Planning for New Fare Payment and Collection Systems: Cost Considerations and Procurement Guidelines

A Smart Card Alliance Transportation Council White Paper

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About the Smart Card Alliance

The Smart Card Alliance is a not-for-profit, multi-industry association working to stimulate the understanding, adoption, use and widespread application of smart card technology. Through specific projects such as education programs, market research, advocacy, industry relations and open forums, the Alliance keeps its members connected to industry leaders and innovative thought. The Alliance is the single industry voice for smart cards, leading industry discussion on the impact and value of smart cards in the U.S. and Latin America. For more information please visit http://www.smartcardalliance.org.

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1 Introduction

The management and operation of fare payment systems in the U.S. public transportation industry require considerable expenditure of labor and materials. The manufacture and distribution of fare media, ongoing equipment maintenance, and the collection and processing of cash may require agencies to spend 5–15% of their total revenue to collect fares. Industry-wide, this expense is even more striking when viewed against a total annual revenue of $10.3 billion generated in 2008.[1]

Transit agencies planning to upgrade fare collection systems must consider the entire range of cost implications associated with fare payment projects. This Smart Card Alliance Transportation Council white paper has two purposes: to outline an approach for planning and procuring a new fare payment system, and to present a cost model made available by the Smart Card Alliance Transportation Council for use in evaluating alternative payment systems.

Two keys for agencies contemplating a new system are scope and approach. Agencies should begin by examining their fare payment strategy (in simple terms, where is the agency today, and where does it want to be in the long term). The answers require an agency to examine how it collects fares today and set goals for how it would process fares in the future.

Fare systems have long investment lives and typically change once a generation, at best. Many U.S. systems currently use outdated technology that is challenging to maintain. Other transit systems have upgraded and invested in contactless smart card technology and are looking to refresh their systems with technology upgrades to meet the expectations of internal and external customers and potentially create new revenue streams through collaborative cross-industry partnerships.

Unfortunately, U.S. transportation agencies are challenged to keep pace with changes in technology. Consequently, agencies must look to future-proof their investments and prepare to change the way they do business internally.

To help set the context for the decision-making process, agencies should address the following questions:

- What are the investment objectives and desired outcomes?
- What are the key business drivers for a decision?
- What are the findings of a condition assessment of the current fare system?
- What is the size of agency, in terms of service area, current and forecast service types, current and forecast ridership, current and forecast service plans, and type of system (regional or non-regional)?
- What fare policy objectives and options are under consideration?
- How will the initiative be funded: capital funds, operating funds, or a combination; federal, state, or local funds or a combination; single year or multi-year availability?
- What will the solicitation framework look like—performance-based or directive-based?
- What procurement and contracting methodology will be used for the process?
- What key organizational issues must agencies address to ensure success?

This white paper presents a conventional approach for planning, conducting a cost analysis, and procuring a new fare payment system or upgrading an existing system. Additionally, a cost model is presented that allows the user to input an agency's current fare payment and fare collection costs and compare them to the costs for proposed alternative systems.

[1] National Transit Data Base, Fiscal Year 2008.

2 Planning for Fare Payment Modernization

Transportation is a capital-intensive industry, and transportation agencies strive to preserve their extensive physical plant in a state of good repair. Unlike rolling stock or heavy infrastructure projects, however, payment systems largely dwell within the continually evolving fields of telecommunications and information science; payment systems also use a variety of technologies and equipment, often require systems integration, and need extensive coordination with supporting capital projects. The multi-dimensional nature of payment projects obligates agencies to conduct rigorous planning and assessment to ensure that benefits, often measured in terms of increased revenues, reduced operating costs, and customer benefits, are commensurate with the project's substantial capital investment.

Modernizing fare collection operations affects a variety of agency-wide functions and activities, from financial management to customer service operations to service operational planning. Fare collection is unique in that it is the primary point of interaction with the customer. If the process is smooth and convenient, the perception of service quality is high. The fare collection user experience is arguably on a par with on-time performance in terms of its effect on customer satisfaction.

A fare modernization initiative must therefore consider multiple factors:

- Accessibility of media
- Choice of media
- Support for fare policy administration
- Transparency of fare policy
- Choice of payment options
- Simplicity of product purchase
- Speed of purchase, validation, and processing
- Up-time of equipment
- Availability of convenient self-service options
- Accurate and efficient data retrieval in support of attended customer service actions
- Security of personal information
- Prevention of fare abuse

How each factor manifests itself is unique to the size of the agency, the mix of transit modes, the demographic mix, and the operational characteristics of the specific environment. All must be considered in the planning process.

Transit managers embarking on a fare modernization initiative are advised to start with an assessment of current operations. The approach will vary from one property to another, depending on the age of the current fare infrastructure, the state of the deployed technology, the financial objectives of the agency, and the dynamics of the local payments market.

An assessment of current operations should include the following:

- The state of repair of existing fare collection assets
- An estimate of the remaining useful life of such assets and their capacity to be upgraded to accommodate current technologies
- The weaknesses and strengths of the existing system
- A review of regional mobility goals and the ability of the existing system to support intermodal fare processing
- The economic profile of current fare collection operations in terms of how much (net) an activity contributes to the agency's overall operating budget

This last point has given rise to a conceptual metric, the cost to collect a dollar. Components of this metric include capital amortization, preventive and corrective maintenance, spare parts, media acquisition, media distribution, customer support, IT management, communications, marketing, promotion, levels of fare evasion and fraud, and payments processing. When calculated as a percentage of revenue collected, the result can be expressed in terms of pennies on the dollar.

It has been common to see metrics for smart card-based fare modernization programs start at levels of around 15% (or $0.15 on the dollar) and reduce these levels to as low as 6%. Such a reduction depends on the size of the agency, achievable economies of scale, the asset deployment strategy (e.g., the presence of gating systems), operational strategies (e.g., attended or unattended stations), and the state of labor contracts. Several agencies have found that the most significant economic effect has resulted from the ability of technology to allow reductions in labor force and/or the transitioning of labor components to the private sector. With the advance of contactless bank card payments and the resulting convergence opportunities, new forms of privatization and public-private partnership programs are emerging.

It is recommended that the assessment process begin with a field study that visits agencies with a variety of operational profiles that have recently deployed new systems. Much can be learned from their experience and the choices made as to the overall fare strategy.

The second step in the planning phase requires that an agency create a framework to help guide the process for selecting a new payment system. This framework can take a variety of forms that include setting goals or defining system performance criteria. Performance factors may emerge simply by defining the advantages and disadvantages of the existing system, using the criteria listed in Table 1.

Table 1. Sample of Performance Criteria

Category	Criteria
Customer satisfaction	Ease of use Security/privacy Extended applications Regional use/coordination
Operations	Reliability Transaction time Fare disputes System transition
Management	Revenue accounting Revenue/ridership/data Fraud management Non-fare revenue Project risk Industry trends
Financial	Capital costs Operating and maintenance costs Contract costs

Agencies frequently want to retain the strengths of an existing system and eliminate or reduce system weaknesses.

Other considerations for the planning phase include coordination of other capital projects that may be required to support a new system, such as station modernization and “smart” technology initiatives. Finally, regional coordination policies may determine project direction, with the overall goal of creating seamless transfer among operators.

Fare policy and structure decisions have traditionally been made independent of payment systems and technology; however, advancing technologies and payment industry trends have increased the fusion between the two. Some of the factors influencing this fusion include:

- Ability to offer a wide variety of fare options using a single payment medium
- Expanded adoption of electronic stored value, including replenishment of a transit account
- Increased flexibility to consider distance-based or time-of-day pricing options
- Regional fare integration
- Influence of the banking industry and the use of bank-issued media to pay transit fares

Finally, the movement toward transactional database capability provides the transit operator with information that can improve operations through the analysis of ridership patterns by route and time period, leading to greater operating efficiency.

3 Developing a Cost Model

The payment system planning phase typically results in set of feasible alternatives for evaluation and comparison of operating, capital, and other cost parameters. Evaluation is often guided by a methodology or model designed to help the agency select the "best" option. The development of a cost model supports evaluation by systematically specifying costs across the entire payment system, including costs for technology, specific equipment types and quantities, staffing levels, and support, and then applying common financial analysis techniques to yield performance outcomes. In short, the model lays out competing options on a level playing field and creates transparency, allowing management to make an informed judgment about a significant capital investment and the trade-offs inherent in alternative operating models.

An agency's immediate concerns with large-scale capital projects of this type are often project cost in the first two years (usually the highest capital budget outlay) and operating and maintenance costs over the project life (lifecycle costs that affect the operating budget).

This section describes a cost model for payment systems that is easily modified to suit a variety of needs.[2] The model is available as an Excel workbook on the Smart Card Alliance web site,[3] and provides an interactive tool for agencies to use to assess different fare payment system alternatives.

3.1 Baseline Analysis

Agencies interested in completing an analysis on the impact of an investment in a new fare collection system should begin with a thorough analysis of current costs. A good baseline is essential to any comparison.

Cost Data Collection

Agency management information systems usually contain information on fare collection costs. However, since fare collection touches so many departments in an agency, it can be challenging to collect all costs. The Excel model identifies a wide range of costs and can assist the agency in determining the scope of this analysis.

Cost Allocation

Agencies report that costs as a percentage of revenue vary from 5% to 65%, depending on the mode of service that is analyzed and the allocation of costs across functions. Cost allocation is a subjective decision that can have a major impact. For example, in rail systems, conductors are responsible for fare collection as inspectors and, in certain cases, sales agents. However, agencies do not agree on what percentage of the total cost of conductors should be allocated to fare collection. Allocating administrative and executive costs also require subjective decisions.

The model attempts to reflect relative changes in cost structure only. If a certain function will not change in the new fare collection system, the agency can elect not to include those costs in the analysis; the costs associated with bus operators, for example, may not include any fare collection costs if their participation in fare collection remains the same.

Internal Business Processes

Different agencies use different processes to achieve the same function. For example, some agencies collect cash using a money train that collects from track-side, while others use an armored car service to collect from stations from the street. Different processes can affect both the initial baseline costs and the impact of a new approach. It is important for an agency to have descriptions of these processes, both to ensure that all costs are collected and to provide the basis for analyzing the impact of changes that result from a new approach. It is likely that many business processes will change in the new system.

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[2] The Excel model was initially developed by SEPTA, with revisions by Gerald Kane and the Transportation Council, and made available for industry use through the Smart Card Alliance Transportation Council.

[3] A beta version of the model is available at http://www.smartcardalliance.org. . T. T

3.2 New System Impact

The new system should be compared to the baseline and to other alternatives available to the agency. In making this comparison, it is important to consider the following issues.

Changes in Work Force

Various types of work force changes could be associated with major system changes or upgrades of this nature. The first example of changes in work force can result from the system improvements, because agencies will design the new system to streamline or eliminate outdated business processes. Generally speaking, existing positions responsible for the outdated business process are eliminated. The converse situation is also true; with these types of system changes, there is a good possibility that completely new positions will be needed to manage any new business processes associated with the major system change.

Another example of an agency's work force change could be mandated by the agency's overall financial health, which in itself could have an effect on the agency's ability to fund major system changes. In general, if an agency's financial condition is in good standing or improving then system upgrades are welcome, as are any required staff changes for these upgrades. This example of change in work force makes these types of system changes easier to accomplish.

The least favorable example of work force change is when agencies have to deal with downward trends in ridership and revenue; this results in a negative impact on the agency's financial condition and deployment of major system changes. When agencies must downsize because of this situation the reductions-in-force resulting from attrition and early retirement buy-outs have the most serious impact on deploying major system changes, because they typically result in an agency sacrificing a significant amount of historical system knowledge.

New Business Process Requirements

When an agency decides to initiate a procurement of this nature, new business processes have to be considered. These new processes can be either the driving force for a new fare collection system or the result of adopting a new system.

Generally speaking, it is better if an agency takes the time to anticipate new business requirements before beginning the procurement process so that new processes can be designed into the system. The appropriate agency staff can establish and concur on requirements that can then be included in a scope-of-work document associated with the procurement contract.

However, there will be situations where new requirements cannot be anticipated. In this case, as soon as a new business process has been identified, any new requirements should be defined and documented immediately so that they can be incorporated into the system design.

All new business process requirements must be approved by the agency staff who will be responsible for using them and for administering any related contracts. Typically new processes are approved as part of system acceptance, but to the extent possible, there should be some type of internal agency testing to ensure that the people involved in a new process have had an opportunity to exercise it. Routinely scheduled workshops are a good mechanism to ensure that a new system's business processes are completely vetted well in advance of system deployment.

Obsolete Business Process Phase-Out

Just as there will be new business process requirements, obsolete business processes will need to be phased out or eliminated as part of a new system deployment. In general, the more common, outdated business practices associated with physically collecting and counting revenues from traditional fare collection systems will need to be revamped during deployment of the new system.

Most transit agencies are finding that both the cost and the level of manual effort required to reconcile the financial data for their fare collection systems can be (and usually are) significantly reduced by adopting advanced technologies and e-commerce applications. These changes should force a paradigm shift in an agency's approach to revenue collection and reconciliation, which can have a major impact on the agency's infrastructure.

Infrastructure changes can range from minor shifts in the daily business routines for internal agency staff to more extensive facility changes. For example, if an agency operates large revenue collection/counting/holding facilities (and their associated personnel), these may no longer be required. If these more traditional fare collection infrastructure items are not currently deployed, fewer obsolete business infrastructure items will need to be eliminated, and the agency can focus instead on implementing a new business approach to fare collection.

Transition Management

Regardless of the situation at the agency, the approach to phasing out obsolete business processes and transitioning to new ones should be determined carefully. Agencies with a more comprehensive infrastructure might be better served by developing some type of hybrid approach where the old system continues even while the new system is in place to capitalize fully on the legacy infrastructure. The objective of a hybrid approach would be to eliminate obsolete business practices over a period of time, so that the agency could realize full value from current facilities and operations before they reach end of life. Managing the transition of an agency's applicable fare collection businesses is a very important aspect of deploying new systems and must be taken seriously.

Agencies will have a variety of decisions to make concerning the internal and external impact of transitioning to a new system. Internally, agencies will have choices between leveraging established agency facilities or outsourcing new or revised activities. A hybrid approach is one likely outcome as both service and human resource-related transition can be smoothed.

From an external perspective, patrons will be presented with new payment options and a revised user experience. Such changes must take place seamlessly, without impeding traffic flow during daily operations. Fare policy may also need to be revised to support any commercial agreements that may underpin the new program's economics.

All of these transition elements must be considered and planned for early in the process since they will have an impact on costs that are included in the model.

3.3 Payment System Cost Model Overview and Operation[4]

The payment system cost model was developed in an Excel workbook format and is available on the Smart Card Alliance web site. The model comprises several linked spreadsheets that capture the operating, capital, and maintenance costs of a current payment system and provides a format in which to compare the system with one or more alternative systems. As described below, the model requires the user to enter all cost data and related information, first for an agency's current payment system, and then for alternative systems for evaluation and comparison. The model is designed to provide the flexibility for a transit agency to model any type of alternative system; the model is adapted to different system alternatives by entering revenue and cost factors that are appropriate for that alternative. The model contains sample input data for illustration purposes only.

The model's overall purpose is to provide a tool for transit agencies and to examine the near- and long-term cost implications of purchasing new fare payment equipment and of adopting different technology alternatives. The selection of the "right" alternative is in part a capital investment problem. The analyst must calculate the return on an initial investment, inclusive of operating and maintenance costs over time, as well as the revenues or cost savings that result. Accordingly, the model uses net present value (NPV) to determine the value of an alternative by discounting cash inflow and outflow over the life of the project back to its present value. NPV is commonly used in capital investment analysis, since it provides a consistent means of addressing the changing value of money over the life of a project.

The cost model also includes a metric that measures revenue collection efficiency—the per-dollar expense of collected revenue. The model computes a ratio between the total amount of revenue collected and the fully allocated collection costs (such as labor, materials, and contract costs) required to

[4] NOTE: The Excel model is provided as an analysis research tool and should not be considered financial advice. The Smart Card Alliance and its members are not responsible for any errors, assumptions or any conclusions drawn from the information provided. The data provided is meant to provide a picture to be considered when making a business decision. It is not intended as strategic advice or as an investment-related projection.

operate and maintain the payment system. For example, assume that a transit agency collects an annual total of $50 million in passenger fare revenue and expends a total of $8.5 million in operating, maintenance, and other costs. The per-dollar expense of collected revenue is $0.17 (8.5/50 = .17). That is, the agency expends 17 cents in resources for each dollar of collected fare revenue. Agencies who wish to improve fare collection efficiency by investing in a new system should first establish a benchmark of current collection costs, which allows for evaluation of the performance of a variety of technology alternatives.

3.3.1 Model Operation and Description

The payment system model requires data entry through a user interface, in which embedded formulas calculate various aggregations and measures. All of the model inputs and outputs are described below. Appendix A includes screenshots showing the different input and output pages.

3.3.1.1 Summary

The Summary page shows the results. (Sample data is included for illustration.) Generally, no data is entered directly into this page. It displays the values that result from the data input into the other sections. In short, this is the model output page and shows the costs of alternative payment systems and their performance based on data input by the user. Highlighting a particular cell will display the formula and location where the result is derived.

3.3.1.2 Baseline

The Baseline page describes the current situation. Generally, the Baseline page includes all equipment maintenance, replacement needs, and operations of the current system, with the assumption that only limited capital investment is required to maintain the system in a state of good repair. To complete this page, the user decides on the future capital and maintenance requirements necessary to continue system operations without significant upgrades to equipment or technology. This data represents a baseline alternative with which to compare alternative options. For the baseline alternative and all other alternatives, costs are entered for each year with an assumption of 15 years of project life. The page includes categories for all major transit modes, but users may choose to delete (or enter zero) for cost items associated with modes that are not applicable for their agencies.

3.3.1.3 Capital

The Capital pages specify the costs for replacement or significantly upgraded payment alternatives. New bus fare boxes, fare gates, and other capital equipment are identified and cost estimates for the life of the project are entered. Capital input is organized by transit mode, and the user may choose to input some or all of the data as determined by the agency's technology and direction. Major infrastructure categories such as new communication systems (e.g., optical fiber) or facility improvements (such as station overhaul) are not listed but may supplement the capital category.

3.3.1.4 Fare Media

The Fare Media page allows the user to select the various fare media types being considered for the future options. This page is also organized by transit mode, and the table displays a variety of fare media types common to new payment systems. The user is asked to identify the quantity of fare media and media costs over the project life for each of the alternatives under consideration.

3.3.1.5 Present Staffing

The Present Staffing page addresses payment system labor costs and identifies job titles and number of positions included in the agency's operating budget. The user must identify the number of all full- and part-time employees who support the payment system (especially the portion of a full-time employee's time spent on fare collection duties) and input the annual costs of the current system. A value for fringe benefits is included in the table. This page is one of the important benchmarks for calculating the cost performance of alternatives.

3.3.1.6 Staffing

The Baseline and Alternatives Staffing pages adjust the values entered in the Present Staffing page to reflect the labor positions and costs required to support the proposed fare payment systems. The Reference page, described below, shows actual position titles and associated labor costs. Labor expenses are entered for each year of a project's life.

3.3.1.7 Operating Costs

Most agencies would expect a new system to be introduced over time. Therefore, the baseline system and the new system will be operational during a transition period. Operating costs during the transition period will be a blend of both. Analysts will need to factor this into the proposed alternatives.

3.3.1.8 Assumptions

The model includes the assumptions used to develop the model and is self-explanatory. The user can modify these assumptions as necessary.

3.3.1.9 Reference

The Reference page serves as a look-up table for economic assumptions about inflation, increased material costs, and various other assumptions. It also averages salary rates for operating positions added or reduced by a fare payment alternative. Also included is an estimate for the annual amount of revenue collected, an assumption that may change with each alternative.

3.3.1.10 Graphing Information

The Graphing Information page includes a series of charts illustrating cost comparisons among the alternatives for operating, maintenance, and capital over the life of the project.

4 Procurement and Contracting Considerations

4.1 Introduction

The procurement or system acquisition stage of a new fare system project presents unique challenges to public agencies unfamiliar with acquiring information technology (IT) systems or intelligent transportation systems (ITS). On the one hand, system procurement requires flexibility, to manage the uncertainties of acquiring a complex system, while on the other, it requires a structure, to define responsibilities and ensure that all participants are protected. Ultimately, the agency must strike a balance between the two requirements and design the procurement to ensure that the most qualified contractors and suppliers are selected.

This section discusses the major steps involved in the procurement process. However, because many factors govern the approach and execution of the process, the process may vary considerably from agency to agency. During the 1990s and in early 2000, for example, several agencies in the United States procured new automated fare collection systems after lengthy planning, design, and implementation stages. The new systems were based on very detailed specifications and requirements that met agency needs for end-to-end solutions. The time requirements and overall complexity of such projects offered valuable lessons to other agencies that were just beginning the process of fare collection upgrade. As a result, new approaches and techniques have emerged to manage procurement in an incremental manner, which allows for better understanding of how the system will operate and provides an alternative to the conventional end-to-end solution. Recent experience has also shown that the procurement method can have substantial influence on the ultimate success of any ITS project, including an electronic fare payment system. The procurement method governs how responsibilities are distributed and decisions are made, as well how much control is exercised by the contracting agency.

Regardless of the specific approach taken, however, the agency must first clearly define a project vision, definition, scope, and mission in non-technical terms, to ensure that all stakeholders understand the intent of the project. To achieve this, agencies often prepare a concept of operations—a document that describes the operation of the system being developed from the various stakeholder viewpoints. This document defines the user requirements for system operations. The users and other stakeholders can review the document, provide feedback, and validate these key assumptions. A typical concept of operations document covers the following information:

- The scope of the project
- All referenced documents
- A description of the current system
- Justification for and the nature of the changes
- A conceptual basis for the proposed system
- Operational scenarios
- Summary of the impact of the proposed changes
- Analysis of the proposed system

The concept of operations describes the context within which the new system must operate. It takes into account the environment, stakeholder objectives, and project feasibility. Most important, it communicates to system developers and users, in non-technical language, how the system fits into existing operations and systems. Publication of the document helps communicate the vision of the system to all stakeholders (i.e., other affected agencies, organizations, and individuals). Lastly, it forms the basis for high level requirements for the system and for ultimately validating that the completed system does what it was intended to do.

4.2 Procurement Planning

After creating the concept of operations document and determining overall technical feasibility, the agency must develop a project budget and schedule. Inputs include maximum current year funding, maximum out-year funding, and maximum funding available for operations and maintenance. Other considerations include personnel available for implementation, operations, and maintenance, and

additional resource requirements such as space availability and facilities. In short, determining overall cost and implementation feasibility is critical before moving forward into the procurement phase. This process involves careful review of project phases and budget and schedule constraints, and the development of cost, schedule, and resource estimates.

Agencies have a number of options for procuring a new fare payment system, and the procurement approach selected stems from the outcome of the project planning and evaluation stages discussed above. Figure 1 illustrates the connection between the planning and procurement stages and shows the series of steps that eventually result in completing the procurement.[5] As the figure indicates, there may be an opportunity to acquire a commercial-off-the-shelf (COTS) system. While adoption of a completely generic new payment system is unusual, another agency may have developed and procured a system similar to the one being proposed. Their procurement experience may represent a unique learning opportunity. And while such a system is not exactly a COTS system, adoption of it may have the following benefits:

- The system has been previously tested
- The cost for system upgrades can be shared with other agencies
- The system can be viewed in operation before procurement

Realistically, most payment systems are hybrids: a design that fits into an agency's existing operations with the inclusion of both COTS and custom components.

Procurement planning is followed by an analysis of the contracting process, that is, the actual contracting alternatives available to the agency (discussed below). The selection of an alternative is followed by the work required to prepare a request for proposals (RFP), which includes developing the work statement, requirements, and specifications; establishing the criteria for selection; and, finally, defining the operations and maintenance plan for the new system.

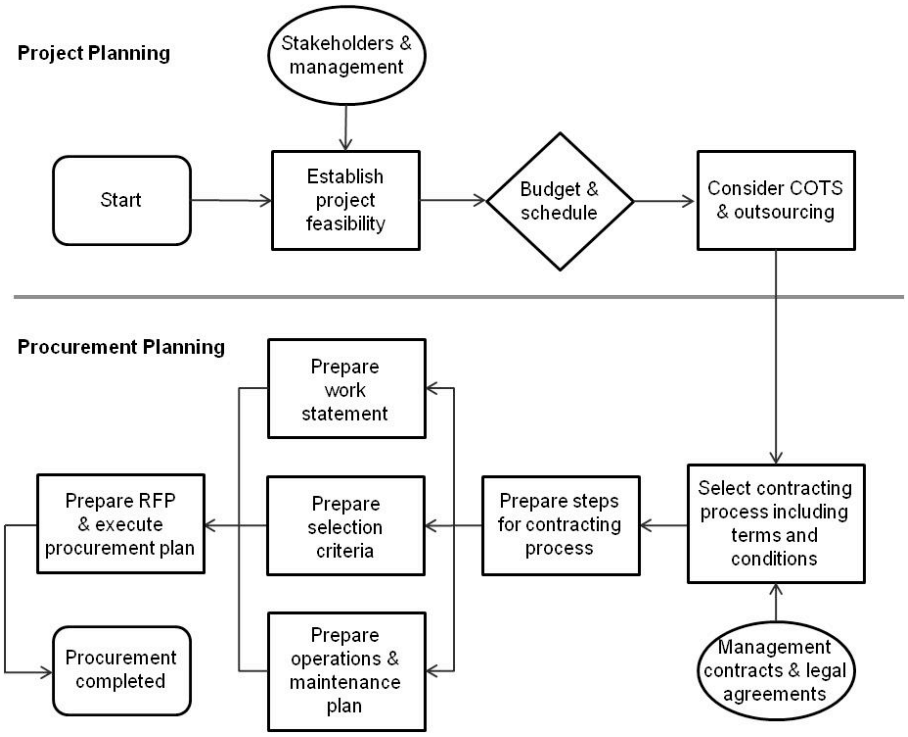

Figure 1. Overview of Tasks Required by the Project and Procurement Planning Process

[5] *Guide to Contracting ITS Projects*, National Cooperative Highway Research Program Report 560, Transportation Research Board, Washington, D.C., 2006.

The procurement phase next moves to the preparation of an RFP, vendor solicitation, and the selection of the preferred vendor.

Overall, the procurement phase includes the process of selection, negotiation, and execution of documents that define the relationships between the purchaser and the supplier. Further, it sets the stage for the success or failure of the project and defines many of the activities associated with the project, including:

- Customer responsibilities
- Form of specifications
- Selection process
- Types of suppliers
- Relationship between customer and supplier

From a broad perspective, many of the above considerations are the same as considerations for other products and services commonly procured by transit agencies. Increasingly, many transit agency capital projects involve the field of systems engineering, a field that integrates multiple disciplines and specialty groups into a team that carries out a structured development process proceeding from concepts to production and operation.[6] As the payment system project is more completely defined and the steps in the procurement process are identified, it is also necessary to invoke the general principles of project management germane to the contracting tasks. These principles have evolved from recognition of the unique characteristics of software-based systems and the challenging task of developing reliable cost and schedule estimates for system development. Some of these principles include:[7]

- **Collaboration**. Software-based projects require a close working relationship between the agency and the contractor to understand agency needs and business processes, clarify uncertainties in specifications, fully define all functions, and modify work as necessary to meet the needs of users and stakeholders.
- **COTS solutions**. COTS solutions can offer a number of advantages over the deployment of unique software, including the acquisition of a relatively mature (previously tested) package, the economic benefits of sharing the cost of upgrades with other agencies, and the ability to acquire capabilities that can be observed before system acquisition is initiated.
- **Pre-qualifications/certification**. Agencies have the option of requiring vendors to demonstrate their qualifications before their proposals are evaluated.
- **Organizational considerations**. Software and systems integration activities often represent the greatest risk to IT and complex fare payment projects. Whenever practical, the project management and organizational structure should permit the agency and the software developer or systems integrator to collaborate on the work and make adjustments as the work progresses.

4.3 A Generic Procurement Model

Four dimensions of procurement are shown in Figure 2: contracting alternatives, award method, contract form, and contract type. Contract terms and conditions are of equal importance and in effect represent a fifth contracting dimension. The options associated with each of the dimensions define the best contracting direction for an individual agency.

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[6] *Systems Engineering for Intelligent Transportation Systems Handbook*. California Department of Transportation and the U.S. DOT Federal Highway Administration, 2007.

[7] Phillip J. Tarnoff, *Considerations for a Guide to Contracting ITS Projects*, prepared for NCHRP, Transportation Research Board.

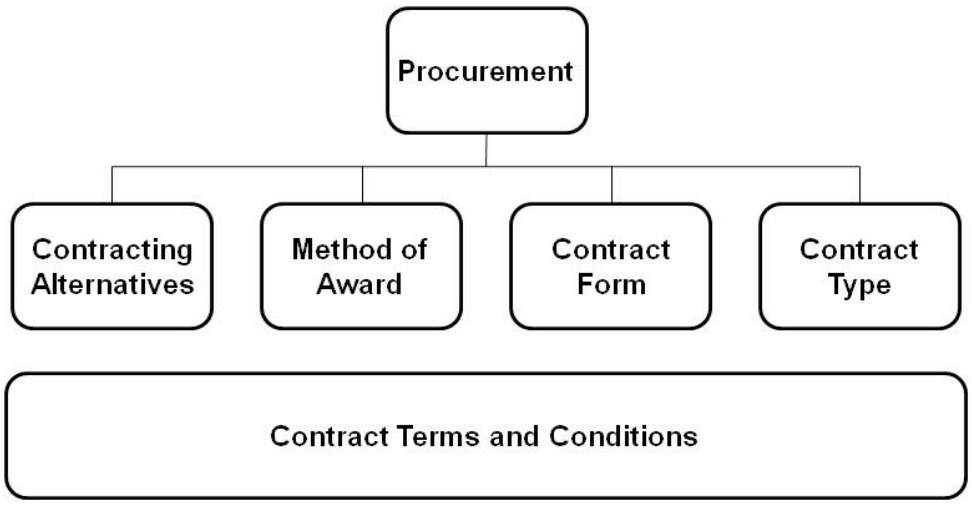

Figure 2. Dimensions of Procurement

4.3.1 Contracting Alternatives

Different contracting alternatives define different project responsibilities for a contractor.

- **Consultant Services**. The agency selects a consultant to design a system. The system design constitutes system requirements and specifications. The contract may include services to assist the agency during system implementation.
- **Systems Manager**. The agency hires a system manager through a consultant selection process. The manager participates in all phases of system implementation, including planning, design, development and testing.
- **Design/Build**. A design/build agreement provides for design and construction of improvements by the contractor and is often preceded by preparation of a partial design (sometimes designated as a 30% design).
- **Task Order**. Unlike the above options, task orders do not assign project responsibility but are used to acquire services or supplies as needed during the project. Task orders are used in conjunction with either the systems manager or design/build alternative.

4.3.2 Method of Award

The method of award defines the criteria used and the steps taken to select a contractor.

- **Low Bid**. Commonly referred to as sealed bidding, this method employs competitive bids, public opening of bids, and low price awards.
- **Negotiation**. Negotiation allows considerable flexibility and typically relies on evaluation of a technical approach, qualifications, and experience as represented in a technical proposal and subsequent presentations to the agency.
- **Best Value**. The best value method combines the features of negotiated and low bid procurements. Contractors submit their proposals for evaluation and negotiations with the procuring agency. The proposal selected is the proposal that offers the best value to the agency.
- **Sole Source**. Sole source selects a contractor without competition.

4.3.3 Contract Form

The contract form chosen defines how the work is authorized.

- **Phased Contracts**. Phased contracts divide the work into predefined phases, and the contractor is authorized to begin work on a particular phase when a letter to that effect is issued by the agency.
- **Task Order**. Task orders (or indefinite delivery) are used when the supplies and services required are unknown at the time of contract execution. Task orders allow the agency to place orders for these supplies and services as needed over the term of the contract.
- **Purchase Orders**. Purchase orders are a form of sole-source contracting used for relatively small procurements. The cap on the size of purchase order contracts varies among agencies but is usually less than $50,000.

4.3.4 Contract Type

Contract types define how contractors are reimbursed for their services. The reimbursement method specified also applies to the payment of any performance incentives or penalties.

- **Fixed Price Contract**. A fixed price contract places the risk and full responsibility for all costs and profit on the contractor. Post award, the price cannot increase, regardless of the costs incurred by the contractor during performance.
- **Cost Reimbursement**. A cost reimbursement contract establishes an estimate of the total cost of the project that constitutes an expenditure ceiling. The contractor cannot exceed this ceiling without the approval of the agency. The contractor is also paid a fixed fee in addition to being reimbursed for the actual cost of performing the work. Thus, while the contractor is guaranteed a profit (in contrast to fixed price contracts, where the contractor can lose money), the amount of profit as a percentage of total cost can vary considerably.
- **Time and Materials**. Time and materials agreements procure supplies and services based on labor hours at agreed-upon fully burdened fixed hourly rates and materials at cost, including handling fees. Time and materials contracts are generally used when it is difficult to estimate the extent and duration of the contractor's work. This type of contract places considerable risk on the agency and requires careful contract monitoring and oversight.
- **Incentive Contracts**. Incentive contracts motivate contractors who otherwise might not be motivated and discourage contractor inefficiency and waste. Predetermined formulas for incentives allow for increases in profit or fees only for achievements that surpass fixed targets. Decreases in profit result when such targets are not met. The incentive increases or decreases are applied to performance targets rather than minimum requirements.

The importance of selecting an appropriate type of contract and contract method for the procurement process cannot be overstated. This generic contracting model defines attributes commonly associated with transportation project procurements, including ITS and fare payment projects. It serves as a starting point and allows agencies to consider innovative contracting approaches that minimize time and resource requirements from project planning through implementation, final acceptance, and completion.

4.4 Recent Procurement Experience and Approaches to Fare Payment Projects

Over the past few years, several transportation agencies in North America have procured new fare payment systems or system upgrades. Three agencies, the Port Authority of New York/New Jersey, the Utah Transit Authority, and the Southwest Ohio Regional Transit Authority (SORTA), requested proposals for payment systems that accept bank-issued cards and devices; these systems are now in the pilot test or implementation stage. The remaining agencies sought bids for conventional closed loop contactless systems.

Table 2 summarizes a sample of these procurements.

Table 2. Recent Fare Payment System Procurements[8]

Organization/ Location	Procurement Approach	Procurement Method	Selection Criteria (Most important first)
GO Transit/ Toronto	Design/Implement/ Operate/Maintain Contract for planning design, installation operations, and maintenance of a closed loop system	Negotiated procurement; RFP, cost, and other factors	• Mandatory requirements • Rated requirements • Concept demonstration • Interviews • Price
Miami Dade Transit/Florida	Propose/Deliver Contract for service-proven, state-of-the-art equipment and system, closed loop system	Negotiated procurement; RFP, cost, and other factors	• Technical solution—including hardware, software, and integration support (30 points) • Price (30 points) • Approach to providing services (20 points) • Qualifications (20 points)
NY/NJ Port Authority	Design/Implement Pilot Project Contract for equipment, system, and services, including debit and credit card acceptance	Negotiated procurement; RFP, cost, and other factors	• Business proposal • Financial—proposed terms, fees and revenue opportunities • Management proposal
Utah Transit Authority/Salt Lake City	Design/Implement/ Operate/Maintain Contract for installation, operations and maintenance for open, real-time, payment system	Best value/ negotiated procurement; RFP	• Best value • Response to requirements • Relevant project experience
SORTA/ Cincinnati	Contract for bank-issued payment devices and use of contactless bank cards	Negotiated procurement; RFP, cost, and other factors	
Port Authority of Allegheny County	Contract for a contactless smart card closed loop system	Negotiated procurement; RFP, cost, and other factors	• Disadvantaged Business Enterprise (DBE) utilization (2 points) • Experience record (10 points) • Project work plan (45 points) • Project organization and management plan (8 points) • Summary of costs (35 points)

Recent trends in system procurement point toward the use of (or at least the consideration of) bank-issued cards for transit fare payment. The appeal of an open payment system stems in part from the availability of mature industry standards and the idea that a payment device can become a commodity; in other words, to move away from a customized system toward a model that is indistinguishable from merchant payment systems. The advent of bank card use may influence an agency's procurement approach in a variety of ways.[9]

1. Greater Reliance upon Requests for Information

[8] Source: SEPTA research, 2009

[9] Craig Roberts, *Observations on Acquiring an Electronic Fare Collection System*, Utah Transit Authority, Payment Council Summit, February 24, 2009.

The use of bank cards within the transit environment requires the agency to foster partnerships and collaborate with a range of businesses and services. A request for information (RFI) provides the agency with a risk-free ability to acquire an in-depth understanding of the businesses and services that are pivotal to any electronic fare payment project, such as telecommunications, web hosting, banking services, back-end processing, and customer service. The RFI step introduces some informality into the otherwise formal and structured procurement process and allows for informal discussions and sharing of draft requirements for vendor comment.

2. Use of Thin Specifications

The use of thin specifications redirects the procurement model and effort toward clarifying functions and requirements, in contrast with the extensive, performance-based technical specifications required by conventional fare payment systems. The project requirements are published based on the agency's understanding and desires about how the system should function, not how to design and install it. Transit agencies rarely require cutting edge technology; rather, they require the coordination of existing technologies to operate effectively.

3. The Power of Pilot Projects

Conducting a pilot project with a small segment of the operation offers a low risk, low cost means of understanding the business and technical issues of an end-to-end system solution. Further, this testing generates support by providing tangible evidence of how new technology works in the real world and allows the agency to refine the project requirements.

4. Collaboration

Despite an agency's best efforts to define requirements, identify business rules, and estimate equipment and support needs, many of a project's details remain unknown until implementation begins. For this reason, the vendor and the agency must share ownership of the project and collaborate to ensure project success.

5. Contractual Considerations

The need for collaboration affects the selection of the contract type. Fixed price, turnkey contracts may create adversarial conditions, whereas cost-plus-fixed-fee contracts may contribute to more of a partnership arrangement. Other considerations include the need for incentives rather than penalties and the need for the agency to share risk with the vendor.

5. Summary

This white paper emphasizes the need for transit agencies to consider the role played by cost analysis when planning and procuring new fare payment systems. Fare payment and collection activities often reside within a wide range of agency operations: media manufacture and distribution, media sales, inventory control, cash collection, processing, and transport, for example, are all part of the fare payment landscape. With this in mind, agency personnel need to understand, define, and capture all costs associated with the fare payment function to establish a baseline for comparison of new or upgraded alternatives. This baseline provides the agency with a complete understanding of the resources needed for current operations, and serves as a guide to identify and evaluate alternative fare systems.

Equipment and technology are not the only considerations. Fare policy and structure must also be considered. For example, agencies are advised to assess current conditions as a way to formulate goals for new systems or derive measurement criteria to evaluate new systems: current fare-box return, the equipment's remaining useful life, or the need for regional fare integration are the starting points from which to frame the issues associated with and the requirements for future improvements. This information helps narrow the alternatives. The outcome of the planning effort is a group of alternatives that are sufficiently defined and specified to enable cost evaluation.

A cost model has been made available by the Smart Card Alliance Transportation Council that can be used as a tool not only to evaluate the cost implications of new system alternatives but also to identify how current system costs will change. The model is composed of a series of tabs, or worksheets, in which the user enters the cost estimates for the alternatives identified during the planning phase. All costs linked with capital, operating, maintenance, and contractual functions are estimated for each alternative. In addition, the user must specify a variety of assumptions related to workforce changes, financial considerations, and equipment lifecycle needs. The model yields a number of outputs that allow a comparison and analysis of alternatives.

The final issues associated with implementation of a new fare payment and collection system are procurement and contracting requirements. In the procurement phase, agencies are advised to define the project requirements fully and prepare a concept of operations that captures the project vision for all stakeholders. As the project moves from the planning into the procurement phase, various contracting options are available to the agency, for which the key elements are the contract form, type, and method of award.

6. Publication Acknowledgements

This report was developed by the Smart Card Alliance Transportation Council to present a conventional approach for planning, conducting a cost analysis, and procuring a new fare payment system or upgrading an existing system. Additionally, a cost model is presented that allows the user to input an agency's current fare payment and fare collection costs and compare them to the costs for proposed alternative systems.

Publication of this document by the Smart Card Alliance does not imply the endorsement of any of the member organizations of the Alliance. The Excel model is provided as an analysis research tool and should not be considered financial advice. The Smart Card Alliance and its members are not responsible for any errors, assumptions or any conclusions drawn from the information provided. The data provided is meant to provide a picture to be considered when making a business decision. It is not intended as strategic advice or as an investment-related projection.

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About the Smart Card Alliance Transportation Council

The Transportation Council is one of several Smart Card Alliance Technology and Industry Councils, focused groups within the overall structure of the Alliance. These councils have been created to foster increased industry collaboration within a specified industry or market segment and produce tangible results, speeding smart card adoption and industry growth.

The Transportation Council is focused on promoting the adoption of interoperable contactless smart card payment systems for transit and other transportation services. Formed in association with the American Public Transportation Association (APTA), the Council is engaged in projects that support applications of smart card use. The overall goal of the Transportation Council is to help accelerate the deployment of standards-based smart card payment programs within the transportation industry.

The Transportation Council includes participants from across the smart card and transportation industry and is managed by a steering committee that includes a broad spectrum of industry leaders.

Transportation Council participation is open to any Smart Card Alliance member who wishes to contribute to the Council projects. Additional information about the Transportation Council can be found at http://www.smartcardalliance.org/about_alliance/councils_tc.cfm.

Trademark Notice

7 Appendix A: Cost Model Input and Output Pages

The following are examples from the beta version of the Excel cost model. Comments and questions on the model should be sent to transit-model@smartcardalliance.org. ***NOTE: This model is provided as an analysis research tool and should not be considered financial advice. The Smart Card Alliance and its members are not responsible for any errors, assumptions or any conclusions drawn from the information provided. The data provided is meant to provide a picture to be considered when making a business decision. It is not intended as strategic advice or as an investment-related projection.***

4.4.1 Summary Page

The Summary page shows the results. (Sample data is included for illustration purposes only.) Generally, no data is entered directly into this page. It displays the values that result from the data input into the other sections. In short, this is the model output page and shows the costs of alternative payment systems and their performance based on data input by the user. Highlighting a particular cell will display the formula and

	Comparison of Alternatives	PRESENT			BASELINE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4		
		Cost in Year 1 ('99 $000)	Total Cost Years 1-15 Escalated $	Total Cost Years 1-15 (NPV)	Cost in Year 1 ('99 $000)	Total Cost Years 1-15 (Escalated $)	Total Cost Years 1-15 (NPV)	Cost in Year 1 ('99 $000)	Total Cost Years 1-15 (Escalated $)	Total Cost Years 1-15 (NPV)	Cost in Year 1 ('99 $000)	Total Cost Years 1-15 (Escalated $)	Total Cost Years 1-15 (NPV)	Cost in Year 1 ('99 $000)	Total Cost Years 1-15 (Escalated $)	Total Cost Years 1-15 (NPV)
Note	st Category		(Note A)	(Note B)												
	Capital Cost															
	Subway-				1,630,000	7,006,903		8,545,500	9,830,197		22,705,000	24,314,444		23,995,000	25,632,193	
	Bus				2,755,200	12,595,870		15,100,000	19,733,417		16,860,000	16,980,000		11,094,000	11,188,347	
	Commuterl Rail				35,000	153,047		4,612,500	4,612,500		12,175,000	12,175,000		4,565,000	4,592,749	
	Subtotal-Capital Cost by Mode				4,420,200	19,755,819		28,258,000	34,176,114		51,740,000	53,469,444		39,654,000	41,413,289	
C	Percent add-ons (rate) 35.68%				1,577,127	7,048,876		10,082,454	12,194,037		18,460,832	19,077,898		14,148,547	14,776,261	
D	Tokens, Smart Cards				400,000	4,090,062		400,000	4,090,062		1,950,000	6,646,634		627,993	33,307,954	
	Subtotal-capital cost				1,977,127	11,138,938		10,482,454	16,284,099		20,410,832	25,724,532		14,776,540	48,084,215	
	SUBTOTAL CAPITAL				6,397,327	30,894,757		38,740,454	50,460,213		72,150,832	79,193,976		54,430,540	89,497,504	
	Operating Costs															
	Labor	42,900,967			43,591,017	814,593,680		43,202,017	803,510,596		39,193,637	675,483,744		42,786,087	756,993,385	
	Fare Media	1,172,409			1,941,000	26,680,327		2,810,000	46,425,234		1,196,000	23,259,569		2,350,000	33,213,636	
	Subtotal-Operating Cost	44,073,376			45,532,017	841,274,008		46,012,017	849,935,830		40,389,637	698,743,312		45,136,087	790,207,020	
	Maintenance Costs															
	Maintenance Staffing	2,704,909			3,149,909	67,970,512		3,679,909	68,442,311		3,714,909	69,093,273		2,864,909	53,284,196	
	Maintenance Materials	945,185			514,000	16,331,056		592,000	12,476,545		625,000	10,027,899		632,835	10,186,680	
	Subtotal-Maintenance Cost	3,650,094			3,663,909	84,301,567		4,271,909	80,918,855		4,339,909	79,121,171		3,497,744	63,470,876	
	Contractual Cost	4,808,394			4,808,394	87,612,666		4,808,394	87,612,666		4,808,394	87,612,666		4,808,394	87,612,666	
	SUBTOTAL O&M	52,531,864			54,004,320	1,013,188,241		55,092,320	1,018,467,352		49,537,940	865,477,150		53,442,225	941,290,563	
	TOTAL YEAR 1 COST	**52,531,864**			**60,401,647**			**93,832,775**			**121,688,772**			**107,872,765**		
	LESS REVENUE GAIN							**(1,568,500)**			**(3,137,000)**			**(1,568,500)**		
	NET TOTAL YEAR 1 COST							**92,264,275**			**118,551,772**			**106,304,265**		
	TOTAL COST, $ IN YEAR SPENT					**1,044,082,999**			**1,068,927,565**			**944,671,126**			**1,030,788,067**	
	NET PRESENT VALUE OF TOTAL FUTURE COST						**605,847,052**			**630,889,683**			**567,634,541**			**616,024,228**
E	**YEAR 1 O&M COST PER $ COLLECTED**			**0.175**			**0.180**			**0.184**			**0.165**			**0.178**
	Incremental Operating Cost (Compared to Present)					1,458,641			1,938,641			(3,683,739)			1,062,711	
	Incremental Maintenance Cost (Compared to Present)					13,815			621,815			689,815			(152,350)	

location where the result is derived.

4.4.2 Baseline

The Baseline page describes the current situation. An example for subways is shown below. Generally, the Baseline page includes all equipment maintenance, replacement needs, and operations of the current system, with the assumption that only limited capital investment is required to maintain the system in a state of good repair. To complete this page, the user decides on the future capital and maintenance requirements necessary to continue system operations without significant upgrades to equipment or technology. This data represents a baseline alternative with which to compare alternative options. For the baseline alternative and all other alternatives, costs are entered for each year with an assumption of 15 years of project life. The page includes categories for all major transit modes, but users may choose to delete (or enter zero) for

Alternative	Mode	Equipment/Modification Type	Quantity	Unit cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	TOTAL
Baseline	**Subway**	Devices - Coin/token	100	6,000	600,000															600,000
		Change Machines	140	7,000	980,000															980,000
		Turnstile reprogramming	1	50,000	50,000															50,000
		Turnstiles	200	15,000								3,000,000								3,000,000
		Turnstile Computer	2	5,000						5,000					5,000					10,000
		Turnstile system software	1	40,000						40,000										40,000
		Booth Processors	170	1,000						85,000					85,000					170,000
		Electrofare	153	2,500								382,500								382,500
		Pass Gates *	10																	0
		Rotogates *	260																	0
		TVMs	55	7,000						385,000										385,000
		subtotal			1,630,000	0	0	0	0	515,000	0	3,382,500	0	0	90,000	0	0	0	0	5,617,500
		Engineering			163,000					51,500		338,250	0		9,000					561,750
		Installation			130,400					41,200		270,600	0		7,200					449,400
		Support			97,800					30,900		202,950	0		5,400					337,050
		Contingency			163,000					51,500		338,250	0		9,000					561,750
		subtotal			554,200	0	0	0	0	175,100	0	1,150,050	0	0	30,600	0	0	0	0	1,909,950
		Total Future Cost for Equip./Mod.			2,184,200	0	0	0	0	824,015	0	5,741,699	0	0	166,939	0	0	0	0	8,916,853
		Maintenance materials			289,000	317,900	349,690	384,659	423,125	465,437	511,981	563,179	619,497	681,447	749,592	824,551	907,006	997,706	1,097,477	9,182,247
		Total future cost of equip./mod. and materials			2,473,200	317,900	349,690	384,659	423,125	1,289,453	511,981	6,304,878	619,497	681,447	916,530	824,551	907,006	997,706	1,097,477	18,099,100
		Total Present value as of the year 2000			2,473,200	282,930	293,606	304,686	316,184	909,013	340,497	3,955,758	366,679	380,516	482,817	409,776	425,240	441,286	457,939	11,840,128

cost items associated with modes that are not applicable for their agencies.

4.4.3 Capital

The Capital pages specify the costs for replacement or significantly upgraded payment alternatives. The example below shows entries for capital costs for an alternative system. New bus fare boxes, fare gates, and other capital equipment are identified and cost estimates for the life of the project are entered. Capital input is organized by transit mode, and the user may choose to input some or all of the data as determined by the agency's technology and direction. Major infrastructure categories such as new communication systems (e.g., optical fiber) or facility improvements (such as station overhaul) are not listed but may supplement the capital category.

Alternative	Mode	Equipment/Modification Type	Quantity	Unit Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	TOTAL
Alternative 2	**Subway**	Upgrade turnstiles	200	15,000	3,000,000															3,000,000
		Devices-Coin/Token	150	10,480	1,050,000										522,000					1,572,000
		Turnstile TPUs	166	5,500	913,000															913,000
		Upgrade booth processors	85	5,000	425,000															425,000
		Replace TVMs	55	7,000	385,000															385,000
		Booth TPUs	150	7,000	1,050,000															1,050,000
		Money Room Equipment	1	100,000	100,000															100,000
		Network	1	500,000	500,000															500,000
		Turnstile computer	1	16,000						8,000					8,000					16,000
		Booth processors	85	4,000						170,000					170,000					340,000
		Electrofare	153	2,500	382,500															382,500
		Turnstile system software	1	40,000	40,000															40,000
		Change machines	100	7,000	700,000															700,000
		subtotal			8,545,500	0	0	0	0	178,000	0	0	0	0	700,000	0	0	0	0	9,423,500
		Engineering			854,550	0	0	0	0	17,800	0	0	0	0	70,000	0	0	0	0	942,350
		Installation			683,640	0	0	0	0	14,240	0	0	0	0	56,000	0	0	0	0	753,880
		Support			512,730	0	0	0	0	10,680	0	0	0	0	42,000	0	0	0	0	565,410
		Contingency			854,550	0	0	0	0	17,800	0	0	0	0	70,000	0	0	0	0	942,350
		subtotal			2,905,470	0	0	0	0	60,520	0	0	0	0	238,000	0	0	0	0	3,203,990
		Total Future Cost for Equip./Mod.			11,450,970	0	0	0	0	284,805	0	0	0	0	1,298,411	0	0	0	0	13,034,187
		Maintenance materials			300,000	315,000	330,750	347,288	364,652	382,884	402,029	422,130	443,237	465,398	488,668	513,102	538,757	565,695	593,979	6,473,569
		Total future cost of equip./mod. and materials			11,750,970	315,000	330,750	347,288	364,652	667,690	402,029	422,130	443,237	465,398	1,787,080	513,102	538,757	565,695	593,979	19,507,756
		Total Present value as of the year 2000			11,750,970	280,349	277,704	275,084	272,489	470,695	267,372	264,850	262,351	259,876	941,411	254,996	252,590	250,207	247,847	16,328,792

4.4.4 Fare Media

The Fare Media page allows the user to select the various fare media types being considered for the future options. This page is also organized by transit mode, and the table displays a variety of fare media types common to new payment systems. The user is asked to identify the quantity of fare media and media costs over the project life for each of the alternatives under consideration.

Alternative	pital/ Operat	Type of Fare Media	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	TOTAL
Baseline 1	**Operating**	Magnetic Passes	1,000,000	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	1,122,267	16,711,738
		RR Paper Tickets	150,000	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	2,374,600
		Paper Transfers	35,000	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	33,369	502,166
		Paper day passes	6,000	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	6,356	94,984
		Bank Fees-Expenses	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	11,250,000
		Total	1,941,000	2,070,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	1,320,892	21,183,488
		Total future cost	1,941,000	2,197,009	1,443,374	1,486,676	1,531,276	1,577,214	1,624,531	1,673,266	1,723,464	1,775,168	1,828,423	1,883,276	1,939,774	1,997,968	2,057,907	26,680,327
		Total present cost	1,941,000	1,955,330	1,211,885	1,177,586	1,144,258	1,111,874	1,080,406	1,049,828	1,020,116	991,245	963,191	935,931	909,442	883,703	858,693	17,234,487
	Capital	Tokens	400,000	0	0	0	1,000,000		400,000					400,000	1,000,000			3,200,000
		Total future cost	400,000	0	0	0	1,159,274	0	491,950	0	0	0	0	570,304	1,468,534	0	0	4,090,062
		Total present cost	400,000	0	0	0	866,277	0	327,175	0	0	0	0	283,424	688,506	0	0	2,565,381
	Contractual	Various	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	73,115,910
		Total future cost	4,874,394	5,171,245	5,326,382	5,486,173	5,650,759	5,820,281	5,994,890	6,174,736	6,359,979	6,550,778	6,747,301	6,949,720	7,158,212	7,372,958	7,594,147	93,231,955
		Total present cost	4,874,394	4,602,389	4,472,133	4,345,563	4,222,576	4,103,069	3,986,944	3,874,106	3,764,462	3,657,920	3,554,394	3,453,798	3,356,049	3,261,067	3,168,772	58,697,636
Alternative 2	**Operating**	Magnetic Passes	1,500,000	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	1,092,799	16,799,186
		Magnetic Transfers	850,000	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	836,609	12,562,526
		Magnetic Day pass	300,000	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	317,800	4,749,200
		RR Paper Tickets	160,000	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	158,900	2,384,600
		Bank Fees-Expenses	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	750,000	11,250,000
		Total	2,810,000	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	2,406,108	36,495,512
		Total future cost	2,810,000	2,552,640	2,629,219	2,708,096	2,789,339	2,873,019	2,959,209	3,047,986	3,139,425	3,233,608	3,330,616	3,430,535	3,533,451	3,639,454	3,748,638	46,425,234
		Total present cost	2,810,000	2,271,840	2,207,543	2,145,065	2,084,356	2,025,365	1,968,043	1,912,344	1,858,221	1,805,630	1,754,527	1,704,871	1,656,620	1,609,734	1,564,176	29,378,335
	Capital	Tokens	400,000	0	0	0	1,000,000		400,000					400,000	1,000,000			3,200,000
		Total future cost	400,000	0	0	0	1,159,274	0	491,950	0	0	0	0	570,304	1,468,534	0	0	4,090,062
		Total present cost	400,000	0	0	0	866,277	0	327,175	0	0	0	0	283,424	688,506	0	0	2,565,381
	Contractual	Various	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	4,874,394	73,115,910
		Total future cost	4,874,394	5,171,245	5,326,382	5,486,173	5,650,759	5,820,281	5,994,890	6,174,736	6,359,979	6,550,778	6,747,301	6,949,720	7,158,212	7,372,958	7,594,147	93,231,955
		Total present cost	4,874,394	4,602,389	4,472,133	4,345,563	4,222,576	4,103,069	3,986,944	3,874,106	3,764,462	3,657,920	3,554,394	3,453,798	3,356,049	3,261,067	3,168,772	58,697,636

4.4.5 Present Staffing

The Present Staffing page addresses payment system labor costs and identifies job titles and number of positions included in the agency's operating budget. The user must identify the number of all full- and part-time employees who support the payment system (especially the portion of a full-time employee's time spent on fare collection duties) and input the annual costs of the current system. A value for fringe benefits is included in the table. This page is one of the important benchmarks for calculating the cost performance of alternatives.

Alternative	Title (position)	of positio	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
Present System	Administration	10	551,718	568,270	585,318	602,877	620,963	639,592	658,780	678,544	698,900	719,867	741,463	763,707	786,618	810,216	834,523	10,261,356
	Revenue Transportation	35	1,403,149	1,445,243	1,488,601	1,533,259	1,579,257	1,626,634	1,675,433	1,725,696	1,777,467	1,830,791	1,885,715	1,942,286	2,000,555	2,060,572	2,122,389	26,097,047
	Revenue Services	55	1,681,134	1,731,568	1,783,515	1,837,021	1,892,131	1,948,895	2,007,362	2,067,583	2,129,610	2,193,499	2,259,304	2,327,083	2,396,895	2,468,802	2,542,866	31,267,266
	Revenue Audit	10	297,804	306,738	315,940	325,418	335,181	345,236	355,594	366,261	377,249	388,567	400,224	412,230	424,597	437,335	450,455	5,538,831
	Revenue Equipment Maint & Engineering	62	2,704,909	2,786,056	2,869,638	2,955,727	3,044,399	3,135,731	3,229,803	3,326,697	3,426,498	3,529,293	3,635,172	3,744,227	3,856,553	3,972,250	4,091,418	50,308,370
	Regional Rail	355	3,760,558	3,873,375	3,989,576	4,109,263	4,232,541	4,359,517	4,490,303	4,625,012	4,763,762	4,906,675	5,053,875	5,205,492	5,361,657	5,522,506	5,688,181	69,942,294
	Bus Operator	1,700	6,780,700	6,984,121	7,193,645	7,409,454	7,631,738	7,860,690	8,096,510	8,339,406	8,589,588	8,847,276	9,112,694	9,386,075	9,667,657	9,957,687	10,256,417	126,113,655
	Trolley Operator		1,272,500	1,310,675	1,349,995	1,390,495	1,432,210	1,475,176	1,519,432	1,565,014	1,611,965	1,660,324	1,710,134	1,761,438	1,814,281	1,868,709	1,924,770	23,667,118
	Paratransit Operation (Septa Admin.)		7,066	7,278	7,496	7,721	7,953	8,191	8,437	8,690	8,951	9,220	9,496	9,781	10,074	10,377	10,688	131,420
	Cashiers	351	12,273,000	12,641,190	13,020,426	13,411,038	13,813,370	14,227,771	14,654,604	15,094,242	15,547,069	16,013,481	16,493,886	16,988,702	17,498,363	18,023,314	18,564,014	228,264,470
	Fare media Sales (Adm. & Cont. Mgmt.)		1,476,000	1,520,280	1,565,888	1,612,865	1,661,251	1,711,089	1,762,421	1,815,294	1,869,753	1,925,845	1,983,621	2,043,129	2,104,423	2,167,556	2,232,582	27,451,997
	Revenue Accounting	5	136,055	140,137	144,341	148,671	153,131	157,725	162,457	167,330	172,350	177,521	182,847	188,332	193,982	199,801	205,795	2,530,475
	Total Direct labor		32,344,593	33,314,931	34,314,379	35,343,810	36,404,124	37,496,248	38,621,136	39,779,770	40,973,163	42,202,358	43,468,428	44,772,481	46,115,656	47,499,125	48,924,099	601,574,300
	Fringe benefits (41%)		13,261,283	13,659,122	14,068,895	14,490,962	14,925,691	15,373,462	15,834,666	16,309,706	16,798,997	17,302,967	17,822,056	18,356,717	18,907,419	19,474,641	20,058,881	246,645,463
	Total		45,605,876	46,974,052	48,383,274	49,834,772	51,329,815	52,869,710	54,455,801	56,089,475	57,772,159	59,505,324	61,290,484	63,129,198	65,023,074	66,973,767	68,982,980	848,219,763
	Present Value		45,605,876	41,806,739	40,623,530	39,473,807	38,356,624	37,271,059	36,216,218	35,191,231	34,195,252	33,227,462	32,287,062	31,373,278	30,485,355	29,622,562	28,784,187	534,520,242

Note: Salary expense is assumed to increase by 3% each year.

4.4.6 Staffing

The Baseline and Alternatives Staffing pages adjust the values entered in the Present Staffing page to reflect the labor positions and costs required to support the proposed fare payment systems. The Reference page, described below, shows actual position titles and associated labor costs. Labor expenses are entered for each year of a project's life.

Alternative	Title (position)	# of positions	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
Alternative 2	Administration	10	551,718	568,270	585,318	602,877	620,963	639,592	658,780	678,544	698,900	719,867	741,463	763,707	786,618	810,216	834,523	10,261,356
	Revenue Transportation	43	1,723,149	1,774,843	1,828,089	1,882,931	1,939,419	1,997,602	2,057,530	2,119,256	2,182,834	2,248,319	2,315,768	2,385,241	2,456,798	2,530,502	2,606,417	32,048,700
	Revenue Services	62	1,891,134	1,947,868	2,006,304	2,066,493	2,128,488	2,192,343	2,258,113	2,325,856	2,395,632	2,467,501	2,541,526	2,617,772	2,696,305	2,777,194	2,860,510	35,173,038
	Revenue Audit	10	297,804	306,738	315,940	325,418	335,181	345,236	355,594	366,261	377,249	388,567	400,224	412,230	424,597	437,335	450,455	5,538,831
	Revenue Equipment Maint & Engineering	86	3,679,909	3,790,306	3,904,015	4,021,136	4,141,770	4,266,023	4,394,004	4,525,824	4,661,599	4,801,447	4,945,490	5,093,855	5,246,670	5,404,070	5,566,193	68,442,311
	Regional Rail	355	3,760,558	3,873,375	3,989,576	4,109,263	4,232,541	4,359,517	4,490,303	4,625,012	4,763,762	4,906,675	5,053,875	5,205,492	5,361,657	5,522,506	5,688,181	69,942,294
	Bus Operator	1700	6,780,700	6,984,121	7,193,645	7,409,454	7,631,738	7,860,690	8,096,510	8,339,406	8,589,588	8,847,276	9,112,694	9,386,075	9,667,657	9,957,687	10,256,417	126,113,655
	Trolley Operator		1,272,500	1,310,675	1,349,995	1,390,495	1,432,210	1,475,176	1,519,432	1,565,014	1,611,965	1,660,324	1,710,134	1,761,438	1,814,281	1,868,709	1,924,770	23,667,118
	Paratransit Operation (Septa Admin.)		7,066	7,278	7,496	7,721	7,953	8,191	8,437	8,690	8,951	9,220	9,496	9,781	10,074	10,377	10,688	131,420
	Cashiers	331	11,573,000	11,920,190	12,277,796	12,646,130	13,025,513	13,416,279	13,818,767	14,233,330	14,660,330	15,100,140	15,553,144	16,019,739	16,500,331	16,995,341	17,505,201	215,245,230
	IT Supporting Services	2	100,000	103,000	106,090	109,273	112,551	115,927	119,405	122,987	126,677	130,477	134,392	138,423	142,576	146,853	151,259	1,859,891
	Fare media Sales (Adm. & Cont. Mgmt.)		1,476,000	1,520,280	1,565,888	1,612,865	1,661,251	1,711,089	1,762,421	1,815,294	1,869,753	1,925,845	1,983,621	2,043,129	2,104,423	2,167,556	2,232,582	27,451,997
	Revenue Accounting	5	136,055	140,137	144,341	148,671	153,131	157,725	162,457	167,330	172,350	177,521	182,847	188,332	193,982	199,801	205,795	2,530,475
	Total Direct labor		33,249,593	34,247,081	35,274,493	36,332,728	37,422,710	38,545,391	39,701,753	40,892,805	42,119,590	43,383,177	44,684,673	46,025,213	47,405,969	48,828,148	50,292,993	618,406,317
	Fringe benefits (41%)		13,632,333	14,041,303	14,462,542	14,896,418	15,343,311	15,803,610	16,277,719	16,766,050	17,269,032	17,787,103	18,320,716	18,870,337	19,436,447	20,019,541	20,620,127	253,546,590
	Total		46,881,926	48,288,384	49,737,035	51,229,146	52,766,021	54,349,002	55,979,472	57,658,856	59,388,621	61,170,280	63,005,388	64,895,550	66,842,417	68,847,689	70,913,120	871,952,907
	Present Value		46,881,926	42,976,490	41,760,174	40,578,282	39,429,840	38,313,901	37,229,546	36,175,879	35,152,034	34,157,165	33,190,453	32,251,100	31,338,333	30,451,399	29,589,567	549,476,090
			46,881,926	48,288,384	49,737,035	51,229,146	52,766,021	54,349,002	55,979,472	57,658,856	59,388,621	61,170,280	63,005,388	64,895,550	66,842,417	68,847,689	70,913,120	871,952,907
Note: Salary expense is assumed to increase by 3% each year.			592,000	619,600	648,520	678,824	710,580	743,858	778,732	815,281	853,585	893,731	935,808	979,910	1,026,137	1,074,593	1,125,385	12,476,545
			2,810,000	2,552,640	2,629,219	2,708,096	2,789,339	2,873,019	2,959,209	3,047,986	3,139,425	3,233,608	3,330,616	3,430,535	3,533,451	3,639,454	3,748,638	46,425,234
			50,283,926	51,460,624	53,014,775	54,616,066	56,265,939	57,965,878	59,717,413	61,522,122	63,381,632	65,297,619	67,271,812	69,305,995	71,402,005	73,561,736	75,787,143	930,854,686

4.4.7 Graphing Information & Charts

The Graphing Information page includes a series of charts illustrating cost comparisons among the alternatives for operating, maintenance, and capital over the life of the project. Below are two examples.