Final Report

Joint Transportation Committee of the Washington State Legislature

Report of the Expert Review Panel on Tolling

December 2009

NOTE TO READERS

This report was completed and submitted prior to Washington State DOT's November 18, 2009 directive to Customer Service Center (CSC) vendors for the tolling of SR 520 altering the terms of the original CSC Request for Proposal (RFP). As a result, the following changes to the CSC RFP are not reflected in the Expert Review Panel's analysis of the SR 520 procurement documents for the CSC:

- Elimination of the incentive to implement tolling prior to June 2011
- Establishment of March 2011 as the tolling date for all vendors
- Requirement for all vendors to eliminate all exceptions and proposed changes to WSDOT contract terms detailed in the original RFP.
- Requirement to submit a Best and Final Offer based on the above changes.

EXECUTIVE SUMMARY

The Joint Transportation Committee (JTC) of the Washington Legislature contracted with AECOM to form an expert review panel (ERP) for the purpose of reviewing costs and strategies for Electronic Toll Collection (ETC) in the state of Washington and in particular review the WSDOT plans for implementing the All-Electronic-Toll-Collection, (AETC) project for SR 520.

SR 520 is a crucial project in the transportation program for the Seattle area and is estimated to cost in excess of $4 billion. SR 520 will also establish the technical and business system direction for ETC for all projects in the State of Washington. SR 520 is the first AETC project in Washington and RFPs have been issued for the roadside Toll Collection System (TCS) and the Customer Service Center (CSC). The systems and procedures that are established for SR 520 will determine the framework for all future ETC projects.

AECOM brought together five individuals experienced and knowledgeable in the management and operation of toll facilities throughout the country. These individuals have experience in both the public and private sector and have served at the national and international level with various industry associations. The individuals conducting this review were:

- Dan Faust, AECOM project manager
- Duane Buchko, AECOM
- James J. Eden, Chief Operating Officer, North Carolina Turnpike
- Jim Crawford, Executive Director of the InterAgency Group, IAG
- Dr. Harold Worrall, President, Transportation Innovations Inc.

Resumes for these individuals are provided in Appendix A. The ERP has experience in the level of accuracy that can realistically be expected in the lane, the business aspects of ETC service delivery, toll interoperability and technical specifications. ERP members have been private contractors, integrators, consultants, toll agency Executive Directors and project managers. They are keenly aware of the effect that policies and business rules can have on the complexity of toll applications and the resultant costs that can occur.

The focus of the ERP scope was to consider the various aspects that might affect transaction processing costs, and to advise WSDOT on the two Requests for Proposals (RFPs) currently in the procurement phase for the SR 520 tolling project. Primary considerations include strategic decisions about technology, business rules and process. The manner in which these strategies are determined and communicated with customers and the contracting community can have long-term effects on ETC processing costs and the ultimate success of tolling in the State of Washington. This is especially true for the SR 520 project, where tolls are expected to generate a large share of construction funding and where cash collections are not an alternative. Specifically, the following areas of inquiry were to be undertaken by the ERP:

- transaction processing costs
- operations and customer service
- technology
- toll enforcement
- WSDOT administration and organization

- special emphasis on SR 520 cost projections

The ERP reviewed a significant amount of source data including prior studies conducted on toll operations and cost projections for WSDOT. In particular, the ERP reviewed in detail the outstanding SR 520 RFPs for the roadside TCS and CSC integration and operations/maintenance. The RFP review focused on the impact of the early deployment of tolling on the existing SR 520 facility, and the degree to which WSDOT would likely receive competitive bids for their two RFPs. Meetings were conducted with the staff of the JTC and WSDOT. Conference calls and workshops were conducted with the JTC staff and WSDOT between the on-site visits. Briefings were given to the JTC on June 18, July 7, and July 30 summarizing the findings to that point in time. Though a focus was given to the review of SR 520, the scope was clearly to consider the long-term effects on ETC processing costs including future ETC applications.

There was initially a concern amongst the ERP that the combination of existing contracts for ETC and the language contained in the RFPs for the TCS and the CSC could lead to a reduced number of bidders. The lack of detail in business rule definition, restrictive contractual requirements and the potential for risks associated with the performance of other contractors could limit the number of bidders and/or increase the bid amounts.

The ERP also noted that WSDOT's initial plans for tolling SR 520 centered on a traditional customer service center operation that emphasized the use of transponder accounts as the primary means of establishing ETC penetration. This approach was based on the business model at the Tacoma Narrows Bridge, which relies upon transponders for all prepaid ETC transactions while offering a cash collection option. The ERP commented that the reliance on transponder accounts was not suitable for an AETC environment, where no cash payment option exists. The reason for this becomes apparent when the consideration is given to the frequency of customer use and the relationship between number of transactions and number of customers.

Research at other toll agencies has indicated that even in a high commuter environment, a small percentage of customers can be expected to generate the majority of the trips/revenue. Conversely, the majority of toll facility customers are occasional and infrequent users who generate 20% of the revenue or less. This skewed relationship of trips and customers is not well understood in the industry, yet is crucial to the successful deployment of AETC systems. Agencies must recognize that a high percentage of infrequent users will not opt for a transponder, and therefore alternative pre-paid account options for these customers must be provided. Experience on AETC facilities has shown that failure to provide such alternatives results in large numbers of customers with few violations, requiring significant resources to bill and collect from these infrequent customers. Further, if alternatives to transponders are not offered, the court system becomes the ultimate post collection process, a situation which will likely overwhelm the capacity of the court and generate substantial negative public perceptions.

For this reason, the ERP emphasized the use of video technology and preregistered license plate accounts—as opposed to transponder accounts—as a means to more appropriately address infrequent users. The ERP concluded that the use of pre-paid video as a cost-effective alternative for the infrequent user not only drives overall toll transaction costs down, but significantly reduces the number of ETC transponders that WSDOT had been planning to purchase and distribute. The ERP emphasized a wide array of prepay options that should be established in an effort to avoid the costly and negative service impact of billing tolls in a postpaid environment and ultimately through the violation enforcement process and the court system. Though WSDOT had planned to use

preregistered license plate accounts from the outset, the emphasis on transponders overshadowed the significance of automatic license plate recognition (ALPR) in reaching infrequent customers.

The ERP opined that the reduced focus on transponders will provide a foundation for efficient transaction processing and a reduced dependence upon post payment methods for collecting tolls. It places the attention of the agency on business rules that serve the infrequent customer as well as the commuter. Furthermore, the use of both pre-paid transponder and video accounts correctly shifts the focus to the net revenue generated as opposed to the gross revenue minus violation losses. The shift in perspective and focus on net revenue is no small task. Typically governmental accounting measures the ability of the agency to collect all of the gross revenue with a minimum of loss. This loss or "leakage" is typically a finding in subsequent audits. A business would measure success as gross revenue minus the cost to collect or net revenue. The agency can proactively set the expectation for the measure of success as net revenue but this should be done early in the project and become a part of the communications process.

Several workshops were conducted with the JTC and WSDOT staff to discuss these fundamental considerations as they relate to the implementation on SR 520 and ETC throughout the state of Washington. The working relationship of JTC staff, WSDOT and the ERP was one of an exchange of ideas and viewpoints. The relationship was professional and respectful and created an environment for advancing the understanding of all involved. The dialogue and exchange of ideas created a deliberative process and a more refined set of recommendations than might have occurred otherwise. In addition to the issues described, the ERP provided a number of detailed recommendations and comments, which are summarized in Appendix B. These comments generally relate to the following central themes:

- more fully develop business rules to accommodate the infrequent traveler
- place a greater focus on the prepayment of tolls using license plate accounts
- consider an interim (two-phased) approach that would allow for tolling SR 520 early, while allowing sufficient time to thoroughly consider the ultimate long-term tolling solution
- remove restrictive language that might limit the number of bidders
- modify the RFPs to minimize the risk of conversion from the existing service center

In response to these comments and workshops, WSDOT issued addenda to the SR 520 RFPs that provided a change in approach and modified requirements to align with the discussions held with the ERP. The following changes made through addenda to the RFPs represent some of the more significant adjustments:

- a more fully developed set of business rules
- greater detail regarding prepayment of tolls using license plate accounts
- a relaxation of the date for collecting tolls on SR 520
- consideration for the contractor to implement tolling sooner with incentives for early completion
- removal of restrictive language that might limit the number of bidders

The ERP believes these changes will result in a more competitive bid environment, less risk to the state, a more efficient tolling system both operationally and for the customer—and ultimately a stronger, more efficient and less costly tolling program for the entire state.

TOLLING IN WA – TNB AND SR 167

The state of Washington faces the same transportation funding dilemmas as the nation. The efficient funding mechanism of gas taxes has been the primary method of funding transportation, but the funding gap for large infrastructure investments has continued to grow. A review of the 2040 plans prepared for the Seattle area recognizes this trend and plans rely heavily on tolling for revenue generation.

At present, two toll facilities are in operation, the Tacoma Narrows Bridge (TNB) and the SR 167 HOT Lane project. Electronic Toll Collection (ETC) is utilized on both facilities and the HOT Lane project is strictly ETC (no cash payment option). The customer service center for the TNB is currently used to establish accounts and process transactions on both facilities.

The replacement cost of SR 520 is currently estimated at $4.6 billion and a major portion of the funding will be provided through tolling. The early tolling of the existing 520 bridge is being undertaken to provide early finance for the construction of the pontoons that will form the foundation for the replacement structure. Because of the constricted area in which tolls can be collected on the existing SR 520, and to maintain the lowest cost possible for toll collections, all tolls will be collected electronically. This places Washington at the forefront of ETC technology. While several agencies are converting to All Electronic Toll Collection (AETC), the technology and procedures for implementing AETC are not well developed. WSDOT has issued two RFPs, a Toll Collection System (TCS) and a Customer Service Center (CSC) RFP, for the development of the toll collection system suitable for the AETC early tolling for SR 520 and for future toll facilities in the state. Since these RFPs define the requirements for electronic toll collection in Washington, the review and comment of the RFPs has been a focal point by the ERP.

TOLL OPERATIONS GOALS AND STRATEGIES

Toll operations goals should at a minimum include the following:

- provide a high level of customer service
  - provide customer account options to efficiently serve customers with varying frequency of use
  - provide efficient methods of contact for the customer
  - provide convenience for the customer to update information
- provide a high level of efficiency
- maximize the net revenue available for transportation projects

Efficient electronic toll operations use automation rather than people to establish and maintain electronic toll collection (ETC) accounts and to process electronic toll payments. Costs are significantly higher when people become directly involved in delivering a service. This strategy must be balanced with what is accepted as "good customer service". A balanced approach does not overly restrict person to person contact but attempts to do so through 3rd parties and other efficient means rather attempting to do so completely with customer service center (CSC) personnel and multiple CSC centers. To maximize efficiency in All Electronic Toll Collection (AETC) systems, the following strategies should be considered:

- provide customer contact through automated means
- process the maximum number of toll transactions without human intervention
- minimize the manual review of license plate images
- minimize the number of Motor Vehicle/DOL look-ups using matching techniques for repeat customers
- minimize the number of toll violation actions by providing multiple methods to establish accounts and grace periods for settling outstanding violations without penalties
- optimize the use of 3rd parties for customer service such as retail outlets for distributing transponders
- minimize the scale and numbers of CSC centers

Two crucial elements should be considered in setting strategies for the implementation of an AETC system**, frequency of use** and **business rule framework**. While not as crucial in a mixed toll-paying environment (cash collections and ETC), understanding frequency of use and the thorough development of business rules can spell the difference between success and failure for an AETC system like the SR 520 project.

FREQUENCY OF USE

Studies at a several toll agencies[1] reveal that the vast majority of the users of a toll facility are infrequent users, while the most frequent users constitute a very small number of customers. However, the frequent customers generate the majority of the trips and revenue. This skewed distribution of frequency and revenue generation is a critical factor to consider when deciding the

[1] "Toll Systems Study" for the New York State Thruway Authority, Vollmer and Associates, 2006 and "Toll Collection Systems Study" for the Ohio Turnpike, Vollmer Associates, 2006

best technology and business processes to apply to the collection of tolls and the types of accounts that will be most convenient for frequent and infrequent users.

The following data are the results of statistically valid surveys conducted on US toll agencies. The two primary studies represent a survey distribution of 40,000 with a return rate of over 20%. The calculated error rate was ±3%. The surveys requested information on customer's frequency of use as daily, once per week, twice per month, once per month and twice per year or less and were conducted on both urban high volume and rural low volume segments.

The results indicated that customers who used the toll roads daily generated 33% of the total trips and yet comprised only 2% of the customers. For those customers who used the toll roads once per week an additional 27% of the total trips were produced by only 9% of the customers. When combined, these two frequency categories generated 60% of the total trips but from only 11% of the customers. The table below demonstrates the skewed relationship between the number of customers and the revenue generated.

Frequency	% Customers	%Trips/Revenue
Daily	2%	33%
Once/week	9%	27%
Twice/month	14%	20%
Once/month	18%	13%
Twice/year	58%	7%

Similar data for Washington State obtained from the SR 167 HOT Lane project operations are shown below and a similar distribution is evident. The data indicate that nearly two thirds of the SR 167 HOT Lane customers use this facility less than once per month. The SR 167 project is somewhat unique, however, in that the HOT lanes are adjacent to general purpose lanes and the data are only for those that used the HOT lanes. It is not inclusive of all vehicles traveling on SR 167. Data obtained from WSDOT's telephone marketing surveys, while not conducted for this purpose, have demonstrated a similar distribution.

Frequency	% Trips	Trips/Day	Cust./Trip	Cust./Yr	% Cust.
≥4/week	24%	229	1	229	1.4%
2-3/week	18%	169	2.5	423	2.6%
once/week	11%	100	7	700	4.3%
once/2 wks	11%	105	15	1,575	9.6%
once/mo.	11%	106	30	3,180	19.4%
< once/mo.	25%	228	45	10,260	62.7%
Totals	100%	937		16,3637	100%

The data demonstrate why toll collection programs that are designed to collect all toll revenue electronically must serve both the frequent and infrequent customer base. Toll operations to date have been designed to collect tolls electronically but cash collection has been available to collect from the local occasional user and the out of town traveler. Until the concept of total electronic collections was advanced, infrequent customers could conveniently use cash to pay tolls. Unlike

TNB, the payment methods for SR 520 (where all tolls are electronically collected) must include provisions for the infrequent traveler who would otherwise pay cash.

Previously, ETC systems were designed based on using transponder technology and primarily served customers who used the toll road frequently. However, as the data indicate, this customer base represents only a very small portion of the total number of customers. The large number of customers who use toll roads must now be provided with a convenient electronic means of paying tolls in advance.

The ERP believes that the initial RFPs issued by WSDOT focused on the frequent customer and that this could have led to the need to collect from a large number of customers (infrequent customers) through post payment billing and violations processing. Toll agencies currently implementing totally electronic toll collections have experienced large post payment processing costs and resistance from the court system because of the large number of individuals involved. The ERP believes that to be successful in implementing AETC every effort must be made to provide convenient prepayment options for the infrequent customer. If convenient prepayment mechanisms are not available for the infrequent customer, they will become involved in costly and negatively perceived court proceedings. Based on this, the ERP came to the following conclusions:

- Market transponders to frequent travelers and prepaid license plate accounts to infrequent customers
- AETC requires a fully developed set of business rules, pricing policies, marketing programs and detailed procedures
- Define and track the costs of establishing accounts and maintaining accounts by method of contact and the costs to process transactions and violations

WSDOT responded as follows:

- expanded definition of non transponder accounts in the RFPs
- extended the grace period allowed to pay tolls
- inclusion of frequency of use data in RFPs
- expanded the definition of business rules and included these in addenda to the RFPs
- committed to conduct additional surveys and collect further data on frequency of use
- committed to work with the selected vendor to develop cost reports

Other recommendations were made by the ERP related to technology, organization structure, administrative considerations and specific modifications to outstanding RFPs. In the RFP addendum issued on August 28, WSDOT adopted all of these recommendations except for the following:

WSDOT has maintained its preference for the strict accounting standards contained in the original CSC RFP. These standards are above and beyond toll industry standards, and place the emphasis and responsibility for accounting oversight outside of WSDOT toll operations, and this responsibility will rest with a CPA who will report directly to WSDOT's Director of Accounting. WSDOT has maintained its preference for the broadly worded "letter of credit" requirement contained in the original CSC RFP, which in effect provides WSDOT with access to $5 million initially and reduced to $1 million upon the completion of phase 1. The specific language is: *Upon Tolling Commencement and achievement of the Acceptance Issued milestone (Phase 1 End Date), the Vendor may reduce the Irrevocable stand-by Letter of Credit amount to* ***$1 million dollars***

which shall remain in place and available to WSDOT during the initial and any subsequent terms of this Contract and for one year beyond the expiration or termination of this Contract.

ELECTRONIC PAYMENT OPTIONS FOR THE INFREQUENT CUSTOMER

In the past, the infrequent or occasional visitor used cash to pay tolls and it was quite convenient. But cash collections are very costly, and for SR 520, in a highly urbanized and congested corridor, cash collections are not feasible. Therefore infrequent customers must be served with alternative payment methods that provide the convenience of cash, but with much lower operational costs.

Post-payment process - Some toll agencies simply bill customers if they do not have an ETC transponder, and pass through the administrative costs of each transaction. If the customer doesn't pay the bill, the account is sent to the violations enforcement process. While this allows the toll operator to recover the administrative costs, it does not address the needs of infrequent customers. To the contrary, it can result in large numbers of court proceedings and poor public relations.

Prepaid or preregistered accounts - A preferred alternative that better serves the infrequent customer with lower administrative costs involves the use of prepaid or preregistered accounts, and video tolling. The toll agency obtains payment and license plate information from the customer in advance of or within a short time after using the toll road. When the customer crosses the toll facility, a camera takes a picture of their license plate, which is matched to their account. Payment information can be provided using a cell phone during travel or over the Internet before or shortly after the trip. Because the back office or administrative costs are less than the post payment process, the costs that are passed through to the customer are less.

The pre-registered account is similar to an ETC account, but without a transponder. The account can be set up as a temporary account in effect for a specific time period, or a permanent account for infrequent customers who live in the area and wish to leave the account open. Once established, tolls can be charged using Automatic License Plate Recognition (ALPR) technology (video technology).

If an infrequent customer fails to establish a prepaid ETC or ALPR account or to pay a bill sent from the agency, the customer goes into a violator status. Many in the toll industry attempt to convert these delinquent accounts into prepaid ETC or ALPR customer accounts. Beyond this point, the violator must be pursued through the court system. This process can be very costly to both the toll agency and the customer and can impact community relations.

BUSINESS RULE FRAMEWORK

As ETC has evolved from enforcement using toll gates to open road tolling with overhead gantries, business processes have evolved as well. Tolls have been collected by cash with toll gate enforcement since tolls were first collected by the Romans. Under that system the primary concern was ensuring that the collector turned over all of the proceeds from the lane. When Electronic Toll Collection began in the early 1990s, computer systems began to track cash and electronic collections. An enforcement process was developed using license plate recognition to track violations when toll gates were not in use. This process continued to slowly evolve and business procedures and processes were developed through trial and error.

With the introduction of AETC and the growing need to become interoperable beyond urban areas and regions, the definition of the business process was recognized as an important first step. Agencies began to define business elements that could affect others with whom they were interoperable and which could affect customer choices, computer systems designs and ultimately the cost to collect tolls. The development of any information system begins with an analysis of business process. Business process improvements precede the development of the automated system and prevent the computer system from defining the business process. This step can prevent the development of costly collection processes. Business process analysis has come to be known in the toll industry as business rules.

If business rules are not fully defined prior to the procurement of an integrator, they must be defined during the integration process and contractors will price the potential risk of delay caused by trying to develop a computer system at the same time that business rules are decided. Further, adherence to a fast paced development schedule can lead to a hurried business process analysis and conformance to available features in vendor software.

ETC systems are particularly susceptible to the effects of business rule definition since they affect the behavior of the individual paying the toll, the potential revenue, complexity of the system and ultimately operational costs. Toll rates that are set too high can cause diversion to competing roadways affecting congestion levels during peak hour travel on those roadways. The types of prepaid accounts offered to frequent and infrequent customers will affect the percentage of customers that will become violators. Consideration of issues such as these during the system development phase can increase ETC contractor costs and subsequent operations costs. This is particularly the case with AETC where there is no opportunity for the infrequent customer to pay the toll in cash lanes.

Business rules are also crucial in the definition of interoperability. Interoperability with existing toll facilities and future toll projects in Washington will affect design decisions on SR 520. For example, if a monthly fee on transponder account is used to encourage infrequent customers to use license plate accounts as opposed to a transponder account, customers may choose to purchase transponders from the TNB customer service center. Interoperability should also be considered for neighboring states and provinces and eventually nationally, especially for Interstate truck travel. The technology selection for SR 520 is particularly important because of the significant investment that will be made for the technology. Without interoperable equipment, it will be very difficult to negotiate policies and business rules between toll agencies and to establish uniformity between toll operations within Washington State.

A business rule framework typically involves the creation of four documents:

- operations policy document
- technical interoperability specification
- security and privacy document
- data transfer document

The operations policy document would include policy statements affecting the following:

- centralized transaction processing versus roaming agreements
- operations business philosophy
- central account management and transponder procurement

- central violations processing
- centralized database with distributed access
- allowable types of prepaid accounts
- pricing of services and toll rates
- business policies regarding the optimization of prepaid accounts
- common technology standards and specifications
- certification process to ensure minimum standards
- compliance with applicable security and privacy standards
- policies regarding accounting standards, reporting and auditing
- compliance with legal framework
- policies regarding customer service

These policies establish a framework within which the detailed procedures and business rules can be developed. Consideration of these policies becomes more difficult as the geographical boundary for ETC expands. For Washington State questions arise as to the need to be interoperable internationally and with other states, perhaps even those at considerable distance such as California. It is important that these policies are established and documented to form a foundation for the development of the ETC system.

The second document of the ETC framework is typically the Technical Interoperability Specification. This document establishes the requirements for standardization and performance of the ETC system and its components. It is not a conceptual design describing how the technical system must be designed but rather a detailed description of what the system must be capable of performing within the policies previously established. A more detailed definition of the Technical Interoperability Specification is included in appendix C.

A Security and Privacy Document is extremely important in establishing a set of expectations for the system developer and the back office operator regarding security. The Security and Privacy Document would include information on external security requirements (credit card security, etc.) as well as internal Washington State security requirements. Details regarding this document can be found in appendix D.

The final document typically found in an ETC framework is the Data Transfer Document. This document defines the flow of data and the requirements for transferring information between units within WSDOT and externally. Examples of internal data transfer include data transferred back and forth between the roadside vendor and the back office vendor and between the ETC system and the WSDOT financial system. Data is also transferred to external entities such as banks processing financial clearing, retail operations that may be distributing transponders, kiosk operators and state motor vehicle operations. Details of the type of information that is contained in the Data Transfer Document are provided in appendix E.

Development of an ETC framework requires a thorough conceptual understanding of how the ETC system is intended to operate both as a business and as a system. The more thoroughly this is done prior to system integration the less risk the integration contractor will assume and the lower the bid. Thorough documentation of the ETC framework will also serve to align the expectations of what the client expects to be delivered with that proposed by the contractor. It should result in a more specific bid and timeline.

ELECTRONIC TOLL COLLECTION COST

Electronic toll collection (ETC) costs can be categorized into two sets of costs:

- system integration
- ongoing system operations (transaction processing costs)

SYSTEM INTEGRATION COSTS

Toll systems are not classical management information systems. Because of the considerable amount of ETC equipment, cameras and sensors that are in the toll lane and because of the sensor data that must be collected and attributed to the correct vehicle, toll systems require considerable integration of hardware and software. Equipment suppliers manufacture components that have their own hardware and software characteristics and these components must be integrated into the ETC system. Companies that develop ETC systems are therefore termed system integrators and the process of developing the system has come to be known as Systems integration.

The cost of systems integration is impacted by the level of detail in the RFP and the provisions for ensuring performance. If the business process is well-defined, the RFP will likely be more specific in terms of what is required. This is especially important for AETC systems because unlike ETC systems that also collect cash, AETC systems must collect revenue electronically from all customers whether they are frequent or infrequent users of the toll road.

There are few AETC systems currently in operation in the US and fewer still that have traffic volumes in excess of 100,000 daily trips, like SR 520. As a result, the development of a state of the art AETC system for the SR 520 project presents some inherent risk because there is limited experience in designing such systems.

To minimize that risk, it is crucial that the systems integrator and the client have a common understanding of what is to be developed and how it is to be operated. The communications between the client and the vendor are predominantly in written form and real dialogue begins with the award of the contract and the preparation of the first design documents. The more clear and detailed the definition of what the client desires, the more likely the system integrator will be capable of evaluating risk and establishing an aggressive pricing strategy. Questions, which are not resolved between the integrator and the client during the procurement phase, will result in perceived risk and higher prices. Detailed business rule definitions in the RFP will provide a greater surety to the integrator that the timeline can be met.

Legacy costs are also a consideration in system integration. Legacy costs are those that result from established processes or accepted equipment standards on existing facilities. Washington State presently tolls the Tacoma Narrows Bridge and SR 167 (HOT lanes) and WSDOT has developed business rules and equipment standards for these facilities. The operation of these facilities and the equipment used will need to be adopted as the long-term direction for WSDOT on all future facilities or modifications will need to be made at those existing facilities. These decisions will need to be made within the context that SR 520 will be developed as an AETC system.

As an example, the pricing and process approach taken on TNB assumed that transponder transactions would be less expensive than cash collections. Therefore, the approach was to provide transponders to as many customers as possible and increase the percentage of revenue collected electronically. As a result of the exchange between WSDOT and the ERP and considering the cost of maintaining ETC accounts, WSDOT is undertaking a different strategy with regard to SR 520.

TRANSACTION PROCESSING COSTS

Transaction processing costs can be generally defined as those recurring activities related to the roadside and back office operations of the ETC system. The components of ETC transaction costs might be broken down as follows:

- back office
  - establishment of a new account
  - maintenance of an existing account
  - payment processing
  - collection costs
  - operations costs (management, audit, reconciliation, hardware, software, facilities, utilities, maintenance, etc)
- roadside
  - Optical Character Recognition, OCR
    - Methods used to reduce the need to manually review images
  - tuning and maintenance

The ERP researched literature in the area of transaction processing costs and found that formal research on comparable toll processing costs and methodologies for comparison are very limited. One study used a unique approach to analyzing ETC costs. The study was published in September of 2008 and was conducted for the OmniAir organization, a toll industry group focusing on standards for ETC. The study conducted by Louthan Consulting[2] was titled, "*Toll Road Cost of Service Benchmark Study" and* considered electronic toll operations costs for four public toll operators in the United States. The agencies included a mix of urban and rural toll roads with varying degrees of ETC maturity. The methodology used was as instructive as the average costs that were contained in the report. **Only back office costs were considered in the study** and the only AETC roadway included was the Westpark segment of the Harris County Toll Road Authority. All of the remaining toll facility operations accepted cash as a method of payment.

The following were identified as key metrics for determining transaction processing costs:

- Number of contacts per account
- The number of new accounts established
- The number of open accounts over time
- The percent of total transactions performed electronically versus cash collections
- The number of contacts per transaction
- The number of transactions per account
- The number of transactions per lane mile
- The accounts per lane mile

[2] "*Toll Road Cost of Service Benchmark Study*", Louthan Consulting, September 2008.

Immediately upon review of the study it becomes clear that the metric that is the standard measure of performance in the industry, **cost per transaction**, is affected by several factors other than efficient performance and **is therefore a poor performance indicator**. For example, a toll road that has more transactions per mile and yet has the same total operating costs as a similar facility with fewer transactions per mile would have a lower cost per transaction. In other words, tolling a facility in both directions would result in a lower cost per transaction than doing so in one direction only. Further, the number of contacts per account is only partially controllable by the agency. There is perhaps no perfect performance measure that would allow for comparing one agency to another; however, there are some important conclusions that can be drawn from the study. One important conclusion is that strategic decisions largely drive ETC transaction processing costs. Specifically, strategic decisions would include the manner in which toll violations are processed, the types of technology chosen, OCR strategies, in house versus outsourcing of various activities, penalty assessment, and numerous other decisions. Once again, the thorough definition of business rules and pricing strategies are highlighted as an important first task as recommended for SR 520.

The next conclusion is instructive of the reason that ETC operations costs vary so significantly between agencies. The study concluded that "**the number of transactions per account is the most sensitive variable" for determining processing costs.** Contrary to the view that ETC transaction processing is always the least expensive transaction that can be processed, there are considerable fixed costs and contact costs associated with ETC accounts and these costs are allocated across the number of transactions for the agency overall. Large numbers of accounts for fewer numbers of transactions will lead to relatively high costs per transaction. The reverse is also true. While not conclusive on what the optimum number of transactions per account should be, it is suggested that an optimum level is calculable.

The analysis was segregated for the establishment new accounts, the management of existing accounts and direct transaction processing. Further, the costs to establish and manage an account were analyzed by the type of contact method used by the customer and the cost to establish and manage an account was found to vary widely depending upon contact method. This suggests that careful planning and marketing will affect the choice of contact method and therefore costs. The following data is extracted from the report and shows the range of costs depending upon the contact method. What appears to be an anomaly is the e-mail cost for maintaining an existing account. However, e-mail exchange necessarily requires the involvement of customer service center personnel and may entail multiple exchanges to resolve an issue. Strategic business decisions and pricing can affect the contact method chosen by the customer.

- Average New Account - $9.71/New Account
  - Walk up to CSC - $8.84/New Account
  - 3rd party - $6.47/New Account
  - Internet/Online - $8.31/New Account

- Existing Account Maintenance - $13.47/Existing Account per year
  - Mail Statements - $ 2.79/Existing Account per year
  - Credit Card Fees - $ 4.92/Existing Account per year
  - Respond to Contacts - $ 2.56/Existing Account per year
    - Walk up to CSC - $ 6.04/Contact
    - E-mail - $10.10/Contact
    - Internet - $ 0.48/Contact

- Phone - $ 1.80/Contact
- By Mail - $ 3.92/Contact

Average costs per transaction in this study were calculated at approximately 4.5¢ per ETC transaction. When combined with approximate cost to process violations per ETC transaction, this equates to about 6¢ per ETC transaction. This calculation did not include roadside costs and appeared to have lower credit card costs than have been experienced in other toll agencies. **Consequently, the ERP believes that an ETC cost per transaction in the 8-10¢ range is an aggressive target for an ETC operation. Further, the ERP suggests that a license plate recognition transaction should be about 50% more or in the 12-16¢ per transaction range.** As has been shown, many factors affect the cost per transaction and great care should be exercised in using the cost per transaction as a valid measure. These figures come from a brief survey of existing toll operations, all of which currently offer cash collections. There is no data available at present to provide a reasonable comparable cost per transaction on an AETC project. The ERP provides these figures only as a guideline for performance does not suggest them as absolutes.

Many factors affect the measure of cost per transaction. If one were to compare the transaction costs of a long distance turnpike that uses a ticket system to an urban road that may have several tolling points along a commuter route, it is clear that there would be many more "transactions" on the urban road versus the single transaction for a turnpike trip that may represent hundreds of miles of travel. If one were to collect tolls in both directions on the TNB, the transaction costs would be halved. Cost per transaction has become the measure of electronic toll collection performance in the industry by evolution, but it can be very misleading. **Since SR 520 will be an AETC application and there is limited data available, the most reasonable approach may be for WSDOT to establish their own benchmarks and to measure improvements in efficiency over time.** These measurements should be used to demonstrate to policy makers, senior management, and the public that the agency is continually improving and reducing costs. As more agencies convert to AETC, WSDOT should engage in exchange programs with those agencies to maintain best practices, reduce costs, and increase customer satisfaction.

It should be noted that pricing can have a significant effect on transaction costs as well. For example, a higher toll rate per transaction for occasional and infrequent customers will assist in recovering the costs of processing license plate images and verifying address information by accessing vehicle registration information. When there are only a few transactions per year, the higher toll rate is less of a burden. Also, prepaid license plate account holders would have less reason to make contact and incur cost for maintaining an account. Where ETC accounts require a transponder that must be properly mounted and associated with the proper vehicle, ALPR accounts do not. There is a tradeoff between the two types of accounts and it is the total cost that affects the net revenue for a facility.

UNIQUE ASPECTS OF SR 520

The early tolling of SR 520 is intended to begin a flow of funds to support construction of the new SR 520 bridge pontoons. The earlier that **net revenue** can be generated the less the interest costs will be for bonds issued for the construction of the final bridge. Therefore, delay resulting from the procurement of an integrator or the integration process will have an economic effect on funding SR 520. Further, the greater the **net revenue** from SR 520 the greater the positive effect on finances.

It is therefore important to advance the early tolling of 520 as much as possible without compressing the schedule for the final design of the roadside and back office systems. If strategic decisions are the primary determinants of transaction processing cost, as suggested in the benchmark study, key policies and business rules should not be formulated ancillary to an integration process. They should be carefully evaluated and established in a separate deliberate process.

WSDOT has established many policies and business rules through the implementation of tolling on the TNB and SR 167 HOT lanes. Those business policies and business rules will, however, require significant additions and some modifications for an AETC application on SR 520. To provide the time necessary to settle and test the policies and business rules for all toll applications in the future without slowing the current RFP process, the ERP suggested a two-phased approach to the integration process. Using the approach recommended by the ERP satisfies the goal for early revenue on 520 and still provides adequate time to carefully and deliberately craft business rules for a central back office that will be capable of handling an AETC application, a HOT lane application, and a mixed ETC application.

The first phase would concentrate on getting SR 520 AETC operational to generate revenue as early as possible satisfying not the ultimate system requirements for the CSC and TSC but based upon a design that will accomplish the goal of generating the most net revenue the earliest. To complement this first phase roadside design for SR 520, the vendor would implement an interim back office for SR 520 only and interface with the TNB back office until such time that the final back office for all facilities could be implemented.

To accomplish existing systems interoperability does not require immediate integration. The existing CSC processes transactions for both the Tacoma Narrows Bridge and the SR 167 HOT Lane project. In the interim solution, any ETC transactions, for which there is not a valid account holder, can be sent to the interim SR 520 CSC for processing. Conversely, ETC transactions on SR 520 that are for account holders at the existing CSC would be sent there for processing. This is exactly the process that is currently done by the IAG for over 23 members on a nightly basis. Further, this process would be an interim solution. Once the final CSC is developed, all account records would be transitioned to the new CSC and it would process all transactions. Since all facilities are operated on behalf of WSDOT, there would be no need for formal agreements.

Although WSDOT recognizes the potential for the ERP recommendation to satisfy the objective of the early revenue and providing sufficient time to adequately develop the central back office, WSDOT has chosen to develop the final CSC capable of processing all transactions from TNB, SR 167 HOT lanes, and the SR 520 AETC application. This CSC is intended to market and service all

transponder and license plate accounts and replace the existing CSC. By developing the final CSC to service all operations, WSDOT hopes to avoid complicating the transition from the existing CSC.

Since there will be one CSC, there are several options for proceeding. The most obvious choice is to migrate all accounts from the existing CSC to the new one and process all ETC transactions at the new CSC. This provides for a single source for ETC accounting records and reduces the complexity for transitioning accounts. It does not, however, meet the criteria of providing net revenue on SR 520 at the earliest date. Further, there is no incentive for the current vendor to expedite the process of conversion and experience at other agencies suggests that delays could occur. WSDOT could find itself in the position of incurring cost with the existing vendor to stimulate the transition and the new CSC contractor at the same time as a result of schedule impact.

WSDOT has chosen to continue with the strategy of migrating all accounts to the new customer service center but by moving the date for completion from October of 2010 to June of 2011 and incentivizing the contractor financially. If the extended date for completion is an acceptable strategy, it will provide the time necessary to thoroughly develop business rules and procedures of operation for the new CSC. The primary concern of the ERP was the short time allowed for these activities to be achieved by October 2010. Using this approach, the integrators bidding the project will be at liberty to establish the most efficient process to accomplish WSDOT's goals. The project could therefore be completed anywhere between November 2010 and June 2011. **The ERP supports this approach as a reasonable alternative since it encourages the private sector to provide its best techniques and resources.**

CUSTOMER SERVICE CENTER APPROACHES

Several alternatives exist for staffing and organizing the operations of the customer service center (CSC). By extending the time frame for completion of the project, WSDOT has provided the time necessary to determine the long-term strategy for operating the CSC. There are several alternatives for staffing CSC operations:

- The CSC could be organized as a WSDOT directed operation with staffing provided by the private sector. This approach allows the WSDOT to be more in control of relationships with the customer base and to design the training and performance management of staff. It allows WSDOT to more easily modify staffing levels depending upon volume and to hone in on the most efficient approaches. This approach could be challenging to WSDOT.

- Another approach might be to outsource the CSC operations completely and build into the RFP incentives for efficiency. If the ETC system, procedures, and business rules were mature and stabilized, this approach would be appropriate. In an environment of uncertainty and changing rules and procedures, this approach could lead to significant modification to the contract and create an opportunity for the vendor to request additional compensation as a result of the changes. In effect, this approach limits the flexibility necessary when implementing a new concept like AETC.

- A further alternative would be to staff the CSC operations with WSDOT employees. While this alternative provides the most direct control of CSC operations, it might be limited in the flexibility to add or reduce staff depending upon the employment processes of WSDOT.

- A final alternative would be to create a management partnership where the CSC is established, directed and maintained by the vendor but a co-located WSDOT individual or team are present to ratify all critical decisions affecting policies, business rules or customer relations. This allows the vendor the flexibility to move quickly and not face delays in processing decisions, without burdening WSDOT with extensive short-term personnel needs. An alternative in this concept would be an oversight consultant working directly to WSDOT with the ability to get quick responses for issues from the appropriate level of WSDOT management.

WSDOT has chosen to outsource the initial operation of the CSC through the current CSC RFP process. The ERP agrees with this approach for it allows WSDOT to begin implementation of an AETC system using contractor resources that should possess a broad base of experience with their application hardware and software as well as CSC operations in general. These resources will be crucial in assisting WSDOT to establish stable, efficient operations and provide an opportunity to scale staffing to the workload.

Essential to the efficient operations of the CSC will be the establishment of performance measures and tracking costs accordingly.

WSDOT should establish the following policies and business rules before operations begin. These same policies and business rules will be subject to modification once operations begin to ensure optimum efficiency. As the business rules and system processes stabilize to an optimum efficiency, staffing plans may need to be altered.

- Toll rates for
  - ETC
  - Pre registered license plate account
  - Day pass or other time period
  - Post-paid accounts (including the frequency of billing)
  - Discounts for new accounts depending upon contact method
  - Discounts for managing account depending upon contact method
- Transponder cost recovery
  - Sell transponders {short and long term) or distribute free of charge
  - Charge per month for a transponder unless frequency of use is sufficient
- Penalty amounts for violations depending upon
  - Number of outstanding violations
  - Willingness to establish an account
  - Waiver of penalty guidelines
- Number of violations to bundle before a citation is issued
- Grace period for post paying tolls
- Whether to allow for and how to handle pre-paid anonymous accounts

The toll benchmark study previously referenced identifies how significantly transaction processing costs can vary depending upon the contact method (walk-ins, e-mail, telephone, internet). The convenience of access must be managed to result in the most efficient process. As an example, if the website is cumbersome and difficult to use and there are many storefronts, more customers will likely use the more costly storefront alternative. Business decisions that can affect transaction processing costs long term go beyond the establishment of business rules. The ultimate cost per transaction will involve many operational approaches that must be constantly monitored and modified.

An additional aspect that can contribute to transaction cost efficiency is the marketing process. Marketing goes well beyond communications with the community at large and should be focused to segments of the populace depending upon their preferences. The first step is to conduct market research to determine who the customers of the facility are. This information is useful in the determination of pricing and business rules. The establishment of various pricing schemes will further affect the behavior of the customer especially in the choice of contact method.

TECHNOLOGY AND TRANSACTION PROCESSING COSTS

Technology choice can affect transaction processing costs in many ways. Some of the aspects of technological impact on transaction processing costs are as follows:

- Interoperability
  - Border states
  - Canadian provinces
  - National tolling
- Violation processing
  - Portability of transponder
  - Proper installation
  - Camera technology
  - Optical Character Recognition (OCR) methods
  - Matching of transactions versus continual processing
- Volume of customer contact
  - Battery issues
  - Installation problems
- Accurate vehicle classification and transaction framing

WSDOT has adopted the current reader and transponder technology as the strategy for the immediate future. This decision will be revisited as technology advances and as suppliers modify their pricing strategies. In addition, several discussions are taking place at the federal level with regard to national interoperability and the result could affect the technology decisions currently made. The current technology is in wide use throughout the U.S. for ETC and is capable of meeting the requirements currently established for AETC.

As a part of the TCS RFP (roadside equipment), WSDOT has not specified specific vehicle classification or camera equipment. Rather, they have described the ability to classify vehicles by the number of axles and also volumetrically. This approach allows the vendor community to bid that equipment which they believe will provide the optimum performance.

All of these factors will need to be considered on an ongoing basis in an effort to reduce processing costs. Many of these parameters of costs will be established in the initial contract with the CSC and TCS contractors and will not be easily monitored and adjusted during the contract period. However, negotiations should be undertaken to encourage efficiencies that can perhaps be shared through contract modifications.

INTEROPERABILITY CONSIDERATIONS

Interoperability was rarely a concern of early deployments of ETC. However, as ETC spread to neighboring regions and states, the issue became more prominent. This is especially true for the daily Interstate and long haul traveler, the commercial trucker. While technological interoperability is just the first step, it is necessary for any interoperability process to be successful.

OPEN VERSUS PROPRIETARY TECHNOLOGY

As ETC applications expand in Washington, early decisions should be made on whether Radio Frequency Identification (RFID) technology will be open architecture or proprietary. At present, WSDOT has decided to continue to use the existing proprietary products which have been deployed on the TNB and SR 167 projects.

Open systems allow the manufacture of equipment by numerous vendors so long as they comply with a technical standard. This creates a natural competition and a market in which transponders and readers trade as commodities. Consideration of the choice of technology of surrounding states should also be a part of the decision. While it is not possible to predict all of the potential scenarios that could occur, the RFID solution chosen should be made early before large scale applications are deployed and large numbers of transponders are deployed making it costly to change. An imminent decision that should be considered is the issue of active versus passive technology.

ACTIVE VERSUS PASSIVE TECHNOLOGY

Another technology consideration in transaction processing costs is whether the technology chosen will be active or passive. Active transponders in the 915 MHz range are likely to have more "handshakes" with the reader increasing the likelihood that the transaction will be properly recorded. Recent progress in passive design has reduced this advantage and cost considerably less than an active transponder. Passive transponders have no battery that has to be replaced and are affixed to the vehicle windshield ensuring that there is a one to one relationship between the vehicle and transponder. This restricts the ability to move the transponder from one vehicle to another but it also establishes that if the transponder was in the lane, a specific vehicle was there. This simplifies the process of maintaining account records and processing violations. The disadvantage of the passive tag is that it cannot be moved from one vehicle to another even if ownership has changed.

WSDOT has concluded that active and passive transponders will be allowed in the ultimate ETC system design. Pricing of these devices should be carefully considered to get the best mix of passive and active tags to minimize costs. Having both types of transponders will provide more customer choice, but costs related to each should be tracked to allow for maintaining optimal efficiency in processing transactions. Active transponders will cost the department more per unit than passive transponders and pricing policies should be set to recover the ongoing costs as well as the initial costs of distributing transponders.

TECHNOLOGICAL CONSIDERATIONS OF AETC VERSUS ETC

The ERP has recommended and WSDOT has agreed that transponders will be marketed for frequent customers, and license plate photo tolling will be marketed for most infrequent customers. As discussed in the section on the infrequent customer this is especially important in AETC applications.

Prepaid tolling methods consist of the RFID transponder transaction and the ALPR (automatic license plate recognition) license plate method. If a transponder is used there is minimal risk that the reader will not communicate properly with the transponder. RFID technology has been widely

deployed in the past 20 years. However, active transponders require a battery to operate and can fail as the power source is depleted. As well, customers have been known to wave the transponder in their hand as opposed to mounting it properly on the windshield. Passive transponders must be properly mounted on the windshield for them to operate. Potential difficulties with RFID accuracy and transaction completion come predominantly from driver behavior.

More technological issues can interfere with ALPR electronic transaction completion than with RFID. The difficulties with ALPR accuracy and transaction completion come predominantly from:

- Atmospheric conditions at the time of the transaction
- Condition of the CCTV camera housing windows at the time of the transaction
- Accuracy of the Optical Character Recognition (OCR) software
- Driver behavior

In recent years, ALPR manufacturers have made considerable progress on the first three by making significant improvements to their systems hence: **overall accuracy of ALPR is approaching that of RFID.** An RFID transaction has reliability above 99% and ALPR transactions have been tested in the low 90s[3]. Some tests indicate that ALPR transactions may be possible up to 95% accuracy. Though the accuracy of ALPR account processing is less than that for an RFID transaction, it is nevertheless important as a service for infrequent and occasional customers that will not purchase a transponder. Otherwise they become potential violators that must be pursued through a billing or violations process. This is also another reason why a grace period is recommended for occasional users. Some toll agencies attempting to convert to all electronic that are dependent upon a billing system are experiencing large numbers of court system transactions and are incurring significant costs in pursuit of large numbers of individuals each with small numbers of violations.

In recent years, camera technology has improved in resolution and light adaptive techniques considerably. Cameras are much more able to adapt to shadows and bright sunlight and to produce a high-resolution, very readable image. Coupled with this development are advancements in optical character recognition (OCR). The algorithms used in OCR engines have become increasingly sophisticated and demonstrate considerable flexibility to adapt to unique license plate reflectivity and unique designs for uniquely designed license plates or "vanity" plates. When OCR technology is applied in an ETC environment, which also has cash collections, it is predominantly used for identifying violations. Since the toll operator wants to ensure that no one receives a violation notice because the OCR conversion was in error, the confidence levels for the OCR conversion are set very high resulting in a large proportion of the images being manually reviewed. When large numbers of images are reviewed, transaction processing costs increase. A strategy that has been introduced recently to reduce manual image review is to process the image files through more than one OCR engine with a different set of algorithms. When both OCR processes result in the same conversion, it is highly probable that the conversion is accurate and review by an individual is not needed. Also when the image is being used to charge a toll rather than initiate a violation notice, a less stringent requirement of certainty is appropriate.

[3] Dulles Greenway Study of Image Tolling, Accenture & JAI Pulnix, 2005.

MATCHING TECHNOLOGY

An additional video technology that has been introduced is that of matching vehicle image data. This technique records digitized information of the vehicle itself in addition to the license plate. Once the digitized image is correctly matched to the right license plate number, future sightings of the same vehicle are analyzed against a standing file containing previous digitized images. If there is a match, the OCR process is performed only as a verification of the correct vehicle identification. This technology has been tested on the Dulles Greenway project in Washington DC and has been found to be highly accurate (in excess of 95% accuracy).

Video technology advances in hardware, software and matching techniques have changed the paradigm of video processing and significantly reduced the need for manual image review. Before these advances, 40 to 50% of all images were reviewed even if the vehicle had appeared numerous times before. Now it is possible to process images to a digital form over 90% of the time and with additional digitized information about the vehicle even higher percentages of vehicles can be accurately identified without manual review.

TECHNOLOGICAL ACCURACY AND DRIVER BEHAVIOR

How can driver behavior affect toll collections with transponders? Active transponders are those that can be moved from vehicle to vehicle. Oftentimes an ETC customer will hold the active transponder up with their hand as they pass through the tolling point or place the transponder on the dash of the vehicle rather than installing the device on the windshield properly. This results in intermittent errors in the RFID read and can result in violations being issued to a customer holding a valid account. When the customer becomes aware that transactions are not processing properly, it is incumbent upon the customer to return the transponder for service. Occasionally customers will leave the transponder somewhere other than in the vehicle. In both of these circumstances, the toll may not be collected due to driver behavior, and a potential violation is created.

To address these driver behavior issues, many toll agencies have implemented a video toll, (V-toll) process that augments the electronic toll. If a car passes through and the transponder is not read, a video camera checks the license plate number of the vehicle against a list of license plate numbers given at the time the ETC account was established. The payment is then deducted from the account via the video toll.

If a customer decides to purchase only one active transponder and use that transponder for a number of family vehicles, the video tolling process may fail (unless additional plates are added to the account); in which case, the transaction will remain in the system as a potential violation. This is simply one example of the way driver behavior can create an anomalous violation even when the customer is in good standing on his ETC account. This type of behavior is more prevalent with active transponders than passive ones.

TECHNOLOGY AND BUSINESS RULES

Technological advances assist in minimizing ultimate transaction processing costs, but they are intricately intertwined with the business rules established for processing. **The ERP strongly recommends that frequent customers have ETC transponders and that infrequent customers**

utilize preregistered license plate accounts, day passes, and other prepaid processes. The best technology should be deployed but it will be ineffective without the proper business rules to take advantage of that technology. **The ERP recommends that WSDOT use every means available to prevent potential violation transactions from occurring and to convert any of those that do occur to a prepaid account of some type.** To manage this ever-changing environment, flexibility is necessary within the rules to allow WSDOT to make the best decision to ensure long term that transaction processing costs are minimal. Grace periods for potential violations to allow for settling violations without penalties and search sites should be utilized to verify the correct address of an individual before sending violation notices to minimize returns.

A significant portion of AETC systems cost is in enforcement. In those instances where it is not possible to prevent a violations process from being initiated, WSDOT should consider whether it is economically viable to pursue the transaction and WSDOT should consider bundling numerous violation transactions into one court action.

Postage costs are a large contributor to transaction processing costs. It is worthwhile to consider providing a discount to customers that allow the agency to communicate via e-mail addresses and/or SMS text messages, including day-pass users. These types of communications, selected at the option of the customer, can be less costly and more effective. Similar business rules might be put forth for establishing and managing a prepaid account.

TOLL ORGANIZATIONAL CONSIDERATIONS

Toll organizations are unique as public entities. In Europe and much of the rest of the world, concessions are commonly found as toll operators. These concessions are primarily private today, but as recently as five years ago, six of the seven major concessions in France were more than 51% owned by the public sector. Toll operations are by their nature partly public and partly private. They are a business and must think strategically as such and yet they are entrusted with the public stewardship of large revenue producing and mobility critical infrastructure.

The state of Washington and WSDOT have determined to establish the Tolls Division within WSDOT. This model of organization is becoming more common as some independent state agencies have been incorporated into the State Departments of Transportation. It is a model that has been used successfully in several states. At the present point in time, many state turnpikes and expressway authorities remain independent.

The Tolls Division of WSDOT will serve as a service and support organization to other organizational units within WSDOT with regard to toll operations, revenue producing financial strategies, project feasibility, and technical support. A range of activities that are typically under the auspices of a DOT should be necessarily modified when applied in a toll environment. For example, basic signing standards apply and the Manual of Uniform Traffic Control Devices (MUTCD) is still the guide that should be followed. However, signing for toll payment communications, toll program communications, signed background colors, and other aspects of signing are unique to the toll industry. Supplemental MUTCD standards for toll operators are currently being developed and WSDOT should engage in that process.

Many functions that would appear to be synonymous with those performed by the DOT are in fact unique. The installation and maintenance of toll equipment are unique, but the installation is in the traffic lane and must therefore be coordinated with the basic civil functions of highway design and construction. Financial functions in most turnpike and toll operations require the services of a Chief Financial Officer (CFO) in those instances where toll finance is segregated from DOT trust fund and/or bond funding. Where funding is blended, this function is likely to be more focused on the financial feasibility of revenue producing projects. Even when the tolls function is in the DOT, the financial process needs to be represented by a CFO, who coordinates with those responsible for issuing debt and accounting for the DOT overall. However, the CFO is focused on the tolls function as a business enterprise.

The organizational arrangement for tolling is also a consideration of bond rating agencies. Bond rating agencies opinions can affect the interest rate of bond issues and the long-term costs of a revenue-producing project. Rating agencies regularly interface with the management of toll agencies and review management practices, strategies for the financing of revenue producing projects and the operations and procurement of toll systems. It is extremely important that rating agencies have a comfort in the skill sets of the individuals managing the Tolls Division. Financial expertise, toll operations, and toll collection business practices and systems knowledge are commonly reviewed by the rating agencies.

The ERP recommends that WSDOT focus the new Tolls Division as a business unit responsible for the operations of revenue producing projects, including the following functions:

- toll project planning
  - project planning
  - operational feasibility
- financial strategy and operations
  - traffic and revenue projections
  - financial planning and feasibility
  - coordination and advice on bond issuance and reporting
  - responsible for revenue collection and accounting
  - total project cost accounting and overhead allocation
- toll systems development and procurement
  - procurement of toll related services
  - hardware and software development, maintenance and interface to DOT systems
  - toll technology standards
  - toll operating reports and statistics
- toll operations management
  - day-to-day operation support
  - staffing and training
  - business rule development
  - marketing and communications

WSDOT's current organizational structure is essentially consistent with these four major functional areas of responsibility and reports to the Deputy Secretary and Chief Operating Officer on the same level as a District operation. This is consistent with the structure adopted by most Departments of Transportation that house a turnpike or tolling function within their organizational structure. Rather than a geographical area of responsibility, these organizations become involved only as revenue producing projects are conceptualized across the State.

To provide support to WSDOT and to access the body of knowledge in the industry, the ERP recommends the acquisition of a general engineering consultant specializing in toll operations and systems integration. A general engineering consultant that has a "hands on" knowledge of other ETC and AETC applications and that stays aware of technological advances in the industry will bring state-of-the-art knowledge to WSDOT. The consultant will be able to advise WSDOT on an as needed basis, assist with training, and provide support to the relationships with rating agencies and others. These services will be especially worthwhile in the first 2-3 years of the start up of the Tolls Division.

SUMMARY

Instituting tolling as a funding source for significant regional projects is a major undertaking and represents a shift in philosophy for providing transportation infrastructure. It is a shift that is occurring in many parts of the U.S. that heretofore had depended upon gas tax proceeds and other user fees. Two separate commissions established by Congress have suggested the establishment of a Vehicle Mileage Tax (VMT). The specifics of the technology that will be necessary to implement a policy such as VMT has yet to be determined. It is clear, however, that funding policy at the federal level is trending toward tolling as the primary revenue source. This is consistent with the strategies identified by the state of Washington for long-term funding. It is significant that the state of Washington is moving toward AETC for SR 520 and will be positioned to technologically support a range of transportation funding choices.

WSDOT is just beginning this transition with the implementation of the Tacoma Narrows Bridge project, SR 167 HOT lanes, and the early tolling of SR 520. As the agency moves to implement AETC on SR 520, a centralized customer service center (CSC) and a flexible roadside toll collection system (TCS), it is establishing a foundation for future toll projects as well. Because of the significance of this step, it is crucial to establish the comprehensive business rules that will address long-term needs for tolling in the State. In order to provide sufficient deliberation time for setting these rules and to separate the goal of tolling SR 520 at the earliest time, the ERP recommended a two-phased solution to the current outstanding Requests for Proposals. WSDOT has implemented a solution which extends the time frame for completion and provides the time sufficient to deliberate and adequately define the business system within which the automated system will operate.

The ERP further recommended that WSDOT place a greater focus on video technology in the implementation of the early tolling of SR 520. This is not to say that transponder technology should not be used. In essence, frequent users of SR 520 should be encouraged through pricing and marketing to utilize a transponder in the payment of their tolls and infrequent customers should be encouraged through the same means to utilize preregistered video accounts, day passes, and other prepaid tolling methods.

WSDOT has met with the ERP on numerous occasions and is in the process of implementing many of the recommendations of the ERP. There have been several addenda issued to the RFPs and a greatly expanded set of business rules issued which will do much to clarify the system requirements for the vendor community. It is expected that the business rules will continue to evolve as pricing decisions are made and other strategies are put in place to create an AETC system. Perhaps most significantly, WSDOT has extended the final implementation date to June 2011 with incentives for earlier delivery. This should positively impact bid prices and allow vendors to price delivery time and risk to the optimum for their approach.

APPENDIX A – RESUMES OF EXPERT REVIEW PANEL

For the purposes of this report, the ERP members' professional resumes have been considerably condensed. Please go to the JTC website for their complete resumes. http://www.leg.wa.gov/JTC/Pages/CompletedStudies.aspx.

DANIEL G. FAUST, PE

VICE PRESIDENT

TOLL OPERATIONS CONSULTANT

AECOM

Education
Engineering Management Studies/2002/MIT Sloan School of Business
Graduate Studies/1996-1998/Drexel University
BS/1984/University of Delaware

Active Registration
1989/PE/Pennsylvania
1990/PE/New Jersey
1991/PE/Delaware

Experience and Qualifications

Mr. Faust has over 25 years of experience in the planning, design and construction of major transportation projects. Mr. Faust's experience includes 11 years with the Delaware River Port Authority, one of the largest bi-state agencies in the U.S., where he served as Chief Engineer/Director of Engineering. In this role Mr. Faust was responsible for developing and implementing the agency's capital improvement program (approximately $140 million annually) across all core facilities including four major bridge structures, highway approach and connecting roadways, a high speed commuter rail system, a passenger ferry system and a cruise terminal facility.

As Chief Engineer, Mr. Faust developed all policies, procedures and standards governing capital improvement and maintenance activity, and reported directly to the Board of Commissioners regarding all capital program matters. In this role, and as a member of the Authority's Strategic Management Committee, Mr. Faust was responsible for short and long-range capital planning initiatives and for analyzing, prioritizing and recommending operational and maintenance improvements across all core facilities. As Chief Engineer, Mr. Faust was chairman of the agency's Safety Rules & Procedures Committee, responsible for the development of operational procedures to support routine bridge operations, and was a member of DRPA's Security Working Group, responsible for developing procedures and protocols for responding to national security threats and emergencies.

Mr. Faust's major project experience is detailed below.

Delaware River Joint Toll Bridge Commission – Capital Program Management Consultant: Mr. Faust is currently serving as DMJM Harris' Project Director for this program management assignment, which involves technical direction, staff allocation, contract administration, Commission coordination and project management oversight in support of the DRJTBC's $950 million Capital Improvement Program. Major program assignments include the $100 million Route 1 Rehabilitation Project, and the $300 million I-95/Scudder Falls Improvement Project. Other program management activity has included: development and maintenance of the Capital Program Master Schedule; procurement support; project management; design review; tracking of project financials and schedules; task order consultant tracking; and development of engineering policy and procedure documents.

Due Diligence Analysis for UTS Alabama Toll Bridges – Evaluation and analysis of operations at three toll bridge facilities for the purpose of determining current condition and operational efficiency, and for forecasting operational and maintenance costs over a fifty-year period. Work included an analysis of toll collection, auditing and management systems and an evaluation of operating costs (including staffing) to identify potential opportunities for net revenue enhancement.

Golden Gate Bridge Moveable Barrier Implementation Study – Technical lead for operational studies and the design of roadway and toll plaza improvements to support the installation of moveable median barrier on the Golden Gate Bridge.

While with the DRPA, some of the significant projects that Mr. Faust was responsible for included:

DRPA Express EZPass Feasibility Study – Mr. Faust led a team of in-house and consultant staff in the study of Open-Road "Express EZ Pass" feasibility at the Betsy Ross and Commodore Barry Bridges in Philadelphia.

DRPA Electronic Toll Implementation – Planning, design and implementation of civil and infrastructure improvements in support of DRPA's conversion to EZ Pass electronic tolling. Planning activities included detailed operational analyses and traffic simulation modeling to optimize EZ Pass lane configurations at all four DRPA bridge plazas.

DRPA "Smart Bridge" Initiative – Design and implementation of a multi-faceted improvement project to improve mobility and operational efficiency on DRPA's four major bridge facilities and approach roadways. Improvements included the installation of traffic surveillance cameras, design and integration of traffic management centers at each bridge facility, development of an ITS master plan, installation of a permanent moveable barrier system on 3 of the Authority's bridges, installation of backbone fiber-optic carrying structures on each river crossing as part of a new wide area network system, and the implementation of a new state-of-the-art 800 MHz trunked radio communication system.

Walt Whitman Bridge Corridor Reconstruction – Five-phase, $200 million reconstruction of a major suspension bridge connecting South Philadelphia and Southern New Jersey. Work included concrete deck replacement, structural modifications and improvements, roadway rehabilitation, safety improvements, signing and ITS enhancements. Work involved extensive community outreach and complex construction staging in order to minimize impacts to traffic on this heavily traveled corridor (over 130,000 AADT).

PATCO "At-Work" Initiative – Design and construction of over $200 million in system-wide improvements to a 14-mile high speed commuter rail corridor, including: accessibility improvements to key stations in order to comply with ADA requirements; structural and architectural improvements to 13 stations; installation of concrete ties; installation of a state-of-the-art Supervisory Control and Data Acquisition (SCADA) system; rehabilitation and replacement of interlockings; and replacement of original power distribution and communication systems. All work was designed and implemented while maintaining 24/7 transit service, with no disruption to peak hour train schedules.

Benjamin Franklin Bridge Capital Improvement Program – Design and construction of over $150 million in improvements for a major suspension bridge carrying vehicular traffic and rail transit service between Center City Philadelphia and Southern New Jersey. Improvements included: rehabilitation of the main suspension cable; repair, strengthening and installation of a cathodic protection system on original concrete approach spans; removal of all existing lead-based coatings over the entire bridge (25 layers) under full environmental containment and recoating with a new paint system; and orthotropic deck repairs and resurfacing. Work was accomplished without impacting vehicular or transit service during peak periods.

DUANE E. BUCHKO, PE

AECOM

SENIOR ASSOCIATE

Education
BS, Civil Engineering, University of Michigan, 1973
Railway Engineering Short Course, University of Illinois

Registration

PE, IL, 1976
PE, WI, 2006

Experience and Qualifications
Mr. Buchko has experience in all phases of civil engineering management, oversight, design, estimating and construction for major projects. Recent emphasis has been on:

- Toll Collection Advisory Services, US 301 Toll Team, Middletown, DE for the Delaware Department of Transportation.
- Concept design, budget estimates and concept of operations for a Toll Collection System for the North Tarrant Expressway Project, a Texas Department of Transportation public/private partnership project in the Dallas/Fort Worth area of Texas.
- Concept design alternatives and budget estimates for two way tolling on the Verrazano Bridge in New York, New York
- The investigation and evaluation of Toll Collection Systems and Toll Collection Operations for private investors interested in obtaining financing to lease and operate the Toll Roads.
- The construction manager for two ORT Plazas on the Miami Dade Expressway Authority (MDX) Route 836.

Mr. Buchko was also a member of the Illinois Tollway's Toll Collection System and Violation Enforcement System Review Teams that reviewed and recommended modifications and improvements for the Tollway's integrated Toll Collection Systems and Violation Enforcement and Processing Systems. Additionally, Mr. Buchko was a member of the Tollway Traffic Incident Management System (TIMS) Review Team that reviewed and recommended enhancements and modifications for the Tollway's TIMS. The Tollway's TIMS includes an integrated Management Center that monitors various conditions throughout the system and coordinates incident responses to reduce congestion by reducing response times and disseminating accurate incident information, alternate route and travel times to the public and other outside agencies. Mr. Buchko was also a member of the Tollway's Safety and Operations Committee that meets monthly to review and provide recommendations in regard to various safety and operational concerns expressed by either employees or patrons on the system.

PROJECT EXPERIENCE

Toll Collection Advisory Services, US 301 Toll Team, Middletown, DE for the Delaware Department of Transportation. Provides review and technical expertise regarding the decision to toll US 301 as ORT versus ORT and Cash. Participates in a presentations for DelDOT's Secretary of Transportation and Directors. Reviews another consultant's study, participates in toll-oriented meetings with DelDOT, the General Engineering Consultant and design consultants. Provides guidance on E-ZPass and all-electronic toll (AET) plaza design. Also serves as AECOM's toll expert

for Section 2 toll facilities design, including civil, structural, and electrical engineering necessary for four ramp plazas. *(9/08 – Present)*

Toll Collection System for North Tarrant Express Project, Dallas/Fort Worth, Texas for NTE Mobility Partners. Developed the concept design, concept of operations and budget estimates for the capital, operations and maintenance costs for the Toll Collection System that NTE Mobility Partners is proposing in their bid for the North Tarrant Expressway Project. This work included the preparation of some guideline drawings, which will be used as the basis for the final design of the Toll Collection System if NTE Mobility Partners is the successful bidder. *(3/08 – Present)*

Two Way Tolling Study for the Verrazano Bridge, New York, New York for the Metropolitan Transit Authority (MTA). Developed Design Criteria and evaluation guidelines that are used to establish Toll Collection Concept Alternatives for evaluation, oversees, and directs engineers preparing concept plans, and estimates for each alternative and documents the advantages and disadvantages for each alternative. Once completed the alternatives will be evaluated and the findings summarized in a report to the MTA. *(3/08 – 12/09)*

Pennsylvania Turnpike Lease Analysis, Pennsylvania. Investigated and evaluated Toll Collection Systems and Toll Collection Operations. Prepared Operating Expenditure and Capital Expenditure Budget estimates for the next 50 years. Responsible for providing professional consulting services to the Liberty Roads Consortium in preparation for a bid to lease, improve, operate and maintain the Pennsylvania Turnpike (the Turnpike) for an indicative 50-year concession. The Pennsylvania Turnpike is a tolled highway system operated by the Pennsylvania Turnpike Commission for the Commonwealth of Pennsylvania. The Turnpike system comprises a total of 532 miles of highway in three sections: the Mainline, totaling 359 miles, running from the Ohio state line in the west to the New Jersey state line and the Delaware River in the east; The Northeast Extension, totally 110 miles and extending from Plymouth Meeting to Scranton; and the Western Expansion, a series of segments in western Pennsylvania, totaling 62 miles. *(10/07 – 3/08)*

Mexican Toll Road Concession Asset Review, Mexico. Investigated and evaluated the Toll Collection Systems and Toll Collection Operations. Involved in the review of Opex, Capex and operational plans, as well as the traffic and revenue reports previously commissioned by others for four Toll Roads in Mexico. The toll roads included: La Venta-Chamapa Highway; Toluca Northern Bypass; Tepic-Villa Union Highway; and the Tijuana-Mexicali Highway. The purpose of the reviews is to provide rating agencies and potential financial participants with a comprehensive overview of the validity of previous reports rather than generate new forecasts of traffic, revenue, Opex or Capex costs and operational needs. *(7/07 – 9/07)*

Miami Dade Expressway (MDX) ORT Plazas, MDX, Miami, Florida. As a member of the General Engineering Consultant Team acted as the Construction Manager overseeing and coordinating the work of Contractors constructing two Open Road Tolling Plazas on the MDX 836 Expressway. *(2/07 – 7/07)*

Indiana Toll Road Widening Project. As QA\QC Manager, reviews all work done on the project and ensures that CTE's QMP for the project is being followed. *(1/07 – Present)*

Annual General Consultant Services, Illinois Tollway. Multiple projects for the Tollway *(7/97 – 12/05)* including, Open Road Tolling Plazas, the South Extension of the North-South Tollway, Electronic Toll Collection Systems, Violation Enforcement Systems and Communications Networks.

PROFESSIONAL

- Founding member of The Interagency Group (IAG) - E-ZPass
- Founder member and Chairman of The Alliance for Toll Interoperability
- IBTTA Board Member 2008 - 2012
- Founding member of Committee to Advance Transportation Systems in the Northeast
- Certified Facilities Manager – *IFMA*

AWARDS/PUBLICATIONS

Lockheed Martin IMS Presidents Award

Control Data National GREAT PERFORMER Award

MIS Week - Cited for Management of Computerized Toll Collection System

International Facilities Management Association/Modern Office Technology

Award for Excellence in Facilities Management at PTC

CAREER OVERVIEW

Present Chief Operating officer – North Carolina Turnpike Authority

- responsible for the development and implementation of all authority operations
  - tolling
  - ITS
  - program marketing
  - PPP operations
  - roadway maintenance
  - CSC, VPC
- developed cashless tolling study and business model (cash vs. cashless)
- worked to advance industry and technology (video shootout / ati)
- developed financial operations model (operations spreadsheet)
- developed many additional operational procedures for this pending startup
- www.ncturnpike.org

Founder member and Chairman of The Alliance for Toll Interoperability

- currently over 35 participating toll agencies in North America
- creating technical and business tolling interoperability in North America
- www.tollinterop.org

2005 Director Transportation Programs and Services – Washington Group International

- responsible for operations and marketing in the us
- developed marketing plan and implementation strategy
- assisted several key clients with project decisions

2004 Vice President Marketing and Business Development – TransCore

- responsible for company-wide marketing and business development effort
- developed company-wide strategy to coordinate marketing efforts
- developed market strategy for launch of new products

1996 – 2003 Director ETC –Lockheed Martin, IMS / ACS

- responsible for project management, marketing and business development effort
- project manager for Maryland (Mtag) and South Carolina (palpass) ETC lane and CSC implementation
- managed company-wide communications and public relations, coordinated company-wide business unit synergy and constituent services
- exceeded company's 20/20 objectives
- directed projects in Florida, New Jersey, New York, Georgia And Texas
- won Presidents award

1986 - 1996 Assistant Chief Engineer/Facilities Manager – Pennsylvania Turnpike

- responsible for all turnpike facilities
- managed electrical, electronic, systems, software, environmental, mechanical, architectural, structural, and civil engineering groups
- managed toll systems and ITS group, which included software development and maintenance, system quality assurance, and contract administration
- chaired IBTTA committee on International Uniform Vehicle Classification
- worked with IBTTA, ITS America, and federal highways on developing standards for Electronic Toll Collection (etc)
- founding member and Secretary of The Interagency Group (IAG) E-Zpass
- established the award winning environmental action team
- managed toll systems design staff that developed the first weigh barrier system
- developed tandem booths with full audit capabilities
- established statewide program to update 400 underground fuel storage tanks
- implemented numerous safety improvements and positive pressure tollbooths
- developed first concept of an ETC-only slip ramp
- established fare evasion teams to ensure audit system integrity
- managed construction and operation of sewerage treatment plants; toll plazas; service plazas, restaurants; gas stations; tunnels; and other facilities
- worked to develop *the committee to advance transportation systems* in the northeast (C.A.T.S.N.E.).
- developed testing procedures for automated toll collection system
- co-authored first Maintenance Online Management System (MOMS)

1972 – 1986 Control Data / Syntonic Technology

- Senior representative for a division of Control Data Corporation, managing a contract with the Pennsylvania Turnpike Commission, maintaining statewide toll collection and tunnel control systems

JAMES A. CRAWFORD

38 Nugentown Road
Little Egg Harbor, NJ
08087-2707

Phone 609-432-9895
Fax 609-348-4676
E-mail jimcrawford@comcast.net

Mr. Crawford is a professional transportation planner with over 35 years experience. Since May of 2005, Mr. Crawford has served as Executive Director of the E-ZPass Interagency Group, the association of 25 member agencies in 14 states that offer E-ZPass as a method of toll payment.

From 1994 until he retired in 2005, Mr. Crawford served as Executive Director of the South Jersey Transportation Authority (SJTA). The SJTA owns and operates the Atlantic City Expressway, a 45-mile toll road connecting the Philadelphia suburbs with Atlantic City, and the Atlantic City International Airport. The Authority also regulates the 1000+ buses a day that visit AC.

During his tenure at the SJTA, Mr. Crawford directed the development of a 2-1/2 mile connection to Brigantine, a $330 million joint venture with MGM/Mirage and the State Department of Transportation. In addition, the Expressway took on a major expansion program, benefiting from an uncontested toll increase implemented in 1998. At the same time, the Atlantic City International Airport was expanded; the SJTA took over operation of the runways from the FAA's Hughes Technical Center and embarked on a $25 million capital improvement program. Mr. Crawford instituted a bus safety program for Atlantic City to improve bus driver awareness in this critical market. SJTA remains committed to expansion of tourism, the primary industry in its market. He initiated a joint marketing program with the ACCVA and expanded its efforts to promote air service to the region. Mr. Crawford retired from the SJTA at the end of May, 2005 with over 29 years of State service.

For the previous four years, he provided consulting services to various transportation agencies and private clients on a broad range of topics. While a Vice President at TAMS Consultants, Inc. an international architectural/engineering firm, Mr. Crawford directed the planning for landside and airside facilities at the International Arrivals Building, JFK International Airport and on land access to the Third Chicago Airport and directed the traffic analysis associated with reuse of the Philadelphia Naval Complex. He has prepared intermodal planning studies for the State of Delaware and participated in the early planning for the Intelligent Highway System in the Northeast States.

For over 16 years, Mr. Crawford served in the New Jersey Department of Transportation. Starting as a planner in the environmental section, he progressed through various titles to Assistant Commissioner for Policy and Planning, a position he held for seven years. During his term at NJDOT, Mr. Crawford worked on the environmental studies for Route 55 and I-287 as well as a number of transit projects. As Assistant Commissioner, he served on a number of boards and commissions, including the NJ State Planning Commission, the Delaware Valley Regional Planning Commission and the Atlantic County Transportation Authority, a predecessor to the SJTA.

Mr. Crawford has a Masters degree in City and Regional Planning from Rutgers and a Masters in Systems Management from the University of Southern California.

Mr. Crawford is a former naval officer and served at the Pearl Harbor Naval Shipyard. Mr. Crawford is married and has two adult children.

Education

BS Civil Engineering, University of Illinois
MBA, University of Illinois
Ph.D. Public Policy, Virginia Commonwealth University

Experience

Founder/President - Transportation Innovations, Inc. 2004 – Present

Upon leaving the Orlando-Orange County Expressway Authority, Dr. Worrall formed Transportation Innovations with a focus on the toll and ITS practice areas. He has consulted with a number of public and private agencies. The client list includes technology firms, engineering firms, asset management firms, financial advisors, transportation operations companies, integrators, the Ohio Turnpike, the New York State Thruway Authority, Harris County Transportation Authority, Jacksonville Transportation Authority, Tampa Hillsborough County Expressway Authority, Florida Turnpike Enterprise, the South African National Roads Agency Limited and others.

Dr. Worrall is also presently serving as the Chairman of the Board of Citilog S.A., a French Corporation that develops and markets video detection solutions worldwide.

Executive Director - Orlando-Orange County Expressway Authority 1992- 2004

Dr. Worrall joined the Orlando-Orange County Expressway Authority (OOCEA) as the Executive Director in May of 1992. He was the chief operating officer for the agency guiding the functions of engineering, construction, planning, toll operations and finance. OOCEA is responsible for 100 centerline miles of four lane limited access highway. He was instrumental in the implementation of electronic toll collection (EPASS) on 200 lanes, the refinancing of over $750 MM in debt and other improvements that altered the outlook for the Authority and brought toll collection operations to high levels of accountability. He was responsible for developing a strategy to build the first segment of the Western Beltway and successfully lobbied the Florida Legislature for initial assistance to make it a reality. Cash collections decreased as ETC was implemented in toll revenue grew from $38.5 million annually to nearly $200 million during his tenure.

Assistant Secretary for Finance - Florida Department of Transportation 90 - 92

Dr. Worrall was the Assistant Secretary of Finance and Administration for the Florida Department of Transportation. He was responsible for the financial, program planning, toll operations, information systems, personnel and general administration of the department. He was responsible for a budget of $4 billion and 2500 of the 9,000 personnel in the Florida Department of Transportation, one of the largest in the nation. He was responsible for correcting an $800 million shortfall in the capital budget and established a financial planning function to assist in putting the department on a sound financial footing. He represented the department with the Governor, the Cabinet of Florida and rating agencies on bond issues.

During the passage of ISTEA he served on various AASHTO committees and participated in discussions with other states on proposed federal policy.

Comptroller - Utah Department of Transportation 87 - 90

Dr. Worrall served as Comptroller with the Utah Department of Transportation and was responsible for the budget and financial functions of UDOT. He was the principal liaison with the Utah Legislature on financial matters and the capital work program and prepared various funding strategies for public/private participation in transportation facilities development. He provided guidance to the information systems division.

Partner - Management and Computer Consultants 85 - 87

Dr. Worrall was a founding partner of Management and Computer Consultants organized in August of 1985. He was responsible for the marketing and performance of a number of client engagements in the transportation area in the U. S. and Canada.

Assistant Commissioner for Finance - Virginia Transportation Dept. 81 – 85

In 1981 Dr. Worrall accepted the position of Director of Finance with the Virginia Department of Highways and Transportation reporting directly to the Commissioner of Transportation. Dr. Worrall was the chief budget and financial officer of the department and served in a liaison capacity to the Virginia General Assembly on financial matters. He was instrumental in preparing bond issues for several toll facilities. His responsibilities included the engineering and administrative information systems of the department.

Principal - R.J. Hansen Associates 73 - 81

Dr. Worrall served as project manager on the development of several transportation information systems and management studies in the US and Canada and later as project director and Vice President in the firm.

Engineer and Systems Analyst - Illinois Department of Transportation 69 - 73

Dr. Worrall served in an engineering capacity with the Illinois Department of Transportation and gained experience in the research, planning and computer science divisions. He served as the section manager in charge of engineering computing department-wide.

Professional Activities

Dr. Worrall is a Registered Professional Engineer in Illinois, Virginia, Florida and Utah. He is a member of the International Bridge Tunnel and Turnpike Association (IBTTA) and served as its President in 2002. He is a member of ITS America and served as the Chairman of the Board in 2000. He teaches transportation Policy in the Masters program at the University of Central Florida and has published numerous industry articles for various publications. He is the author of "A System at Risk: the Economics of Transportation" and is a frequent presenters on issues of interest to the toll and ITS industries.

APPENDIX B. ERP RECOMMENDATIONS

This detailed list of recommendations is the result of the ERP's review of resource documents and other information provided during the course of the project, in particular the two requests for proposals (RFPs) for a customer service center (CSC) and Toll Collection System (TCS). These recommendations have evolved between June and October, 2009 through a number of workshops and meetings with the WSDOT Tolls Division, JTC members, and staff.

The recommendations have been categorized on the following pages, but in many cases, recommendations in one area are integral to other areas of inquiry.

RECOMMENDATIONS – BUSINESS RULES & INFREQUENT CUSTOMERS

❶ All-Electronic-Toll-Collection (AETC) is a paradigm shift from electronic toll collection (ETC); it is not a transition and requires major changes in business rules, pricing and procedure.

WSDOT Response: WSDOT acknowledges and has embraced this new paradigm.

❷ Survey users to determine the frequency of use on SR 520, and from the survey, estimate the number of accounts of various types.

WSDOT Response: WSDOT is committed to additional surveys and data collection.

❸ To minimize costs resulting from future technology changes, WSDOT should, as much as possible, market transponders to frequent customers (two or more round trips per week) and use prepaid Automatic License Plate Recognition (ALPR) accounts, day passes, grace periods, and violation negotiations to minimize the number of court cases.

WSDOT Response: WSDOT is committed to marketing ALPR accounts to infrequent users and acknowledgement that the initial RFP relied too heavily on transponder penetration as the sole means of electronic toll collection. Current RFP amendments reflect this commitment and a more balanced approach utilizing both transponder (frequent users) and ALPR (infrequent users) accounts.

❹ Determine the fixed and variable costs of the following activities and establish a management process to report on the same as performance indicators and other information that can be used to modify business rules and procedures.

Establishing an account by various contact methods:

- Cost reporting:

  IVR phone system
  Phone personal contact
  Internet/website
  Mail
  CSC personal contact
- Other reporting:

  Number of accounts established of each type

Cost per transaction type to set up an account

Managing an account by each contact method allowed:

- Cost reporting:

  Adding an additional vehicle
  Changing licensing information
  Modifying personal/address data
  Updating credit card information
  Topping up an account with cash
  Terminating an account

- Other reporting:

  Number of modifications by type
  Transaction cost by type by contact method

Processing video tolls (V-tolls):

- Cost to process V-tolls
- Number of V-tolls by account

Violations processing:

- Cost reporting:

  Cost of manual image review
  Cost of filing a uniform traffic citation

- Other reporting:

  Number of violations per license plate
  Number of first time violations
  % recovery of tolls at first mailing
  % recovery of tolls through the court
  Number of new accounts resulting from the violations process
  $ recovered through fines and penalties

WSDOT Response: staff anticipates working closely with the selected vendor to develop these and other reports.

❺ Establish business rules for all current and future toll facilities for the accounts, discounts, and pricing schemes listed below:

For establishing accounts both ETC, ALPR, and day passes:

Establishing accounts
Maintaining accounts
Processing v-tolls
Processing violations

Types of accounts allowed:

- ETC
- ALPR preregistered
- Billing customer
- Day pass
- Rental car transactions

Toll discounts for:

- Type of account
- Method of contact

Pricing:

- By type of account: Initial/monthly fees

WSDOT Response: staff has developed many of the business rules indicated, and will work closely with the selected vendor to refine these rules during the early phase of implementation; with respect to pricing, staff will advise the Transportation Commission as to appropriate pricing strategies and will work closely with the selected vendor to establish rules and accounts based on this pricing.

❻ Procedures for the business rules outlined above.

RECOMMENDATIONS – TOLL COLLECTION SYSTEM (TCS) RFP

❶ Define the standard lane transaction record and processing for the activity listed below.

ETC transactions:

- Valid transaction
- Low balance
- Insufficient funds
- Suspended account
- Stolen transponder
- Closed account

ALPR record:

- Valid transaction
- Low balance
- Insufficient funds (if allowed)
- Suspended account
- Closed account

Potential violation

WSDOT Response: Staff will establish standards in collaboration with the selected vendor.

❷ Consider an interim, two-phase approach to the TCS process (as defined below) to provide sufficient time to develop comprehensive business rules and permit full migration from the existing CSC to the new statewide CSC, while allowing for the "early" collection of tolls (in November 2010).

Phase 1:

- Minimize vehicle classification: Investigate existing bridge design to better understand what classification equipment would work best.
- Consider no classification and accept the class on the transponder in the interim.
- Process vehicles exempt from paying by identifying their transponder:

  Must control the exempt inventory.
  Must take a license plate image for all exempt vehicles.

Phase 2:

- As currently described in the RFP.

WSDOT Response: WSDOT has extended the tolling implementation date to June 2011 and provided an incentive for tolling earlier than that date. To provide for a possible delay in migration to the new CSC, WSDOT has put vendors on notice that they should be prepared to implement an interim solution to permit tolling by no later than June 2011. The ERP supports this approach.

❸ General RFP modifications should be made as follows:

Remove the price cap.

WSDOT Response: Price caps have been removed.

Remove the letter of credit requirement.

WSDOT Response: The letter of credit requirement will remain.

RECOMMENDATIONS – CSC RFP

❶ Consider an interim, two-phase approach for the CSC (as defined below) to provide sufficient time to develop comprehensive business rules and permit full migration from the existing CSC to the new statewide CSC, while allowing for the "early" collection of tolls (in November 2010).

Back office alternatives:

- Phase 1 – by 10/10/2010 or sooner:

  Allow the selected SR 520 lane vendor to process transactions through their back office remotely in the interim and interface with the existing back office by exchanging transactions just as the IAG does presently.
- Phase 2:

  As the RFP describes.

Provide more time for the completion of the project and proceed with developing the business rules

WSDOT Response: WSDOT has extended the tolling implementation date to June 2011 and provided an incentive for tolling earlier than that date. To provide for a possible delay in migration to the new CSC, WSDOT has put vendors on notice that they should be prepared to implement an interim solution to permit tolling by no later than June 2011. The ERP supports this approach.

❷ Modify the back office (CSC) RFP to incorporate cost efficiencies in a variety of areas, as listed below.

Use prepaid video accounts for infrequent customers.

Allow day passes etc.

Use rental car toll processing companies for rental tolls.

Optimize the use of electronic communication:

- E-mail
- SMS phone messaging
- Computer generated telephone calls to customers

Charge less for customer communications that are electronic.

Allow a grace period for settling violations, perhaps 7 days.

Minimize paper statements and communications.

Minimize personal communications:

- Consider less CSC facilities
- Use kiosks and retail operations for cash account maintenance

Reword RFP to encourage cost saving ideas from vendor community.

Highlight the need to establish a partnership in the RFP.

WSDOT Response: The recent CSC amendment incorporates provisions in all of these areas and emphasizes the need for CSC proposals to address cost efficiency in general.

❸ General RFP modifications should be made as follows:

Remove the price cap.

WSDOT Response: Price caps have been removed.

Remove the letter of credit requirement or clarify its purpose.

WSDOT Response: The letter of credit requirement will remain.

Remove the requirement for a CPA on the integrator's team; this is an unusual requirement that will be difficult to comply with, and the ERP is not clear on the benefit.

WSDOT Response: The CPA requirement will remain.

ORGANIZATIONAL RECOMMENDATIONS

❶ Utilize the project planning, design, and construction offices of WSDOT and not duplicate them in the Tolls Division.

WSDOT Response: WSDOT has accepted this general comment

❷ Organize the Toll Division in accordance as follows:

Financial Strategy and Operations:

- Financial planning
- Bond issuance
- Revenue accounting
- Project cost accounting

Toll Systems Development and Procurement:

- Hardware
- Software
- Installation
- Maintenance
- Other systems

Toll Operations Management:

- Day-to-day operational support
- Staffing
- Business rules

WSDOT Response: This is consistent with the structure of our new Toll Division approach.

❶ Define the technical interoperability specification:

Interface requirements:

- WSDOT financial systems
- Other state financial systems

WSDOT Response: These requirements are well-defined.

Methods of interfacing to other applications or to decide if these applications will be pursued:

- Parking
- Ferry system
- Transit
- Commercial

WSDOT Response: Interoperability with these and other applications is difficult to define at this point. However, the current system as modified, which places less of an emphasis on current transponder technology, will allow Washington State to implement interoperability in the future with minimal legacy costs.

❷ Define the security standards for maintaining and processing sensitive data.

Credit card/ACH security procedures

Banking data

Encryption methodology

Personnel security procedures: Levels of security

WSDOT Response: WSDOT is requiring vendors to describe and demonstrate how their proposed solutions meet ISB and PCI security standards.

❸ Define backup and recovery standards and procedures.

Short-term failure

Long-term failure

Facility locations

Fail over methods

Continuing operations

WSDOT Response: WSDOT will require vendors to demonstrate how their proposed solution will meet ISB and WSDOT standards for system backup and recovery.

❹ Consider using fingerprint technology for license plate recognition, allowing for the system to match a digitized image rather than doing an OCR conversion each time.

WSDOT Response: The RFP and amendment provide performance criteria and do not specify how vendors are to achieve those criteria. It is anticipated that fingerprint technology will be proposed by all vendors in order to meet the specified criteria.

❺ Consider using two OCR engines to reduce the amount of manual image review.

WSDOT Response: The RFP and amendment provide strict performance criteria for camera accuracy but do not specify how vendors are to meet these criteria.

OTHER RECOMMENDATIONS

❶ Establish an internal steering committee within WSDOT to maintain alignment of vendor and client expectations:

No more than 7 members.

Meet weekly while project is ongoing.

Chaired by the WSDOT project manager.

WSDOT Response: WSDOT acknowledges the importance of this recommendation and believes that they are well-positioned on this issue.

❷ Establish a liaison with the JTC to update on progress and issues.

WSDOT Response: WSDOT concurs and will continue to work closely with the JTC as the SR 520 project progresses.

❸ Select a WSDOT representative to direct the vendors and represent WSDOT.

WSDOT Response: Staff concurs with this recommendation and will rely upon its project manager to serve in this capacity.

❹ Retain the services of a general toll consultant to support the implementation of tolling on the SR 520 project and assist WSDOT as it continues to expand the use of tolls statewide. The ERP suggests a budget of $2 million for these services over a three-year term. The ERP believes this investment will greatly benefit WSDOT, particularly given the unique and cutting edge deployment of AETC and the move to a statewide CSC. In addition to providing expert toll consulting services, a general consultant will help to train WSDOT in-house staff and build institutional knowledge that can be leveraged for years to come.

Depth of expertise available on call:

- Traffic and revenue verification
- Toll operations
- ETC Toll systems
- Knowledge from other toll operators in the U.S.

WSDOT Response: Staff has concurred with this. The ERP is not currently aware of any effort to move forward with this.

❺ Fully develop the legal framework to support business rules and policies and prepare a package for legislative consideration addressing the following:

Violations process

Other business rules and policies

WSDOT Response: WSDOT concurs and is prepared to work closely with the legislature on these issues.

❻ Develop and pursue the toll pricing through the Transportation Commission.

WSDOT Response: Acknowledged and agreed.

- a glossary of terms
- standards and specifications
    - roadside equipment standards
    - software standards
- ETC lane processing
    - vehicle identification description
    - vehicle classification description
    - image collection description
- transaction clearing process
- financial clearing process
- violations processing
- lane/plaza level
    - hardware requirements
    - software requirements
    - interface requirements
- host/back office
    - hardware requirements
    - software requirements
- communications infrastructure
    - sizing based on potential transaction volume and record size
- banking requirements

- the legal framework for privacy
- legal and statewide policy framework for security
- statewide methods of secure communications such as:
    - Virtual Private Network
    - encryption standards
    - network integrity (failover procedures)
- archival standards
- security provisions against internal threats
- security provisions against external threats
- security dataflow
- security management organization
- hardware architecture standards for the prevention of intrusion

APPENDIX E. DATA TRANSFER DOCUMENT DETAIL

- data naming conventions
- data transfer timelines
- general data flow diagrams
- roadside transaction definitions
- valid account transaction definitions
- image file transfers
- file transfer acknowledgment standards
- detailed interface flow and record layouts
    - between internal operations
    - with external entities
- lists of authorized external providers
- transponder status definitions