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Salem, Anita; Gallenson, Ann; Aten, Kathryn

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Industry practices in metering and monitoring

Anita Salem
Ann Gallenson
Kathryn Aten



Industry Practices in Metering and Monitoring

The objective of this study was to provide information and understanding to assist the Marine Corps in implementing metering and information systems to support effective use of vehicle fuel. A research project, including the study described here, and also a thesis and MBA project (see Henton & Noack, 2015; Robinson, 2015) examined how industry organizations implemented vehicle telematics systems, with a particular focus on how the organizations aligned fuel usage metrics to business goals and mission. The study described here, draws on a model developed through previous work in support of the Expeditionary Energy Office of the Marine Corps, which highlighted the importance of policy, procedure, technology, education and culture to effective fuel use.¹



This study employed an embedded case design, examining two organizations: FedEx, a global logistics company, operating more than 49,000 motorized vehicles, 652 aircraft, and located in over 220 countries and territories; and Granite Construction, a national construction company that uses Caterpillar heavy equipment and Ford commercial trucks. Detailed descriptions of each case are included in the thesis and MBA project.



This study developed 1) a conceptual model based on information gathered during a literature review and case studies of recommended practices in implementing telematics systems 2) a discussion of key findings of the case analyses and 3) a checklist of implementation considerations.

Conceptual Model for Vehicle Telematics

Monitoring for energy efficiency increases business effectiveness

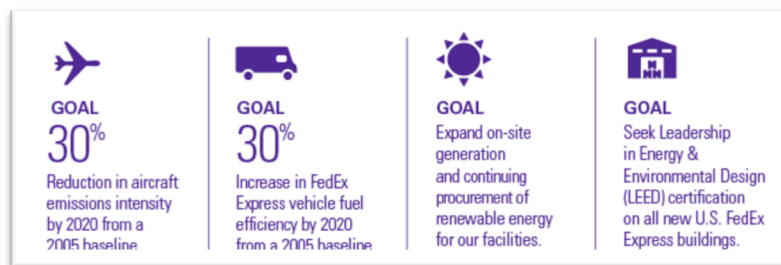
Our analysis showed that fuel efficiency was just one of the many benefits of monitoring vehicle fuel usage. Telematics systems are becoming a key component in many organizations' strategic and operational planning activities. In the two companies studied, the use of telematics began as a way to reduce fuel costs and monitor vehicle health, but quickly grew into a more comprehensive tool for understanding and supporting effective business processes. In both companies—FedEx and Granite Construction—leaders reported benefits accruing when the organization attended to a broad range of individual and organizational behaviors related to efficient and effective fuel use.

¹ Salem, Anita.; Gallenson, Ann. "A Study of Human Behavior & Operational Energy in the USMC." (2014). <http://calhoun.nps.edu/handle/10945/44732>

Fuel metering was in fact a significant factor in reducing the use of fuel—resulting in a reported 10-40% reduction. However, additional uses of telematics further supported efficient fuel use and effective business practices. For example, telematics were used to enhance route design. Better routes allow vehicles to travel fewer miles or on less abusive roads to accomplish business objectives. Telematics systems were used to monitor vehicle usage patterns, such as hard driving and required maintenance, increasing the efficiency and effectiveness of vehicle fleets by increasing vehicle longevity, improving reliability, and minimizing the time vehicles were off-road. This improved overall efficiency and also increased mission effectiveness and safety. Finally, telematics systems were used to enhance workforce management – for instance by integrating scheduling, adding in order management, and including the monitoring of human performance. Systematic and holistic workforce management indirectly improved fuel efficiency by increasing the effectiveness of workers.

All solutions are local

FedEx and Granite Construction took a systems approach to save energy across their organizations. For instance, FedEx sought to save energy in aircraft, vehicles, renewables, and



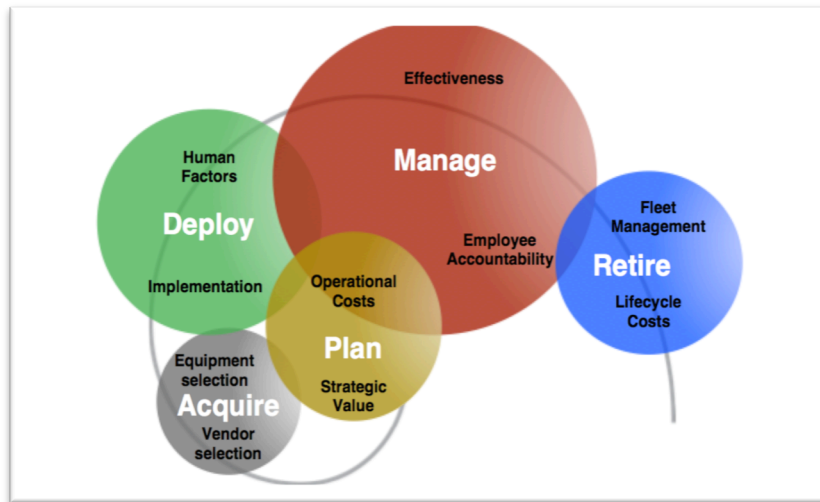
facilities. Their air fleet, which constitutes a large part of their fuel and maintenance expense, is phasing out old, inefficient airplanes as quickly as possible. Their vehicle fleet is using advanced Telematics to increase fuel efficiency and reduce maintenance costs. Where possible, FedEx hubs and facilities are LEED certified. Finally, FedEx has been experimenting with energy saving initiatives including solar panels, multiple biofuel alternatives, and alternative vehicles since the 1990's. These energy decisions are based on local conditions, taking into account whether the infrastructure requirements for these options are available and cost effective, and whether local communities view such changes positively.

Because of their early efforts in energy efficiency and their desire to earn respect and good will in the communities they serve, FedEx is seen as an energy advocate. FedEx reports on their energy activities in an annual Global Citizenship Report (GCR). Even though FedEx's services are more expensive than many of their competitors, energy stewardship is a key element in their business strategy. FedEx leaders explained that it important that FedEx be seen as an integral and responsible part of the communities they serve. Local actions create a global brand and influence customers' perceptions, resulting in an increased willingness to pay higher fees for perceived greater value. Leaders thus saw energy efficiency as providing significant tangible and intangible benefits over the costs incurred.

Fuel usage is part of a process

The companies we studied viewed energy and operational efficiency as integrated, system processes spanning diverse organizational processes. The conceptual model of these processes, developed through this study is shown in Figure 1. The telematics-organization lifecycle processes include: planning, acquiring, deploying, managing and retiring. The lifecycle begins with a focused plan that should account for operational and strategic value. The acquisition process should align vendors and equipment with the plan. Deployment processes should focus on human and technology system integration and implementation. During active management of the Telematics system, the data should measure effectiveness and ensure accountability. Finally, as vehicles are retired, decisions should be based on expected lifecycle costs and fleet management requirements.

Figure 1: Telematics-Organization Lifecycle



Key findings related to these phases are summarized subsequently and a detailed checklist is included in an appendix at the end of this report.

Planning

Both the literature review and case studies highlighted the need for clearly identifying the strategic value of a telematics system. Strategic value is generated within the organizational system and accrues from a focus on supporting operational decision-making. For Granite Construction, the ability to see if they were on target with goals for effectiveness was an important value that emerged from the telematics system:



"The site person is looking at the overall site and how is that progressing against the plan. Have I moved enough dirt, filled enough locations, dug enough this week— Am I on target?"

For FedEx Express, value emerged from the focus on reducing operational costs and increasing the return on investment:

“Everything that we deploy has to have a good return on investment. In other countries, we’re trying to stay with what works in that country. In Japan, we’re successful with electric and hybrid vehicles. We now have them in France, Germany and the U.K. The infrastructure has to be in place first.”

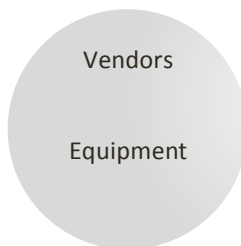
FedEx’s global reach allowed them to test experimental vehicles and energy solutions in regions that had the infrastructure and public support for the technologies. New technologies were tested and perfected in regions that were receptive to them. Customers in these regions were open and supportive of changes and patient with adjustments to service. When additional communities developed the required infrastructure, learning from previous implementations facilitated the adoption and change in new communities.

As detailed in the checklist in Appendix A, key issues to be considered during the planning phase include:

- Understanding the strategic value and outlining operational benefits
- Measuring operational benefits throughout the lifecycle of your fleet
- Exploring the benefits of telematics across all operations
- Utilizing telematics to improve your situational awareness
- Positively impacting safety, and reducing compliance violations
- Anticipating emerging opportunities as they arise

Acquire

In the acquisition phase, it is important to pay attention to equipment and vendor selection—particularly if these systems are not integrated. For Granite construction, this meant selecting known vendors:



“Frequently, you know, there are startups with a lower price, but you use IBM or Caterpillar for a reason. And, we’re going to have several of these—there is not one (system) to do it all.”

Our case analysis suggests that in the acquisition phase, leaders should look across their fleets for technologies that can improve the existing vehicles as well as introduce new vehicles and technologies. For FedEx, selecting systems that embedded the efficiencies into the vehicles allowed the operators and the mechanics to focus on the mission and their customers:

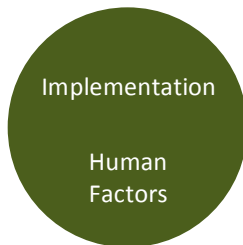
“There’s a lot of technology out there that will help improve the performance of existing fossil fuel based vehicles. Plus as vehicles become more advanced, the fuel efficiency technologies are being included as safety features. The technology is very reliable and we can now achieve significant results.”

Both telematics equipment and the vendors should be considered during the acquisition phase. As detailed in the appended checklist, key issues to be considered include:

- Assessing the accuracy of sensors and ensuring that data is relevant and timely
- Designing displays that are appropriate for the business strategy
- Making sure the right people see the information in a way that is easy to use.
- Ensuring vendors are convenient and offer needed features, customer support, and experience
- Customizing reports for the particular organization and aligning to the organization's strategic plan

Deploy

During the deployment phase it is important to attend to the unfolding implementation process and to the integration of organizational, human and technology factors influencing usage. For FedEx, the key implementation factors include making adjustments based on results not schedules and selecting the right projects.



When FedEx implemented new technologies or practices managers were key to the successful deployment. Local managers had to understand the benefits and details of the technology and fully adopt the rollout plan. An early, and less successful rollout program for algorithmic routing was schedule rather than results driven. Adjustments to the technology and practices caused delays in subsequent steps and created a false sense of completion.

Subsequent phases, though refined, were met with resistance and skepticism from the line workers (drivers in this case.) These sites became resistant to further implementation. New sites were identified for a full rollout and the initial sites, had to be gradually coaxed into subsequent changes. FedEx adopted a revised rollout strategy for the new sites that highlighted system benefits:

"I rolled out a beta testing station for routing with the most disgruntled drivers first. I knew the advantages it was going to bring to that group. They didn't want it and they were vocal. Through positive reinforcement and showing them how much better they were doing, they actually adopted it and were surprised at the benefits from it. They started singing its praises, which influenced others."

FedEx's second strategy was to make changes where they believed success was assured. Two of FedEx's Sustainability Impact Teams are examples² (Figure 2).

² FedEx blog post, 2015 - posting<http://about.van.fedex.com/blog/license-to-optimize/>, accessed 11/19/2015.

Figure 2: Sustainability Impact Team Objectives and Savings

Objective (2005 baseline)	FedEx Program	FY14 Savings
Reduce aircraft emission intensity 30% by 2020	Aircraft Fleet modernization	\$30.7M
	Fuel Sense Aircraft Operation Efficiency	
Increase vehicle fuel efficiency 30% by 2020	Fuel-Efficient Driving	\$62 M
	Vehicle Technology Improvements	
	Alternative Fuel Vehicles	

The initial objective of the Aircraft Sustainability Team was to reduce aircraft emissions intensity 20% from 2005 levels by 2020. By 2013, the objective was exceeded (22.3% reduction) and the objective was raised to 30% by the same 2020 deadline. FedEx accomplished the revised objectives by focusing on both assets and operations. Aircraft were replaced with more fuel-efficient, longer-range, and larger payload models. FedEx optimized key aircraft related operations through their “Fuel Sense” initiative. The Fuel Sense initiative was an internal, strategic communication campaign highlighting big gains from small changes made by individuals across the organization. The rally was “Fuel Sense only works when we work together.” Translating the savings of small changes helped convey the significance of small, often individual actions. For example, “Simply keeping APU (auxiliary power unit on the aircraft) usage down by 60 seconds across all flights adds up to saving 230,000 gallons. The emissions avoided here is equivalent to taking 470 cars off the road for a whole year.”

The initial objective of the Vehicle Efficiency Initiative was to improve fuel efficiency of the vehicle fleet by 20% from 2005 levels by 2020. In 2015 that objective was exceeded (27%) and the objective was raised to 30% by the same 2020 deadline. FedEx is on track to exceed this objective before the deadline as well. The achievement has been accomplished by implementing a “Reduce, Replace, and Revolutionize” strategy. The strategy employed routing efficiencies to reduce the number of vehicles needed, downsizing vehicles that travel more miles to maximize fuel economy, and trading old technology for fuel-efficient and environmentally beneficial vehicles. Improvements included more efficient engines, the use of alternative fuels, and new vehicles (hybrids and all-electric where the infrastructure supports them). Reduce, Replace and Revolutionize is part of FedEx’s broader strategy, which includes routing, using alternative vehicles where the infrastructure will support it, and life-ending older technology (vehicles) to make way for the new.

The final factor in deploying a Telematics system is paying attention to how the system supports human interaction. For Granite Construction it was important to avoid overloading users with information. The focus was on accomplishing the mission with the least amount of disruption:

“So we’ve been trying to really be careful about overloading these guys. The superintendents spend way too much time in front of computers. Their value is really looking at the assets, talking to the people that are working on them, and just being visible. So we’re trying also to figure out just how much is enough, right?”

As summarized in the appended checklist, key issues to be considered during deployment include:

- Piloting the system in small chunks
- Measuring your effects and making adjustments
- Integrating with your existing systems
- Actively managing the expectations of your workforce
- Considering the human factors
- Providing tools and software that are easy to use, reduce driver distractions, and minimize cognitive loads

Manage

Total lifecycle management requires monitoring and adjusting the telematics-



organizational system to maximize efficiency and effectiveness. Matching the right truck to the right route, optimizing the duty cycles of the vehicles, matching the load requirements per routing area per day, and monitoring the vehicle health and driver behavior were all important factors at FedEx:

“When you talk about telematics, it is a broad brush used for a number of different things. We have a scenario where you have dashboards and scorecards. A dashboard, which is the information specific at a macro level, and then you have the ability to look at specific scorecards for the management team.”

Due to FedEx’s expanse of vehicles, the data from vehicles are collected and aggregated by a data management vendor who filters the data to FedEx’s specifications and sends it to FedEx’s internal data centers. FedEx’s data centers create individual (vehicle or personnel) score cards and data dashboards that management uses in decision-making.

For Granite Construction, it was also important during the management phase to communicate the value of the system to the workforce:

“We know where we’re not spending money on filters and oil too soon or we’re not putting the machine’s health in jeopardy...we get more for our money with a warranty and the machines last longer, less breakdowns, utilization goes up, morale’s up. You know, the guys are running a nice machine.”

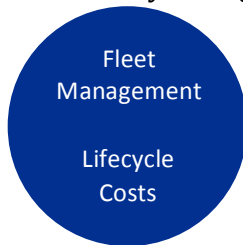
Knowing the status of the vehicles improved performance and reliability. Employees appreciated the increased safety and were proud of their vehicles.

As listed in the appended checklist, important considerations during this phase include:

- Ensuring that data is sound, and that you're actually increasing vehicle utilization, reducing costs, reducing risks, and improving decision-making and reliability
- Revisiting strategic plans or implementation processes and making adjustments
- Actively involving employees by utilizing training and communication to increase employee accountability
- Providing rewards and social incentives

Retire

Our analysis suggested that there is a relationship between monitoring and vehicle performance and life. Ongoing monitoring extended vehicle life and allowed the assignment of vehicles to routes appropriate for their age. At Granite Construction, it was clear that idling not only wasted fuel, it reduced the reliability of the vehicles:



“So for me, fuel consumption is very important. It’s over 20% of my overall fixed cost for this location, so idle time is extremely important to me because idle time is a waste of cash and it wears out the tractor significantly.”

At FedEx, aging trucks were assigned to routes that maximized their utility and delayed retirement. For instance, older trucks were transferred to urban areas where they could be parked while the driver made multiple deliveries to business and high-rise housing units. Thus, FedEx maximized the asset’s utility throughout its life cycle and selected a retirement moment that optimized the return on investment without incurring large maintenance and destruction costs. FedEx sought for vehicle removal and destruction to be quick and incur minimal costs:

“What we need to do is slow the lifecycle of a vehicle down by changing it’s yearly utilization. So we manage the utilization to offset the cost of capital improvement of the vehicle. ... We get it into that sweet retirement spot at a specific point in time tied to our capital cash flow allocation.”

Fuel use was related to routing decisions, maintenance practices, driving practices, and the selection of new technologies, which influence the life of a fleet. Taking into account the full lifecycle costs of their vehicle fleets assisted the companies we studied in their decisions to acquire, extend the useful life of, and retire their vehicles. Vehicle telematics were also used as a tool for building an ethos of responsible fuel use.

As shown in the checklist, important considerations in the Retirement phase include:

- Matching the vehicle to the job
- Selecting appropriate technologies for each situation
- Extending the useful life of vehicles
- Building an ethos of responsible fuel use

Key Findings

Our analysis highlighted six key insights related to both the inherent value that telematics systems provide managers and corporate leaders, and the methods used to manage the systems.

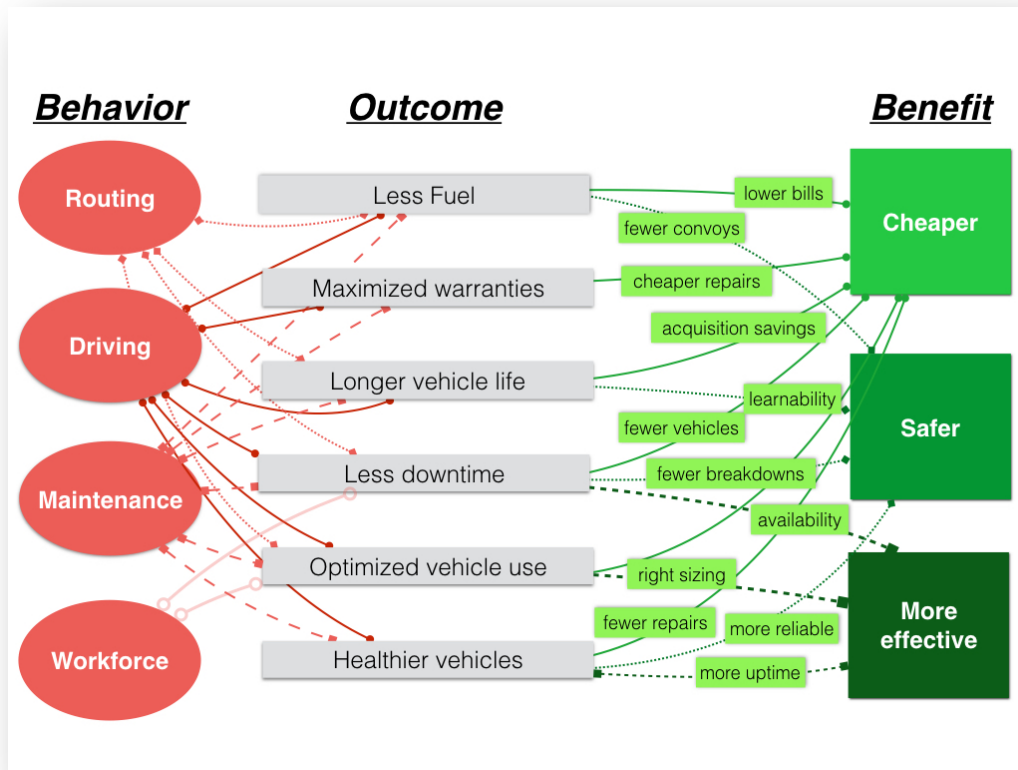
1. Fuel performance is tied to fleet management
2. Telematics are a service enabler
3. Telematics provide situational awareness
4. The value of telematics systems is emergent
5. Data must always be interpreted
6. Change doesn't (and shouldn't) just happen

1. Fuel performance is tied to fleet management

As shown in Figure 3, energy behaviors can combine to deliver desired outcomes. These outcomes include less fuel used, maximized warranties, longer vehicle life, less downtime, optimized vehicle use, and healthier vehicles. For example, if one wants to use less fuel, that can be accomplished not only by changing driving behaviors such as idling and speeding, but also by better maintaining vehicles. Factors such as combustion, tire inflation, and transmission tuning have significant influence on a vehicles' overall miles per gallon.

The routing of vehicles can also have significant impact on outcomes. More efficient routes mean less miles traveled and fewer miles result in less fuel used and longer vehicle life. Likewise, an efficient workforce reduces downtime and optimizes vehicle availability.

Figure 3: Organizational and Individual Behavior, Outcome and Benefits



Telematics systems can increase the situational awareness of operations resulting in interrelated benefits including: reduced business costs, a safer environment, enhanced effectiveness and the accomplishment of business objectives.

Not surprisingly, telematics systems can help; reduce fuel costs by reducing fuel use, lower maintenance costs by maximizing warranties and lowering repair costs, and reduce acquisition costs by extending vehicle life and optimizing vehicle use. For industry, telematics systems can provide a clear return on investment. A heightened awareness of a vehicle fleet enhances safety by reducing the number of convoys, decreasing the need to learn about new vehicles, and reducing the number of breakdowns. Finally, our study indicated that organizations become more effective when they have increased situational awareness that comes from a telematics system. Reducing downtime results in more available vehicles for the mission. Optimizing how vehicles are used allows for rightsizing vehicle fleets and healthier vehicles results in more uptime.

2. Telematics are a service enabler

The implementation of telematics should be positioned to demonstrate support for operations:

- Couriers (Operations) serve the customer
- Maintenance serves Operations
- Routing serves Operations, Maintenance, and Management

Leaders emphasized that maintenance and fuel are support functions. When efficiency metrics that resulted from telematics were tied to operational and strategic goals, the organization was able to build buy-in and engage the workforce.

Granite Construction highlighted several ways they engaged their employees during implementation. The leaders noted it's important to:

- Make a strong connection between data insights from telematics and the smooth running of operations
- Communicate how safety and reliability are increased when a vehicles' health is monitored and drivers are discouraged from hard-driving
- Demonstrate a concern for people and equipment to support employee morale.

1. Vehicle data should be used to provide better "service" to operations
2. Maintenance (fuel efficiency) as a "service" increases morale and builds buy-in
3. Financial accountability of the units leads to acceptance and shared goals for efficiency

"When we started this two years ago, it was really for these guys. You know, it was about maintenance people caring for the fleet."

At Granite, the efficiencies gained through the use of telematics had a direct impact on employees—employees understood the connection between operating efficiency and job security. This suggests that ensuring that key stakeholders understand the relationship between their individual goals and efficiency goals is important.

FedEx's company ethos focused on the company's triple bottom line of people-service-profits. This ethos included cultivating a sense of community. Beginning in 2008, FedEx added a GCR as part of its annual informational package provided 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, tangible 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 argues that it plays an important role in how the world is connected:

"FedEx is committed to operating and innovating in new ways that can help our business as well as our industry."

3. Telematics provide situational awareness

Ultimately, vehicle telematics are a tool for situational awareness. For industry, business analytics are an integral part of the organizational function, allowing organizations to assess their business processes and minimize the risk to vehicles and personnel. An up-to-date awareness of how people and fleet are operating, allows leaders to make the effective choices about resource allocation, maintenance, and operational possibilities:

“An aha moment...knowing we can actually go this far (or do this maintenance) because we know what this thing is going to do in this environment.”

1. Usage data allows for better resource allocation
2. A reactive approach to maintenance and fuel uses more resources and costs the company more.
3. Being aware of fuel and maintenance improves mission effectiveness

Knowing where vehicles are, what condition they are in, and what can be expected from equipment allows for better decision-making. Monitoring fuel efficiency and usage patterns facilitates effective decisions about where and when vehicles operate. Being able to be proactive regarding maintenance makes resources utilization more effective and allows preventive

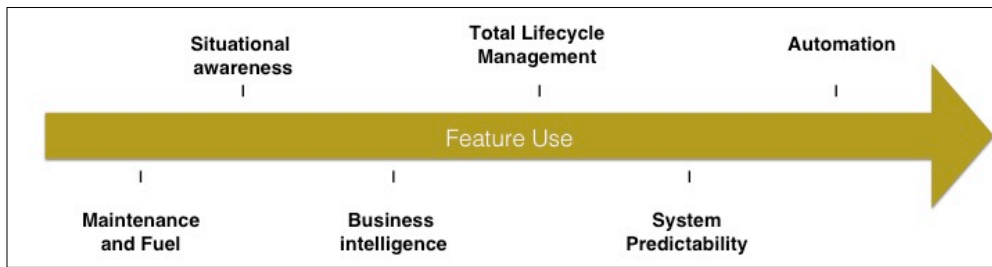
maintenance and repairs to be done when needed, not on a schedule based on averages. And, finally, knowledge of fuel-use patterns and vehicle reliability improves mission effectiveness by allowing the organization to extend its reach and plan operations based on historical data.

Telematics reports contain aggregated, compiled, and filtered data that create critical information about the health of the system. FedEx uses scorecards to show whether they have the right vehicle on the right route and to indicate if it is well maintained, loaded, and driven. Managers have views (dashboards) into the information streams based on their functional areas, region, and role. Data is used to manage the flow of the daily business, to align packages with vehicles, vehicles with routes, and facilities and vehicles with the workforce. Data is used to monitor and manage all systems. FedEx uses external vendors to collect and aggregate the data. It is sent to FedEx's data centers where it is analyzed and uploaded to dashboards, routes and scorecards. Granite Construction uses both external reports from Caterpillar and their own reports tied in to their internal business analytics.

4. Value is emergent

Another important lesson is that the value and opportunities that telematics systems provide are not always immediately evident. It is important to have clear business reasons for implementing a system, however once the system is implemented elements interact in unique ways for each organization (Figure 4).

Figure 4: Feature Use and Potential Outcomes



In the Granite Construction case, the initial trigger for the telematics system was a need to reduce fuel costs. Utilizing built-in vehicle systems, Granite began monitoring core vehicle functions such as fuel use and maintenance cycles. As they have become more comfortable with the data and the technology, they are discovering how the telematics systems allows deeper insight into their overall operations:

“I am actually extremely happy with what I have....and it’s something that gets better and even more useful as time goes on.”

This situational awareness allowed the organization to manage fuel use more efficiently, conduct routine maintenance, and observe the movements of their vehicles. Then, the organization was able to expand the kinds of data that they use to include other business intelligence – are their employees where they’re supposed to be? Are warranties being maximized? Are routes optimized?

As they began using these additional features, the use of telematics expanded to include managing the total lifecycle of the fleets. Telematics are used to optimize preventive maintenance, reassign vehicles to more appropriate environments, and adjust fueling procedures. As the companies became more consistent in their use of telematics they were able to more accurately predict the future – useful lifetimes of vehicles, asset placement, training requirements, fuel requirements. Finally, the companies are moving to more fully automated fleets that integrate telematics into work processes. Vehicle meters and monitors allow unmanned operation with much more efficient use of men and materials. Caterpillar for instance, is using fully automated excavation and loading equipment in some of their mining operations – the backhoe automatically shovels earth into a loader, a sensor knows when the loader is almost full, and the system then moves a second loader into place.

1. Grow your program from core goals
2. Manage throughout the total lifecycle
3. Focus on situational awareness and business predictability

For FedEx, constraints offered opportunities. Variations in laws across state and provincial lines (exhaust limits, idling, safety, and the environment) provided practice guidelines, specialized vendors, and opportunities that created competitive advantages. For example, idling restrictions and emission limits on commercial

fleets in some regions drove vehicle manufacturers to provide automatic shut-down systems and cleaner engines. FedEx only has to specify the idle time they need and it is set by the manufacturing factory. Likewise, Granite Construction was driven to telematics by local and state emission and mileage requirements.

Safety regulations also triggered the implementation of telematics. Safety regulations called for vehicle manufacturers to provide onboard computers and sensors in their new models and prohibited drivers from being distracted with visual displays, phones, and other cognitive distractors while in transit.

5. Data must be interpreted

The ideal of a fully automated, self-regulating system, however, is still in the future for complex and changing environments. Our analysis indicates that systems in such environments currently require close human oversight. As one participant said “you've got to have a little bit of reality.”

Reality begins with making sure that you know what you want to measure and why you want to measure it. Repeatedly our participants stressed the importance of being clear (and limited) in their original selection of what they wanted to monitor. Metrics must be tied to clear business outcomes. Additionally, participants noted that data systems can make errors:

1. Select what you want to measure—and why
2. Data systems err—look for patterns across time
3. Usage patterns can be subtle—coordinate with operations

“Well, you’ve got to remember, this is data. You’ve got to have a little bit of reality to go with it...the motor graders we know, they’re running. They’re not just idling. They’re doing something.”

One needs to look at usage patterns over time and within context to ensure that the information is accurate. This requires human oversight by someone who has a clear understanding of operations. Usage patterns of vehicles can have subtle, acceptable variations that only a human overseer can interpret and act upon.

6. Change doesn't (and shouldn't) just happen

Finally, it's important to remember that building buy-in and being adaptable are important. Building buy-in speeds up the process of change, reduces work-arounds, and makes the change sustainable. To build buy-in, the companies we studied focused on equipment that was “good enough” rather than putting off implementation until the “perfect” technology came along. Leaders noted that technology has a short shelf life, and suggested selecting a system that makes the most sense, now. For FedEx, telematics work in some instances and are less important in others. Not all vehicles

1. Don't let better get in the way of good—find the sweet spot
2. Make changes based on results not schedules
3. Add value to existing practices

support the telematics system, and not all need to. Finding the “sweet-spot” for the right technologies took some trial and error. For example, algorithmic routing worked in suburbs but not as well in urban areas or rural areas. FedEx does not expect to get away from petroleum products for a long time, but the company plans to work to make incremental changes that serve their stakeholders and demonstrate good citizenship in the communities they serve.

Second, meeting objectives is more important than meeting the schedule. Implementing changes where they result in high returns, rather than across the environment, is essential to success. Lastly, leaders noted that if one wants to see telematics adopted, it is important to align the efficiency efforts with existing practices. For example, if an organization has a strong safety ethos, show how reducing fuel use enhances safety. If an organization has established modes of communication, use them to communicate. If an organization values reliability, connect the dots between fuel efficiency, reliability, and mission.

Recommendations and Conclusion

The objective of this study was to provide deeper understanding of the use and value of fuel-related metering and monitoring of vehicles. Three key takeaways are: use Telematics for deep situational awareness, make targeted changes and adapt as necessary, communicate widely.

First, vehicle telematics combined with process and mission data can support situational awareness and diagnosis of barriers to effectiveness and efficiencies in organizational systems and strategies. Targeted reports, available through dashboards, can provide managers and senior leadership with the timely information to make and monitor critical business decisions. Dashboards can provide operations management timely access to critical systems and higher leaders the ability to look across the organization and drill down to the individual level when needed.

Next, make incremental changes and adapt. Reduce fuel use where benefit is the greatest, not unilaterally. Make changes that create substantial savings for the entire organization by targeting innovation to the locations or processes it is best suited for, for instance, retiring old equipment in remote areas and using new technologies when they are suited to the load and work required. Further, our analysis suggests the importance of stocking appropriately—maintain a minimum surplus fuel level for the task. Fuel conservation and innovation are also directly related to span of control; where you have the most control (e.g. facilities), use innovative fuels and technologies. These savings can then transfer to situations where you have less control. Leaders in both companies stressed the importance of the mission and keeping those closest to the actual work focused on the mission and critical tasks.

Finally, implement the changes that make the most impact first and communicate to the full organization and to the affected communities. Changing aircraft and vehicles

for those that are engineered for fuel conservation and the work tasks can create significant savings. Letting people know about these incremental successes sets a standard within the organization and sends a message of global responsibility. Fuel and conservation goals need to be reachable, hailed as successes, and scaled up over time. Reducing fuel use takes time, system-wide strategies, and organizational processes to support them.

Telematics Checklist

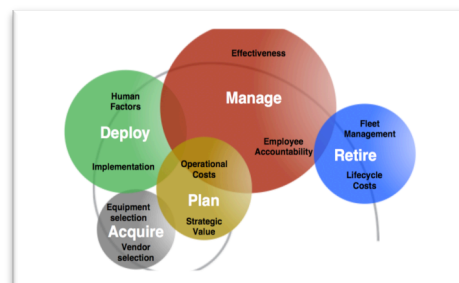
Plan

Strategic Value

- Mission support**
Are you measuring things critical to the mission and its effects? Do you have a way to incorporate opportunities that emerge as you use the system?
- Situational Awareness**
Are you aware of how people and vehicles are deployed? Are vehicles and people matched to optimize effectiveness?
- Safety**
How is the workforce kept healthy, safe, and pain free? How can logistical improvements—routing, supply, and maintenance—impact safety?
- Compliance**
How can telematics help you meet state, federal, foreign regulations?

Operational Costs

- Fuel use**
How can reduced fuel use transfer to other mission objectives—budget reallocation, timeliness of mission, extended reach?
- Vehicle routing**
How can you get the right vehicle in place at the right time?
- Workforce Management**
Is personnel efficiency or accountability important?
- Asset management**
Will improved routing, better vehicle allocation, and proactive maintenance improve mission effectiveness?



Acquire

Equipment Selection

- Accurate Sensors**
Are your instruments accurate and do they reduce error?
- Appropriate Sensors**
Is the targeted data relevant, timely, and easily integrated?
- Useful Displays**
Can you view and create reports, and needed trends? Are your displays targeted to the right change agents?
- Usable Displays**
Is data readable, easily accessed, interpreted, and reported?

Vendor Selection

- Features**
Do feature sets align with strategy and Human Factors?
- Support**
Is there good customer service—availability, reputation...?
- Experience**
Is there a solid history of product lines, installation, and maintenance?
- Customizable**
Can displays and reports be retrofitted, reported by line of business, business unit, manager, vehicle, etc.?

Deploy

Implement

- Time**
Are your pilot programs balancing proof of concept with demonstrable results?
- Training**
Is training appropriate and memorable? Do users have the required skills?
- Integration**
Do your systems talk to each other? Is there manual “copy and paste”
- Metrics**
Do the metrics cascade from your goals and mission? Are the metrics realistic?
- Roles**
Who sees what? Do decision makers see the right data? Should it be voluntary or automatic?
- Communication**
Do communication modes align with existing networks? Does data reflect the mission and goals? Can exceptions and alerts be easily communicated?
- Change management**
Are you setting workforce expectations? How can you leverage pride and competition? How can you minimize privacy fears?

Human Factors

- Attention**
Are “road distractions” minimized? How can mission risks be reduced?
- Cognitive Load**
Do the data visualizations require a lot of “think time”? Is the data readable?
- User Control**
Is there human oversight on interpreting metrics? Do users feel that they are losing too much control? Can users drill down in the data?
- Error prevention**
Are errors or wrong choices minimized? Are good behaviors instilled?
- Access**
Is it easy to get to the information? Is information readily available using existing tools?

Manage

Effectiveness

- Sound Data**
Is the data partitioned by mission area, statistically analyzed, and integrated?
- Utilization**
Are you maximizing reach—downtime, resources, supply, distance travelled?
- Fuel costs**
Can you transfer savings to more training time, equipment and resources?
- Operational costs**
How does fuel interact with refueling, maintenance, personnel, and logistics?
- Risk**
How does reduced fuel translate to risks versus mission—what are the tradeoffs?
- Decision-making**
How does the data help you manage assets, personnel, tactics?
- Reliability**
How can telematics support proactive maintenance that reduces down time, increases safety, and extend the life of the vehicle?

Employee Accountability

- Rewards**
Do you use financial, social, task, and personal rewards?
- Communication**
How do you make personnel aware and answerable for driving behaviors?
- Training**
How do you educate in efficient, safe, and non-aggressive driving?
- Cohesiveness**
How do you use data to motivate personnel, build an ethos, and make fuel savings a game?

Retire

Fleet Management

- Vehicle Routing**
Is vehicle life extended through route changes and relocation?
- Maintenance**
Is vehicle maintenance reducing fuel and extending the life of the vehicle?
- Driving practices**
Do driving practices lead to fuel efficiency and extend the life of the vehicle?
- New technologies**
What are the risks and benefits of selecting new over proven telematics?
- Right vehicles**
Are vehicles matched to location for optimum performance? Are aging vehicles more costly due to miss assignment?
- Fix or destroy**
What are the costs/benefits of keeping older vehicles?

Lifecycle Costs

- Acquisition**
Can built-in telematics systems be used? Can new systems serve multiple functions?
- Maintenance**
Are vehicles maintained beyond usefulness and cost effectiveness?
- Retirement**
Are retirement/destruction policies timely?
- Cohesiveness**
How do you use data to motivate personnel, build an ethos, and make fuel savings a game?