entrenched in a new status quo. Additionally, it is important to gain advocates on all levels within the organization who must embrace the change and help lead the way. The specific change goals must be targeted to the right audience and have a realistic scope. At FedEx, "best practices were targeted towards managers, and proper methods were targeted to couriers" (Interview FE07, August 27, 2015).

3. Prove the Value of the Change

Finally, upper management must demonstrate the difference that one person can make. This individual effort must somehow translate into the larger goal. Emphasis should be placed on the importance of one person doing one positive thing that cumulatively makes a major difference for the organization. As expressed by one interviewee, “We asked each group to identify one behavior that could save one drop of fuel” (Interview FE07-08, September 2, 2015). FedEx was careful not to tie these individual behaviors to individual monetary incentives, which can actually act as a disincentive for some employees. Since fuel costs fluctuate, the company may actually spend more on fuel in a quarter even if fuel-efficiency goals are met. Therefore, the focus was more on the amount of fuel saved (which leads to relatively lower costs than not saving fuel) and the resultant reduction in emissions. FedEx discovered that while there may be a major monetary factor or incentive tied to fuel-savings goals, tying a dollar amount directly to an individual or small group and subsequently rewarding them can actually act as a disincentive to that specific group and others who may feel alienated (Interview FE08-09-10, September 3, 2015). Also, not every employee can contribute in the same way, so it is important to not alienate some roles by minimizing their importance. It must be a team effort with the right incentives and right training.

D. RECOMMENDATIONS

Several ideas emerged throughout this case study that should help the Marines to use fuel more responsibly and achieve better fuel efficiency standards. The following section offers four recommendations that are derived from the academic literature review, data coding and analysis of interviews, and FedEx senior managers who participated in interviews. While no specific recommendation is a complete solution for the Marine Corps, applying one or all of the recommendations, in part or in total, can lead to more responsible fuel usage in the Marine Corps.

1. Vehicle Telematics Are Not a Stand-Alone Solution

Our research revealed that, in general, telematics and related fuel-saving technology is both readily available and offers measurable benefits in terms of cost-benefit analysis. While an individual technology may offer fuel-saving benefits, the greatest gain comes from a suite of technologies which are optimized across an array of variables encountered by the corporation. There is no single solution in terms of technology and no single solution that best fits all situations.

The role of users at various levels in the organization was part of the optimization formula of telematics solutions. At the most basic level—the vehicle—telematics and other innovations were engineered in without any options provided to the individual operators of when or how to use them. Opportunities for decision-making were tailored to the executive levels, with data analysis primarily being done in an aggregated form with decisions flowing downward from the executive levels. There was a sense from some managers that data points were collected merely as indicators for use at the highest levels; rather than actively looking at the data on a regular basis, it seemed that the only reason to dig down into details was if an issue was identified and being actively pursued, such as irregularities outside of normal expected operations. From this, we determined that vehicle telematics should be considered together with data analysis tools and other technologies (such as dynamic route planning tools and calculated load-out solutions) as a comprehensive technological solution that will facilitate a significant reduction in fuel usage for the organization. Furthermore, it is crucial that management utilizes the data from telematics devices in a thorough manner to look for efficiencies and to develop comprehensive solutions that consider additional factors, such as acquisition, maintenance, and training.

The implications for the Marine Corps are that private organizations like FedEx have vetted many technologies and successfully implemented them in large fleets of vehicles. Feasible technological solutions do exist; however, solutions must be implemented at the right level. The analysis of how FedEx implemented telematics and related fuel-savings technologies provides insight for how the Marines could go about

implementing similar technologies, as well as the level of managerial effort required. We believe our analysis of FedEx indicates that it is an exhaustive effort that is not undertaken lightly, however, a bit of wisdom shared by one executive stated that waiting has a cost as well.

It's nearly impossible to keep up with technological change. Not moving forward based on the anticipation of the next better opportunity can come at the cost of competitive advantage (or more responsible fuel usage for the Marines). A more favorable outcome can likely be accomplished by committing to technical solutions with two clear objectives. First, to extract what value or competitive advantage can be realized through the technical solution. Secondly, have an exit strategy to get out or upgrade. (Interview FE01, June 16, 2015)

2. Successful Fuel Savings Initiatives and Technology Implementations Will Tap into Cultural Values

Our research revealed that technological solutions can provide powerful tools to reduce fuel usage and encourage the responsible use of fuel; however, overall responsible fuel usage intended to translate into long-term savings requires tapping into the cultural values of the organization. For example, FedEx cultivated a sense of professionalism at all levels, as evidenced by one senior manager who told us that they encourage the perception that “FedEx has professional drivers and this is the way professional drivers behave” (Interview FE07-08, September 2, 2015). FedEx was subsequently able to tap into that professionalism when eliciting desired behaviors from employees. The Marine Corps can feasibly tap into the professional warrior ethos of its soldiers to elicit a similar response. This response is likely to be perpetuated by positive group dynamics when the change is perceived as a value added proposition to the existing cultural norms (objective, identity, and ethos).

Previous research indicates that Marines, as individuals, have viewed energy-efficient technologies and initiatives as being purely financially driven or even faddish (Ciarcia, 2013). Therefore, it is important to align technology implementation goals and initiatives with the ethos, identity, and objective of the Marines as something that facilitates the primary mission. In fact, based on our research at FedEx, new technologies

and initiatives must not replace the primary mission, fundamentally alter it, or even distract from it. Rather, the value added proposition of the changes must be realized. If new fuel-saving technologies and initiatives truly enhance the expeditionary effectiveness of the Marine Corps, then the implementation of new technology and change management must be verifiably aligned with the primary mission and must be successfully communicated in order for it to be understood by all Marines. Our case study of FedEx revealed how FedEx was able to tap into its employees' sense of professionalism and strict adherence to mission accomplishment, effectively bringing about the desired changes in fuel savings. This facilitated changes in both technological and procedural initiatives.

Data gathered in the interview process indicated the need to relate to individuals on an emotional level to connect with organizational values. One senior manager told us, "Emotion works because people want to be identified by groups—being part of the crowd. This is what we do here and if you want to be part of who we are, you need to do this" (Interview FE08, September 3, 2015). This quote and similar sentiments voiced during interviews aligned with conclusions expressed by Trist (1981) referencing the socio-technical aspects of innovation:

Change of this type, which involves the discontinuity of a paradigm shift, is an emotional as well as an intellectual experience for those undergoing it. Prolonged opportunities need to be given for "working through" the difficulties and issues that arise at so many levels—conscious and unconscious. (Trist, 1981, p. 47)

These concepts have the potential to help the Marine Corps incorporate responsible energy use into the Marine Corps ethos as part of who they are and what they do. Similar to the aforementioned professional FedEx drivers' mantra, the Marines could operate from the perspective that Marines use fuel responsibly because it saves lives, increases operational reach, and reduces convoys. In other words, it is the right thing to do, so Marines do it. Interview participants acknowledged that cultural change at FedEx took enduring effort to see it through.

Culture change requires tenacity, grit, and vision to stay on track. Need a number of people to drive it. [Change] goes slowly so [you] need a lot of

persistence to achieve it. Some is intentional and some is not. You need to be smart about the intentional changes you are looking for. (Interview FE08-09-10, September 3, 2015)

3. Leadership Must Embrace Fuel-Savings Initiatives

Upper and middle management must genuinely buy into the need for change and value the goals of fuel savings in order to foster the belief in that change to those who work for them. Simply put, a good idea does not perpetuate itself. This was evident with FedEx's Fuel Sense, which they characterized as "an enterprise-wide, purpose-driven initiative" (Interview FE09, September 3, 2015) of enduring value that was also tailored to the individual. Furthermore, it was not a small effort or just another initiative, but a permanent change in culture at FedEx. Mitch Jackson, vice president of environmental affairs and sustainability, echoed leadership's role in making a difference during a keynote speech on energy initiatives: "Leadership is necessary on sustainability issues relevant to the organization and to society. We have to be leading in areas that are relevant and germane to what we do each day because if we don't, who will?" (Tennessee Energy Education Initiative, 2013). Therefore, leaders must embrace and promote a cultural change at all levels from a broad and narrow perspective.

Linked to the role of leadership is how messages are conveyed within an organization. More specifically, we feel that an aspect of the training practices used by FedEx could be adapted and applied to the Marine Corps. One interviewee pointed out how FedEx made a clear distinction in the intended audiences in their approach to training: "We have training programs. There are two of them. One is called 'practices,' which is targeted towards the managers. Then the other piece is 'methods,' [which] is targeted towards couriers" (Interview FE07-08, September 2, 2015). The point was that the message needed to be both specific and relevant to the audience even though the larger topic was generally about the same thing. The training strategy targeted to managers was how "they are going to coach their folks and they are going to hold them accountable to doing that" (Interview FE07-08, September 2, 2015). The same interviewee related how the strategy translates to holding people accountable for better results in both groups.

4. Size and Pace of Change(S) Must Be Just Right

It is critical that changes are implemented on a small enough level that an individual can effect change, but have a broad enough impact when all work together to have a noticeable effect. Find something that everyone cares about or can contribute to in order to avoid the perception that the approach is something for someone else to be doing or to be concerned with. Specifically, those individuals who do not recognize how it relates to them may think, “It’s not my problem.” FedEx broke this barrier with their theme of “one”:

Everybody can contribute. We have heard frustration from the front line, feeling like they couldn’t have an impact. So what we asked them to do was just save one drop of fuel. So our mantra is “one person, one action, one drop.” That’s the reason why we are sticking with this theme, this theme of one, because everybody is just one. (Interview FE07-08, September 2, 2015)

Directly related to the theme of one was the range of control at the individual level: “If you set metrics/measures/requirements that the person does *not* have control of, you will get frustration instead of results, and they lose focus” (Interview FE07-08, September 2, 2015).

Some of FedEx’s successes with increasing acceptability of new technology and behavior changes were predicated on the idea that change had to be done at the right pace, and the change had to be an acceptable amount. Recalling from our analysis the concept of the Goldilocks principle and the “same, but different” approach, understanding the rate and size of change is not something to disregard as trivial. As described by one manager, “The basis of change management is quick wins to show change is working” (Interview FE07-08, September 2, 2015). One quick win should be built on another so long as the rate of change is not so fast as to be overly unsettling or overwhelming. If change is approached too slowly, what was a step in the right direction can become the new status quo. This could lead to having to overcome the new status quo (again) before implementing the next change. Proponents of change should seek out the optimum pace of change that allows the changes to work, or to accomplish the immediate initiative, while avoiding the tendency to become the new norm. The correct pace of

change should be determined by managers who have considered, among other things, the aforementioned findings and recommendations. Our analysis of FedEx revealed that user acceptability and behaviors are greatly influenced by the size and speed of change.

Our research with FedEx also indicated that if the organization can influence small behavioral changes that are perceived as positive, beliefs will actually form around those behaviors and become self-reinforcing. It is worthwhile for Marine leadership to consider how to institute relatively small and acceptable changes in employee behavior. Individual and organizational belief systems can evolve from management-inspired behavior changes. At the forefront of an initiative, organizations may intuitively attempt to influence major behavioral changes or even the belief structure of their employees in order to induce desired changes in behavior. The lessons learned from this case study indicate that is not necessarily the best approach. Instead, employees can be convinced of their own free will to adopt the behaviors that support the desired values that originally precipitated the need for the change. The relative power of the notion that belief follows behavior has its limits. Still, the changes seen at FedEx are a powerful example that belief can be formed or molded around a behavior associated with fuel savings. A similar argument can be applied to the Marine Corps.

E. CONCLUSION

This section detailed three findings and four recommendations. Each finding and recommendation entails a technological and social dimension to responsible fuel use. In the case of FedEx, fuel efficiency is good for business and for the greater good, but to do something about it takes a cultural push within the organization. Like the lesson in technology acceptance, those individuals leading the charge with great ideas must craft their messages in ways that convey true value in the desired changes while appealing to the social dimension.

VI. CONCLUSION

This case study looked at a single corporate entity that utilizes fleets of vehicles as a core element in accomplishing its mission. The investigation provided insights into how FedEx has cultivated fuel efficiency by engaging both people and resources to support the effort. The full range of perspectives attained was constrained by the objectives of the case study and the scope of participation by interviewees. Revelations that surfaced exposed flaws in the starting assumptions, which led to limits that must be recognized and potential for future research. The culmination of analysis and findings presented four general takeaways that can be applied in other organizational arenas.

A. WHAT FEDEX DID TO SAVE FUEL

FedEx, an enduring leader in the shipping industry, has promoted fuel efficiency through deliberate actions within the company and a calculated investment in new technologies that support its enduring mission. FedEx leveraged its own corporate culture to reinforce initiatives and foster continuing efforts to change. The momentum of introducing new technologies was initiated in a way that avoided radical disruptions to the current norms. The pace of technology introduction included calculated steps to avoid stagnation at intermediate points in order to purposely avoid the creation of a new status quo before the end state was achieved. The corporation introduced changes while making a conscious effort to remain focused on its mission. FedEx has been mindful to not let the transformation initiatives become the company's mission. The courier's job, and FedEx's mission, is to deliver the packages on time; saving fuel is not the mission, but delivering packages in a way that conserves fuel enhances mission effectiveness in the long term. Technologies that promote fuel conservation are progressing every day, but the benefits can only be realized if technology is being used. Waiting to capitalize on the next opportunity is the same as doing nothing. FedEx followed a strategy of thoroughly analyzing options and anticipating new alternatives, while taking action in incremental strides towards improved processes and better technology. The company was prudent to

recognize that desired goals were not going to be reached with a single breakthrough, but rather through a persistent pursuit of objectives.

B. LIMITATIONS AND BOUNDARIES

The principle limitation of this case study was the focus on a single organization. There is a significant leap to state that what worked for a single corporation will be the example for all to emulate. FedEx was selected as a significant leader in its industry with a worldwide fleet that is dependent on fuel to accomplish its objective. A comparative entity would be United Parcel Service (UPS), which fills the same purpose and function for the novice consumer. A key aspect to internal operations is the social climate of FedEx. A significant difference internal to FedEx's counterpart, UPS, is the presence of a unionized workforce. This single characteristic likely has considerable effect on the introduction of technology and change into company operations.

A second limitation encountered in the study of FedEx was obtaining a full cross-sectional representation of personnel. The goal at the onset of the project was to interview drivers, supervisors, managers, and executives to get perspectives from several vantage points. Gaining access to some perspectives proved to be challenging; in general, the interviews came primarily from manager and executive positions, with driver and operator perspectives subject to the interpretation that was shared during interviews.

The original assumptions at the beginning of the case study were quickly challenged once the interview process started. The original premise of the case study was to find out if personnel are using prescribed technology at various levels to support fuel efficiency. During the literature review, many of the theories pertaining to the use and acceptance of technology come from the perspective of individual users. The analysis emphasized corporate culture over individual behaviors within the organization. Applying the logic of technology acceptance theories to corporate entities stretches beyond the intentions of the models and tends to challenge the application of the framework from its original design.

C. FUTURE RESEARCH

Future research may find significance in comparison studies with like organizations. The inclusion of United Parcel Service (UPS) and the United States Post Office (USPS) may offer distinctly different insights into the use or implementation of fuel-saving opportunities. The similarities between these entities are the delivery of material to addresses utilizing a fleet of various vehicles. The underlying differences in corporate identity and variation in company characteristics may reveal unanticipated contrasts in how initiatives are best cultivated within each entity.

The introduction of a comparison organization with a more varied mission may yield more universal insights. The parcel delivery function experiences variation in demand with daily uncertainty; however, there is a window, however small, that allows for forecasting and proactive planning based on actual daily demand. The requirement of a specified package delivery is a known obligation prior to the driver's physical handling of the package, even if it is only known less than a day before it needs to be delivered. Conversely, a business model that revolves around being ready for the unknown and needing to operate at its best when it is being the most reactionary, such as law enforcement applications, may offer insights under less controllable conditions. The demands placed on an individual vehicle and driver may change drastically with little or no advance notification. For example, rationing just enough fuel for an uneventful night of slow patrols and parking to monitor traffic in a police cruiser would seem foolish if an event at the tail end of the shift triggers a high speed chase for the cruiser that is low on fuel.

While the assumptions at the origin of this case study were reformed over the course of the project, in hindsight the clarification provides a distinction between individual technology users and organizational-level use of new technologies. Future applications of technology acceptance and technology adoption models that deliberately compare individual consumers and organizational-level consumers may provide true validation of such theories to group entities.

D. FINAL TAKEAWAYS

This study examined the various factors that facilitate or hinder fuel-saving initiatives and technology. Our case study of FedEx focused on its fleet of ground vehicles and the company's major change management initiative in its aircraft fleet. This research may offer the Marine Corps a better understanding of how to implement fuel savings technologies, as well as how to implement necessary cultural changes related to fuel savings.

APPENDIX

Table 6. Coding Scheme Applied to Participant Interview Responses.

ROOT CODE CATEGORY	CODE SUB- CATEGORY	APPLIED CODES	CODE DESCRIPTION
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Behaviors

Driving behaviors

Unnecessary idling	Idling when it is not necessary for mission accomplishment
Speeding	Going over company/state speed limits
Harsh driving	Hard driving such as fast acceleration, hard braking
Inattention	Operating a vehicle and not attending to the activity
Inefficient running	Operating a vehicle when not fully loaded

Routing behaviors

Route planning	Defining and selecting vehicle paths
Scheduling	Planning vehicle and personnel schedules
Dispatching	Assigning vehicles and personnel

Vehicle maintenance

Maintaining vehicles	Upkeep of vehicles
Repairing vehicles	Fixing or replacing faulty parts

Vehicle design

Vehicle modifications	Changes to vehicles that impact fuel use
Vehicle features	Vehicle attributes resulting in reduced fuel use

Implementation

Product Selection

Vendor support	Customer service, training, etc.
Vendor experience	Expertise, ability, competency
Features	Specific functional offerings

Implementation Process

Time	How the process evolves over time
Integration	How the system combines and interacts with other systems
Roles	Who is responsible for the process
Communication	How information is shared within the organizations

Data Flow

Environmental sensors	What tools are used to collect data
Fuel gauges	Fuel measuring instruments
Behavior sensors	Tools to monitor human behavior
Vehicle monitors	Tools used to evaluate the condition of the vehicle
Data networks	Tools used to transfer information
Integrated sensors	Combinations of tools
Feedback	Mechanisms for communicating fuel usage

Data measurements

Data relevance	What is the data about?
Data consistency	Is the data treated the same?
Data accuracy	Is the data accurate and reliable?

	Data scope	How much is looked at?
Adoption	Data Analysis	
	Data normalized	Manipulating data to account for statistical accuracy
	Data intervals	Selection of data that accounts for seasonal, operational, and usage variations
	Data partitioning	How data is grouped and distributed
	Feedback	Mechanisms for communicating fuel usage
	Attitudes	
	Cognitive	What people think about the technology
	Affective	What people feel about the technology
	Ease of Use	
	Cognitive load	Mental effort required to plan, learn, understand, react to, do, or remember something
	Attention	Ability to notice, see, or be aware of something
	User control	Ability to customize or adapt the technology
	Error control	Minimizing mistakes, wrong choices
	Physical access	Match with human capability
	Usefulness	
	Operational value	Model element for efficiency and effectiveness of the organization
	Operational awareness	Insights into overall business operations
	Routing effectiveness	How the fleet is managed—routes, dispatching, traffic
	Maintenance improvements	Related to the electrical and mechanical condition of the vehicles

Vehicle time utilization	Time that the vehicle is actively working
Financial value	Model element for the material benefits or monetary rewards
Insurance costs	Factors impacting insurance rates and costs
Personnel costs	Costs of managing personnel
Equipment costs	Costs for tools, hardware, software
Fuel costs	Gas costs
Lifecycle costs	Costs over the lifetime of use
Ideological value	Model element related to ethical values—political, cultural, moral beliefs
Safety and health concern	Physical, psychological health
Environmental concerns	Concern for the planet, nature, resources
Strategic value	Model element related to goals, plans, and outcomes
Decision-making support	Information and processes feeding business decisions
Mission support	Organizational goals and targets
Workforce management	Scheduling, educating, managing employees
Social Value	Model element related to interpersonal needs, relationships and interactions
Community	Connection with others
Job satisfaction	Happiness with work environment, tasks, organization
Growth and education	Formal and informal training or learning

LIST OF REFERENCES

A. SOURCES

- Alotaibi, S. J., & Wald, M. (2013). Acceptance theories and models for studying the integrating physical and virtual identity access management systems. *International Journal for e-Learning Security*, 3(1/2), 226–235.
- Amos, J. F. (2012). *2012 report to the House Armed Services Committee on the posture of the United States Marine Corps*. Washington, DC: U.S. Marine Corps. Retrieved from http://armedservices.house.gov/index.cfm/files/serve?File_id=9f8809bc-9232-423f-a469-916fa778971b
- Ciarcia, J. (2013). *Key drivers of Marines' willingness to adopt energy-efficient technologies* (Master's thesis). Retrieved from <https://calhoun.nps.edu/handle/10945/38903>
- Davis, F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation, Massachusetts Institute of Technology). Retrieved from <http://dspace.mit.edu/handle/1721.1/15192>
- Dillon A., & Morris, M. (1996). User acceptance of information technology: Theories and models. *Annual Review of Information Science and Technology*, 31, 3–32.
- Emery, F. E. (1967). The next thirty years: Concepts, methods and anticipations. *Human Relations*, 20, 199–237.
- FedEx Corporation. (2000). *FedEx Corporation 2000 annual report*. Memphis, TN: Author. Retrieved from http://s1.q4cdn.com/714383399/files/doc_financials/annual/2000annualreport.pdf
- FedEx Corporation. (2008a). *FedEx Corporation 2008 annual report*. Memphis, TN: Author. Retrieved from http://www.fedex.com/us/investorrelations/financialinfo/2008annualreport/fedex_annual08.pdf
- FedEx Corporation. (2008b). *FedEx Corporation 2008 global citizenship report: Executive summary*. Memphis, TN: Author. Retrieved from http://images.fedex.com/downloads/shared/about/GCR_2008_Executive_Summary_EN.pdf

- FedEx Corporation. (2014a). *FedEx Corporation 2014 annual report*. Memphis, TN: Author. Retrieved from http://annualreport.van.fedex.com/2014/docs/FedEx_2014_Annual_Report.pdf
- FedEx Corporation. (2014b). *FedEx Corporation 2014 global citizenship report: Moving possibilities*. Memphis, TN: Author. Retrieved from http://csr.fedex.com/wp-content/uploads/2015/03/fedex_fullreport.pdf
- FedEx Corporation. (2014c). *FedEx Corporation brochure: What does FedEx deliver?* [Brochure]. Memphis, TN: Author. Retrieved from http://about.van.fedex.com/wp-content/uploads/2015/01/Corporate-Brochure_Feb2014.pdf
- FedEx Corporation. (2015). Time flies: The FedEx timeline. Retrieved from <http://about.van.fedex.com/our-story/history-timeline/timeline/>
- FedEx Newsroom. (2003). FedEx Express introduces hybrid electric truck. Retrieved from <http://about.van.fedex.com/newsroom/united-states-english/fedex-express-introduces-hybrid-electric-truck/>
- Fishbein, M. & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.
- Jaques, E. (1956). *Measurement of responsibility: A study of work, payment, and individual capacity*. New York, NY: Dryden.
- Kollmus, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. doi:10.1080/13504620220145401
- Marine Corps Expeditionary Energy Office (E²O). (2011). *United States Marine Corps expeditionary energy strategy and implementation plan*. Washington, DC: U.S. Marine Corps. Retrieved from <http://www.hqmc.marines.mil/Portals/160/Docs/USMC%20Expeditionary%20Energy%20Strategy%20%20Implementation%20Planning%20Guidance.pdf>
- Martinez, M. (2005, June 24). Stocks dive as FedEx cites costly fuel for poor earnings. *Seattle Times*. Retrieved from <http://www.seattletimes.com/business/stocks-dive-as-fedex-cites-costly-fuel-for-poor-earnings/>
- Mason, R., McKenney J., Carlson, W., & Copeland, D. (1997). Absolutely, positively operations research: The Federal Express story. *Interfaces*, 27(2), 17–36. Retrieved from <http://www.jstor.org/stable/25062228>
- Mathieson , K. (1991). Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research*, 2(3), pp. 173–191. doi: 10.1287/isre.2.3.173

- Nardon, L., & Aten, K. (2012). Valuing virtual worlds: The role of categorization in technology assessment. *Journal of the Association for Information Systems*, 13(Special issue), 772–796. Retrieved from http://calhoun.nps.edu/bitstream/handle/10945/44272/Aten_Valuing_Virtual_Worlds.pdf?sequence=4&isAllowed=y
- Ozer, G., & Yilmaz, E. (2010). Comparison of the theory of reasoned action and the theory of planned behavior: An application on accountants' information technology usage. *African Journal of Business Management*, 5(1), 50–58. Retrieved from http://academicjournals.org/article/article1380527980_Ozer%20and%20Yilmaz.pdf
- Salem, A., & Gallenson, A. (2014). *A study of human behavior and operational energy: Analysis and recommendations for the Marine Corps to increase its operational reach*. Monterey, CA: Naval Postgraduate School.
- Schwartz, M., Blakeley, K., & Rourke, R. (2012). Department of Defense energy initiatives: Background and issues for Congress (CRS Report R42558). Washington, DC: Congressional Research Service. Retrieved from <http://www.fas.org/sgp/crs/natsec/R42558.pdf>
- Securing America's Future Energy. (2013, December 3). A conversation with Jeff Immelt and Fred Smith [Video file]. Retrieved from https://www.youtube.com/watch?v=ZHh9J39V9_k
- Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, 15(3), 325–343. doi:10.1086/209170
- Tennessee Energy Education Initiative (2013, July 27). Sustainability at FedEx: Keynote by Mitch Jackson [Video file]. Retrieved from <https://www.youtube.com/watch?v=9tBSs2afC-c>
- Trist, E. (1981). The evolution of socio-technical systems: A conceptual framework and an action research program (Occasional Paper No. 2). In A. Van de Ven & W. Joyce (Ed.) *Perspectives on Organizational Design and Behavior* (pp. 19-75). New York: Wiley.
- Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273–312.
- Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science* 46(2), 186–204. doi:10.1287/mnsc.46.2.186.11926

B. INTERVIEWS AND VIDEOS

Interviews conducted and videos reviewed for this research are compiled with descriptive source information in Table 4.

Table 7. Interviews and Video Sources

Source	Description	Quantity/Unit	
Interviews			
FE01, June 16, 2015	Managing Director Executive	26	pages
		69:39	min/sec
FE02, July 2, 2015	Senior Manager *Interview not recorded, typed notes only	14	pages
FE03, July 6, 2015	Senior Manager	24	pages
		57:16	min/sec
FE04, July 23, 2015	Senior Manager	26	pages
		54:21	min/sec
FE05, August 13, 2015	Former Fellowship Participant	25	pages
		63:53	min/sec
FE07 PT2, August 20, 2015	Managing Directors	46	pages
		94:11	min/sec
FE07 PT3, August 27, 2015	Managing Director	35	pages
		72:52	min/sec
FE07-08, September 2, 2015	Managing Director and Senior Manager	23	pages
		59:20	min/sec
FE08-09-10, September 3, 2015	Senior Manager, Managing Director, and Communications Specialist	21	pages
		57:46	min/sec
FE07 & 11, October 16, 2015	Senior Manager, Managing Director	30	pages
		80:25	min/sec
Videos			
https://www.youtube.com/watch?v=9tBSs2afC-c	Sustainability at FedEx: Keynote by Mitch Jackson, 27 July 2013	36:40	min/sec
https://www.youtube.com/watch?v=ZHh9J39V9_k	A conversation with Jeff Immelt and Fred Smith, 3 Dec 2013	58:02	min/sec

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