# Total Cost of Ownership Analysis:
## Shared Platforms vs Bespoke Design-Build Fare Collection Systems

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# EXECUTIVE SUMMARY

The last 10 years have seen a technology shift in fare collection system architecture, predominantly in North America, although this trend has been accelerating in other regions. This shift has seen significant growth in the number of transit agencies procuring ticketing systems that are multi-agency, Software-as-a-Service (SaaS), Shared Platform solutions moving away from tailored systems built specifically for the agency.

One of the claimed benefits of moving to a Shared Platform approach is the cost savings available for the agency.

In this White Paper, Consult Hyperion looked at eight transit agencies of varying sizes in the United States that have recently undergone procurement of a new fare collection system, in order to review the costs and assess the potential cost savings for agencies from following a Shared Platform approach over the traditional Bespoke Design-Build.

The table below highlights the contracted system costs from the 5 cities that opted for a Bespoke Design-Build (BDB) solution and based on the Cost Model developed in this report the direct savings a Shared Platform (SP) could have delivered for these cities.

| | City A | City C | City D | City F | City G |
|---|---|---|---|---|---|
| **System Size / Type** | L / BDB | L / BDB | M / BDB | S / BDB | S / BDB |
| Total System Cost | $ 63,641 | $ 43,076 | $ 61,971 | $ 6,270 | $ 9,381 |
| Number of Validators | 1014 | 966 | 1055 | 270 | 170 |
| Annual Operation Cost | $ 5,303 | $ 4,307 | $ 3,261 | $ 1,253 | $ 852 |
| Cost of Fare Collection | 3.1% | 4.7% | 6% | 6.8% | 9.1% |
| SP Potential Cost Saving | $ 38,411 | $ 20,912 | $ 32,532 | $ 2,629 | $ 6,890 |
| SP Annual Cost Saving | $ 3,200 | $ 2,091 | $ 1,712 | $ 526 | $ 626 |
| SP Cost of Fare Collection | 1.9% | 2.3% | 3.1% | 3.4% | 6.7% |
| **SP % Cost Saving** | **60%** | **49%** | **52%** | **42%** | **73%** |

* $ figures in 000s

The results clearly show there is an opportunity for substantial savings for agencies that select a Shared Platform over the Bespoke Design-Build approach. The differences between those savings are broad, between 42% and 73%, but significant at both ends.

However, cost is not the only factor in the decision to implement a new solution and the model agencies select. In this white paper we explore the benefits of both approaches, as well as break down the cost analysis and methodology used.

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# INTRODUCTION

The last decade has seen a revolution in urban transit payments.

In 2012, Transport for London (TfL) first introduced the capability for fare collection based on contactless EMV (cEMV) standards using Account-Based Ticketing (ABT) to accept bank issued payment cards and mobile wallets. This enabled it to:

- **Remove** the need to purchase single trip, daily and weekly fares in advance of travel.
- **Reduce** the need to queue to buy tickets or top up Oyster value at ticket offices or vending machines.
- **Improve** throughput in small old Victorian stations and large interchange stations.
- **Reduce** dependence on needing to issue fare media.
- **Make** it more convenient for visitors to ride the system using a card they are already carrying.
- **Save** money, by reducing the cost of operating the fare collection system.

Amongst many more benefits, this launch has led to wider adoption of ABT fare collection systems around the globe. These solutions have developed beyond TfL's initial cEMV deployment to support all passenger groups by expanding the tokens these systems use to include NFC and barcode-based mobile tokens and smartcards. These use Stored Value accounts linked to the passenger's token to enable the ability for cash paying or unbanked passengers to experience the benefits of Account-Based systems: convenience, fare equity and fare flexibility.

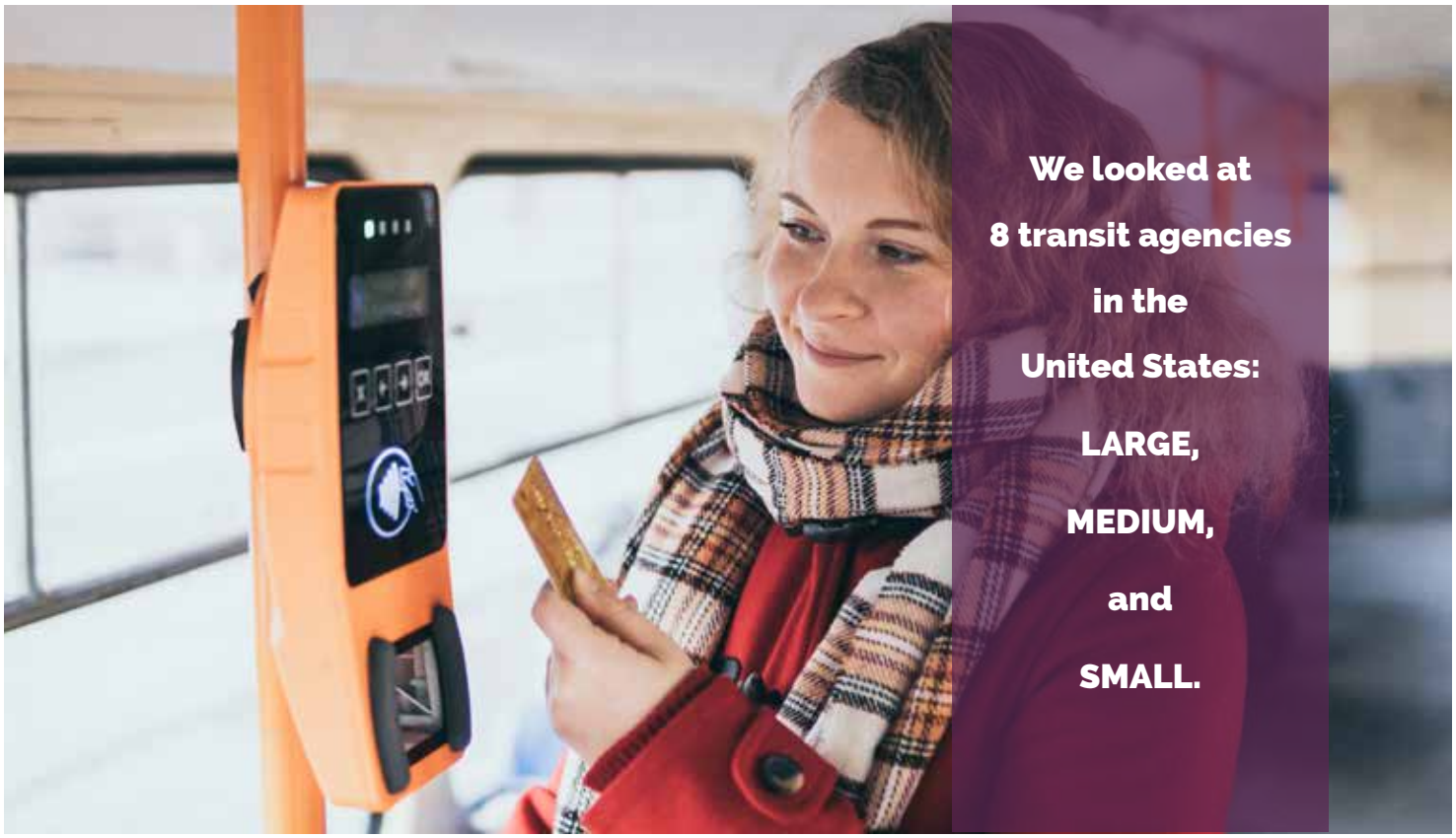
These widespread changes in transit payments have led to still further developments in the way fares are collected and processed. In the last five years, predominantly in the United States, there has been significant growth in the number of transportation agencies procuring fare-collection systems that are multi-tenanted, Software-as-a-Service (SaaS) solutions, called Shared Platforms. This model for delivering a fare collection system is often referred to as Fare Payments-as-a-Service or Fare Collection-as-a-Service. These Shared Platforms are increasingly being selected over what has been typical in fare collection of each agency running a Design, Build, Operate and Maintain (DBOM) project to build their own system. Shared Platform offerings were once largely found in small agencies whose operations were in the main buses, but now, growth in the appeal of this type of solution has increased to encompass medium and large-sized multi-modal agencies.

Through Consult Hyperion's detailed market analysis, we have identified the core differences in the options available to transit agencies. We have then explored specific implementations to understand the relative cost benefits of each model and to highlight the circumstances in which each approach may be most beneficial.

This is an important analysis because these procurement and development processes can be quite overwhelming for transit agencies, taking many years and costing many millions of dollars with some examples of large overruns on time and budget. If there is an alternate approach that could, a) shorten the deployment time, b) reduce costs, or c) reduce project risks, then it could be time for more agencies to embrace this new approach, rather than the perceived comfortable bespoke Design-Build route.

We looked at 8 transit agencies in the United States, large, medium, and small, that have recently undergone procurement of a new fare collection system, including agencies that followed the Design-Build approach as well as the Shared Platform approach. Using board papers and financial reports, we analyzed the available relative costs for each deployment to see if there was a cost benefit and to see if there were any obvious follow-on costs incurred through project change requests. To enable comparison between the approaches, a formula was developed to provide normalized costs for each city providing a like for like comparison.

The results highlight that a significant cost saving is possible for agencies selecting a Shared Platform implementation. However, cost is not the only metric in the procurement of fare collection systems and some cities still prefer to have a system that is bespoke to the agency.



# 1 FARE COLLECTION SYSTEMS

Fare Collection systems are large, complex IT infrastructures that are built to support the collection and processing of fare revenue for public and private transportation networks. These systems have broad functionality, covering a wide range of features typically over a wide geographical area encompassing:

- **Sales**, through vending, retail, agency websites and mobile apps.
- **Acceptance** validators on board vehicles, on platforms or as part of a gateline.
- **Communication networks**, both mobile and fixed line.
- **Data processing centers**, which manage all the transactions, determine the fare to be charged and process payments.
- **Customer services**, through CRM systems which connect to websites and call centers.
- **System management**, to ensure the system is maintained and operationally efficient.
- **Reporting system**, to provide management reports on the system operation and financial aspects.
- **Revenue inspection**, to ensure riders are not cheating the system.
- **Ancillary services**, such as parking and building access.

A typical fare collection system architecture is shown below.


1 Fare Collection System Architecture

## Modernizing Themes

Over the past 10 years, vendors have been modernizing the architectural components of fare collection systems as new technologies have been developed. Below is a brief summary of the improvements that have been made to credentials, front and back offices.

## Credentials

Credentials carried by customers of the transit agency to access travel have changed dramatically over the last 30 years, as the industry has transitioned from metal tokens and paper tickets through magnetic stripe tickets to smartcard and QR code technology. More recently, large agencies have led the way in offering 'open-payments' where their systems can accept bank-issued credit cards, debit cards and digital wallets (cEMV) directly at the point of entry. Through the pandemic, smaller agencies have also started accepting bank issued contactless cards, digital wallets and other contactless options such as mobile barcode ticketing and account-based systems as they seek to make the travel experience contact-free.

The other complimentary technology shift over the past 10 years has been to account-based ticketing (ABT) where the card or mobile phone acts only as an identifier to the passenger's account held in a central back-office location. Previously, in closed-loop card-based systems, the card contained the primary source of data managing the stored value balance or product data, with a data mirror held centrally. There are several issues with card-based systems, such as, each reader must contain all the rules to determine the fare to deduct from the card and it is slower to load value or products to the card, without the card being present, for instance web transactions. ABT using closed-loop cards and mobile wallets has been used to extend the same benefits of an account-based cEMV system, such as fare capping, to all passengers. This includes cash paying and unbanked passengers that don't have cEMV accounts who can now use a credential issued by the agency or another pre-existing credential.

## Front Office

Customer credentials are presented to validators or readers that are located at gatelines, on platforms or onboard vehicles. In some cases, these validators integrate within another system component such as a driver controller, AVL (Automatic Vehicle Location), a faregate or maybe even a parking meter or bikeshare hub.

More recently, 'open architecture' has been a growing methodology in the design of fare collection systems where a core central system can connect to front office devices supplied by other vendors. This methodology provides purchasing choice to the agency and the ability to connect older, but still useful front office devices with a new back office or vice-versa to maximize the life of all components.

This open architecture approach is enabled by the use of open APIs that make connecting new front office devices and other components a much simpler integration than a proprietary interface. These validation or sales APIs can also be shared with third-party organizations to connect other transportation services such as bike share or ride share, helping cities move closer to being able to enable multi-modal and/or Mobility-as-a-Service (MaaS) offerings.

For larger systems which are open and not controlled by gates, fare inspection is still required as a means of deterring fare evasion. Mobile devices that can read smartcards and QR codes are commonly used as fare inspection devices to determine eligibility to ride the system.

Fare collection retail operations used to be limited to in-person sales and vending of fare media and reloads. Now there are more options, as agencies look to reduce the need to offer their own in-person retail capability. Websites and mobile commerce now form the backbone of agency supplied retail operations, with physical retail integrated into stores people visit every day, such as pharmacies and local shops. This is made possible through integrations with external retail and bill-payment network partners, again, more recently with open APIs.

Customer relationship management systems are updated to ensure the latest information is made available. This information may be accessed by call center staff, by systems that report the latest status such as validations, ticket vending machine transactions and by the customers themselves through mobile apps and websites.

**Back Office**

The engine which processes card taps, QR code scans and magnetic stripe reads in near real time from across the network, forms the nerve-center of the whole operation. For bank cards, transactions arrive and are processed through risk management and journey construction before being priced and added to the list of traveled journeys for the day.

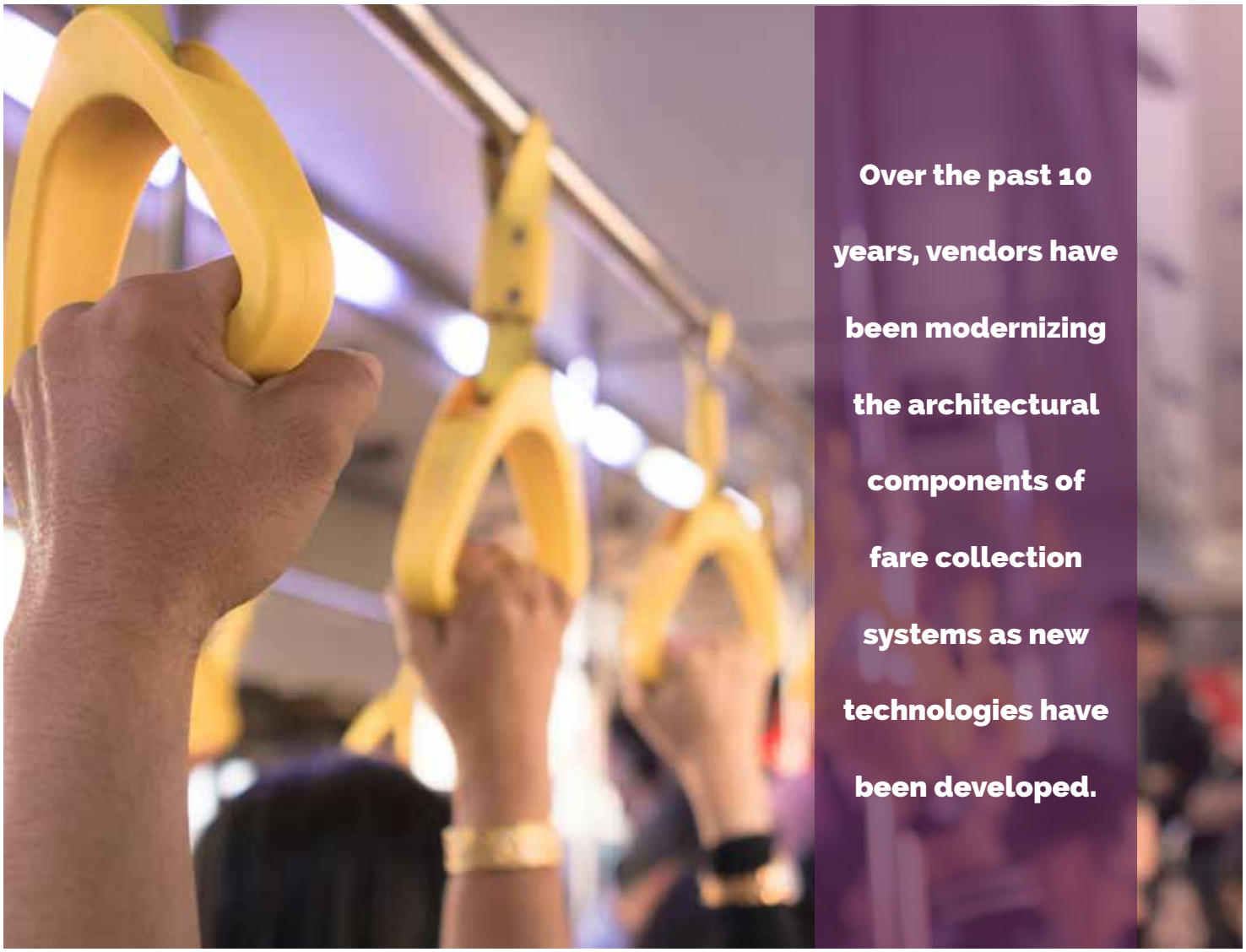
For magnetic and some QR transactions, the front-office system validates the journeys based on pre-paid products then deny-lists calculated and pushed from the back-office to prevent fraudulent use. (Some QR transactions are also ABT based, and the balance or product entitlements are held in the back office.)

The whole system needs constant maintenance and control to configure and update it to ensure the latest software and security features are enabled. This is primarily carried out remotely through a system management and reporting system, where faults can be observed and rectified in real time, with the aim of avoiding the need to visit the defective component.

In open-loop systems, throughout the day, there will be a need to authorize transactions with the issuing bank to manage the agency's exposure to risk. This is handled by the payments processing engine. It does not operate in real-time as a customer taps their card at the entry to the system, because this can take too long and be disrupted when communications between the validator and back office are interrupted, especially problematic for validators on moving vehicles. Rather, this happens in near real-time while the customer is traveling.

For cEMV systems that enable variable fares rather than retail fixed price taps, at the end of the day the total value of journeys is combined, and discounts or capping applied, the final value is settled with the bank.

All the data from the system is stored in a real-time data warehouse, which is accessible by the fare collection vendor and the transit agency to support their reporting and analysis needs. This data can help the vendor to analyze the health of the system over time or provide daily, weekly, and monthly financial reports to the agency. Anonymized data captured over a longer period can be used by the agency to tune the system to ensure enough transport is provided in the right areas in their region.



**Over the past 10 years, vendors have been modernizing the architectural components of fare collection systems as new technologies have been developed.**

# 2 DEPLOYMENT APPROACHES

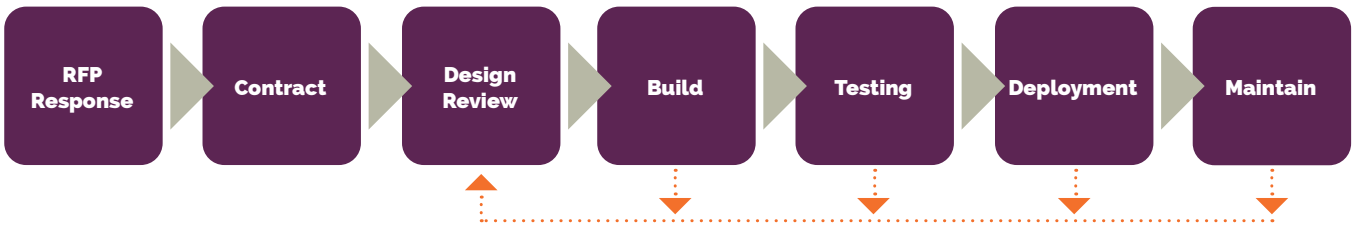
Over the past 30 years, there have been several approaches to the delivery of fare collection systems into the market as agencies look for more efficient ways to move customers through the transit system. At the start, the approach was to design a bespoke system that met the requirements of the agency before building it, operating it and maintaining the systems in a waterfall like approach. Now, as the needs of agencies are well established, new Shared Platform-based iterative and continuously updated approaches to fare collection are growing in the market.

But what is important to agencies? Keeping overall cost down, tailoring a new system to its precise needs, or being able to easily update the system without time consuming projects? Is there a situation where the only way to go is for a Bespoke Design-Build approach given some specific local and historic conditions in play? Could a Shared Platform approach ever deploy in a city like New York to cover all modes? Do agencies want a platform where they can work in partnership with their vendor to innovate around new services?

**Bespoke Design-Build Approach**

Since fare ticketing moved from paper tickets being clipped by an inspector on board a train to magnetic stripe, to digital technologies such as contactless cards, large IT infrastructure companies designed and built systems to sell and process fare media. These systems can be very complex, spanning wide geographic areas and servicing many different transportation modes.

Systems are built to the bespoke requirements of the transit agency, who work diligently to define their system requirements in the proposal phase of the project to meet the travel needs defined by local government and agency executives. While there are common themes between agency requirements, for instance, to all accept payment cards, typically, each agency will have enough specific requirements to necessitate a large amount of development. Often, this starts with the fares policies which are highly complex and contain a vast array of historically accumulated rules that the IT firms must build into their systems.




2 Bespoke Design-Build Process to Deployment

In most cases, the response to the procurement process forms the contractual agreement on which the system is built and deployed. However, the first step post-procurement, often more than a year after the requirements were first penned, can be to carry out a detailed design review that ensures the complete system will be delivered according to agency needs. At this point, new stakeholders might be brought to the table, which can result in a modification of the contractual design leading to a change order. Change orders can be very costly for agencies (partly because they are not competitive) and can involve a long process of redesign and costing, board approvals and implementation, resulting in slow initial deployment or releases of new features.

These systems have historically been built with the primary data center on-premises at, or very close to, the agency with back-up data centers either located within the same city or at another location, perhaps co-located with other agency back-up centers. The data center is then integrated into retail outlets, validation devices, system reporting and customer service operations to complete the system using proprietary APIs specific to that implementation.

A transition is underway in the development of these systems from being totally bespoke, to a productized approach where system components can be developed once and then copies of those components can be deployed and developed upon in multiple projects. These systems are also transitioning from being hosted 'on-premises' to being hosted in the cloud. However, even where components have been reused between projects, it doesn't follow that those components will be continuously updated and kept the same across all deployments. Deployments often become self-contained "islands" after a short period.

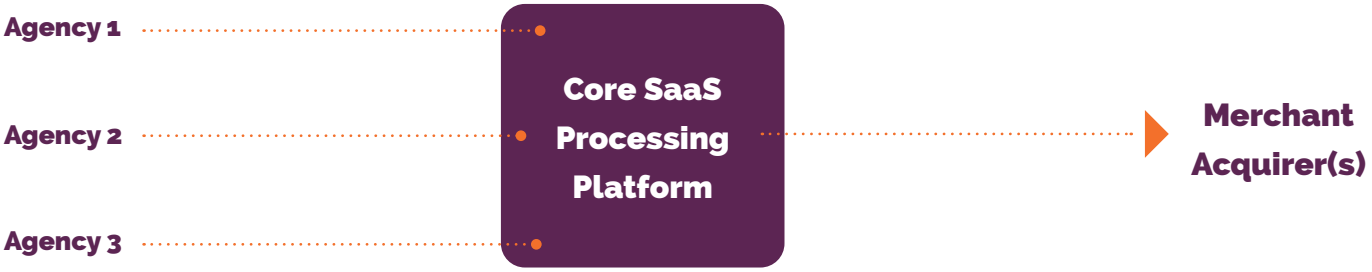
It can take several years to deploy systems following contract award, as can be seen, for example, in Melbourne[1] and Boston[2] where roll out has been beset with delays.

**Shared Platform Approach**

In the last 10 years, a number of software focused companies have developed a new approach to delivering fare collection systems. This approach makes use of modern cloud computing to deliver Software-as-a-Service (SaaS) core fare payment processing platforms. These shared multi-tenanted platforms, typically architected for the cloud and hosted in Microsoft Azure or Amazon Web Services, are scalable to support numerous transit agencies in one place with a single shared codebase, rather than deploying a bespoke system for each.

1 https://www.theage.com.au/national/smartcard-runs-two-years-late-20080205-ge6ot4.html
2 https://www.wcvb.com/article/boston-mbta-new-fare-collection-contract-years-late-millions-over-budget/36422382

Development on a Shared Platform generates a common upgrade for all agencies that are signed up, rather than having to be developed on each agency deployment. This creates an environment of constant evolution of upgrades and features which are delivered to a common timeline, ensuring the platform is always up to date with the latest features. The downside to this platform approach is that outside of allowed configuration changes or extensions connected to the platform API's and SDK's, there is less room for a truly bespoke offering, tailored to the exact needs of the agency.




3 Shared Platform simplified architecture

However, there are many commonalities between the agencies. The means of processing and managing an account-based open or closed-loop transaction model is, in principle, the same from one agency to another, especially within the same country so long as different fare rules can be accomodated. The software required to read and process a credential at a reader or validator is the same. The APIs to connect a call center and manage a CRM system are the same. The main differences lie in how these processes are configured, and this is where SaaS fare collection providers can tune the platform to the needs of each agency.

The success of these systems is achieved by deploying architectures based on open standards and API integrations, which makes it relatively simple, compared to a proprietary integration, to expand systems to meet the changing needs of the transit agencies. If they need to add parking or add an interface with a Micromobility scheme, the published API can be used to integrate with the core system. Creating API connections to a parking services organization or a bikeshare provider allows SaaS fare collection providers the flexibility to focus on core services but bring in specialist partners to complement their services.

In many cases, value-added services are pre-integrated into the system, such Masabi's integrations[3] with Uber, Moovit and the Transit app, or those companies registered to the Cal-ITP open-loop procurement framework such as LittlePay. With these connections to the core platform already integrated because of there being so many more deployments using the same API, all that is required is a commercial agreement with the partner to deploy the value-added service. No time is required to complete extensive technical integration and testing.

These APIs are maintained in step with the core platform to ensure they are always current with the latest capabilities so that all tenants can make use of new features as they come online. This contrasts with systems that follow a modular, but discrete deployment approach which might deploy several different versions of a particular API over the course of ten years all of which have to be maintained and upgraded on separate development projects.

This Shared Platform approach to fare collection makes the time to initially deploy systems much quicker than the Design-Build approach because the core of the system is already designed and developed and only needs devices to be connected and configured. This means there is potential, for agencies that select a Shared Platform fare collection supplier, to deliver some base functionality, such as open payments, to their customers very quickly while the remaining features are being incorporated into the external API's.

One benefit of the Design-Build approach is that the system can be tailored for the agency, allowing it to fit exactly with the needs, plans and policies of the agency. This is where the design process that kicks off the project can tune the goals set out in the technical requirements documentation supplied by the agency to ensure a perfectly tailored system. In a Shared Platform offering, there is less opportunity to deliver tailored requirements, such as maintaining an existing bespoke fare collection technology such as SmarTrip or Clipper. However, it can be possible to continue to use the existing closed loop cards as a credential for an account held on a new Shared Platform with fare calculation managed centrally.

The constant evolution of the Shared Platform approach also ensures the system is protected from service and system degradation assuming the vendor keeps the service running on the best platform, updated to be supported on the latest software and utilizes fit for purpose hardware devices such as handhelds or validators. This is in contrast to the Design-Build software deployed on hardware (front-office devices or back-office servers) running a particular operating system at the start of the project, which may run to 10 years or longer, is unlikely to be up to date and compliant with critical system security requirements by the end of the project term. This naturally leads to either a large change order to support new hardware and software when the old hardware becomes obsolete or end of life, or the agency having to put the contract back out for tender, with inevitably a large bill either way.

The issue of long-term maintenance and evolution of software systems was less of an issue when fare collection back offices were mostly a closed system that only had to connect to itself, TVM's and a transit operator's own POS systems. However, modern fare collection systems now connect to many offsite services, including international payment systems and app stores which mandate the need to continually upgrade and secure these solutions.

3 https://www.masabi.com/partners/

If an agency has commissioned a Bespoke Design system, they must then ensure they or the vendor manage the different certification, obsolescence and replacement cycles for each component of their system. As components require software updates, recertification or become end-of-life, agencies will need to procure upgrades through a change order process with their vendor. Shared Platforms, by contrast, will be amortizing most of those updates across their whole shared estate, so that each agency does not need to invest or plan an ongoing software upgrade strategy.

Essentially the Shared Platform doesn't have a natural obsolescence anymore, in the same way that the Bespoke Design projects do, as the codebase and its associated supported hardware list doesn't stand still, so long as the platform vendor continues to invest in the platform. An agency will have to gradually update hardware over time as it wears out and might find that the original hardware is no longer manufactured. However, with the open API strategy typically employed with Shared Platforms, integration with new hardware is straightforward and often already carried out in advance by the platform provider.

**If an agency has commissioned a Bespoke Design system, they must then ensure they or the vendor manage the different certification, obsolescence and replacement cycles for each component of their system.**

# 3 METHODOLOGY AND DATA

As part of our ongoing industry research, Consult Hyperion analyzed the cost of fare collection systems deployed in either a bespoke Design-Build or Shared Platform approach. Taking eight US cities of various sizes and leaving aside the 'super cities' such as New York or Chicago that have historically followed purely a Design-Build approach, the amount of money spent on fare collection systems and any subsequent change orders were identified. All the data collected in the study was sourced from publicly available data such as board and financial reports.

The key metrics we identified were as follows:

- Total System Cost
- Change Order Costs
- Contract Term
- Agency Annual Ridership
- Agency Fare Revenue
- Number of Validators
- Number of Vending Machines (Cash / Cashless)

From this source data, figures for annual operation cost and the percentage cost of fare collection were calculated. Data for some cities was easier to find than others, for example, larger cities were generally more open regarding the data they share on their public websites.

The cities selected were a mix of agencies that had selected a bespoke Design-Build approach and agencies that had selected a Shared Platform approach. Only the vendor costs have been analyzed in this report.

**Cost Data**

*Agency Size*

The findings are broken down by the size of the agency measured in terms of its Ridership, where a:

- Large City (L) = Ridership over 75 million
- Medium City (M) = Ridership between 25 and 75 million
- Small City (S) = Ridership below 25 million

*Ridership* is defined as the number of unlinked passenger trips in a year. The type of system operational in each city defined as System Type as follows:

- Bespoke Design-Build Implementation = **BDB**
- Shared Platform Implementation = **SP**

*System Cost*

Each fare collection contract has a total cost associated with it which consists of a combination of capital and operational expenses. Capital expenses (CapEx) tend to cover upfront costs, the most significant being hardware (HW), software (SW) development, system deployment, program management and training costs. While operational expenses (OpEx) cover warranties for the hardware and software, maintenance and operating costs and any transaction commissions. All these costs, including contractual change orders, are included within the Total System Cost value.

The contracts will also state what HW volumes are expected under the contract. The big HW costs that have been focused on for this analysis are for validators, cash and cashless vending machines. This information will be used as a measure of the system's scale.

Finally, the Annual Operation Cost has been determined by simply dividing the Total System Cost by the term of the contract. The Cost of Fare Collection is a percentage of the Annual Operation cost against the annual fare revenue.

## Comparison Table

| | City A | City B | City C | City D |
|---|---|---|---|---|
| **System Size / Type** | L / BDB | L / SP | L / BDB | M / BDB |
| **Total System Cost** | $ 63,641 | $ 15,526 | $ 43,076 | $ 61,971 |
| **Change Order Costs** | $ - | $ - | $ 8,776 | $ 727 |
| **Contract Term (Years)** | 12 | 5 | 10 | 19 |
| **Number of TVMs (Cash)** | 12 | 0 | 103 | 148 |
| **Number of TVMs (Cashless)** | 11 | 0 | 77 | 48 |
| **Number of Validators** | 1014 | 1302 | 966 | 1055 |
| **Annual Operation Cost** | $ 5,303 | $ 3,105 | $ 4,307 | $ 3,261 |
| **Cost of Fare Collection** | 3.1% | 2% | 4.7% | 6% |

* $ figures in 000s

| | City E | City F | City G | City H |
|---|---|---|---|---|
| **System Size / Type** | M / SP | S / BDB | S / BDB | S / SP |
| **Total System Cost** | $ 5,056 | $ 6,270 | $ 9,381 | $ 543 |
| **Change Order Costs** | $ - | $ 69 | $ - | $ - |
| **Contract Term (Years)** | 4.5 | 5 | 11 | 2 |
| **Number of TVMs (Cash)** | 0 | 13 | 0 | 0 |
| **Number of TVMs (Cashless)** | 0 | 13 | 0 | 0 |
| **Number of Validators** | 0 | 270 | 170 | 179 |
| **Annual Operation Cost** | $ 1,123 | $ 1,253 | $ 852 | $ 271 |
| **Cost of Fare Collection** | 4.6% | 6.8% | 9.1% | 10.3% |

* $ figures in 000s

## Contract Term

As observed in the comparison table above, Bespoke Design-Build systems do have longer contracts than Shared Platform systems. When comparing the overall costs of the contract based on the contract term the cost of the system may appear more per year for Shared Platforms due to their shorter contract length and as a result the capex of the hardware being amortized over a smaller number of years and appearing more expensive per year. In order to show a like for like comparison, we normalized the costs of a Shared Platform model and applied them to Design-Build systems.

**Shared Platform Model Comparison Data**

To generate a logical evaluation between Bespoke Design-Build and Shared Platform models, the city which was found to have the most cost-effective Shared Platform model fare collection system was selected as a baseline for comparison. Based on the Cost of Fare Collection percentage, this was City B.

Given the diverse nature of systems in the various cities, for example, some cities have large bus and rail operations while some cities only have bus, the figures can be hard to interpret and compare.

There are many differences between this set of transit agencies, and it is challenging to compare them. For example, take two agencies with identical numbers of hardware, validators, TVMs etc., identical ridership and revenue. It is still highly unlikely that the cost of their fare collection systems would be the same. This is because project costs are fundamentally down to how specific agencies define their procurement requirements. The more custom the requirements the higher the overall cost as vendors seek to mitigate the risk around the extra work and customization, and subsequent maintenance.

However, in order to find a way to normalize the data with which to generate a comparison figure for this study, the Total System Cost cannot be used directly and therefore needs to be broken down further, in order to identify a credible amount for comparison between the cities. Given the information available from the agencies, the following key publicly sourced data has been used to define a formula which enables the comparison cost:

- Agency Fare Revenue
- Agency Ridership
- Number of Validators
- Number of Vending Machines (Cash / Cashless)
- Contract Term

These data points have been selected with the goal that they represent the scale of a fare collection system. A large system can be expected to have a high Fare Revenue, a large number of Validators and possibly Vending Machines, while a smaller operator will generate less revenue and may only have a few hundred validators.

With City B used as validation, the input data led to the following formula which contains costs for CapEx (HW, Installation and Program Management) and OpEx (a commission on the revenue over the duration of the contract or a maintenance and operating fee):

**Normalized Cost = HW + Warranty + Commission**

**Where:**

- HW is based on the number of Validators and Vending Machines and includes costs for program management and installation.
- Warranty is calculated on an average two-year period post deployment
- Commission is calculated based on a percentage of the transaction amount for 60% of transactions over the contract term. It is assumed that 40% of transactions will remain cash through the farebox.

Applying the formula for each city, the *Normalized Cost* for a Shared Platform model vendor delivering the same system over the same contractual term are shown in the table below along with the *Annual Normalized Cost* and the new *Cost of Fare Collection*.

| | City A | City C | City D | City F | City G |
|---|---|---|---|---|---|
| **System Size** | L | L | M | S | S |
| ***Normalized Cost*** | $ 25,229 | $ 22,163 | $ 29,438 | $ 3,640 | $ 2,490 |
| **Contract Term (Years)** | 12 | 10 | 19 | 5 | 11 |
| **Number of TVMs (Cash)** | 12 | 103 | 148 | 13 | 0 |
| **Number of TVMs (Cashless)** | 11 | 77 | 48 | 13 | 0 |
| **Number of Validators** | 1014 | 966 | 1055 | 270 | 170 |
| ***Annual Normalized Cost*** | $ 2,102 | $ 2,216 | $ 1,549 | $ 728 | $ 226 |
| **Cost of Fare Collection** | 1.2% | 2.4% | 2.9% | 3.4% | 2.4% |

* $ figures in 000s

# 4 COST ANALYSIS

The data generated in the previous section now allows a direct comparison between the costs for a Bespoke Design-Build implementation versus a Shared Platform model approach. The table below highlights the direct savings a Shared Platform model could deliver for cities.

| | City A | City C | City D | City F | City G |
|---|---|---|---|---|---|
| **System Size** | L | L | M | S | S |
| **Potential Cost Saving** | $ 38,411 | $ 20,912 | $ 32,532 | $ 2,629 | $ 6,890 |
| **Annual Cost Saving** | $ 3,200 | $ 2,091 | $ 1,712 | $ 526 | $ 626 |
| **% Saving** | **60%** | **49%** | **52%** | **42%** | **73%** |

* $ figures in 000s

The results clearly show there is an opportunity for substantial savings for agencies that select a Shared Platform model over the Bespoke Design-Build approach. These potential savings range from **42% to 73%.**

City A and City G show the potential of more than 60% savings if they adopted a Shared Platform approach. Neither of these cities has yet to modify their contract with change orders, which are common in Design-Build deployments and much less so with Shared Platforms, which tend have evolving systems that make ongoing feature development available to their full customer base on a frequent basis. Once change orders or update fees are applied over time, a Shared Platform approach could represent even greater savings for these cities. Cities C, D and F show the smallest, but still significant, potential savings from adopting a Shared Platform approach and they have all modified the original contract through change orders pre-deployment.

The most significant variable potentially attributable to these results is the level of agency specific features that the Design-Build vendor has been asked to deliver. Note, typically, the cost of fare collection would include broader agency costs combined with the costs directly attributable to the vendor. In this report, only the vendor costs have been analyzed.

### Other Costs and Variables to Consider

It is very rare that all requirements and variables between two cities are in alignment for several very legitimate reasons. These differences do make comparisons between the systems in one city and another difficult to achieve. Three significant variables are change orders, Shared Platform transformation and commission.

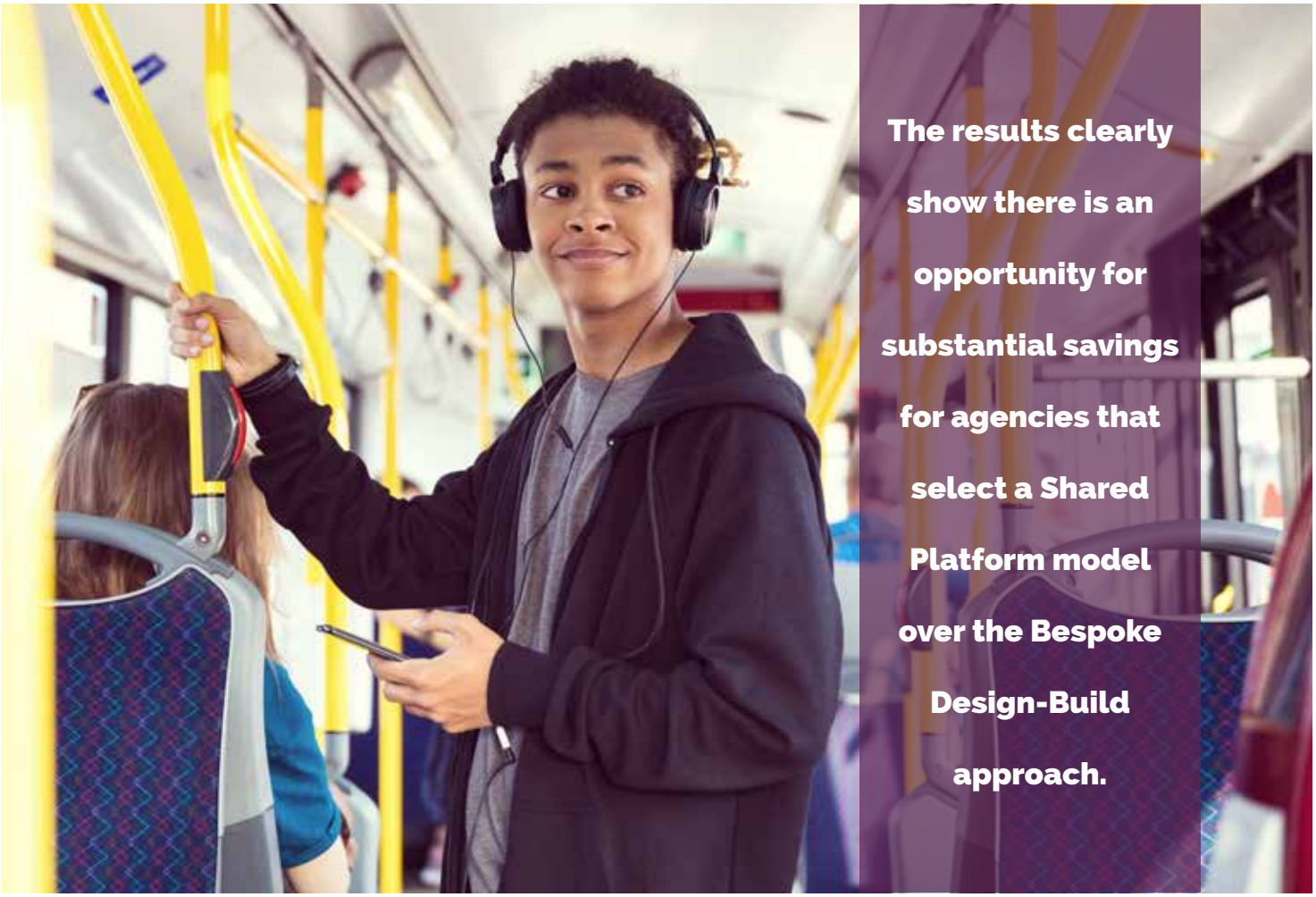
*Shared Platform Transformation*

There is an argument that a Shared Platform model can achieve additional cost savings because the system is easier to deploy and operate with updates continually added to the platform, easing the burden on the IT and fare collection teams. This may or may not be accurate and would need further investigation.

*Commission*

In Shared Platform systems, a commission is charged for each transaction that is sent to the platform and therefore there is a close alignment for this cost to ridership. However, not all trips are made using the Shared Platform as some still prefer to use a farebox. For this study, a blanket 60% of the ridership has been used to determine the commission figure for Shared Platforms.

Another aspect of commission is that, in the same way payment interchange is more favorable to large merchants who have a greater volume of transactions, transit commission is also generally less for those agencies with higher ridership. The model used in this analysis did use a weighted commission based on agency fare revenue set to industry norms.



# 5 IS COST EVERYTHING?

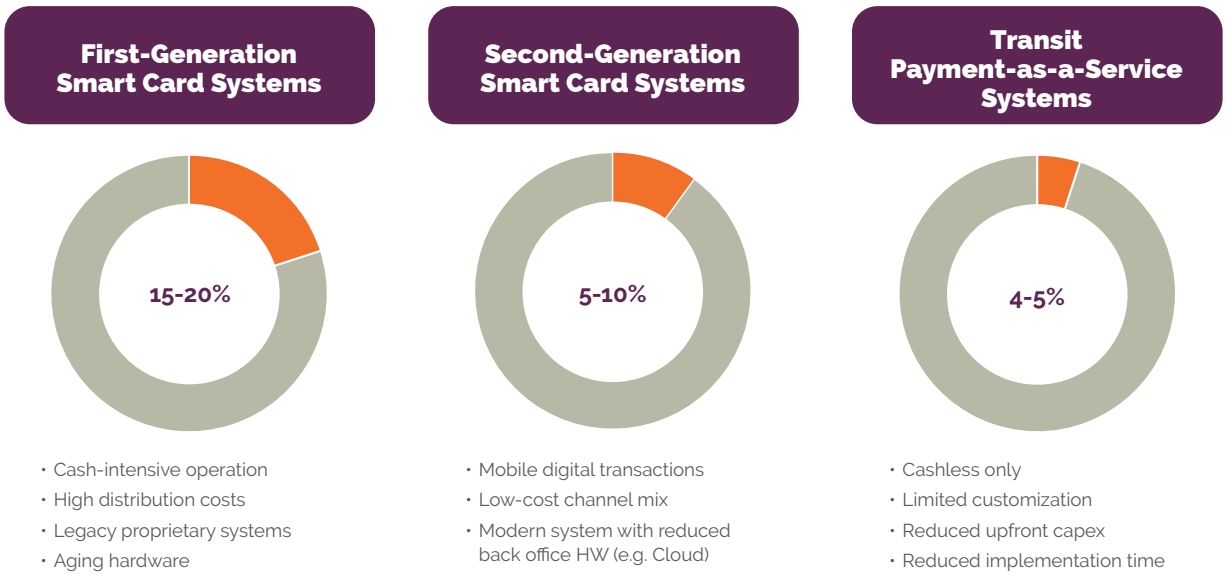
While the cost savings are clear, there are other drivers within agencies which may steer it towards the Bespoke Design-Build model. For an agency which must deliver reliable services to the millions they serve every day, for some the conventional or established Bespoke Design-Build approach can be hard to move away from. There is a tendency to stick with the approach taken by similar peer cities, which is perhaps why we are seeing one vendor serve the majority of mega-cities, a handful serving larger cities and a greater number of vendors serving the rest of the market.

There is also an aspect of legacy support. In London, where the acceptance of bank issued credit and debit cards was first launched at scale, legacy and other fare media technologies are still in use across the network. This includes Oyster smartcards, national ITSO smartcards, QR codes (on rail) and even paper tickets with magnetic stripes. If agencies want, or are obliged by regulation, to continue offering a range of different media for various customer groups and if the Shared Platform provider is unable to migrate these services, then it is a difficult proposition and greater technical challenge for a new vendor to come in and operate these types of systems. Therefore, vendors naturally increase their costs to cover this technical challenge and why agencies are prepared to pay more.

The same is true of legacy fares policies. Often transit agencies have very large and complex fare rules and policies that stem from the history of each agency. For example, small, often private, operators serving different parts of a city with different modes of transport may have been brought into a single public authority bringing historical bespoke fare policies with them. While an agency might feel obliged to support these various historical policies, there is a case, recognizing the political barriers, for a wholesale review of these policies. This would lead to a simplification of the agency offerings, to make it simpler for customers to understand, and then to get the best deal for a fare collection system that is simpler, and therefore cheaper to implement.

An illustration of this difference of the cost of fare collection between operators of legacy fare collection systems and those who are operating cashless technologies can be seen in the illustration below[4]. Generally, the more legacy, and the more cash handled, the greater the cost of fare collection. If this can be replaced by a more digital, Shared Platform approach, there is an opportunity to drive to low percentage operational costs.

4 https://www.lek.com/sites/default/files/PDFs/2331_Second-Generation-Fare-Collection-Systems.pdf




4 Trends in the Cost of Revenue Collection as a Proportion of Revenue

# 6 CONCLUSIONS

There is a clear shift in the market towards a Shared Platform based approach to fare collection. This is seen not only in the new players in the market, but also with the direction being taken by long serving vendors who are looking to streamline their offerings. This brings many benefits for some cities, including the flexibility to start with a simple fare collection system and expand over time bringing new features. The Shared Platform approach can also represent a more cost-prudent approach with a reduced up-front investment.

Cost over the duration of the operation of the system can also be more predictable. Cloud-based multi-tenant platforms can be continually updated to the latest software version ensuring there are no forced system retirement or obsolescence dates at any time in the future.

A simpler justification for agencies deploying a Shared Platform fare collection system is clearer outside of the biggest cities. In situations where, for instance, there is a large amount of legacy processing, fare media or legacy fare policies that must be maintained, it may appear to be more complex for the agency to migrate to Shared Platform system and it's another strong reason for these agencies to want to stick with a Bespoke Design-Build supplier. However, for some deployments, Shared Platform providers are partnering with Systems Integrators (SIs) to offer larger cities the benefits of an 'as-a-Service' approach for efficient delivery of the shared and pre-debugged core software & hardware with the SI providing bespoke extensions using the APIs and SDKs from that shared platform. This hybrid approach is a delivery model to keep an eye on over the next few years.

It is also worth noting that some agencies find it hard to relinquish control of their software and hosting to this new approach. Even if a Shared Platform is being continually developed for all tenants according to a pipeline of improvements, it is not necessarily customized and prioritized for a single agency's needs. The benefit offsetting this compromise is that a single agency does not have to take on the whole cost, technical strategy, and design risk on new features and doesn't have to expend internal resources on procuring, guiding, testing, debugging, and deploying those new features.

However, the agency does have to determine whether the direction of new features and updates from their Shared Platform continues to align with their needs sufficiently as time progresses. Should the Shared Platform deviate from the direction they need, or not develop fast enough, they may consider shifting to an alternate platform that delivers the required capabilities and updates or going back to bespoke Design-Build approach if their needs are so different from other agencies.

Overall, the decisions that go into selecting a vendor to deliver a fare collection system for a city are varied and comprise more than just the financial proposal. There are a wide range of technical and operational aspects that are included in the final analysis of which vendor to select. Nevertheless, the cost savings that can be made by selecting a vendor that operates a Shared Platform model are hard to ignore. This is where a technical consultancy, such as Consult Hyperion, can help to provide perspective and ensure the right approach is followed.

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