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Abstract

Title: Applying the latest Technology and Business methods to Improve Delivery Operations at LPGas marketers.

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Background: Between 1999 and 2002 a business analysis was conducted by The Fuel Web, Inc. (Battle Ground, Washington) to determine if a significant operational cost savings were available to LP Gas marketers by automating the management of the LP Gas deliveries with modern business tools and methods. The research involved conducting a business process analysis over a two year period in partnership with two LP Gas Marketers located in the western United States. The objective was to see where the impact of using new technologies and business processes would provide a significant improvement in operating efficiencies, improved customer service and streamlined back office processes. The results of the study concluded that a properly implemented integration of the Internet, tank monitoring, advanced forecasting, modern scheduling and routing methods as well as mobile computer systems could provide a very significant positive impact on the bottom line and a significant streamlining of overall operations. Based on this, a new business platform has been developed by the Fuel Web, Inc. and is being used successfully by many propane marketers around the country.

Objective: To provide dramatic gains in operating efficiency, competitive position and customer satisfaction by integrating modern business tools and methods into a new business platform for the LP Gas Marketer.

Modern business tools and methods developed for the LP Gas Marketer:

- Internet based business platform, requiring only a PC with a Internet connection.
- The low cost "intelligent" LP Gas tank monitor.
- Deployment system to manage installing tank monitors at all customers.
- System for monitoring and maintaining many thousands of deployed tank monitors.
- Advanced statistical modeling of customer fuel usage relative to weather and user patterns.
- Real time forecasting of future customer usage based on historical patterns, real time statistical modeling and real time weather forecast.
- Real time 90 day delivery queue that shows future product demand, delivery load, routed and mapped truck schedules.
- A mobile computer application using off the shelf handheld computers with real time synchronization of orders, completed delivery transactions, two way messaging and GPS tracking on to live mapping of delivery operations.
- Integration with the propane marketers commercial Web portal for end user access to account information, delivery schedules, order and payment processing.

Results: The Fuel Web has been awarded contracts since 2004 to supply a completely new business platform to LP Gas marketers in various geographic regions throughout North America. These projects are ongoing with tens of thousands tank monitors installed and hundreds of users.

Applying the latest technology and business methods to improve delivery operations at LP Gas marketers

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Propane Delivery Management Tank Monitors

Abstract

The LPG delivery industry business operating platform has not benefited in a significant way from the emergence of many new technology and business process methods. Our research has discovered why this is the case and the substantial opportunities available to improve business operations by adopting new business strategies and technology. Considerable opportunities exist for the companies that move forward and substantially change the way they do business to dramatically improve the way business is done, profits are made, customers are served and the future health of the industry secured.

Introduction

The initial premise for investigating how modern business process improvement might affect LPG marketers in the USA was based on meetings and conversations with the management of two mid-size LPG marketers in 1999 and 2000 with regard to the application of tank monitors to improve delivery efficiencies. After some analysis of historical operational data, more discussion and more review it was concluded that tank monitors could have a big impact on the operating efficiencies especially if deployed on as many tanks as possible. However it would require a new business platform that could take advantage of the new data, provide the tools required to realize the savings from reduced deliveries as well as manage the installation of thousands of units. As these meetings took place and as additional research was conducted this led to the decision to evaluate the extent to which LPG marketers did apply modern business methods and to what extent they could. Research revealed that LPG marketers in general do not in a significant way apply newer technologies or process methods that are readily applied in other business arenas to improve operating efficiency, customer service and strategic capabilities. In fact, from the researcher's perspective it appeared that for the size of the industry it was many years behind in its use of software and information systems compared to what was widely available at the time. Further research uncovered numerous opportunities to improve or eliminate existing processes by streamlining, automating and improving accuracy as well as adopting new capabilities to improve customer service and refine operations. This apparent slow pace in moving to more modern business platforms is made more apparent as the general state of development in software systems, communications, system integration, portable systems and sensor technologies over the last 8 to 10 years has increased at a phenomenal rate, as technology companies leverage the capabilities provided by, and demand created from, the widespread use of the Internet. The investment done by the large technology developers and consumer businesses in response to the marketing opportunity provided by the Internet has rendered many once sophisticated technologies to commodities. Powerful analytical database systems, financial grade transaction servers, unattended server-to-server communications, low cost desktop computers, low cost phone systems, software and hardware development systems, wireless systems, powerful handheld computers, GPS tracking, mapping, routing, electronics manufacturing all have been substantially reduced in cost and in many cases to a commodity status. These technologies are now making it possible to develop new business platforms and solutions for a fraction of the cost and a fraction of the time that it required only five years ago. Business tools and capabilities that were once only available to large organizations are now available to small and medium size businesses and have leveled the playing field between the large and small organization.

The remainder of this discussion highlights what we discovered during our research and subsequent product development— the reasons for, challenges to, and benefits of applying these new capabilities at the LPG marketer.

State of business operating platforms at the LPG marketer

During our research we discovered that the business platforms utilized by the LPG marketers are divided into three categories; (1) those targeted at the larger, multi-location LPG or fuel oil companies, based on proprietary or legacy software systems developed over many years, (2) more recent offerings targeted at the smaller LPG company utilizing the Microsoft Windows platform and, (3) those developed in house by the LPG company utilizing various general software development platforms. Many of these were first developed for the fuel oil marketer and then adapted to the LPG marketer. In almost all cases during our research we discovered the existing business platforms were severely limited as a foundation for easily applying new technology or integrating with third party products.

After further research it was determined that there are several key reasons for the state of business operating platforms at LPG marketers.

LPG marketers have limited support from the petroleum industry. Even though the LPG marketer is bound tightly to the multinational petrochemical industry, the petrochemical industry does not consider the LPG market large enough to provide the technology and marketing support that they provide to the gasoline, lubricant and chemical retailers and distributors. So even though these businesses are similar in character (small, regional, privately held), they benefit from the engineering and technology expertise of their supplier (petroleum company), in its effort to win retail market share. So whereas the petrochemical companies partner with many small regional business establishments to achieve their goals, LPG marketers do not participate in the same way.

LPG marketers have not had easy access to modern business tools and products. There are several reasons for this apparent paradox; a fragmented hard to reach market, some singly unique combinations of business operating requirements, limited access to resources in process engineering and information technology and cost. As a group, the LPG marketers provide a significant opportunity for any of the large mainstream product or technology companies. However, as thousands of individual small businesses owners or partners spread across the country they do not fit effectively into large vendor marketing efforts and are too costly for these companies to approach directly or tailor a marketing program specifically to address their needs. The delivered LPG business is truly unique as a business. The operating requirements are those of an industrial/commercial business requiring specialized training, certification, equipment and installations typical of an industrial plant or supplier due to the hazardous nature of the product while at the same time needing retail expertise in product marketing, customer service, sales and customer relations. This cross between industrial and retail requirements has the profound effect of having the LPG marketer fall into a hole where their requirements for infrastructure products and services cannot be met by the leading product or services vendor as these vendors typically align as either industrial or retail but not both. This in effect isolates the LPG marketer from access to the significant engineering and information technology resources these vendors can provide. This also results in the LPG marketer having three choices – build it themselves, rely on niche vendors to supply or adapt products as suitable solutions or adapt a mainstream solution. To build it themselves requires the expertise and resources that can never match the ability of a large mainstream technology vendor nor leverage the commoditization of yesterday's technology; relying on niche vendors usually ends up in a long wait as these companies are similarly resource and expertise constrained when it comes to embracing and adapting new technology and in any case cannot match the resources and expertise of the mainstream technology companies driving the development of the technologies and business methods; adapting a mainstream solution has traditionally been a difficult task but has become more and more viable as advances in business platform integration and configuration make customization products and integration of different vendors' solutions more palatable.

General limitations of existing business platforms and system vendors currently used at LPG marketers

The technology used as a back-end for many of these systems has not been upgraded to the newer standards by their developers and, as a result, the developer cannot easily take advantage of new capabilities provided by the much larger companies driving the state of the art in new business tools and methods. Adding new capabilities requires adapting the legacy system in some non-standard way, taking extra time and cost. This directly impacts the LPG marketer by limiting the ability to take advantage of improved methods and capabilities. It may also potentially cost the LPG marketer development fees to have the system vendor accommodate the new capability. Often this case also results in ineffective use of development funds by the LPG marketer because the system vendor is just responding to a development request from the customer without thinking through the long term implications and taking a comprehensive engineered approach to the problem. LPG marketers are not software or system engineers and cannot be expected to make a request that is in the best long term interest of both the LPG marketer and the system vendor. This compounds itself as it happens over and over again

to the point where the system becomes a liability to both the system vendor and the LPG marketer. If the backend system that is the foundation of the business platform is open and flexible as with modern day systems, the system vendor and LPG marketer can be confident that new capabilities can be more easily accommodated. Then, when special development is required, it will be a more effective long term use of development funds.

The data entry methods lack sufficient input validation to guarantee the consistency that is required to apply automated processing. The familiar phase 'garbage in - garbage out', becomes well understood when trying to adapt data in old systems to new systems and processes. New systems require consistent data for analysis and reliable execution of business rules. Bad data makes it impossible to apply modern day technologies to business processes. This greatly complicates the task of either integrating with a newer system or migrating the LPG marketer to a new system. This problem is compounded the longer the system is used and the data inconsistencies continue to build; the users then develop alternative methods to deal with the problems created by the inconsistencies thereby creating more non-standard inputs and use. Often when migrating to a new or different system, the data problems are so bad and the workaround routines so ingrained, the task of cleaning up the data and flushing out the associated baggage is skipped only to be recreated over time in the new system.

Existing business platforms do not expose the business rules that are used to process data and make decisions. No capabilities are provided to understand how the systems work so the LPG marketer can make an educated decision about the applicability of the business rule method and result. In addition, no capabilities are provided that enable the LPG marketer to make an informed recommendation to the system vendor about additional capabilities of business rules that it needs to address a business problem or opportunity. New business platforms expose how the system makes decisions and in some cases allow the user to modify how and when rules are applied and in what order they are executed. This capability gives the LPG marketer the system as a strategic asset to apply to new problems for strategic advantage and improved business operations instead of a black box that is misunderstood, misapplied and a generator of extra work.

System vendors do not fully educate and advise the LPG marketer on the correct way to implement their data in the system. Often in the rush to execute the contract and meet commitments the system vendor does not enforce the correct use of its system or the correct migration of data from the legacy system. Naturally the LPG marketer is inclined to maintain the familiar when moving to a new system instead of rethinking the way they do business to take maximum advantage of the capabilities of the new system. The result is a minimized realization on the investment in the new system by bringing the problems associated with the old system into the new system, continuing the execution of bad habits by system users and increasing the non-productive overhead associated with using the system. These problems compound themselves as costs increase to the point where the burden associated with applying the system to new business objectives prevents the LPG marketer from growing and puts at risk its ability to maintain its existing business levels and customer relationships.

Existing system vendors are software development companies and traditionally, as in this case, cannot provide a system that integrates software systems, hardware systems and general computing technology. As server systems get smarter and cost less, customers get more demanding and the cost of development decreases, the need for and ability to provide fully integrated hardware and software solutions becomes a reality. This provides a significant opportunity for any business shopping for a new business platform. Tightly integrated systems cost less, solve problems more completely, are easier to use and maintain and allow businesses to focus on their strengths while the system handles the routine tasks and business rule execution with minimal intervention required from the users.

The Research and Discovery Process

In April 2001 The Fuel Web, Inc. was formed as part of a joint development contract with two mid-size LPG marketers in North America. The objective of the development contract was to analyze the way LPG companies do business, particularly the retail delivery operations, apply business process improvement techniques to the analysis of existing operations and to discover ways to improve the way the businesses operate.^{1,2} Later in the development process seven additional LPG marketers joined the development effort to assist in doing a final shake out and to refine the product requirements, processes and methods.

The process improvement started with an executive team establishing a mission statement, goals, business process categories, process analysis teams, handbook guides. The team also established basic practices and procedures for team meetings, communications and overall management of the project as well as the expected long term impact of the outcome of the effort. The first year was spent flowcharting the existing processes and reviewing existing methods while focused primarily on retail delivery operations. Existing processes were documented in back office accounting, marketing, sales and wholesale operations. At that point, The Fuel Web led the suggestions for process improvement based on its knowledge of hardware systems, software systems and communications systems and began prototyping with the eventual objective of developing a delivery management platform based on the knowledge we had gained and would gain from the overall process.

The discovery process involved prototyping different functions of what has become the delivery management platform and having our development partner companies use the systems as much as possible in day to day operations to test our methods and assist in refining our recommended processes. In concert with the prototyping of the software system The Fuel Web built and deployed 2500 tank monitors it had developed to investigate the process of mass tank monitor deployment and discover what product features are most important to meet the needs of the LPG Company. 1600 of these tank monitors were deployed at 80% of the tanks serviced by one retail operating location in a effort to evaluate the full deployment strategy. 900 additional monitors were deployed at the remaining 8 partner companies to obtain hands on feedback from as many operators as possible in diverse geographic locations. This deployment was evaluated for cost and ease of installation, specific product features required to meet the needs of the LPG marketer, overall life, lifecycle maintenance cost, tank monitor cost, data requirements, technology investment payback and compatibility with future business requirements.

What turned out to be a very significant advantage of evaluating the tank monitors side by side with the business platform analysis was discovering the capabilities required by both systems to truly streamline the ability to effectively deploy, maintain and take advantage of the data from thousands of tank monitors.

The above process was conducted between April 2001 and January 2004. During this time all nine companies agreed to start a production rollout of over 50,000 tank monitors beginning summer 2004 to fully deploy the monitors on as many tanks as possible and start the migration of their existing delivery operations to the delivery management business platform. Currently approximately 30,000 tank monitors are deployed and the LPG companies are starting the shift of delivery operations systems to The Fuel Web, Inc.'s e-Fuel Delivery Management business platform. Table 1 lists the business needs discovered during this project, possible solutions and a description of the impact on the LPG marketers operations.

Table 1

This table lists the business requirements discovered, a solution and a summary of the impact on delivery operations.

Business Area	Requirement	Solution	Impact
Customer Usage	Timely data on tank fuel level	Tank Monitor	Can help eliminate run outs, maximize the size of the delivery and provide better data for forecasting usage.
	Detailed usage and local temperature data	Tank Monitor that records and communicates frequent fuel level as well as inside and outside temperature.	Statistical analysis can be many times more accurate when a high frequency of data sampling is available such as when the right tank monitor is used with the system.
		Tank monitors with alerts for unusual usage, fill, low level, equipment problems or eventually even leaks.	Allows LPG companies to proactively respond to unusual fuel usage situations before run outs occur or problems are discovered by others. Allows live tracking of fills, (are customers being loyal), and proactive management for stuck gauges.
	Accurate usage forecast. Accurate usage forecast during transition seasons.	Integration of automated weather feeds from local weather stations and forecasting agencies.	Combined with detailed usage to determine accurate relationships between professional weather forecast and user behavior. Eliminates inaccuracies when manually entering DD forecast. Provides a standard basis for responding to the affects of weather.
		Integrated statistical models created in real time.	Instead of applying a general set of usage statistics like DD, create a statistical model specifically for each tank based on detailed tank monitor usage, local temperature data and professional weather forecast
			Analyze detailed usage history to determine the best way to forecast usage. Apply the usage rate from the same period last year to forecast this year.
	Tools to realize the savings potential provided by tank monitors	Usage forecast for each tank, 90 days into the future.	Anticipate driver and bobtail requirements way in advance, smooth daily demand to minimize resource requirements, eliminate over time, have time to make decisions on how to adjust resources due to gains in efficiency
Scheduling-Routing	Minimize delivery cost, maximize customer service	A system that uses accurate 90 day+ usage forecast and 90 day+ route discovery tools to analyze and determine the best time to fill a tank. Maintain a real time order queue showing all orders for the next 90 days.	Discover the lowest cost route to drive today to minimize operating cost over the next 90 days. Develop confidence in the ability to target deliveries at fuel levels as low as 5%. The impact of improved scheduling methods double for every 10% reduction in the target fill level of the tank
	Ease of use and integration with existing systems	A platform that manages deliveries for all tanks and interfaces with your existing system.	Integrates with existing systems. Focuses on doing one thing well.
	Planning Tools	Graphs of delivery demand showing details 3-4 months into the future. Maps that show views of each day's delivery route and estimated delivery cost over the future 90 days. Ability to move scheduled deliveries between days	Anticipate unusual demand and the drivers/trucks required to service. Smooth out delivery resource requirements.

Table 1 (continued)

This table lists the business requirements discovered, a solution and a summary of the impact on delivery operations.

Business Area	Requirement	Solution	Impact
Scheduling- Routing (continued)	Centralized scheduling	All account data in one database system, tools to manage. An accounting system that allows bobtails to make deliveries for more than one retail location	Allows for better control over deliveries. Have the best people focused on the most critical task of delivery planning and optimization. Schedule and route a multi-location company all together.
Delivery	Streamlined delivery transaction posting	Handheld computer systems that transfer delivery records directly into the accounting system in real time	Eliminates errors, eliminates manual entry, and eliminates delays in generating customer invoices and processing payments.
	Driver operating efficiency	Handheld computers that record events, track location, delivery times and truck operating parameters.	Measure driver effectiveness, better manage slack time, reduce over time, improve accuracy and customer service
	Respond to changing customer requirements	Real time processing and communications of new or changed order status to drivers using wireless communications integrated with handheld computers	Respond to unexpected customer requirements efficiently. Improve customer service. Respond more quickly to competitive threats
Driver Turnover	Minimize the impact of driver and delivery personnel turnover	Centralize scheduling; use system generated routes, driving directions. and maps	Drivers become effective more quickly, need for experienced drivers less critical, impact of turnover reduced.
Growth Management	Be able to add new customers with high confidence that they will be serviced reliably.	A system that automates data entry as much as possible.	Frees up critical resources to concentrate on servicing the customer and anticipating new business requirements.
Product Planning	Tools to make smart decisions about LPG purchases and take advantage of purchasing opportunities	Rollup of individual tank forecast into overall product demand requirements over the coming 90-180 day period. Quickly see available inventory storage in your customers tanks as well as your storage and bobtails.	Better understanding of actual demand in the short term and long term: <ul style="list-style-type: none"> - Place smarter energy contracts. - Make sure bobtail storage never runs out. - Improves ability to take advantage of special deals for bulk product.
Tank Monitor Deployment	Minimize installation cost	Integrated tank monitor hardware and installation management software. Complete system developed specifically for mass deployment.	Allows LPG company to deploy monitors on tanks as fast as possible without having to enter the customer's house or business.
		Processes and procedures that support the effective use of self-installation by the end customer	Allows LPG marketer to keep the average cost of installation at < \$15.00 US.
		A tank monitor that costs around \$100 complete.	Easy to justify the capital cost required for widespread deployment.

Table 1 (continued)

This table lists the business requirements discovered, a solution and a summary of the impact on delivery operations.

Business Area	Requirement	Solution	Impact
Tank Monitor Deployment (continued)	Minimize lifecycle maintenance cost	A system that provides utility grade tank monitor network operating status, diagnostics and resolution. A tank monitor that provides 10+ years of maintenance free service, no battery replacement requirements.	Keeps ongoing maintenance cost as low as possible. Critical when deploying thousands of tank monitors.
IT resource requirements	Minimize the cost and complexity of computer systems and internal IT expertise.	Web based service solution, requiring minimal investment at the LPG marketer, no IT requirements, 24/7 availability from any place that has a computer connected to the Internet.	Online solutions delivered over the Internet minimize the investment required and provide a means for the system developer to reach a wide audience and offer a very sophisticated product at low cost.

Key areas of opportunity to improve delivery operations discovered during the R&D project.

Summary - How to improve delivery operating efficiency:

It is our conclusion that the six most important steps to improving delivery operating efficiency are:

- (1) Reduce the tank level at which deliveries are made to increase the number of gallons delivered per mile or the number of gallons delivered per hour.
- (2) Eliminate non-delivery stops.
- (3) Eliminate run-outs.
- (4) Managing delivery resources to match demand as closely as possible.
- (5) Constantly be looking to streamline using technology to reduce organizational overhead and reduce processes that are subject to error or slow to complete.
- (6) Manage your data and processes.

There are additional ways to improve efficiency at LPG company operations by automating, streamlining and re-thinking processes, but the above are the key areas of focus for The Fuel Web, Inc. because they make the most dramatic effect. Focusing on these areas will also lead to finding other places to improve efficiency using modern tools and services.

Reducing the tank level at which deliveries are made:

TFW conducted an analysis of actual historical operating data from our development partners to determine what the impact would be in making deliveries only when the tank is at the target fuel level and, as a matter of course, what the effect would be of targeting to make deliveries at lower and lower fuel levels. The analysis was done by comparing the actual number of deliveries made in 1 year to the number of deliveries that would be made if deliveries were only made when the tank is at a 30% level, a commonly used fill percent target. Additionally a comparison was made against the number of deliveries that ideally would be made at a 20% and 10% tank level. The below results are for one primarily residential retail location, (Chart 1), and do not include no fill delivery stops. Reducing the fuel level at which a delivery should be made increases the maximum delivery gallons by 20% going from 30% to 20% fill level and 40% going from 30% to 10%. The overall effect of only making deliveries when the tank is at the fill level can be as high as a 44% reduction in required deliveries per year at a 10% fill level (Chart 2). Even just making deliveries at the target fill level of 30% provides a 21% reduction in required deliveries (Chart 2). The ability to run deliveries successfully using a substantially lower target fill level requires high confidence in your forecasting and scheduling system to make sure run-outs never occur.

Chart 1

Profile of one LPG Marketer location studied, by account type

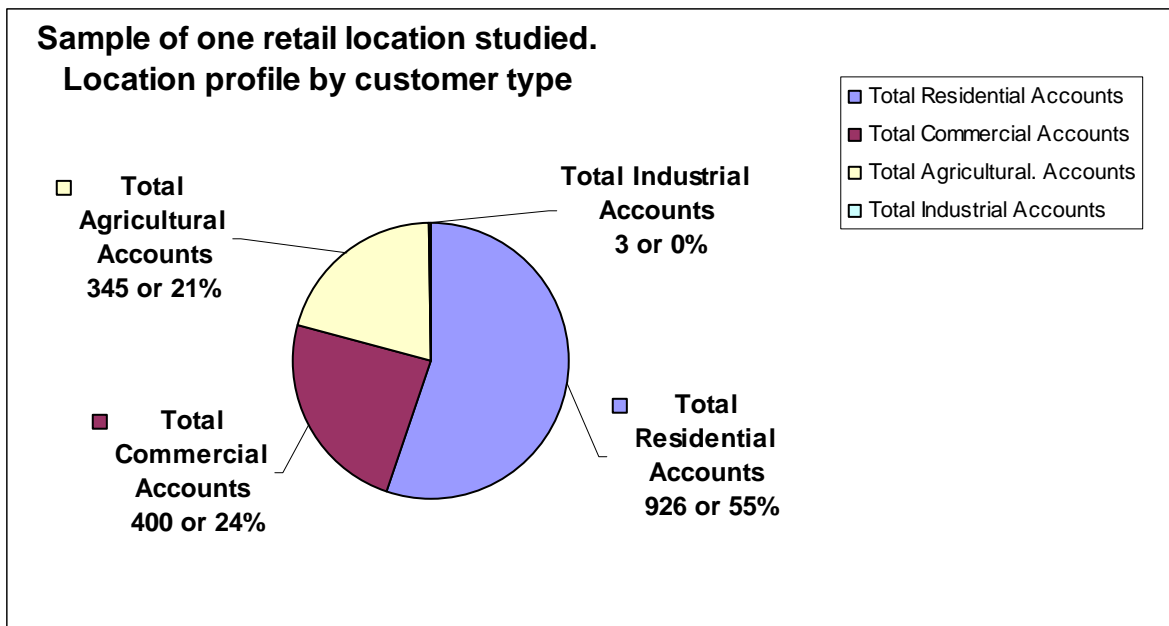
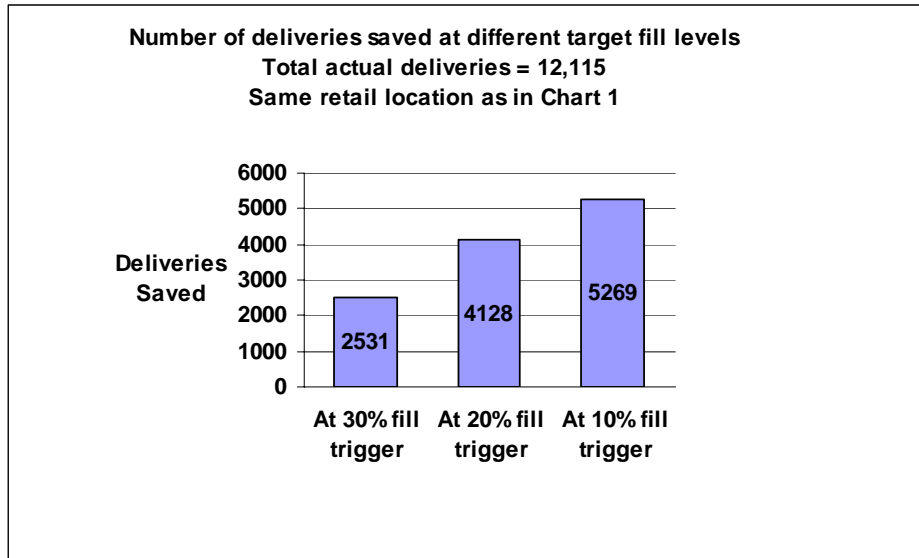


Chart 2

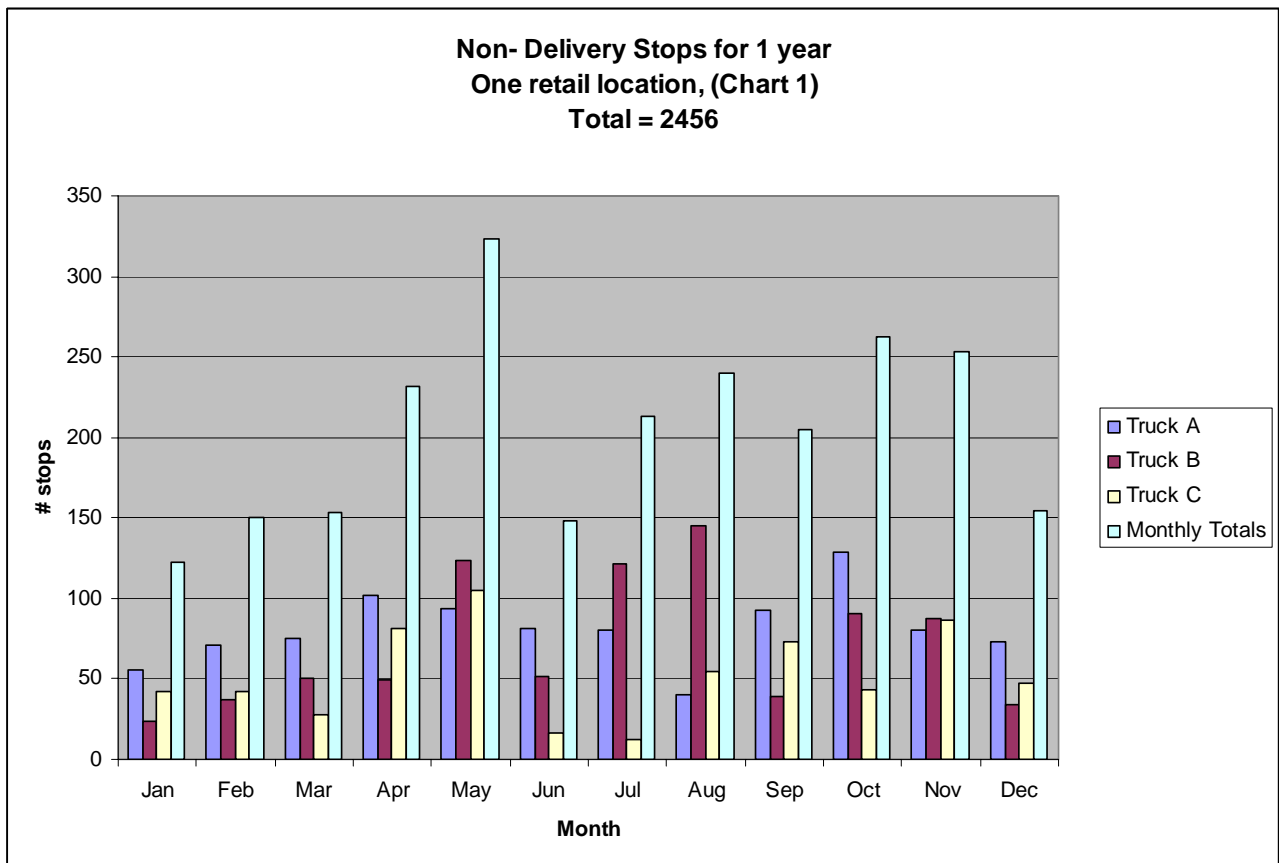
Savings potential from reducing target tank fill level at one of the LPG Marketers' locations studied.



Eliminating Non-Delivery Stops:

Additionally, the previous savings estimates do not include delivery stops where no delivery was made. In this case study, a manual count of non-delivery stops from the daily truck manifest for a single retail location (Chart 1), showed 2456 non-delivery stops for 1 year (Chart 3). A more advanced forecasting and scheduling system based on more and better data and real time updates should eliminate non-delivery stops just as it would allow reducing the target fill level.

Chart 3



Eliminating Run outs:

Our research indicates that the direct cost to make a delivery where there has been a run out is 3 to 3.5 times the cost of a normal delivery, in addition to the potential liability exposure from gas checks, frozen pipe burst, elderly exposure and at least the potential loss of the customers business. Implementing a system that integrates tank monitors and advanced forecasting-scheduling systems allows the LPG marketer to virtually eliminate run outs to customers and the associated cost and potential liability.

Managing delivery resources to match demand as closely as possible

It’s common sense, as well as true for the most part, that business operations that are running at a steady work level and at high capacity are efficient, effective and easier to manage. It makes sense – processes become routine, people are well trained, the right balance is achieved in the number of people needed, planning becomes easier, situations that used to be out of the ordinary are now routine, customers become confident about service levels and the business can reinvest in itself. Everything is easier and more efficient when operations are running smoothly.

However, the best a real business can expect is to attain a smooth operating mode most of the time or at least some of the time. The degree to which a business can achieve, sustain and repeat operating in this mode is dependent on the business’ individual dynamics, the tools they have to manage operations and the actions taken. The more complicated and dynamic the business, the more important it is to have good management planning tools and the more effort it takes to refine processes.

From our observations the LPG business is truly unique in its operating requirements, as previously outlined. The nature of the business makes it both complicated and dynamic. One of the most important, if not the most important factor driving delivery operation efficiency, is to know when the best time is to make a customer delivery. The requirement to make deliveries to meet customer fuel requirements is the essence of the business. However, determining the best time can be very difficult to do with much accuracy using current business platforms and processes. For the LPG marketer, the key factor required to manage delivery resources effectively is difficult to determine, and even when it is determined, it has low accuracy. Having more information and better tools to be able to make a high quality decision about the best time for a customer delivery could have a dramatic effect on the ability to manage resources relative to demand. Making a good decision about when to make a customer delivery starts with knowing with some confidence. How much LPG is in the tank now, how fast it will be used and how scheduling one delivery will impact all other deliveries that must be made.

Table 2

Some of the dynamics that affect knowing when is the best time to make a customer delivery. These are listed individually but typically work together to complicate the process.

Business Dynamic	Characteristics
Seasonal transitions	Heating load varies dramatically from day to day over several months due to alternating weather patterns and results in the customer’s use of their heating system in difficult to anticipate patterns. LPG companies compensate by pre-filling tanks before the weather changes.
Dramatic weather changes	Coming at anytime completely disrupting normal delivery planning. Customers where weather can affect access for delivery must be treated proactively to avoid a bad run out situation. These are usually the first customers to get a delivery when bad weather threatens an area. Delivery resources have to be managed to make sure trucks, drivers and fuel is available for these situations.
Recreational Sports	Dispenser usage can be affected by season, a short term weather change or a local event. Typically must be put on a more expensive fixed delivery schedule to avoid the risk of run-outs.
Residential Outdoor living	Pools, spas outdoor heaters create high demand that is difficult to forecast. Sudden run outs are possible. Usually put on a more expensive fixed delivery schedule.
Construction Projects	As residential or commercial expansion or upgrades create more load, it’s difficult to anticipate. Normally the LPG Marketer would find out after the fact by noticing additional usage or from a run-out or almost run-out situation. The best a LPG marketer can do is for drivers and service men to be on the lookout for changes and adjust the K factor and/or BTU

Establishing the current tank level can be done from recent delivery records or by installing tank monitors. Figuring out how fast the LPG will be used is much more difficult. Customer fuel usage rates can be very dynamic and are affected by many factors such as weather, personal habits, seasonal activities, construction-remodeling activities, business process changes, equipment operation, building efficiency, etc. Here again the right tank monitor can provide a high frequency of data sampling on tank level and local weather conditions so at least there is enough information to develop strong statistical relationships that can be used for accurate usage forecasting. As well, scheduling deliveries effectively is even more difficult. It requires at least a good estimate of current tank level, a good forecast of when the tank level will hit the fill trigger as well as the impact of driving routes for all deliveries over time. To make really smart decisions about what tanks to fill you need to know when is the next time you would need to make a delivery at each tank if one is not made now, to be able to answer the question, to drive by a tank or fill a tank that is not yet at its fill trigger level.

It is our observation that the only way to tame the most important dynamic affecting LPG delivery and be able to adjust delivery resources to match demand, is to be able to forecast 60-90 days out, have some confidence when each customer's tank will reach the fill trigger level, and then have a scheduling system that can use this information to schedule all deliveries to be made within the forecast time horizon at the lowest fuel level without risking a run-out. Ideally you would be able to review the delivery schedule and demand over a 60-90 day forecast window and make obvious adjustments. This type of system could provide tools to smooth out daily demand, minimize changes required to optimize resources relative to demand and provide enough time to make needed resource changes so the balance between the number of deliveries and the optimum required resources can be maintained.

Customer Usage Forecasting and Scheduling Deliveries

Based on results of the process analysis, with the help of a large tank monitor deployment and product testing, the following observations can be made. In general, on an annual basis, (1) LPG Marketers make about 50% of their deliveries when the tank level is not at or near the fill trigger point, (2) make an additional 25% of total deliveries at stops with no delivery, (3) have numerous run outs and are always afraid of having more and (4) must provide resource needs relative to demand much more conservatively than should be the case. Based on our research, we see that these areas provide the most significant opportunities to improve delivery efficiency. Improving all or any of these areas results in delivering more product at the same or lower cost (see chart 2), by reducing deliveries, eliminating run-outs and eliminating non-delivery stops as highlighted in Charts 2 and 3.

We discovered five basic reasons why a LPG Marketer cannot address the above areas as effectively as they might.

1. The systems usage forecast estimating when the customer's tank will hit the fill point is off by 15 to 100%, so deliveries are scheduled prematurely or too late. The forecast could be wrong for many reasons, from bad data input or missed data maintenance and updates to the inherent limitations of the degree day system.
2. Not trying to optimize delivery size, all deliveries are made on fixed schedules and routes. Probably being done because the LPG marketer has no confidence in their systems ability to accurately estimate the tank level.
3. The drivers need work so the schedule is filled with any customers at or below 50%.
4. The drivers have extra time so they are doing drive by checks at tanks they think might be low.
5. Even if the system forecasts correctly the LPG marketer has no way to guarantee they will get to the tank at the best time because their scheduling system does not manage capacity and overall demand.

We also discovered that items 2, 3 and 4 can be eliminated if there are good solutions to items 1 and 5. So the foundation for dramatic improvement in delivery operating efficiency for the LPG Marketer comes down to: (a) having confidence in knowing how much LPG is left in the tank now, (b) a good estimate of how much will be left in the future and (c) and having a scheduling system that can route and schedule deliveries using this information. Then, when deliveries are made the maximum product can be delivered at the lowest cost over time and operations have tools for optimizing future demand vs. resources.

Current usage forecasting systems limit the understanding of how customers actually use LPG, the ability to anticipate customer LPG usage and the ability to schedule effectively. Some of the limitations are:

- Bad data: examples - missing final tank level on short fills, negative gallons as a delivery, missing or incorrect tank size

- Not enough accurate data about the customer's tank level, local weather, customer heating preferences and the customer's use of non heating LPG appliances or processes. The degree day system uses industry average usage rates, 30 year regional average weather data, K factor adjustments based only on recent deliveries and seasonal usage rates based on only heating or hot water. More accurate local data makes the degree day process statistically obsolete.
- Limited set of choices for establishing how the customer's usage should be forecast.
- Historical usage patterns are not identified and applied to improve the future usage forecast for that customer.
- No way to statistically relate professional weather forecasts to the customer's usage patterns for building historical relationships to weather for use with a weather based forecasting method.

After considerable research we believe that through the application of standard technologies and process automation a dramatic improvement can be made. Major improvements would be:

1. More, and more accurate data, such as that provided by some tank monitors, would allow:
 - Establishing statistical relationships based on actual local historical data. This would make possible many more ways to classify a customer's usage, automate its determination and greatly improve accuracy.
 - Automating the management of the way each tank is forecast, its accuracy and improving the tools to review and adjust how the forecasting system is working for each tank.
 - Development of an accurate statistical relationship between the customer's local inside and outside temperature, frequent float level readings and real weather forecast.
 - o Find the statistical relationships and build an executable model using actual data from customer usage, local customer outside temp, local customer inside temp and the nearest professional weather service data.
 - o Maintain parameters for the statistical model for each tank; update the parameters and the forecast when anything affecting the forecast model changes such as new tank monitor data or a change in the local national weather forecast.
 - Development of additional forecasting methods more specific to the customer type and allowing more flexibility in assigning forecast methods, for example:
 - o Forecast the next week using the same usage profile as the same week last year. For the next 12 weeks use the same usage profile for each equivalent week from the prior year.
 - o Forecast the next week at the same average usage rate as last week. After next week forecast using the average usage rate from the prior whole year.
 - o For new customers use the same forecast profile as a customer who is similar until enough data is collected to establish an accurate forecast profile for the new customer.
 - o Use standard usage rates based on a BTU load profile or that has been manually assigned until enough real data is available to develop a good statistical relationship.
2. Continuously maintaining a 90-day current level forecast for all active tanks, including will call, monitored and not monitored. This would allow:
 - A live 90 day order schedule, with demand rolled up by truck and location for each day, week, month and quarter in the near future. Anticipate demand for product and deliveries. Manage the transition seasons more effectively. Immediately see the affect of actual delivery operations on future requirements.
 - Route and schedule customers in the 90-day forecast window to see system estimates of actual number of gallons/miles/hours to complete deliveries.
 - Smooth out capacity requirements by adjusting deliveries while reviewing estimates of the time and miles to be driven over the 90-day period. See the tradeoffs between changing capacity and adjusting daily demand. Know far enough in advance to affect personnel and equipment changes.

Conclusions

A huge opportunity exists to significantly reduce operating costs with a business platform that can reliably forecast usage, schedule and route trucks to make deliveries at the lowest possible fuel level in the tank, while minimizing the impact of nature. This will require a change in business focus and a substantial cultural change by the LPG marketer.

From this brief summary of the results of our business analysis, testing, product development and deployment up to this point, it is evident that there are many opportunities to apply new technologies and the associated improved and expanded processes and methods. As The Fuel Web, Inc. continues the development of its integrated Delivery Management System

and continues widespread mass deployment of tank monitors, we will gain a further understanding of the positive effects of the application of new technologies to the delivered fuel business and be in a position to further communicate our findings to the LPG industry.

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References

Books

1. Process Mapping – How to Reengineer Your Business Processes, V. Daniel Hunt, Wiley
2. Business Process Improvement Workbook – H.James Harrington, Erik Esseling, Harm Van Nimwegen, McGrawHill

Journals

3. LP GAS
4. Butane/Propane News

Web Sites

5. Department of Energy - <http://www.energy.gov/>
6. The Fuel Web – Joint process analysis LPG development contract