

# ACRP

## REPORT 24

AIRPORT  
COOPERATIVE  
RESEARCH  
PROGRAM

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## Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies



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## ACRP REPORT 24

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# Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies

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IN ASSOCIATION WITH

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WASHINGTON, D.C.

2009

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## AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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The research discussed in this report was performed under ACRP Project 10-03, “Evaluating Airport Parking Strategies and Supporting Technologies,” by a research team of recognized experts in airport parking planning, operations, and technologies. Jacobs Consultancy was the primary research consultant. Peter Mandle, Director at Jacobs Consultancy, was the Principal Investigator and W. Gavin R. Duncan, Principal Consultant at Jacobs Consultancy, was the Deputy Principal Investigator. The other authors were Andrew Blaisdell, Consultant at Jacobs Consultancy; Thomas A. Butcher, Executive Vice President at Walker Parking Consultants; Mike Mannix of the Mannix Group; and Diane Ricard, Principal of DMR Consulting. Alice Richard, Senior Consultant at Jacobs Consultancy, coordinated the literature review. Serena Quan coordinated the internal production and word processing. Deborah Lubin served as the technical editor.

The research team would like to express its gratitude to the members of the project panel for their support and insightful comments throughout this research project. The research team would also like to thank the many airport staff who took the time to share their insights, experience, and opinions with the research team and to respond to follow-up queries. The research team also appreciates the contribution of the representatives of the parking operators and equipment vendors and manufacturers who shared their knowledge of existing and forthcoming strategies and technologies.



# FOREWORD

By Marci A. Greenberger

Staff Officer

Transportation Research Board

*ACRP Report 24: Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies* presents various parking strategies and technologies that are employed, or have potential applications, at airports in the United States. This guidebook will assist airport operators in (1) determining their specific goals as they relate to public parking and their customer needs; (2) gaining an understanding of the parking strategies and technologies that correspond to their goals; and (3) evaluating benefits, costs, and implementation.

With parking as the primary source of non-airline revenue at airports, and usually the customer's first and last experience with the airport, it is an important focus in an airport's overall strategic plan. *ACRP Report 24* provides—in a single source—a buffet of parking strategies and technologies to complement and achieve airport operators' long-term goals and objectives. This guidebook will be useful to airport parking owners and operators, and their consultants, as they strive to better accommodate the needs of their customers, improve customer service, increase operational efficiency, and enhance net revenues.

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Airport parking is unique compared with other parking facilities in that the customer as an airline passenger is different from the customer using parking facilities serving office buildings, shopping malls, hospitals, or downtown areas. Furthermore, each airport is unique among all other airports, as they vary in size, configuration, and the demographics of passengers served. Thus, their needs require a careful evaluation of strategies that best fit.

Under ACRP Project 10-03, Jacobs Consultancy was assigned to develop a guidebook that could be used to compare and contrast available parking strategies and supporting technologies and then provide guidance on implementation for each. The research team reviewed relevant domestic and foreign literature and interviewed parking managers at airports known to have unique solutions, as well as senior management of non-airport parking facilities and equipment vendors. These interviews were conducted both domestically and internationally. The resulting strategies are categorized to allow the reader to easily evaluate relevant parking approaches to meet their goals and objectives.

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# Overview of the Guidebook

This *Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies* describes a broad range of parking strategies and supporting technologies that have been used by the operators of airport and other public parking facilities to provide a high level of customer service, enhance revenues, improve operational efficiency, and achieve other relevant management objectives.

As used in this guidebook, the term *parking strategy* refers to the entire spectrum of parking products, value-added services, rates and rate structures, safety and security features, and the techniques used to control parking revenue, promote operational efficiency, manage capacity, and balance facility use. Many of these strategies can be enhanced through the application of supporting technologies. The term, *technologies* refers to parking access and revenue control systems, ticket and ticketless payment systems, vehicle detection and guidance systems, parking reservation systems, and other parking-related hardware and software.

## Purpose of the Guidebook

This guidebook is intended to help airport management and the operators of airport parking facilities compare and contrast various parking strategies and supporting technologies to achieve their specific objectives. The information provided herein may be used to evaluate and select potential strategies and their applications considering the specifics of the airport and its customers. The objectives of airport parking operators, as described in the following section, differ from those of the operators of other parking facilities because airport parking customers differ from those using hospital, university, office, center city, or other public parking facilities.

The information contained in this guidebook is applicable to the operators of all commercial service airports regardless of location, passenger volumes, customer demographics, and parking facility size or configuration. The guidebook can be used by the managers of all airports regardless of their goals or objectives. As such, it presents a broad range of potential strategies and technologies, not all of which are applicable to every airport.

## Distinguishing Characteristics of Airport Parking Customers

Some of the characteristics that distinguish the customers of airport parking facilities from the customers of other public parking facilities include the following:

- **Airport customers are concerned about flights.** Airport parking customers are likely under greater stress than the customers of most other parking facilities. This stress results from the

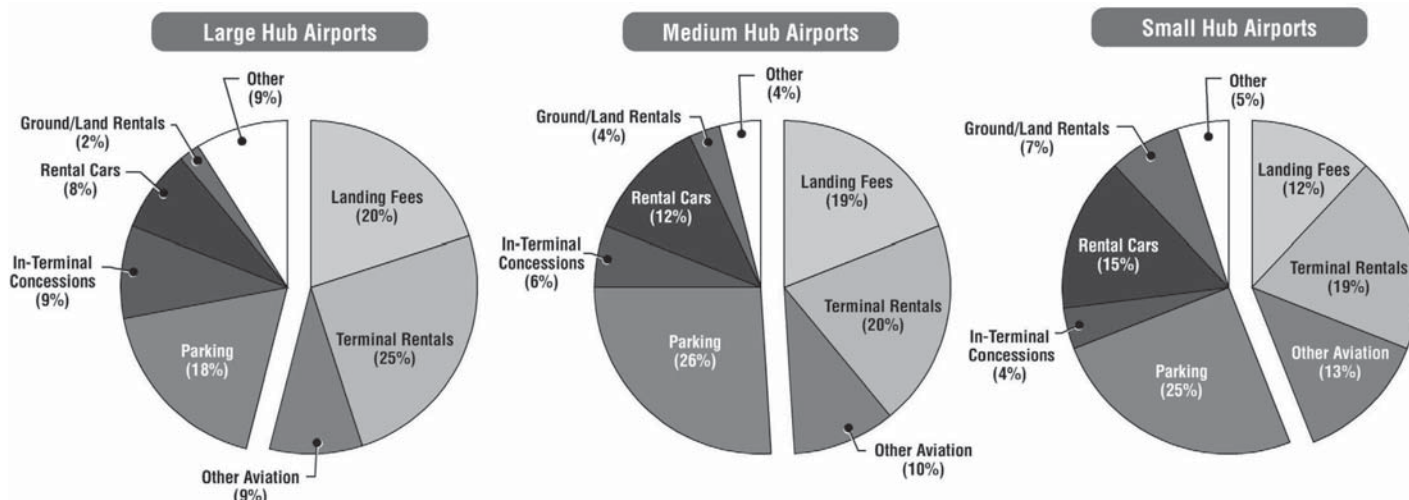
realization that their inability to readily find an empty parking space or other minor delays may cause them to arrive too late to check baggage, claim a reserved seat, store their baggage in an overhead compartment, greet an arriving passenger, or—in an extreme case—miss a flight. Thus, airport parking customers are less tolerant of long waits for a shuttle bus, long searches for an empty space, long walks to/from a terminal, and long entrance or exit delays.

- **Airport customers use facilities infrequently.** Compared to customers who park in office, university, hospital, or downtown parking facilities, airport parking customers rarely park at the airport because most airline passengers fly fewer than four times a year. As a result, they may be unfamiliar with the current parking fees and services, the shortest vehicular and pedestrian circulation paths, or the optimum parking location to meet their needs. Because they travel infrequently, it may take these customers several months to recognize and respond to changes in parking fees, services, or products. Thus, airport parking operators may require 4 months or more to evaluate how customers are responding to new parking fees, services, or products. Some customers may be intimidated by structured parking or a large parking system with multiple choices, particularly at airports that draw customers from a region or community containing few multilevel parking facilities.
- **Airport customers park for long durations.** Airport customers often park for several days, or occasionally several weeks, while users of other public parking facilities rarely park for more than 8 hours. Airport customers parking for longer than 24 hours (i.e., long-duration customers) typically account for less than 30% of all entering and exiting vehicles, but occupy more than 70% of all parking spaces and generate most of the parking revenues. Some long-duration customers, particularly those who travel infrequently, forget where they parked their vehicles and require assistance from airport staff to locate their vehicles. As described in Chapter 4 of this guidebook, the needs of customers parking for short durations (especially those parking for less than 4 hours) must be accommodated to minimize congestion on curbside roadways and recirculating traffic volumes.
- **Airport customers pay higher fees.** Airport parking rates are often higher than, or equivalent to, those in downtown parking facilities. Because of these rates and multiple-day parking stays, airport parking customers frequently pay higher fees than customers parking in other public parking facilities. It is not unusual for airport parking customers to pay more than \$25 for the use of airport parking facilities, which is uncommon in public parking facilities in all but a few large cities. Airport customers pay these fees because (1) the cost of parking represents a small percentage of the total door-to-door travel cost (e.g., airfares, rental car charges, lodging, and other costs), (2) they place high value on time and convenience (particularly those traveling on business purposes), and (3) some have no option other than driving to, and parking at, the airport.

## Distinguishing Characteristics of Airport Parking Operators

Some of the characteristics that distinguish the operators of airport parking facilities from those operating other publicly owned parking facilities include the following:

- **Emphasis on customer service.** Airports, which often serve as the gateway to a community or region, represent a visiting passenger's first or last impression of a community. Similarly, airport parking facilities may provide a resident's first or last impression of the local airport. As a result, airport operators seek to provide customers with higher levels of service than those provided at most other public parking facilities. Therefore, airports are often the first location for implementing many innovative parking products, services, and technologies.
- **Need to be financially self sustainable.** Federal law in the United States requires that commercial-service airports be as financially self-sustaining as possible. To meet their financial obligations, airport operators rely on revenues from (1) airlines, including landing fees, termi-



Source: FAA, AAS-400, CATS, Report Form 5100-127.

**Figure 1.1. Revenue sources at U.S. airports.**

nal rents, and other charges and (2) concessionaires and other non-airline tenants (e.g., in-terminal food and retail concessions, rental car companies, ground transportation providers, and public parking facilities). As shown in Figure 1.1, the single largest revenue source at U.S. airports is usually public parking, representing approximately 25% of all airport revenues and more than 40% of non-airline revenues. Often, surplus revenues generated from public parking provide cash flow to support other airport functions (e.g., general aviation, public areas of terminals) that either generate no income or require subsidies. Surplus parking revenues also represent the single largest source of debt-free cash flow to fund airport capital improvements. At some airports, parking revenues are shared with the airlines, which helps attract new airline service or maintain existing service by reducing airline costs.

- **Larger parking facilities required.** Typically, over 1,000 parking spaces are provided at commercial-service airports, and over 15,000 public spaces are provided at several large-hub airports. Most of the very large parking structures in the United States (e.g., those with over 5,000 spaces) are on airport grounds. These large parking facilities are required to accommodate the needs of airline passengers traveling in private vehicles (typically over 70% of all passengers) and those who park at the airport for multiple days.
- **Large amount of revenue handled.** Annual parking revenues are frequently over \$10 million at small-hub airports and over \$100 million at the largest airports. Although all parking operators strive to minimize theft and fraud, this objective is particularly important to airport operators because of the magnitude of the revenues, their importance to airport operations, and the negative implications (and potential high profile) of theft or fraud associated with such losses in a public agency. Therefore, airport parking operators often use state-of-the-art procedures and technologies to protect and control their revenues.

## Methodology

The information contained in this guidebook was gathered by identifying innovative parking strategies and technologies, and then conducting interviews with nearly 100 individuals and agencies familiar with the strategies. Those interviewed included employees at airports in the United States, Canada, and Europe; parking equipment manufacturers and vendors; private parking operators; parking consultants; and others. The information contained in the interviews

was supplemented by a comprehensive literature search, which is summarized in the bibliography presented in Appendix D.

The information in this guidebook was verified to the extent possible through interviews with multiple sources. As such, the data describing the costs and benefits of the strategies represent the best data available during the research period. However, limited or no data were available for those strategies that have only been implemented by private parking operators or at privately operated airport parking facilities. Similarly, some strategies have been implemented at only one or two airports and, again, limited or no data were available at the time this guidebook was prepared.

Finally, the information contained in this guidebook is current as of spring 2009. After completion and publication of the guidebook, it is expected that (1) additional strategies and technologies not described or anticipated will be introduced, (2) additional airport parking operators will implement some of the listed strategies (and be able to describe their experiences), and (3) some strategies in use at airports mentioned in the guidebook may be discontinued.

## **Organization of the Guidebook**

Subsequent chapters of the guidebook describe the following:

- Documenting the goals of airport management and using those goals to evaluate potential strategies (Chapter 2),
- Assessing customer needs and preferences (Chapter 3),
- Potential parking strategies and supporting technologies organized in eight functional categories (Chapter 4),
- Selecting potential strategies and supporting technologies (Chapter 5),
- Evaluating potential strategies and supporting technologies (Chapter 6),
- Key implementation steps (Chapter 7),
- Estimated costs of implementing, operating, and maintaining a strategy (Appendix A),
- Glossary of terms (Appendix B),
- Suggested sources for further information (Appendix C), and
- Bibliography (Appendix D).

# Documenting the Goals of Airport Management

This chapter provides an overview of how to document the relevant goals of airport management and the metrics that can be used to evaluate the performance of potential parking strategies.

## Evaluation of a Parking Strategy Begins with Management Goals

When identifying and evaluating potential parking strategies, it is beneficial to confirm and define the relevant goals of airport management prior to implementation. The goals for each airport are unique and reflect management's vision for the airport, its mission statement, and its specific values. To achieve these goals, management may have a strategy or long-term plan of action consisting of new parking products, services, or supporting technologies (see Figure 2.1).

The following three parking-related goals are frequently cited by airport managers:

- **Provide a high level of customer service** for the traveling public and employees.
- **Improve operational efficiency** by reducing the costs of parking operations while maintaining or improving customer service and safety, and enhancing revenues.
- **Enhance net parking revenues**, consistent with achieving airport management's other goals.

Each airport operator places different emphasis on these three goals (and subsets of these goals), reflecting the unique characteristics of the airport, the degree of competition (or partnership) with off-airport (private) parking operators, the adequacy of available parking facilities, the interval before the next required parking facility expansion, and other factors. Few operators seek an equal balance among these three goals (i.e., a point in the exact center of the triangle in Figure 2.2), with most operators leaning toward one goal or another. For example, some airport operators prefer to forego potential revenues to provide improved customer service (e.g., provide a high proportion of close-in, covered parking spaces), while other operators choose to enhance net revenues by avoiding or postponing capital costs (e.g., deferring construction of structured parking and, instead, expanding surface lots that are distant but within walking distance of the terminal), and some seek to improve efficiency at the expense of both customer service and revenues.

## Confirming and Documenting Relevant Management Goals and Objectives

The airport operator should have a clear idea of its short- and long-term goals and objectives for the parking program to guide its selection of parking strategies. Furthermore, it is imperative that these goals and objectives are consistent with the overall goals and objectives of the organization. With an established foundation of goals and objectives, the airport operator can





**Figure 2.1. Typical management process.**

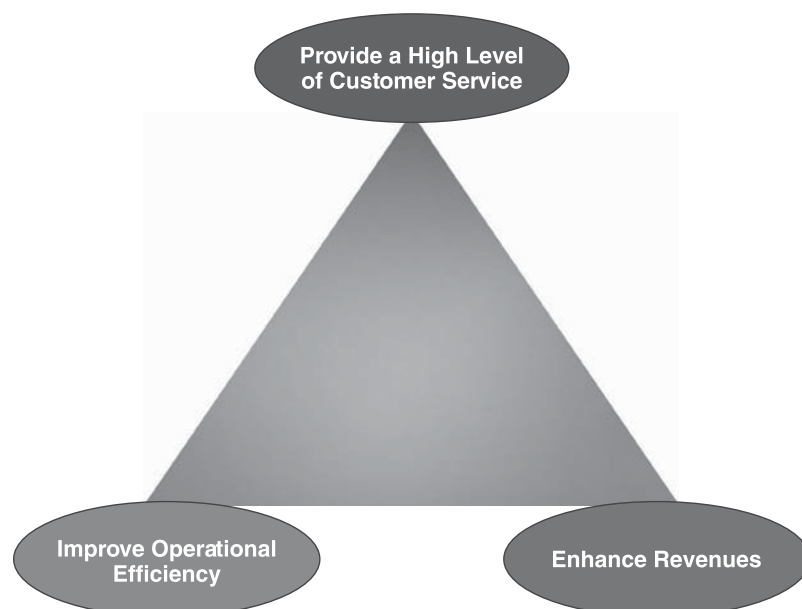
then determine the technologies and level of investment necessary to implement strategies that support these goals and objectives, and the types of data that must be collected to measure progress.

Numerous departments or divisions within an airport organization are affected by, or influence, parking operations. Included are airport operations, finance, properties and concessions, facility maintenance, planning and engineering, information technology (IT), environmental, construction, accounting/audit, public relations, and security/police. These relationships should be considered when identifying and evaluating parking strategies to assure that they support the overall goals and objectives of airport management.

It is recommended that representatives from all departments that are affected by, or influence, the parking program be involved in the development and prioritization of goals and objectives. By considering the range of needs and constraints, tradeoffs that achieve the best possible outcome can be developed.

Parking strategies reviewed in this research project were grouped according to the three goals important to airport operators. Many of the strategies will add value in achieving one or more airport operator goals to (1) improve customer service, (2) reduce operating costs, and (3) enhance parking revenue.

If the operator has not already defined and documented its goals and objectives for the parking program, these three goals can serve as a starting point for the development of potential goals and objectives. Providing customers with a safe and secure environment is another overarching goal that, although addressed separately, influences parking operations and customer service. Strategies selected in support of the goals and objectives will depend on the relative level of importance placed on each goal identified by the airport operator, as well as any constraints.



**Figure 2.2. Parking-related goals.**

The airport operator has many issues to consider when developing and prioritizing goals, objectives, and supporting strategies for its parking program, including the following:

- Expected change in origin and destination (O&D) airline passenger volumes (O&D passengers are those beginning and ending their journeys at the airport);
- Estimated future parking requirements by type of product;
- Available parking spaces by type of product;
- Net revenue projections in relation to revenue needs for the organization;
- Funding considerations/constraints;
- Relationship of parking provided by the airport operator and that provided by private operators, including
  - Supply,
  - Market share versus desired market share,
  - Products offered, and
  - Parking rates;
- Willingness to use airport resources to market the airport's parking facilities;
- Targeted customers and their demographics;
- Interaction between the location and operation of the airport's public and employee parking facilities, if any;
- Airport development plans/capital program;
- Airport roadway and, particularly, curbside capacities;
- Environmental implications; and
- Airport development and land use plans, including the availability of land for parking.

## **Developing Metrics to Evaluate the Performance of Selected Parking Strategies**

Metrics are important for measuring progress toward achieving goals and for determining the most effective parking strategies. Metrics are useful for providing updates to management, justifying or discontinuing investment in certain strategies, planning, and program monitoring and improvement.

It is important to develop a baseline from which to compare the selected metrics. To establish the baseline, an airport operator can collect and analyze “before” data either by selecting a time period for analysis of existing data or collecting new data. Progress can be measured based on improvements over a subsequent time period or over similar periods by year. Progress may also be measured by evaluating performance compared to a future target. Metrics selected will depend on what the airport operator is trying to achieve and the resources it allocates for performance monitoring. The following examples are some of the more commonly used parking-related metrics to monitor and track parking revenues, facility utilization, customer service, operations, and other aspects of public parking:

- Revenues and net revenues
  - Revenue, operating cost, and net revenue per space overall;
  - Revenue, operating cost, and net revenue per space, by parking product;
  - Revenue per transaction, by parking product; and
  - Revenue per airline passenger.
- Facility use
  - Daily peak-period spaces occupied (i.e., peak use), by parking product (if available);
  - Daily overnight spaces occupied, by parking product;
  - Percent occupancy or relative occupancy by parking product;
  - Average length of stay, or length of stay distribution;

- Hourly, daily, or monthly number of transactions by facility or parking category; and
- Available spaces by parking product (e.g., during a construction project that will cause a temporary loss or displacement of spaces).
- Customer service
  - Customer complaints by number of exits or by time period;
  - Customer satisfaction measures, such as the use of mystery parkers;
  - Customer delays at entry or exit during peak periods (or frequency of delays exceeding a specified goal); and
  - Average processing time or distribution of processing times at the entry or exit plazas.
- Payment methods
  - Non-revenue exits by facility;
  - Percent of exits paid by credit card, using pay-on-foot stations, using access cards, or using other payment methods;
  - Percent of unpaid and/or exception transactions; and
  - Use of validations.
- Operations and operating costs
  - Personnel (or staff hours) per 1,000 transactions and
  - Expenses as a percentage of gross revenues.
- Planning and marketing
  - Parking spaces per resident O&D passenger;
  - Airport's share of the parking customer market;
  - Share of passengers choosing to park versus those being picked up and dropped off; and
  - Number of occurrences when the demand exceeds the available spaces (e.g., a facility is closed) and when overflow or holiday parking facilities are used.

The airport operator may also wish to compare (benchmark) its metrics with those of other airports with similar characteristics, with the metrics of privately operated off-airport parking facilities, or the metrics of non-airport parking facilities or programs. The metrics should be developed to allow for fair comparisons, considering the metrics developed for the private facilities or programs of interest, and the frequency with which they are updated.

## Benchmarking

As applied to airport parking, benchmarking is the process of comparing the fees, number of spaces, types of products and services, revenues, operational practices, and other aspects of an airport's parking operations with those at other airports. Benchmarking helps airport operators understand how their parking operations rank or compare in relation to a particular indicator or metric. Benchmarking can also be used when seeking the approval of senior management by increasing management's awareness of the operations and facilities at other "peer" airports. The metrics used for such comparisons (e.g., parking rates or spaces) are usually simpler than those described in the previous paragraphs.

Benchmarking analyses are most commonly conducted by comparing an airport with its peer airports. Typically, peer airports are selected considering the following:

- **Passenger volume.** Airport management frequently compares its airport with airports of similar size. Ideally, size is defined in terms of the number of annual O&D airline passengers, since these passengers are the customers for parking products. Since most medium- or small-hub airports serve few connecting passengers, comparable airports can be identified using the number of enplaned or deplaned passengers. Many large-hub airports, however, serve as hubs for a major airline and therefore have a large number of connecting passengers. When identifying

comparable airports for purposes of benchmarking parking statistics, connecting passenger numbers should not be considered.

The number of annual enplaned passengers is readily available from such sources as (1) Airports Council International–North America and (2) the Federal Aviation Administration (FAA) Compliance Activity Tracking System (CATS) 400 database (see Report 127 at <http://cats.airports.faa.gov/reports/reports.cfm>) for passenger and revenue data. A good source for originating and terminating airline passenger volumes is the U.S. Department of Transportation’s Research and Innovative Technology Administration (RITA) Bureau of Transportation Statistics.

- **Proximity.** Airport operators (and their governing boards or commissions) frequently compare their operations with those of nearby airports, particularly those of a similar size. Nearby airports are likely to have customers with similar costs of living and price sensitivities and to experience similar weather conditions influencing passenger preferences for covered parking and operating costs (e.g., costs for snow removal).
- **Airlines.** The operators of airports, particularly those serving as connecting hubs, often compare their airports with other airports that have the same dominant airline (e.g., Minneapolis-St. Paul International and Detroit Metropolitan Wayne County airports, both of which serve as hubs for Delta Air Lines).
- **Extent of privately operated off-airport parking.** Airports in areas where there is little, if any, off-airport parking will require more parking spaces and thereby generate more revenues per passenger and in total than comparatively sized airports in areas where there are many off-airport parking spaces.
- **Passenger demographics.** Selecting airports that accommodate passengers with a similar mix of trip purpose and place of residence may be helpful. For example, airports serving destination resorts and comparatively few local residents who park for long durations (e.g., Honolulu, Las Vegas’ McCarran, and Orlando International Airports) will have different parking characteristics than airports serving a high proportion of local resident business travelers (e.g., LaGuardia, Mineta San Jose International, and Reagan Washington National Airports). The operators of airports serving comparatively few local residents may be reluctant to increase parking rates that would affect local residents, preferring to generate revenues from services offered to non-residents.
- **Use of public transportation.** The parking characteristics of airports with high passenger use of public transit (i.e., more than 10%) will differ from the parking characteristics of airports with lower passenger use of public transit.

Some other factors to consider when conducting a parking-related benchmarking analysis include the following:

- **Definition of the product.** The type of product defined as *short-duration parking* or *economy parking* varies from airport to airport. When conducting a benchmarking analysis of parking rates by product, it is necessary to confirm that similar products are being compared.
- **Local taxes.** Some states and municipalities tax the airport parking fees paid by customers. The parking rates published by most airports include the costs of such taxes, while the rates published by many privately operated parking facilities exclude taxes. When gathering reported parking revenues from airports, it is necessary to determine whether the reported gross revenues include taxes collected.
- **Airline agreements.** At airports with “residual” agreements, higher parking revenues are transferred to the airlines in the form of lower airline rates and charges, which result in no net gain to the airport enterprise, except the positive aspect of lower airline costs. At airports with “compensatory” agreements, typically parking revenues are not transferred to the airlines. Therefore, the extent of the benefits resulting from increased parking revenues may vary depending on the type and specifics of the airport operator’s agreement with the airlines.



## CHAPTER 3

# Assessing Customer Needs and Preferences

Airport operators use information on customer utilization, needs, preferences, and satisfaction to evaluate the performance of their parking program in relation to their goals and objectives, to understand how the program is performing and why, and to implement or fine-tune their parking strategies accordingly. The different types of data used by airport operators to evaluate their parking operations are described in this chapter, as are ways to collect and analyze the data using focus groups, stakeholder groups, customer surveys, and airport staff experience.

### Data Collection and Analysis

Data captured on a routine basis, as well as supplemental data collection on an as-needed basis, can be used to analyze patterns, trends, and changes in the behavior of parking customers. These analyses can provide information on patterns of use, but they do not explain the reasons for customer preferences.

Examples of statistics that may be useful for analyzing airport-operated parking operations include the following:

1. Parking transactions compared to airline flight schedules,
2. Customer durations in parking facilities,
3. Occupancies by facility or product,
4. Counts of customers on the airport parking shuttle,
5. Counts of facility entering and exiting volumes,
6. Customer place of residence and distance traveled (obtained from license plates in certain states),
7. Average revenue per transaction by facility or product, and
8. Distribution of customers by payment method and by parking facility or product.

It is helpful to analyze these data at different times of the year to understand seasonal and daily variations in parking activity, including demand during peak and off-peak periods. Comparisons can be made with passenger use of other access modes (or trends in this use) obtained from survey counts of taxicab dispatches, private vehicle traffic, customers on privately operated off-airport parking courtesy vans, or informal surveys of the use of off-airport parking facilities. For some analyses, additional data are helpful to develop meaningful comparisons among similar customer groups, such as data gathered from surveys of O&D airline passengers.

### Focus Groups

Focus groups are useful for obtaining opinions and perceptions of customers or potential customers regarding a product or a service. Focus groups—especially those conducted on airport parking products and access modes—are typically conducted by a moderator, last for 90 to

120 minutes, and have 8 to 12 participants. Focus groups are held to analyze or address a specific topic or purpose. Typically, more than one focus group is conducted to address a topic, with participants recruited because they have similar characteristics. For example, to evaluate strategies that could increase an airport operator's share of the public parking market, a series of focus groups might be organized to include (1) local residents who travel for business purposes and who park on-airport, (2) local resident business travelers who park in privately operated off-airport parking facilities, and (3) local resident business travelers who use taxicabs and limousines to access the airport. Within these categories, there might be a range of users stratified by income level, frequency of travel, and other characteristics, or a further segmentation.

Focus groups are a forum for asking open-ended questions, which allow the moderator to ask follow-on questions to participant responses. Unlike customer surveys using structured survey instruments, which aim to collect answers from a representative sample of customers and are meant to be unbiased, focus groups are biased. The intent is to understand the likes and dislikes of customers and their underlying perceptions, why they behave the way they do, and what strategies might change their behavior. Results from focus groups are obtained quickly in comparison to customer surveys, in which data input, quality control, manipulation, and analysis must be performed to understand the results.

Focus groups can be used to gather opinions from small groups of customers about existing airport parking products, their likes and dislikes related to competing privately operated parking facilities, or alternatives to airport parking (e.g., curbside pickup/drop-off, use of taxicabs and other access modes). Focus groups also provide a means to test customer reactions to potential parking products and services, and to solicit original ideas from participants. Focus groups can also be used to develop formal survey questions for a larger population of customers. Focus groups are used to help develop or refine products and services in many industries. For example, focus groups are used in the advertising industry to test new advertisements before the sponsor makes a large investment in a television advertising campaign.

## Stakeholder Groups

Stakeholder groups are used to obtain feedback, monitor customer satisfaction, and test ideas on a regular basis. A stakeholder group may consist of a diverse range of customers from several interest groups (e.g., the business community, neighborhood groups, and the general population), or there may be several special-interest stakeholder groups (e.g., a group of representatives from large employers, chambers of commerce, hotel and convention bureaus, trade organizations, small business associations, travel agents, or other organizations). Unlike focus groups, stakeholder groups have an ongoing interest in the outcome of their participation, and members of stakeholder groups have an agenda. Stakeholder groups may also be formed for a specific purpose and have a defined duration.

## Customer Surveys

Several types of customer surveys can be administered to assess customer preferences, needs, and trends or patterns, as follows:

- **Customer satisfaction surveys.** Airport operators may use customer satisfaction surveys to measure customer satisfaction with products or services and to monitor and improve customer service. To evaluate a parking program, customer satisfaction surveys would request customers to rate elements of the parking program, such as payment methods, experience with exit/entry delays, specific parking products, cleanliness or safety of facilities, frequency of shuttle bus service, courtesy of shuttle bus drivers, availability of spaces, ease of finding spaces,



walking distances, and parking rates. Some basic information on customer demographics may also be collected. Open-ended questions may be included, but it should be recognized that respondents may choose not to answer, or may provide vague answers. To encourage completion of these surveys, some airport operators have found it helpful to offer incentives to those completing surveys (e.g., parking discount coupons).

Information could be obtained by distributing mail-back surveys to customers entering or exiting parking facilities, but it should be recognized that such surveys have very low response rates (i.e., less than 10%). Drop-off boxes for the surveys can also be provided in the parking facility. An alternative survey method is to distribute a card inviting customer participation in an online survey.

A broader airport customer satisfaction survey (e.g., an intercept survey) could be administered in the terminals to determine customer satisfaction regarding a range of products and services. Such surveys can include questions that require those surveyed, and who have used the airport's parking facilities on their current trip or in the past, to rate or compare parking products or services and their satisfaction with those products or services. Such in-terminal surveys can be administered on the spot by interviewers, by using mail-back cards, or by inviting customers to participate in online surveys at their leisure.

Customer satisfaction surveys may be administered periodically, or before and after the introduction of a new parking facility or changes to a parking program. This type of survey could ask respondents for contact information to follow up in the future. Such follow-up surveys provide one method for developing a database of potential candidates for focus groups.

- **Revealed preference surveys.** Revealed preference surveys are administered to a representative sample of airport customers to establish patterns of facility use by asking airport passengers questions regarding their current or previous trips to or from the airport. The most comprehensive form of revealed preference surveys for airport planning purposes is the O&D survey, which is typically administered to enplaning passengers to collect information on mode of access to the airport for the current flight, trip purpose, length of stay, trip origin, location of residence, travel party size, number of checked and carry-on bags, number of flights taken over a 12-month period, airport arrival time in relation to flight departure time, and other questions dependent on the purpose for the survey. If airline passengers are sampled by flight, the database can be supplemented with information on flight destination and departure time. This type of survey puts parking use in the context of the bigger picture of all airport ground access modes by allowing the airport operator to understand the percentage of parkers in relation to all ground access users, and to develop profiles of customers using parking facilities operated by the airport operator, as well as profiles of potential customers currently using privately operated parking facilities and other ground access modes. This type of information can also be used to support regional transportation planning and travel demand modeling.

The O&D survey is an important tool used for airport ground access planning, terminal planning, operations planning, and as an input for marketing and advertising programs. This type of survey may be administered in the context of a master plan, or it may be administered periodically (every 2 to 5 years) to monitor airline passenger behavior over time. Surveys may be administered at a "typical" travel time when the airport is not experiencing heavy vacation or business travel, or at a peak time, or both, depending on the airport operator's intended use of the survey data. Periodic surveys should be administered at similar times of the year to allow for comparison. Because of the cost to conduct valid surveys of parking customers, few airport operators regularly conduct revealed preference surveys solely for the purpose of analyzing parking products, but rather include one or two questions about parking in larger, more comprehensive passenger surveys.

License plate surveys are an alternative to O&D surveys and also provide useful information for marketing and advertising programs. Since the license plate of every parked vehicle is recorded at most airports as part of nightly license plate inventories, it is possible to use license



plate numbers to determine the vehicle owner's place of residence and the market area from which the airport is attracting customers—particularly at airports that attract passengers from multiple states.

- **Stated preference surveys.** Stated preference surveys are a method of data collection used to determine how customers might behave in the future under varying conditions. The survey recipient is provided with tradeoffs from which to choose related to one or more topics of interest, which, when analyzed together with demographic information, allow the development of predictive tools for the variables surveyed. Stated preference surveys could be applied to the airport parking program, for example, to analyze the potential impacts of changes to public parking fees. Stated preference surveys could be used to determine parking price sensitivity by various passenger groups, to estimate the change in the number of parking customers and revenue that would be gained or lost at various parking rates, and the modes to or from which passengers would divert. Stated preference surveys may be administered at the airport by intercepting customers or by distributing invitation cards to customers to participate in an online survey. Stated preference surveys are valuable for predicting customer responsiveness to changes in products or services or the development of new products being considered, particularly when potential demand or financial impacts may be significant. This type of survey should be conducted on an as-needed basis. Designing and conducting such surveys require specialized skills and experience.

## Experience

Airport operations staff, customer service staff, and public relations staff often have an inherent understanding of customer needs and preferences because of their day-to-day involvement with the parking program and contact with customers. Based on operational issues and their experience with the public, these staff members often are able to identify when the peak periods of demand occur for various customer groups (e.g., business and non-business travelers) and the products preferred by particular customer groups. Staff members answering questions, responding to customer complaints, and reviewing customer satisfaction cards can offer valuable insight on certain topics. This insight may be useful in relation to product improvement or development, as input to data collection methodologies, or in validating data analysis results.



## CHAPTER 4

# Parking Strategies and Supporting Technologies

This chapter presents more than 65 strategies and supporting technologies that were identified during the research process and are listed in Figure 4.1.

### Parking Strategy and Technology Categories

To assist the user of this guidebook in finding relevant strategies, the identified strategies and technologies are grouped according to how they are used by customers and airport operators. This grouping resulted in eight categories. A brief description of the categories is as follows:

- **Category A: Parking Products—Duration Based.** These products are generally defined by the length of stay of the customers the products are intended to attract or serve. These products include short-duration parking, long-duration parking, free 30-minute parking, cell phone lots, and other parking products that are duration based.
- **Category B: Valued-Added Parking Products.** These products provide customers a higher level of service than do traditional parking products. These products include valet parking, reserved parking zones, guaranteed spaces, validated parking, and other value-added products available at additional cost.
- **Category C: Complementary Customer Services.** These services, which could be applied to any of the duration-based or value-added parking products described above, are intended to enhance the level of customer service. They include vehicle washing and servicing; on-site sale of food, beverages, and other products; loyalty programs; baggage check-in; pet kennels; and other services. Typically, these services are available at additional cost and are not part of the basic parking services.
- **Category D: Parking Space Availability and Guidance Systems.** These systems guide customers to empty spaces located in specific parking facilities, empty spaces on specific parking levels or in specific zones, or specific individual empty spaces. This guidance can be provided to customers using signals, dynamic signs, or messages broadcast over the Internet, via telephone, or via highway advisory radio (HAR) while customers are en route to, or at, the airport. This category also includes systems that help pedestrians remember where they parked their vehicles.
- **Category E: Cashierless Transactions.** Cashierless transaction technologies include a variety of parking payment methods that generally do not require cash and therefore minimize or avoid the need for cashiers to handle cash, and potentially reduce or eliminate the need for exit cashiers. These technologies include pay-on-foot (POF) systems, credit card in/out, automatic vehicle identification (AVI) systems, pay by cell phone, and in-lane processing. Supporting technologies, such as license plate recognition, are also included.

- **Category F: Revenue Enhancement Strategies.** These strategies allow an airport operator to increase the revenues generated by public parking facilities. They include rate adjustments, Web-based reservations, yield management, coupons, advertising, branding, and marketing.
- **Category G: Safety and Security Strategies.** This category includes strategies intended to improve the level of safety afforded parking customers. They include video surveillance and audio communications systems.
- **Category H: Operational Enhancements.** This category includes strategies intended to reduce operating costs and improve operations. Alternative methods of operating airport parking facilities (e.g., using airport staff or a private management company) and design/build/operate and maintain programs are included. Automated overnight license plate inventory (LPI) is also included.

Each category and its individual strategies/supporting technologies is presented later in this chapter and includes its purpose; use of this particular strategy by customers; reported benefits; implementation actions, key considerations, costs, and schedule; supporting strategies; and examples of airports where the strategy has been implemented.

## Examples of Strategies Not Included

Several categories of parking strategies were not included in this guidebook, as follows:

- **Architectural and Design Strategies**—This guidebook is not intended to serve as a design reference nor is it intended to improve the design of proposed or existing parking facilities. Many design features can increase customer service, enhance safety, and improve operational efficiencies. For example, several passive design features—such as visible stair or elevator cores, improved lighting, or improved visibility—can improve the level of safety, and their use should be considered when planning and designing a parking facility. However, such features are not addressed in this guidebook.
- **Environmental and Sustainability Strategies**—This guidebook is not intended to serve as a reference for features or programs that can reduce the environmental impacts of a parking structure, allow for sustainable design and operations, or result in eligibility for Leadership in Energy and Environmental Design (LEED™) certification. Although the guidebook does describe the use of strategies to reduce vehicle circulation, install solar panels, and install electric vehicle charging stations, these strategies represent just a few of the many available programs that can reduce environmental impacts.
- **Parking Operations**—This guidebook is not intended to document best practices in parking facility operations. It does not address staff training, supervision, or responsibilities or other day-to-day operational tasks. It does not address maintenance procedures, the use of security patrols, or revenue control practices (e.g., cash handling, auditing, or accounting).
- **Multi-Use Facilities**—In addition to airline passengers (i.e., “public” customers), some airport parking structures are used by rental car companies, ground transportation operators (e.g., the operators of taxicabs, limousines, courtesy vehicles serving hotels/motels), or employees of the airport operator, airlines, or other airport tenants. This guidebook is not intended to address the operation, design, or planning of such multi-use facilities.

## Potential Parking Strategies and Technologies

Detailed descriptions of each strategy and supporting technology identified by the research team are provided in the remaining sections of this chapter.

**Category A: Parking Products—Duration Based**

- A.1 Hourly/Short-Duration Parking
- A.2 Daily Parking
- A.3 Economy/Long-Duration Parking
- A.4 Very-Short-Duration Parking/Curbside Areas
- A.5 Free 30-Minute Parking
- A.6 Cell Phone Lots
- A.7 No Overnight Parking Zones
- A.8 Vacation Parking
- A.9 Holiday/Overflow Parking
- A.10 Parking Condominiums

**Category B: Value-Added Parking Products**

- B.1 Valet Parking—Curbside Drop-Off/Pickup
- B.2 Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In
- B.3 Valet Parking—Non-Curbside Drop-Off/Pickup
- B.4 Valet Parking—Customer Transported to/from Airport in Shuttle Van
- B.5 Business Parking
- B.6 Monthly Billing—Pay per Use
- B.7 Reserved Parking Zone—Pay per Use
- B.8 Guaranteed Space—Unlimited Use
- B.9 Validated Parking—Retail
- B.10 Validated Parking—Park-Sleep-Fly
- B.11 XXL (Extra Large) Parking
- B.12 Parking for Ladies and Families
- B.13 Secure Parking and Secure Parking with Valet Service

**Category C: Complementary Customer Services**

- C.1 Vehicle Washing and Servicing
- C.2 Concierge Services
- C.3 Onsite Sale of Food, Beverages, and Other Products
- C.4 Pre-Ordered In-Flight Meals to Go
- C.5 Loyalty Programs (Frequent Parker Programs)
- C.6 Passenger Check-In Kiosks
- C.7 Baggage Check-In
- C.8 Pet Kennels
- C.9 Shaded Spaces
- C.10 Shaded Spaces with Solar Panels
- C.11 Electric Charging Stations

**Category D: Parking Space Availability and Guidance Systems**

- D.1 Space Availability via the Internet Prior to Arrival
- D.2 Space Availability via Phone/Radio Prior to Arrival
- D.3 Space Availability by Facility
- D.4 Space Availability by Parking Level
- D.5 Space Availability by Aisle/Sector
- D.6 Space Availability by Space
- D.7 Managed Fills
- D.8 Parking Compartments
- D.9 Space Locators
- D.10 In-Vehicle Parking Technologies

**Category E: Cashierless Transactions**

- E.1 Pay-on-Foot Systems
- E.2 Credit Card In/Out
- E.3 Automatic Vehicle Identification/Radio-Frequency Identification
- E.4 IntelliDrive
- E.5 Proximity Cards
- E.6 License Plate Recognition
- E.7 Cellular Telephone/Pay by Cell
- E.8 In-Car Meters
- E.9 In-Lane Processing

**Category F: Revenue Enhancement Strategies**

- F.1 Parking Rate Adjustments
- F.2 Strategic Pricing
- F.3 Web-Based Reservations
- F.4 Yield Management
- F.5 Coupons
- F.6 Advertising Sales—Interior, Exterior, Tickets, and Equipment
- F.7 Branding
- F.8 Marketing

**Category G: Safety and Security Strategies**

- G.1 Visual Surveillance—Camera
- G.2 Emergency Audio Communications

**Category H: Operational Enhancements**

- H.1 Parking Facility Operation Options
- H.2 Privatized Facility Development
- H.3 Automated Overnight License Plate Inventory

**Figure 4.1.** *Parking strategies by category as included in this guidebook.*

# CATEGORY A:

## Parking Products—Duration Based

- A.1 Hourly/Short-Duration Parking, 18
- A.2 Daily Parking, 20
- A.3 Economy/Long-Duration Parking, 21
- A.4 Very-Short-Duration Parking/Curbside Areas, 22
- A.5 Free 30-Minute Parking, 23
- A.6 Cell Phone Lots, 25
- A.7 No Overnight Parking Zones, 26
- A.8 Vacation Parking, 28
- A.9 Holiday/Overflow Parking, 29
- A.10 Parking Condominiums, 30



## CATEGORY A

# Parking Products—Duration Based

### A.1 Hourly/Short-Duration Parking

#### Purpose

Reduce curbside demand and congestion by providing convenient parking for customers dropping off or picking up airline passengers and assuring that spaces are available for these customers in a designated short-duration parking area.

#### Use by Customers

Hourly or short-duration parking facilities (for parking durations of less than 4 hours) are provided for customers dropping off or picking up airline passengers. By attracting customers who would otherwise use the terminal curbsides, these short-duration parking areas help reduce curbside demand and congestion, as well as circulating traffic.

Because customers can stop immediately in front of the terminal for free, hourly/short-duration parking facilities must offer an attractive alternative (see Implementation Actions). To help attract these customers and assure that conveniently located short-duration parking spaces are available (see Benefits), long-duration parking customers (e.g., those parking for 24 hours or more) are typically discouraged from parking in hourly/short-duration facilities either by charging daily or overnight rates in the short-duration facilities that are much higher than those for long-duration parking in other airport facilities, or by a ban on overnight parking in the short-duration facilities.

#### Benefits

A separate parking facility for short-duration customers creates an attractive alternative to the terminal curbside areas; helps reduce curbside demand and congestion, as well as circulating traffic; and provides a high level of customer service.

If an hourly/short-duration facility is not provided, the most convenient parking spaces in a lot or garage tend, over

time, to be occupied by long-duration customers because of the lower turnover rates. When long-duration parking customers occupy the most convenient spaces, short-duration customers cannot find an empty, convenient space, or must spend more time searching for a space. Short-duration customers are, therefore, likely to use the curbside if they have found (or learned from other customers) that conveniently located parking spaces are unavailable, that they must walk long distances to/from the least desirable spaces (i.e., those located in the rear), or that they can expect to spend time searching for an available space.

#### Implementation Actions

Providing a separate parking area for short-duration customers requires the following actions by an airport operator:

1. Reserve the most conveniently located spaces at an airport (e.g., the spaces directly opposite the primary terminal doorways or adjacent to a pedestrian crosswalk, elevated skywalk, or pedestrian tunnel) for short-duration parking. The spaces should be a short walk (ideally less than 400 ft) from the terminal ticket counters/baggage claim area. Customers should not be required to use a shuttle vehicle or, if possible, travel vertically without use of an escalator or elevator. Hourly/short-duration parking customers are more sensitive to walking distances than those parking for several days.

Customers parking for 4 hours or less represent less than 15% of all occupied spaces at an airport, but represent a high percentage of the total transactions. This is true because the spaces occupied by short-duration customers turn over more frequently (perhaps 6 to 10 times per day) than those occupied by long-duration customers. Thus, relatively few spaces (usually less than 5%) are required for hourly/short-duration parking compared to other airport parking products. However, these short-duration spaces serve about two-thirds of all parking customers and perhaps three-quarters of all pedestrians traversing between

parking and the terminal (which is why locating these spaces at the same level as ticketing/baggage claim is preferred and also reduces demands on elevators or escalators).

2. Physically separate the short-duration spaces from other nearby spaces serving customers parking for longer durations via the use of fences or barriers, or by reserving an entire level or lot.
3. Provide separate entrance(s) or use a “nested” parking area. A common exit is acceptable. Separate entrances are required to distinguish the higher-priced tickets issued to hourly customers from those issued to other customers.
4. Establish daily parking rates (i.e., maximum rates) in the hourly/short-duration area that are much higher than those charged in nearby daily facilities, while charging the same rates for the first 4 hours as those charged in other airport parking facilities. (Generally airport operators charge the same rates for the first few hours, but some airports with limited capacities charge higher rates.) The average differential cost (the difference between the cost of parking for 24 hours in hourly and daily facilities) is about \$20 at selected large-hub airports and about \$8 at medium- and small-hub airports.

Although some sources suggest that the daily rate for parking in hourly/short-duration facilities should be twice the rate for parking in daily facilities, it is recommended that parking rates reflect the local market and airport-specific demands and layout. Since few, if any, customers park for 24 hours in an hourly facility, it may be appropriate to establish a higher differential rate if an hourly facility attracts overnight customers. Parking rates are typically established by experienced airport staff, often with assistance from a consultant or the parking facility management company (see Section H.1).

Customer responses to parking rate changes vary based on the local economy, customer sensitivity to costs, customer demographics, and other factors.

## Key Considerations

Hourly/short-duration parking strategies have worked well at airports that have

1. Established appropriate differential parking rates. Some airport operators have set very high maximum daily rates in their hourly parking facility (>\$40/day) with the expectation that few, if any, customers would be willing to pay this rate. Therefore, convenient spaces are always available for the true hourly/short-duration parker. However, because such high rates are often cited in the media, it is helpful, when setting rates, to explain their intended purpose and that the hourly rate is the same as in other facilities.
2. Provided sufficient spaces (i.e., supply equals demand).

3. Used signage that clearly identifies the product offered (see Section F.7).
4. Assured that the hourly/short-duration facility contains the most convenient spaces (i.e., a less expensive parking facility does not offer equivalent walking distances or levels of convenience).
5. Annually reviewed demands and trends in space occupancies to determine when a facility is approaching capacity.

## Implementation Costs

The costs depend on whether a new hourly/short-duration parking area is to be constructed or if an existing facility is to be modified, and the size of the facility. Costs would be incurred for building or modifying new surface or structured spaces (see Appendix A), access control equipment (see Appendix A), and new roadway guide signs.

## Ongoing O&M Costs

O&M costs are the same as those for other surface lots or structures (see Appendix A). There are no specialized or unusual costs associated with providing hourly/short-duration parking facilities.

## Implementation Schedule

The required time for implementation depends on whether hourly/short-duration parking is to be provided in a new facility or if portions of an existing facility are designated for this use.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Daily Parking (A.2),
- Very-Short-Duration Parking/Curbside Areas (A.4),
- Free 30-Minute Parking (A.5),
- No Overnight Parking Zones (A.7),
- Passenger Check-In Kiosks (C.6),
- Baggage Check-In (C.7),
- Space Availability (D.3, D.4, D.5, and D.6), and
- Parking Rate Adjustments (F.1).

## Examples of Application

Many airports provide hourly/short-duration parking areas separate from adjacent daily parking facilities. Airports where overnight parking (or limited parking duration) in a designated portion of a daily parking area is prohibited, thereby creating an hourly parking area, include those serving Dallas/Fort Worth, Denver, Madison, and Salt Lake City.



## A.2 Daily Parking

### Purpose

Provide conveniently located facilities for customers parking for 1 to 3 days and who are willing to pay higher fees for this convenience.

### Use by Customers

Daily parking spaces are typically located within walking distance of the terminal. At many large airports, daily spaces are located in a multilevel structure opposite the terminal, thereby providing covered parking for customers. Typically, those levels adjacent to pedestrian bridges or crosswalks are reserved for hourly/short-duration customers, with the remainder of the structure available for daily customers. In surface lots, the daily parking areas are typically adjacent to the hourly/short-duration spaces, but farther from the terminal.

Depending on the airport operator's customer service goals and revenue needs, the daily parking area (or the combined daily and hourly/short-duration areas) may contain between 20% and 60% of the total public parking spaces provided at the airport.

### Benefits

The availability of separate hourly/short-duration, daily, and economy/long-duration parking facilities offers customers a menu of parking products with varying costs and convenience. Providing multiple parking products allows airport operators to manage demand by adjusting parking rates to balance demand among the available parking facilities (i.e., assure that spaces are available for customers), enhance revenues, and operate efficiently.

### Implementation Actions

Providing a separate parking area for daily customers requires the following actions by the airport operator:

1. Reserve conveniently located spaces on airport, located a short walk from the terminal (e.g., with unassisted walking distances of 600 ft or less). Customers should not be required to use a shuttle vehicle, but moving sidewalks are permissible.
2. Physically separate the daily parking spaces from other nearby spaces serving customers parking for shorter or longer durations via the use of fences or barriers, or by reserving an entire level or lot.
3. Provide separate entrance(s) or a "nested" parking area. A common exit is acceptable.
4. Establish daily maximum rates (i.e., the cost for parking 24 hours) that are much lower than those charged in nearby hourly/short-duration facilities, but higher than those charged for parking in economy/long-duration facilities. The average differential cost for parking 24 hours in a daily facility and an hourly/short-duration facility is about \$20 at selected large-hub airports and about \$8 at medium- and small-hub airports. The average differential cost for parking 24 hours in a daily facility and an economy/long-duration facility is about \$8 at selected large-hub airports and about \$5 at medium- and small-hub airports.

Although some sources suggest that the maximum daily rate in a daily parking facility should be half that charged in an hourly/short-duration facility and twice that in an economy facility, it is recommended that rates reflect the local market, and the airport-specific demands and layout.

### Key Considerations

Daily parking has worked well at airports that have

1. Established appropriate differential parking rates.
2. Provided sufficient spaces (i.e., supply exceeds or, at a minimum, equals demand).
3. Used product names or branding that clearly identify the product offered.
4. Assured that the level of service in the daily parking facility (e.g., walking distances, availability of covered spaces) is clearly differentiated from that provided in economy/long-duration facilities.

### Implementation Costs

The costs depend on whether a new daily parking area is to be constructed or an existing facility is to be modified, and the size of the facility. Costs would be incurred for either building or modifying new surface or structured spaces (see Appendix A), access control equipment (see Appendix A), and new roadway guide signs.

### Ongoing O&M Costs

O&M costs are the same as those for other surface lots or structures (see Appendix A). There are no specialized or unusual O&M costs associated with providing daily parking facilities.

### Implementation Schedule

Developing a new parking structure may require 3 years or more, while developing a new surface lot (or expanding an existing lot) may take 1.5 years, including receiving

prior approval from management selection and award to an architect/engineer, preparation of construction documents, financing, bid and selection of a contractor, and actual construction.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Hourly/Short-Duration Parking (A.1),
- Economy/Long-Duration Parking (A.3),
- Business Parking (B.5),
- All Complementary Customer Services (C),
- All Parking Space Availability and Guidance Systems (D),
- All Cashierless Transactions (E), and
- All Revenue Enhancement Strategies (F).

## Examples of Application

Many airports provide daily parking facilities separate from adjacent hourly/short-duration and economy/long-duration parking facilities.

### A.3 Economy/Long-Duration Parking

#### Purpose

Provide an inexpensive parking product serving customers parking at the airport for more than 3 days and/or who are more sensitive to parking costs than convenience/travel time. Encourage customers to park for the duration of their flight, rather than being dropped off and then picked up when they return, to reduce vehicle miles traveled and vehicle emissions, and to attract additional customers and increase parking revenues.

#### Use by Customers

Economy/long-duration parking facilities attract customers who are typically more price sensitive than time sensitive. Generally, this includes those traveling on vacation or for other non-business purposes and customers who are not reimbursed for their parking or other travel costs. Customers using economy/long-duration parking facilities are often provided free shuttle service because of the long walking distances between the parking lot and the terminal. Because of the shuttle service provided, these parking facilities are referred to as “shuttle lots” or “remote lots” at some airports.

Economy/long-duration parking customers, particularly non-business customers, often travel over weekends, unlike

business customers who rarely park during weekends. As a result, the peak demand in an economy/long-duration facility typically occurs on weekends (or holidays), compared to the midweek peaks often observed at other airport parking facilities. At many airports, the peak demand for economy parking occurs during low-demand periods for daily parking.

## Benefits

The availability of separate hourly/short-duration, daily, and economy/long-duration parking facilities offers customers a menu of parking products with varying costs and convenience. Providing multiple parking products allows airport operators to better manage demand by adjusting parking rates to balance demand among the available parking facilities (i.e., assure that spaces are available for customers), enhance revenues, and operate efficiently.

## Implementation Actions

Providing a separate parking area for economy/long-duration customers requires the following actions by the airport operator:

1. Locate the economy/long-duration parking area at a site not required for other airport- or aviation-related uses, readily accessible to motorists (e.g., along or near a major entry road), and physically separated from spaces serving daily parking customers. Some airports have multiple economy lots because no individual site is large enough to provide a sufficient number of spaces.
2. Provide separate entrance(s) or use a “nested” parking area. A common exit is acceptable.
3. Establish daily maximum rates (i.e., the cost for parking 24 hours) that are much lower than those charged in hourly or daily parking facilities. The average differential cost for parking 24 hours in an economy/long-duration facility and a daily parking facility is about \$8 at large-hub airports and about \$5 at medium- and small-hub airports.

## Key Considerations

Economy parking has worked well at airports that have

1. Established appropriate differential parking rates and considered the cost of alternative parking and airport access options.
2. Provided a good level of service for customers by arranging shuttle bus shelter locations to minimize customer walking distances and offering appropriate headways on shuttle buses.

3. Minimized the number of cashiered exit locations (to minimize staffing needs, especially during late-night hours, and thus reducing operating costs).
4. Provided sufficient spaces (i.e., supply exceeds or equals demand, allowing customers to readily find available spaces).
5. Used names or product branding that clearly identify the product offered (see F.7).

### Implementation Costs

The costs depend on whether a new economy parking area is to be constructed or an existing facility is to be modified and the size and location of the facility. Costs would be incurred for building or modifying new surface or structured spaces (see Appendix A), access control equipment (see Appendix A), and new roadway guide signs. If shuttle buses are required, the cost for providing, operating, and maintaining the buses is a key component of the total cost.

### Ongoing O&M Costs

O&M costs for economy/long-duration parking facilities are the same as those for other surface lots or structures (see Appendix A). There are no specialized or unusual costs.

### Implementation Schedule

Developing a new parking structure may require 3 years or more, while developing a new surface lot (or expanding an existing lot) may take 1.5 years, including receiving prior approval from management to selection and award to an architect/engineer, preparation of construction documents, financing, bid and selection of a contractor, actual construction, and acquisition of buses, if needed.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Hourly/Short-Duration Parking (A.1),
- Daily Parking (A.2),
- Loyalty Programs (C.5),
- Passenger Check-In Kiosks (C.6),
- Baggage Check-In (C.7),
- Pet Kennels (C.8),
- Shaded Spaces (C.9 and C.10),
- Space Availability Prior to Arrival (D.1 and D.2) and by Facility (D.3) (other space guidance systems are appropriate if a multilevel structure is being considered),
- All Cashierless Transactions (E), and
- All Revenue Enhancement Strategies (F).

### Examples of Application

Many airports provide economy/long-duration parking facilities.

## A.4 Very-Short-Duration Parking/Curbside Areas

### Purpose

Reduce curbside congestion and staff time required to enforce curbside roadway operations. Introduce a new source of airport revenue.

### Use by Customers

Very-short-duration parking/curbside areas (also known as brief parking zones) are located immediately adjacent to the terminal building and replace the traditional free curbside drop-off/pickup areas. Customers enter and exit through gate-controlled lanes and, upon exiting, pay a duration-based fee for the use of these “curbside” spaces. At some airports, customers whose durations at the curb were shorter than the prescribed limit (e.g., 10 minutes) may exit for free. Typically, payment is made using pay-on-foot stations because there are no cashiers at the exits.

In the past, several airport operators used parking meters mounted on the curbside roadways to help manage traffic and vehicle dwell times. Today, parking meters are rarely used at commercial service airports in North America because of the effort (and cost) of meter enforcement, issuing tickets, and collecting the coins from each meter. Very-short-duration parking areas represent an alternative approach to using parking meters to control curbside areas.

If desired, separate lanes or parking areas can be provided for private and commercial vehicles, with authorized automatic vehicle identification (AVI) tags or other devices enabling access. At some European airports (e.g., Charles de Gaulle International in France and Munich Airport in Germany), the very-short-duration parking areas are the only drop-off/pickup options available to customers at the terminal and have completely replaced traditional curbsides.

### Benefits

These very-short-term parking areas at curbside encourage the use of hourly/short-duration parking by eliminating the free curbside alternative. The number (and cost) of traffic control staff required to enforce curbside roadway operations is reduced and the length of time vehicles remain stopped at the curbsides is monitored. An additional source of airport revenue is created.

## Implementation Actions

Implementation actions by the airport operator include

1. Assess whether the airport's federal security director will allow unattended vehicles in an area adjacent to the terminal.
2. Assess the likely response of the traveling public to the removal of free curbside areas. Review and evaluate potential responses with senior airport management and political representatives.
3. Determine if the gate-controlled very-short-duration parking area(s), required bypass lane, and adjacent pay-on-foot station can be implemented on the curbside roadway(s) considering the roadway width, utility and drainage structure locations, and traffic volumes.
4. Determine if the hourly/short-duration parking area has sufficient capacity to accommodate the traffic diverted from the curbsides.
5. Proceed with selection and award to an architect/engineer, preparation of construction documents, financing, bid and selection of a contractor, and construction.
6. In advance of initiating this product, develop and conduct a public outreach/public relations program explaining the purpose of the new very-short-duration parking area.

## Key Considerations

Very-short-duration parking/curbside areas have been most successfully implemented at European airports that have

1. Incorporated the very-short-duration parking area into the original design (e.g., Terminal 2 at Munich Airport).
2. Reconfigured an existing curbside roadway (e.g., Terminal 2 at Charles de Gaulle International Airport). However, the staff at Charles de Gaulle reported that customers have had difficulty adjusting to the "Depose Minute" as it is known, and motorcyclists drive around the gate arms.

## Implementation Costs

The primary costs at Charles de Gaulle International Airport were the new revenue control equipment (gate arms, pay-on-foot stations, and lane dividers). At Charles de Gaulle, the reported cost was about €50,000 (about US \$75,000) per terminal building per level. No data were available for the brief parking (Haltezone) portion of Terminal 2 at Munich Airport.

## Ongoing O&M Costs

O&M costs are estimated to be similar to the costs for similar parking revenue control equipment installed at standard parking lots.



Source: Jacobs Consultancy.

**Figure A.4. Charles de Gaulle International Airport.**

## Implementation Schedule

No information was available on the total time required for implementation at Charles de Gaulle International Airport (including prior approval from management, vendor selection, marketing, planning, construction, and startup), but construction required only a few weeks at each terminal.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Hourly/Short-Duration Parking (A.1) and
- Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In (B.2).

## Examples of Application

Examples of airports with very-short-duration parking areas are Terminal 2 at Charles de Gaulle International Airport (Depose Minute) and Terminal 2 at Munich Airport (Haltezone). (See Figure A.4.)

## A.5 Free 30-Minute Parking

### Purpose

Reduce curbside demands and congestion, as well as circulating traffic, by allowing customers dropping off or picking up airline passengers to park for free for 30 minutes. Improve customer perception of the airport.

### Use by Customers

Customers exiting a parking facility within the first 30 minutes of entry are not charged parking fees. This service attracts



motorists who would otherwise use the curbside areas and reduces curbside demands and congestion. Free parking may be offered in any parking facility, but most often is offered in hourly/short-duration or daily facilities.

The length of time free parking (or grace period) is offered may be any duration selected by the airport operator, but is typically 30 minutes or 60 minutes. Customers who exit after 30 minutes of entry are charged the posted parking rate (e.g., customers exiting during the second half hour or any portion thereof are charged the posted rate for 31 to 60 minutes).

## Benefits

The reported benefits include

- Reduced curbside congestion and circulating traffic volumes.
- Helped the traffic officers responsible for curbside traffic control and enforcement (and improved customer compliance with this enforcement) by allowing officers to direct curbside motorists to a free parking area.
- Improved customer service. Some airport operators believe that the local public perception of the airport and its parking facilities benefit from the availability of 30-minute free parking.

Airport operators that have established 30-minute free parking have reported increased customer complaints due to customers who (1) felt that the grace period did not allow them sufficient time to walk between the parking area and the terminal and to assist or meet a passenger, (2) were unable to exit within the allotted grace period because of exit delays, or (3) believe that the 30 minutes' grace period should apply to all time increments, and that they should, for example, be charged for 1.5 hours if they parked for 2 hours.

Providing the first 30 minutes of parking for free reduces total revenues. Depending on airport demographics and parking activity patterns, parking durations of 30 minutes or less may represent approximately 2% of total parking revenue, and approximately 5% of the revenue from a daily parking garage.

In 2000, in response to a request from the Port Commission, the Port of Seattle offered free 60-minute parking in the multilevel parking structure at Seattle-Tacoma International Airport on a trial basis. Eventually, the Port discontinued the free 60-minute parking program because staff determined that it

- Led to a large number of customer complaints and created a severe problem for the operations staff/cashiers who had to respond to these complaints.

- Resulted in a “sharp reduction” in parking revenues. (At this time, no data are available on the actual change in parking revenues.)
- Had minimal effect on curbside traffic or congestion, although traffic officers appreciated the ability to direct curbside motorists to the free 60-minute parking area rather than asking them to leave the curbside area. However, the officers did not perceive a significant difference in traffic volumes or patterns.

## Implementation Actions

Implementation actions by airport operators as identified by airport operators who have implemented this strategy include

1. Select the grace period and the rate to be used for the subsequent time increments. The most commonly used grace period is 30 minutes. The rate for the subsequent time increments should reflect the same fees that would be charged if there was no grace period. That is, if the airport parking rate is \$1 for each 30-minute increment, the rate for parking between 31 and 60 minutes should continue to be \$2, not \$1.
2. Modify all signage, websites, and other material displaying parking rates to reflect the new rate structure.
3. Develop and implement a promotional package to inform the local community that free parking is available for durations up to 30 minutes.
4. Coordinate with curbside traffic officers and enforcement officers so that they may direct motorists to the free parking area.
5. Develop and train staff in procedures for responding to anticipated customer complaints.

## Key Considerations

Key considerations identified by airport operators include

1. The length of the grace period should reflect the length of time customers need to walk between the parking facility and the terminal, and to assist/greet passengers.
2. Assure that signs and other information where parking rates are displayed clearly indicate the rates to be charged customers remaining for longer than the established grace period.

## Implementation Costs

The primary costs associated with providing a 30-minute grace period are any required modifications to the signs, websites, and other materials where parking rates are posted, and any revenues that the airport may forego.

## Ongoing O&M Costs

The most significant recurring cost is the parking revenue foregone as a result of the provision of free 30-minute parking.

## Implementation Schedule

Implementation, including receiving approval from management, vendor selection, marketing, planning, construction and startup, may require 2 months or less, depending on the time required to modify signs and other materials.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Hourly/Short-Duration Parking (A.1) and
- Daily Parking (A.2).

## Examples of Application

U.S. airports with free 30-minute parking include those serving Charlottesville, Kansas City, Memphis, Milwaukee, Mobile, Salt Lake City, San Antonio, Sarasota, and Tulsa. Examples of airports where 30-minute free parking was provided and then eliminated include those serving Des Moines and Seattle-Tacoma.

## A.6 Cell Phone Lots

### Purpose

Reduce demand and congestion at the arrivals/pickup curbside area and reduce the volume of recirculating traffic by providing a free parking area, away from the terminal area, where motorists may wait for arriving airline passengers.

### Use by Customers

A cell phone lot (also referred to as a “cell phone waiting lot,” “park and call zone,” etc.) provides an area where motorists can park for free for a maximum of typically 60 minutes and wait for a cell phone call from family or friends announcing their arrival at the terminal, at which time they drive to the curbside passenger pickup area. At some airports, motorists are often required to stay with their vehicles in the cell phone lot, while other airports provide cell phone waiting lots adjacent to coffee kiosks, convenience stores, or retail areas in order to attract waiting customers to purchase goods or products.

Cell phone lots are typically located in parking lots that provide easy vehicular access from the main airport entry road and to the terminal building, but are not within walking distance of the terminal. Remote sites are preferred to discourage use of the lots by short-duration or long-duration customers. Cell phone lots at some airports contain public toilets, flight information displays (FIDs), and other customer amenities. At Huntsville International Airport, a flashing light is activated when a customer has exceeded the time limit in the lot.

## Benefits

Specific benefits identified by airport parking operators include

- Reduced recirculating traffic volumes.
- Potentially reduced curbside congestion and vehicle emissions.
- Supported curbside enforcement by enabling traffic officers to direct motorists to a free waiting area.
- Eliminated improper parking along shoulders of airport entry roads and enforced parking restrictions in these areas.

Some airport operators expressed concern that a cell phone lot would reduce parking revenues by diverting customers who would otherwise park in an hourly lot. San Antonio International Airport staff determined that cell phone lots cause minimal revenue loss because few customers use the 30-space cell phone lot, and few of those customers would have otherwise paid for parking.

## Implementation Actions

Implementation actions identified by airport operators include

1. Select a site that accommodates 20 to 60 vehicles, is located along the major terminal access road, and provides for easy wayfinding to the terminal curbsides. The site should not be within walking distance of the terminal.
2. Design and construct the site. Airport operators frequently use paved areas that are no longer being used for their original purpose. As noted, some airports provide minimal customer amenities while others provide FIDs.
3. Promote use of the cell phone lot. At Milwaukee General Mitchell International Airport, the airport operator provided a gift bag with a cell phone containing prepaid minutes plus cell phone accessories to the first user of a cell phone lot. To cite another example, the operator of Charlotte Douglas International Airport sold the naming rights for the airport’s cell phone lot.

## Key Considerations

Key considerations identified by airport operators include

1. The cell phone lot should not be located within walking distance of the terminal.
2. The cell phone lot and the route from the lot to the terminal should be easy to find. Few customers will use an out-of-the-way site requiring multiple turns, even with good signage.
3. The cost should reflect the goals and needs of the airport operator. To gauge customer response, some airport operators begin with a low-cost (in consideration of the return on investment) pilot program using an existing lot (or unpaved lot), while others have provided FIDs and other amenities from the outset.
4. There should be coordination with traffic enforcement officers to assure that curbside motorists can be easily directed to the cell phone lot.
5. Consideration should be given to co-locating the cell phone lot with an on-airport service station or convenience store.
6. The provision of 30 minutes free parking (see A.5) is another way of introducing the same customer service. However, providing both 30 minutes free parking and a cell phone lot at the same airport may be a duplication of customer services.

## Implementation Costs

The primary costs associated with providing a cell phone lot are: (1) any required modifications to an existing surface parking lot or construction of a new parking lot including signage and desired amenities (see Appendix A), and (2) the marketing and promotional program.

## Ongoing O&M Costs

O&M costs are for maintaining a surface parking lot, any amenities provided, and security patrols if the lot is remotely located. (See Appendix A.)

## Implementation Schedule

Implementation receiving prior approval from airport management includes site selection. Construction may require 3 to 12 months depending on whether or not new construction is required.

## Supporting and Complementary Strategies and Technologies in This Guidebook

None were identified.



Source: Jacobs Consultancy.

**Figure A.6. Salt Lake City International Airport.**

## Examples of Application

More than 40 airports have cell phone lots. Those with FIDs and other high-end amenities include Phoenix Sky Harbor and Salt Lake City International Airports. (See Figure A.6.) Denver International Airport management plans to relocate the airport cell phone lot to a new retail development adjacent to the airport entry.

## A.7 No Overnight Parking Zones

### Purpose

Reduce curbside demand and congestion by providing convenient parking for customers dropping off or picking up airline passengers and assuring that conveniently located spaces are available for these customers in a designated area.

### Use by Customers

No overnight parking zones are a form of hourly or short-duration parking facilities (A.1). The key differences between these parking products are

1. Use of enforcement rather than rates to discourage daily customers. In no overnight parking zones, signs are posted indicating that vehicles parked for long durations are ticketed or towed, while in hourly/short-duration areas, customers parking for long durations are charged much higher rates than they would be in daily parking areas.
2. Avoidance of the need to physically separate the spaces allocated for short-duration customers from daily customers. Signs limiting duration can be posted at any location, eliminating the need for separate levels or nested areas having separate entries and exits.



Other aspects of hourly/short-duration parking are the same for no overnight parking zones, which provide conveniently located spaces for use by customers dropping off or picking up airline passengers (i.e., with durations less than 4 hours) who would otherwise use the terminal curbsides.

## Benefits

A separate facility for short-duration customers creates an attractive alternative to the terminal curbside areas, and helps reduce curbside demand and congestion, as well as circulating traffic volumes.

Without a separate facility for short-duration customers, the most convenient spaces in a lot or garage tend, over time, to be occupied by long-duration customers. (See A.1 for additional information.) As a result, if customers find (or learn from other customers) that conveniently located parking spaces are unavailable, that they must walk long distances to/from the least desirable spaces, and/or that they can expect to waste time searching for an empty space, short-duration customers are more likely to use the terminal curbside areas.

## Implementation Actions

Providing a separate parking area for short-duration customers by establishing a no overnight parking zone requires the following actions by the airport operator:

1. Designate the most conveniently located spaces for short-duration customers. Such spaces include those located directly opposite the primary terminal doorways or adjacent to a pedestrian crosswalk, skywalk, or tunnel. The spaces should be a short walk from the terminal ticket counters/baggage claim area. Customers should not be required to ride a shuttle vehicle.
2. Designate sufficient spaces to accommodate expected demand. Customers parking for 4 hours or less typically account for less than 5% of all occupied spaces at an airport. Therefore, relatively few spaces are required to accommodate short-duration customers.
3. Install enforceable, regulatory signage stating *No Overnight Parking* or *2-Hour Parking*, and *Vehicles Will Be Towed at Owner's Expense*, at the designated spaces. In some communities, in order to be legally enforceable, this signage (or the parking regulations) must be approved or authorized by a regulatory agency. (See Figure A.7.)
4. Enforce the posted regulations by ticketing or towing vehicles on a regular basis. Customers will tend to overstay the posted limits if they perceive that they are not enforced. Enforcing overnight parking prohibitions requires less effort than enforcing time-based prohibitions, as enforcement staff need only patrol the designated spaces once a day.



Source: Jacobs Consultancy.

**Figure A.7. Salt Lake City International Airport.**

Some airport operators have used no overnight parking zones with minimal enforcement. The extent of the enforcement/ticketing required appears to be related to the availability of parking in nearby daily areas, and the general compliance of local motorists with traffic signage and regulations.

5. Coordinate with airport police or traffic control officers to assure that adequate staff are assigned to enforcement, and that these efforts receive the desired priority.

## Key Considerations

No overnight parking zones have worked well at airports that have

1. Obtained the cooperation and support of the enforcement officers and confirm that these officers are allocated sufficient time to regularly enforce the designated limits. However, as noted, some airports have found that little enforcement of no overnight parking zones is required.
2. Confirmed that the posted signs are legally enforceable.
3. Used clearly visible signage and designated a zone or area rather than isolated spaces.
4. Used a contract towing service, and installed signs indicating the contact information to retrieve towed vehicles.

Use of frequent ticketing and towing generally creates a negative customer service experience compared to the other alternatives for providing dedicated spaces for customers parking for short durations.

## Implementation Costs

Costs are incurred for installing the required regulatory signage, at about \$100 per space.

## Ongoing O&M Costs

The primary O&M cost is the enforcement of the designated limits, which depends on the frequency with which officers patrol the area and the enforcement measure (e.g., tickets and towing).

## Implementation Schedule

The time required for implementation depends on whether the spaces selected for no overnight parking are to be located in a new facility or portions of an existing facility designated for this use. The time required to designate spaces or a zone in an existing facility may be less than 2 months, depending on the time required to obtain management's approval and to have the appropriate regulatory authority for implementing these parking limits.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Daily Parking (A.2),
- Very-Short-Duration Parking/Curbside Areas (A.4),
- Free 30-Minute Parking (A.5),
- Passenger Check-In Kiosks (C.6),
- Baggage Check-In (C.7),
- Space Availability (D.3, D.4, D.5, and D.6), and
- Parking Rate Adjustments (F.1).

## Examples of Application

Airports that prohibit overnight parking (or limit parking durations) in a designated portion of a daily parking area, thereby creating an hourly area, include those serving Dallas/Fort Worth, Denver, Madison, Phoenix, and Salt Lake City.

## A.8 Vacation Parking

### Purpose

Attract price-sensitive, long-duration customers, such as those traveling on vacations, who would otherwise not choose to park at the airport, by offering deeply discounted parking rates.

### Use by Customers

Vacation parking lots are intended for customers parking for durations of more than 1 or 2 weeks. Compared to economy or other reduced-rate parking lots, customers are offered lower parking rates and lower levels of convenience. Vacation

parking lots are the least conveniently located parking areas at an airport. These lots may be located near terminal buildings serving charter flights and discount/low-fare airlines.

At vacation lots, customers may be charged a flat weekly rate (thereby discouraging use by customers staying for shorter durations). Discounts offered are even greater than those offered at other lots that promote *Free Parking for the Seventh Day* or similar discounts.

At Charles de Gaulle International Airport in Paris, no shuttle bus service is available for the vacation lot, resulting in minimum walking distances of over 1,000 ft. At Germany's Munich Airport, the vacation parking area is located much farther from the terminal than are the other parking products.

Although vacation parking sites are typically more remote and less convenient than other parking products, the primary difference between these lots and economy or remote parking lots is the rate structure.

## Benefits

Benefits are improved service for participating customers and potentially increased parking revenues. Specific benefits identified by airport parking operators include

- Increased market share and revenues. Additional revenues may result from attracting price-sensitive customers (e.g., those parking for long durations and traveling on low-cost discount or charter flights) who might otherwise select privately owned parking facilities or use drop-off/pickup or other travel modes.
- Provision of a parking option for customers whose cost for parking would otherwise exceed their airfares. The availability of vacation parking lots expands the selection of parking products and may induce potential customers to consider other, more convenient products.
- Accomplishment of other goals while minimizing risk of reduced revenues. The use of flat weekly rates minimizes the change in revenues. In addition, customers parking for a week typically generate about 15% to 20% of total revenue, and those parking for 2 weeks or more generate less than 3% of total revenues.

## Implementation Actions

Implementation actions identified by airport operators include

1. Select and develop the preferred site. Cashierless technologies are particularly appropriate because the low hourly entering/exiting volumes may not justify staffed exits.
2. Market and promote the product.

## Key Considerations

These include the extent of the potential market and the availability of airport property for use as long-duration parking areas.

## Implementation Costs

The costs depend on whether a new parking area is to be constructed or if an existing facility is to be modified and the size of the facility. Costs include building or modifying new spaces and the provision of access control equipment (see Appendix A), and new roadway guide signs.

## Ongoing O&M Costs

O&M costs are the same as those for other economy lots (see Appendix A). No specialized or unusual costs would be incurred.

## Implementation Schedule

Development of a new vacation parking lot (or expansion of an existing lot) may require 3 to 6 months, including receiving prior approval from management depending on use of an existing or new lot, and the extent of the marketing and promotion program.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All Cashierless Transactions (E) and
- All Revenue Enhancement Strategies (F).

## Examples of Application

Airports with vacation parking facilities include those serving Brussels, Paris (Charles de Gaulle), and Munich, as well as some privately operated lots in North America.

## A.9 Holiday/Overflow Parking

### Purpose

Accommodate rarely occurring peak parking demands though the use of a temporary lot or a lot opened only during holiday periods.

### Use by Customers

Most airports experience peak parking demand during spring break or the Thanksgiving and Christmas holidays that

exceeds the numbers of available spaces. It is not financially feasible to construct and maintain structured parking spaces or other conveniently located spaces to accommodate peak demands that occur fewer than 10 days per year, and perhaps only during a few hours on those days. Therefore, airport operators develop and operate holiday/overflow parking areas.

Customers are directed to these areas by signs (and operations staff) indicating that limited or no spaces are available in the primary parking areas and advising customers of the availability of these alternative facilities.

Often the parking rates in holiday/overflow lots are lower than those in daily or economy lots because the holiday/overflow lots are less conveniently located, provide less frequent shuttle bus service, and offer fewer amenities.

## Benefits

Benefits are improved customer service (avoids turning customers away), potentially increased parking revenues, and efficient operations. Specific benefits identified by airport parking operators include

- Enhanced service to a market primarily composed of infrequent, long-duration travelers (e.g., those traveling for non-business purposes) who may not have allowed sufficient time to seek parking or considered that airport parking facilities, like airport terminals, are extremely busy during these times, and who would be severely inconvenienced if they spent excessive time searching for an empty space or were unable to park at the airport.
- Deferred construction of daily or economy parking facilities. Because they are used infrequently, holiday or overflow lots are often built using lower design standards and have less expensive pavement structures, shelter, and other amenities that would not otherwise be used.
- Reduced operating costs. Typically, holiday/overflow lots are served by less frequent shuttle bus service, and may require longer walks to shuttle bus stops/shelters.
- Facilitated use of flat rates. Some airport operators establish flat daily rates for holiday or overflow parking areas or collect a flat fee upon entry (or a fee based on the customer's estimated trip duration or an honor system), thereby avoiding or minimizing cashier costs and simplifying the required revenue control equipment.

## Implementation Actions

Implementation actions identified by airport operators include

1. Identify a potential site. Ideally, the holiday/overflow lot will be located on an existing paved or improved surface,

or the future site of a parking lot or airfield pavement area.

2. Establish parking rates and a method of fee collection.
3. Establish a method of informing customers when the lot is open.
4. If the lot is to remain open for a brief period only (e.g., 2 to 3 weeks), establish a method of notifying customers: (a) where they can board the specialized shuttle service upon return to the airport, (b) when the shuttle bus service will cease and the alternative transportation service that will be available, and (c) when towing or removal of vehicles that remain in the lot after a specified date will begin.

## Key Considerations

Those identified by airport operators include

1. Implementing a method of directing customers to the holiday/overflow lot.
2. Determining actions to implement upon closure of the lot at the end of the holiday season.
3. Selecting a site that is accessible and not required for other uses on a regular or priority basis.
4. Providing temporary shuttle bus operations, schedule, and stop designations.

## Implementation Costs

The costs depend on whether an existing or new surface lot is to be used, and the design standards to be used. Costs include pavement, signage, striping, shelters, fencing, entry/exit controls, and directional roadway signs. (See Appendix A.) There are opportunities to use alternative pavement materials and thickness.

## Ongoing O&M Costs

O&M costs are lower than those for other surface lots as the lot is used on a temporary basis and fewer amenities are offered. (See Appendix A.)

## Implementation Schedule

The required time for implementation depends on whether the holiday/overflow lot is a new facility or an existing facility being reused.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Daily Parking (A.2) and
- All Cashierless Transactions (E).

## Examples of Application

Many airports provide holiday/overflow parking areas.

## A.10 Parking Condominiums

### Purpose

Provide secure, covered parking for customers wishing to leave their vehicles at or near the airport for several months and who are willing to enter into a long-term lease for a personal garage. Generate new revenues for the airport.

### Use by Customers

Parking condominiums are enclosed, secure, climate-controlled personal garages that customers lease (or purchase) for extended periods (e.g., 5, 10, or 20 years). They are primarily intended for use by second-home owners (i.e., owners of ski lodges or summer homes located within 60 to 100 miles of an airport) seeking easy access to their cars once their flights land. Parking condominiums are also used by frequent flyers and executives wishing to park their vehicles in secure, covered spaces for long durations. (See Figures A.10a through A.10d.) Owners are provided shuttle service to and from the terminals and, at some locations, access to a clubhouse offering beverages and airline information. Automobile servicing, fueling, and cleaning are typically available as well.

Parking condominiums cost between \$15,000 and \$40,000 at Denver International Airport and between \$40,000 and \$110,000 at a site near Salt Lake City International Airport, depending on the size of the unit. Ultimately, the Denver site will hold 347 units (62 were built initially), while 325 units are proposed for Salt Lake City, and 130 are located at Kalispell (MT). A 1-acre parcel can accommodate 60 to 65 garage units.

### Benefits

Ability to increase airport revenue by offering a desired parking product. Specific identified benefits include

- Provide a product (secure, covered, ultra-long-duration vehicle storage) desired by a customer market composed primarily of resident frequent flyers and wealthy, non-resident passengers owning second homes nearby. These customers may not be able to store their vehicles at the airport because airports typically do not allow customers to park their vehicles at the airport for more than 30 days without prior approval.





(a)



(b)



(c)



(d)

Source: AirportResortParking.com.

**Figure A.10.** (a) Parking condominiums at Denver International Airport. (b) View of overall airport parking condominium development. (c) Parking condominium interior. (d) Parking condominium development site vicinity.

- Generate new revenues as a result of fees paid by the concessionaire selected to construct and operate the parking condominiums. Typically, the concessionaire pays ground rent either for the entire site or that portion of the site occupied by the parking garages as well as a percentage of their gross revenues. The revenues paid to the airport are a function of the annual ground rent, which may vary from \$0.50 to \$0.77 per square foot, resulting in annual rent of \$21,800 to \$33,500.

## Implementation Actions

Implementation actions include

1. Determine if a market exists for such parking condominiums—are there many second homes, particularly in high-end resort communities, located near the airport?
2. Identify available site(s) not reserved for future uses. The site should be capable of accommodating at least 30 parking condominiums, each a minimum of 15 ft wide by 24 ft long.

3. Prepare and issue a Request for Information (RFI) to gather information about prospective developers and their interest in the opportunity.
4. Prepare and issue Instructions for Bids (IFB) or a Request for Proposals (RFP), or enter into negotiations with a preferred developer. Consideration should be given to the business terms of the agreement since it is unlikely that a percentage of gross revenues will be acceptable to the developer due to the long-term nature of the project and the sale of the condominiums. Airport enterprises have typically relied on ground rents for these agreements.

## Key Considerations

This strategy has worked well at airports that have

1. Available sites not needed for aviation-related uses. The site(s) need not be located near the terminal or the main access roads.

2. A potential market. See prior comments regarding proximity to high-end resorts containing a large number of second homes.
3. Helped market or allowed cross-marketing of the product by, for example, providing a link on the airport website.

### Implementation Costs

The primary costs are staff time associated with (1) preparing and reviewing RFIs, IFBs, or RFPs, and (2) follow-on contract administration.

### Ongoing O&M Costs

Costs are negligible, since all design, construction, and ongoing O&M costs are the responsibility of the concessionaire. At some airports, the concessionaire contracts with a local fixed-base operator (FBO) or other party to provide the on-demand, 24-hour shuttle service. However, at some other airports, the condominiums are located within walking distance of the terminal.

### Implementation Schedule

Implementation (including prior approval from senior management, vendor selection, marketing, planning, construction, and start-up) may require 3 to 6 months.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Secure Parking and Secure Parking with Valet Service (B.13) and
- Vehicle Washing and Servicing (C.1).

### Examples of Application

Parking condominiums are provided on or near the airports serving Boise (ID); Butte, Great Falls, Kalispell, and Missoula (MT); Denver, Steamboat Springs, and Vail (CO); Phoenix (AZ); Salt Lake City (UT); and Spokane (WA). Parking condominiums are proposed on or near the airports serving Bend (OR) and Sarasota (FL). The condominiums are operated by several companies, including Airport Resort Parking LLC; Airport Garages, Inc.; and USA Garage Condos.



## CATEGORY B:

# Value-Added Parking Products

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## CATEGORY B

# Value-Added Parking Products

### **B.1 Valet Parking—Curbside Drop-Off/Pickup**

#### **Purpose**

Improve customer service by allowing customers, who are willing to pay higher fees, to drop off and pick up their vehicles at the terminal curbside.

#### **Use by Customers**

Customers using valet parking with curbside drop-off and pickup (i.e., traditional valet parking), leave their vehicles with an attendant located at the terminal curbside or other convenient area, and upon their return to the airport, retrieve their vehicles at the same or another convenient location.

Customers' vehicles are stored securely at a nearby or remote location, and then driven back to the designated pickup area by valet staff prior to the customer's arrival. The operator of the valet service maintains possession of the customers' keys so that the vehicles can be moved to/from the storage area.

Traditional valet parking is considered a premium product, with parking rates that are generally higher than the cost of self-parking at covered, close-in parking facilities.

To avoid potential disputes regarding damages or scratches to the customer's vehicle, operators of valet parking services often require that customers sign an inspection form when dropping off their vehicles, or otherwise photograph/record the vehicles' appearance.

#### **Benefits**

The reported benefits include

- Improved customer service and satisfaction—particularly for business travelers or others willing to pay higher fees for the convenience of valet parking.

- More efficient storage of vehicles/less space required per vehicle compared to self-parking. Valet attendants park vehicles in smaller stalls (i.e., less space between vehicles) or tandem spaces (since the operator knows which vehicles need to be retrieved first), and can park these vehicles where they can be readily accessed.
- Opportunity to use sites on airport property that are otherwise ill suited for parking or high-priority aviation uses to accommodate a high-value parking product. Valet vehicles can be stored in any secure location and need not be stored at sites that are easily accessible by motorists or conveniently located near the terminal building.
- Improved gross revenues as a result of the higher fees paid by valet customers (versus self-parkers).
- Opportunity to supplement standard parking products during periods of construction, unusually high demand, or other periods when available public parking inventory may be temporarily insufficient.

#### **Implementation Actions**

Implementation actions identified by airport operators that decided to offer this service after evaluating the new net revenues resulting from a valet parking service include

1. Select a curbside area where customers can drop off and pick up their vehicles. Often this is an underutilized portion of the terminal curbside so as not to displace the primary curbside areas. Although the drop-off and pickup areas are often located at the same site, they need not be, however, providing separate sites may increase labor costs depending on how unattended cars are secured.
2. Determine how much curbside should be reserved for valet use. The amount of space required is a function of the anticipated business volume/maximum number of cars parked at the curbside, the distance to/from the vehicle storage area, and whether double parking is allowed. For initial planning, space for 5 to 10 vehicles is adequate at most airports.

3. Select a secure site for long-term vehicle storage accommodating 50 to 100 vehicles (or more depending on the potential market). The location of the vehicle storage area has a major effect on customer service (response time) and costs of operations (number of staff required to shuttle the vehicles to/from the storage area).
4. Select a third-party contractor to operate the valet service. Airport operators, even those that operate their public parking facilities, generally retain a third-party contractor to operate valet service because of the liability associated with moving customer vehicles.

The valet contractor can be the same contractor operating the airport's public parking services or a contractor specializing in valet parking operations. Most often, the contractor is retained using a management agreement (i.e., the contractor is reimbursed for its costs plus a management fee), but some airport operators retain a contractor using a concession contract (i.e., the contractor pays the airport a percentage of the gross revenues plus a guaranteed amount).

5. Market the service. The availability of the valet parking service needs to be well publicized.

## Key Considerations

Those identified by airport operators include

1. Valet parking typically generates lower net revenues than traditional parking. The higher gross revenues from valet parking are typically offset by higher costs for (a) labor (e.g., full-time curbside attendants plus adequate staff to move the vehicles between the drop-off/pickup areas and the storage locations), (b) increased liability because of the risk associated with moving customer vehicles, and (c) marketing. As a result, most airport operators report that more net revenue per space can be generated by close-in self-parking than if these spaces are used for valet parking.
2. The fees established for valet parking should reflect the marginal costs for providing this service. If the cost for this premium service is too low, valet parking may attract customers who would otherwise have paid for close-in parking and who, at most airports, generate higher net revenues than do valet customers.
3. Select attractive and convenient curbside areas for valet customer drop-off/pickup that are visible to potential customers, but do not interfere with overall curbside roadway operations.
4. Obtain prior approval of procedures for storing unattended vehicles at the curbside (e.g., after a customer drops off a vehicle and before the vehicle is shuttled to the storage area, or when a vehicle is brought to the curbside in

anticipation of an arriving passenger who is delayed) and consider local security regulations.

## Implementation Costs

The primary costs are (1) staff costs associated with advertising and selecting a third-party contractor and then overseeing the contractor and (2) any net parking revenues that the airport may forego because of the migration of customers from close-in parking to valet parking.

## Ongoing O&M Costs

The primary ongoing O&M costs are oversight of the contractor.

## Implementation Schedule

Implementation (including receiving management approval, site selection, and selection and award of contract to a third-party operator) may require 6 months or less, depending on the time required to select and award a new contract.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Vehicle Washing and Servicing (C.1),
- Concierge Services (C.2),
- Onsite Sale of Food, Beverages, and Other Products (C.3),
- Loyalty Programs (C.5),
- Web-Based Reservations (F.3), and
- Yield Management (F.4).

## Examples of Application

Airports with traditional valet parking include those serving Burbank, Dallas/Fort Worth, Denver, Honolulu, Las Vegas, Little Rock, and Seattle-Tacoma. Valet parking was used on a temporary basis during construction at the airports serving Portland (OR) and New York (John F. Kennedy International Airport).

## B.2 Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In

### Purpose

Improve customer service by allowing customers, particularly frequent flyers willing to pay higher parking fees, to drop off and pick up their vehicles, check their baggage, and receive their boarding passes at the terminal curbside.

## Use by Customers

Customers using this service stop at a designated curbside area where they can check their bags, receive boarding passes, leave their vehicles with a valet attendant and then proceed directly to the security screening checkpoint. Where available, this service may be offered only to first-class passengers or “gold level” frequent flyers. It is typically provided by an airline at a major connecting hub airport in conjunction with a parking or valet parking operator. The airline may subsidize the parking costs in order to offer the service at a reduced cost to its passengers.

From a parking operations perspective, this service is nearly identical to traditional valet parking—a valet attendant accepts and returns the vehicle, which is stored safely and securely at a nearby or remote location. The primary difference compared to traditional valet parking is that, in addition to the valet attendant, airline representatives are available to accept and check the customer’s baggage and issue a boarding pass.

This service is offered by Lufthansa German Airlines at Munich Airport. (See Figures B.2a and B.2b.) Airport and airline representatives did not respond to requests for information about this service.

## Benefits

The apparent benefits include those associated with traditional valet parking (see Benefits in Section B.1), as well as the following marketing advantages realized by the airline:

- Improved airline customer service and satisfaction—particularly for business travelers, frequent flyers, or



Source: Jacobs Consultancy.

**Figure B.2b. Curbside check-in counter window.**

others willing to pay higher fees for the convenience of valet parking.

- Marketing and promotional advantages realized by the airline offering this service to its frequent flyers.

## Implementation Actions

Implementation actions differ from traditional valet parking because of the role of the airline and required access to the baggage handling system. Key implementation steps required by an airport operator include

1. Negotiate the business arrangements with the cooperating airline(s) to define how the costs, revenues, and operating responsibilities are to be shared.
2. Develop the curbside window or counter position where the airline representative will accept baggage and issue boarding passes.
3. Determine how checked baggage will be screened and transferred to the outbound baggage handling system.

Marketing and promotion of the service are the responsibility of the airline(s).

Other implementation actions, similar to those required to implement traditional valet parking, include selecting (a) the curbside area where customers would drop off and pick up their vehicles (which will need to be adjacent to the airline window or counter), (b) a secure site for long-term vehicle storage, and (c) a third-party contractor to operate the valet service and serve as a representative of the airline and the airport enterprise.

## Key Considerations

As noted, the following considerations were not confirmed by the entities offering the service. However, the key consid-



Source: Jacobs Consultancy.

**Figure B.2a. Valet parking spaces opposite curbside check-in window at Munich Airport.**

eration is anticipated to be the terms of the business arrangement with the airline. It is suggested that arrangements should reflect (1) parking revenues that would be received by the airport enterprise if the valet service were to be operated directly by the airport operator, (2) amount of curbside to be allocated to the airline and how use of this space is to be enforced, (3) responsibility for the movement and storage of customer vehicles, and (4) terminal area to be leased for this purpose, and any required modifications to existing space.

The building space to be leased by the airline should allow for the secure movement of baggage from the curbside window or counter position to the baggage handling or screening area. At Munich Airport, the valet curbside is adjacent to the end of the ticket counter, allowing for baggage to be inserted into the baggage system behind the counters.

### Implementation Costs

The primary implementation costs are those for modifying or constructing the terminal building/ticketing area to allow for baggage handling. Other key costs are the same as for traditional valet parking: (1) the opportunity costs (net revenues) resulting from valet operations (particularly if fees are subsidized by an airline) versus those that would be realized from other parking products, (2) staff costs for selecting, managing, and overseeing the valet contractor, and (3) costs of coordination with the airline or contractor providing baggage check.

### Ongoing O&M Costs

The primary ongoing O&M costs are for oversight of the contractor.

### Implementation Schedule

The actual schedule for implementation is unknown, but the elements requiring the most time are expected to be the airline negotiations and terminal building modifications. As with traditional valet parking, selection of a third-party operator and award of contract is estimated to require 6 months or less.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Vehicle Washing and Servicing (C.1),
- Concierge Services (C.2),
- Onsite Sale of Food, Beverages, and Other Products (C.3),
- Loyalty Programs (C.5),
- Web-Based Reservations (F.3), and
- Yield Management (F.4).

## Examples of Application

Valet parking at curbside with airline check-in is available at Terminal 2 at Munich Airport (offered by Lufthansa German Airlines). Similar services are being implemented at UAE's Abu Dhabi International Airport (with Etihad Airways), Qatar's New Doha International Airport (with Qatar Airways), and Toronto's Pearson International Airport (with Air Canada).

## B.3 Valet Parking—Non-Curbside Drop-Off/Pickup

### Purpose

Improve customer service by providing customers, willing to pay higher fees, with attendant parking (and retrieval) of their vehicles, which they drop off (and pick up) at or near the parking facility entrance.

### Use by Customers

Customers using non-curbside drop-off/pickup valet parking drop their vehicles off at a designated valet or vehicle drop-off area located near the entrance to a remote parking facility or surface lot. After dropping off a vehicle, the customer is greeted by a valet attendant who accepts and parks the vehicle in a secure location. The customer then board a shuttle bus waiting nearby; the shuttle driver may offer to take the customer's baggage and place it on the shuttle bus. Customers are then transported directly to the terminal. Although valet customers may share the bus with other customers, once they board the shuttle bus, they generally encounter no stops en route to the terminal.

Upon returning to the airport, valet customers are picked up at the terminal curbside by a shuttle bus driver who again may offer to provide baggage assistance, and transports the customers to a designated valet zone where their vehicles are waiting. If the customer previously provided a credit card number to the parking operator (i.e., the customer is a frequent parker or reserved a space using a credit card), the credit card receipt will have been placed inside the vehicle, the vehicle will have been cleaned of ice or snow (or serviced if so requested), and the customer can simply exit the lot.

### Benefits

Reported benefits include

- Improved customer service and satisfaction—particularly for the business traveler or others willing to pay higher



fees for the convenience of valet parking and baggage assistance.

- Attractive valet-type service that avoids the need to provide dedicated curbside space at the terminal.
- More efficient storage of parked vehicles because attendant-parked vehicles require less space than self-parked vehicles. Attendant-parked vehicles occupy narrower stalls or tandem spaces are used (since the parking operator knows which vehicles need to be retrieved first, and can park these vehicles so that they can be readily accessed).
- Opportunity to store vehicles in less popular or less convenient portions of self-parking facilities. Attendants can park and retrieve vehicles from areas that are rarely used by customers.
- Improved gross revenues as a result of the higher fees paid by valet customers (versus self-parkers). However, these higher revenues are typically accompanied by (a) higher operating and labor costs (e.g., full-time attendants are required to park and retrieve vehicles), (b) increased liability insurance costs (because of the risk associated with the movement of customer vehicles), and (c) marketing expenses.

## Implementation Actions

Implementation actions include

1. Select the parking facility where the valet service is to be provided. The parking facility should have an appropriate entry/exit configuration.  
Entry configuration—Ideally, the parking facility entry should provide physical separation between valet and self-parking customers. The valet entry area should provide a covered area where customers can park and unload their vehicles adjacent to a shuttle bus stop.  
Exit configuration—The exit should provide separate lanes for valet and self-parking customers. The valet exit should include three to five spaces, depending on the size of the operation, near a shuttle bus stop where vehicles can be parked securely while waiting for arriving customers.
2. Modify shuttle bus operations. The shuttle bus route should include stops at the lot entry and exit. Shuttle bus drivers should be allowed to leave the bus to provide customers with baggage assistance (i.e., step out of the bus while they transfer baggage between a customer's vehicle and the shuttle bus). Ideally, the shuttle bus driver should be also able to accept tips from customers for this service. Often airports prohibit parking lot shuttle bus drivers from accepting tips or leaving buses unattended.
3. Select a third-party contractor to operate the valet service. Airport operators, even those that operate their public parking facilities, generally retain a third-party contractor

to operate valet service because of the liability associated with moving customer vehicles.

The valet operator can be the same contractor operating the airport's public parking services or a contractor specializing in valet parking operations. Most often, the contractor is retained using a management agreement (i.e., reimbursed for its costs plus paid a management fee), but some airport operators have retained a valet contractor using a concession agreement (i.e., the contractor pays the airport enterprise a percentage of gross revenues plus a guaranteed amount).

4. Market the service. The availability of the valet parking service needs to be well publicized.

## Key Considerations

When implementing a non-curbside valet service, consider

1. Typically, valet parking operations generate lower net revenues than equivalent self-parking operations because of the higher operating costs. However, the costs of this valet parking product are lower than those of curbside valet parking (see B.1) because vehicles are moved shorter distances and only within a parking facility (versus public roadways). Therefore, the required number of valet attendants is lower, as is the risk of damaging a customer's vehicle.
2. Whether an existing parking facility can be readily converted to valet service.
3. Whether the valet parking service and self-parking should be operated using a single operator or separate operators. Use of a single management contractor avoids potential concerns regarding allocation of costs and simplifies bus-ing operations.
4. The valet parking fees should reflect the extra costs for providing valet services and include a differential cost to manage demand between the valet and self-parking portions of the facility. If the cost for this premium service is too low, valet parking may attract customers who would otherwise have paid for self-parking.

## Implementation Costs

The primary implementation costs are (1) staff costs associated with advertising for, selecting, and oversight of the parking contractor and (2) any net parking revenues that the airport enterprise may forego because of the migration of customers from self-parking to valet parking.

## Ongoing O&M Costs

The primary ongoing O&M costs are for oversight of the contractor.



## Implementation Schedule

Implementation (including the actions required to receive management approval, selection, and reconfiguration of a parking facility, and contractor selection/award) may require 6 months or less, depending on the time required to select a contractor and award a new contract.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Vehicle Washing and Servicing (C.1),
- Concierge Services (C.2),
- Onsite Sale of Food, Beverages, and Other Products (C.3),
- Loyalty Programs (C.5),
- Web-Based Reservations (F.3), and
- Yield Management (F.4).

## Examples of Application

Non-curbside valet drop-off/pickup is frequently offered by privately operated off-airport parking providers.

### B.4 Valet Parking—Customer Transported to/from Airport in Shuttle Van (Trunk-to-Trunk Service)

#### Purpose

Improve customer service and promote the use of economy/long-duration parking facilities, thus attracting additional customers and revenue.

#### Use by Customers

Customers entering the parking facility are directed by signs or traffic attendants to park in a designated portion of the facility, where they are met by a shuttle bus driver who transfers their bags from the car to the shuttle vehicle, and transports the customers to the terminal. Upon their return, customers are driven directly to their vehicles, where the shuttle bus driver transfers their bags from the shuttle to the car.

Customers may share the shuttle vehicle with other parking customers (or, in some instances, rental car customers or hotel/motel guests). This product is referred to as “trunk-to-trunk” service or “carside-to-curbside” service, or, when offered by privately owned, off-airport lots, as “valet” service.

Managed fills, whereby traffic attendants direct customers to empty spaces but buses follow fixed routes, are a variation of this product.

## Benefits

Reported benefits of trunk-to-trunk service include

- Improved customer service (compared to a shuttle bus service operating on fixed routes and headways). With trunk-to-trunk service customers experience reduced search times for empty spaces, waiting times for shuttle buses, and walking distances to/from the bus, and are offered baggage assistance at both ends of the trip.
- Improved use of available parking spaces because customers are directed where to park.
- Avoidance of the need for bus shelters within the lot, and the maintenance and lighting of such shelters.
- Improved customer safety because customers need not wait alone at bus shelters during late night hours in a large lot.
- Reduced pavement maintenance and costs resulting from the use of small shuttle vans (compared to large shuttle buses).
- Higher gross revenues compared to traditional economy parking because of the ability to charge higher rates. For example, at airports that offer trunk-to-trunk service, this product costs between \$3 to \$6 per day more than the traditional economy parking product. (However, at Baltimore/Washington International Thurgood Marshall Airport, customers using coupons pay an additional \$1 per day rather than \$6 per day.)

In 2004, trunk-to-trunk service was offered at the Pikes Peak Lot at Denver International Airport, but this service was eliminated because the increased costs of operations—primarily the higher busing costs—led to lower net revenues. The operators of other airports (e.g., Baltimore/Washington International Thurgood Marshall and Dallas/Fort Worth International Airports) continue to provide this service because of the enhanced customer service, improved market share, and larger selection of parking products offered.

## Implementation Actions

Implementation actions identified by airport operators include

1. Select the parking facility where the service is to be offered. Ideally, it should be configured to allow shuttle vehicles to circulate easily and efficiently (i.e., minimize route length).
2. Establish desired maximum customer wait times for both pick up and drop off.
3. Select the bus path(s) for drop off and pick up (they may differ), choose preferred vehicle size, and choose the number of vehicles required to provide desired headways. Buses follow the shortest path between customer drop-off spaces, and need not follow fixed routes.

4. Determine method to direct entering motorists to empty spaces: traffic attendants in communication with bus drivers, dynamic message signs, barriers, or other.
5. Confirm ability of shuttle bus drivers to provide baggage assistance and accept tips from customers. Tips are a significant portion of valet driver income and will encourage drivers to provide the desired level of customer service. Provide additional customer service training for drivers. Provide method to remind customers where they parked their cars (e.g., pre-stamped cards).

## Key Considerations

When implementing trunk-to-trunk service, include

1. Considering lot configuration and pavement strength. The ideal lot provides simple circulation paths for motorists and buses, and has full-strength pavement along all aisles rather than just the aisles intended for use by buses traveling along fixed routes.
2. Selecting appropriate rates. Although this is a consideration when introducing any parking product, it is particularly important when the product is competing with other existing products and when the new product includes unusual operating costs (such as shuttle bus operations).
3. Adopting a policy to permit shuttle drivers to provide baggage assistance and accept tips, which is a key to good service.
4. Using a management contractor. At airports where trunk-to-trunk service is provided, the service is operated under the terms of a management contract (rather than a concession agreement), even at airports where airport staff operate the remaining portions of the airport parking facilities.
5. Maintaining the ability to easily direct motorists to empty portions of the lot, and procedures to be used when the lot approaches capacity.

## Implementation Costs

The primary capital costs are for (1) reconstruction of existing pavement or construction of stronger pavement in a new lot to allow heavy vehicles to circulate along all aisles, (2) acquisition of shuttle vans (assuming that existing vehicles need to be replaced), and (3) dynamic signage directing motorists to empty spaces, or other wayfinding measures. The primary operating costs (as opposed to those occurring in a traditional economy lot) are those for operating additional shuttle bus hours (buses will drive longer distances and operate at increased frequencies), and for traffic attendants/lot supervisors (to coordinate bus drivers).

A comparison prepared for Sacramento International Airport indicated that the cost to convert an 8,000-space surface

lot from traditional economy parking to trunk-to-trunk service would be about \$6 million for pavement reconstruction and \$1 million per year in additional operating costs.

## Ongoing O&M Costs

The ongoing O&M costs are those associated with operating the buses and having traffic attendants/lot supervisors.

## Implementation Schedule

Implementation (including the actions required to receive management approval, marketing, planning, construction, and startup) may require 6 months or less, depending on the time required to plan the operation, acquire new vehicles (if needed), train drivers, and publicize the product.

## Supporting and Complementary Strategies and Technologies in This Guidebook

This product is complementary with many other strategies and most technologies, including

- Economy/Long-Duration Parking (A.3),
- Loyalty Programs (C.5),
- Managed Fills (D.7), and
- Coupons (F.5).

## Examples of Application

Airports with trunk-to-trunk service include those serving Baltimore, Dallas/Fort Worth, and Fort Myers, as well as many privately operated parking lots.

## B.5 Business Parking

### Purpose

Improve customer service and revenues by attracting customers, who would have otherwise parked in lower-priced lots or off-airport facilities, to a higher-priced surface lot. Improve customer perception of the airport. Facilitate use of small parking lots (e.g., with less than 300 spaces) that might not support traditional parking configurations.

### Use by Customers

Customers using business parking facilities are offered more frequent shuttle bus service than with other parking products, as well as additional amenities intended to serve the needs of business travelers. Examples of these include bottled water, coffee, tea, or other beverage; a free daily

paper such as *USA Today*; Internet access; and use of meeting rooms.

Business parking is generally provided in small surface lots that require customers to use a shuttle bus or walk long distances, but in locations that are closer to the terminal than other economy parking products. Parking rates for business parking are typically higher than for economy parking products because of the more frequent bus service and other amenities offered.

The use of small surface parking lots is feasible because business parking is generally operated without cashiers, relying entirely upon credit card in/credit card out systems or other cash-free technology. This approach is practical, as the intended customers are frequent travelers familiar with the use of the business parking facility.

## Benefits

Potential benefits include

- Improving gross revenues resulting from higher rates and potentially increasing market share.
- Attracting specific market segments (e.g., resident business travelers) through improved customer services and amenities.
- Allowing productive and beneficial use of surface lots that an airport operator might otherwise not consider financially viable. An example could be a small parking lot where the costs of providing cashiers on a round-the-clock basis are not justified by the expected revenues and where it is not feasible to develop a single exit plaza serving this lot and a larger, nearby lot.

## Implementation Actions

Implementation actions include

1. Select and develop a potential site. Ideally, the site should be a small lot offering easy access from the airport entrance and easy access to/from the terminal via shuttle bus or walking.
2. Install appropriate cashierless access control technologies providing adequate capacity to accommodate expected peak demands.
3. Develop an operational plan including shuttle bus routes and frequencies, and a source and distribution plan for proposed amenities. Assure that adequate buses are available to maintain high-frequency service.
4. Develop a marketing plan and brand for the new product. The marketing plan should emphasize the convenience, improved service, and amenities offered. The selected brand could be displayed on airport promotional material, webpage, wayfinding signage, and shuttle bus exteriors.

## Key Considerations

When implementing this strategy, include

1. A good first impression. A business parking lot should provide a high level of service from the outset and continue to maintain a high level of service. For example, customers must encounter (a) reliable bus service that meets or exceeds the published waiting times, (b) no entry or exit delays, and (c) friendly and courteous bus drivers. Reliable parking access and revenue controls are particularly important, as no cashiers are available nearby to respond to problems or delays.
2. Branding and marketing. Initial and ongoing marketing efforts are required to attract the desired customers. Although a clearly identifiable brand is important, it is necessary to reach out to potential customers and emphasize the benefits of the available service and amenities.
3. Site. Potential customers should be able to easily find the site. Customers should consider the site to be near the terminal and to offer short travel times to/from the terminal.

## Implementation Costs

The primary costs are for (1) any required modifications to the surface lot, including the new revenue control system, (2) acquiring the appropriate buses, and (3) ongoing marketing and promotion, if required. Appendix A provides the costs of credit card in/credit card out entry and exit controls. Marketing and promotion are expected to require a full-time person during the initial months of operation.

## Ongoing O&M Costs

O&M costs are equivalent to those for any other comparable traditional parking facilities.

## Implementation Schedule

Implementation (including the actions required to obtain management approval, marketing, planning, construction, and startup) may require less than 2 months to 6 months, depending on the time required to acquire and install the access control equipment and new signage, and to implement the marketing program.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Loyalty Programs (C.5),
- Credit Card In/Out (E.2),
- Proximity Cards (E.5),

- Branding (F.7), and
- Marketing (F.8).

## Examples of Application

Airports that offer, or once offered, business parking include Indianapolis International Airport (closed with the opening of the new Midfield Terminal in 2008) and Albuquerque International Sunport (now under design).

## B.6 Monthly Billing—Pay per Use

### Purpose

Improve customer service. Attract additional customers and revenues by offering frequent travelers, and those traveling for business purposes, an additional level of convenience.

### Use by Customers

With this product (sometimes referred to as corporate parking), customers are sold access cards or corporate cards (e.g., a proximity card, magnetic-stripe card, or AVI transponder) that allow them to enter and exit a parking facility and enable airport staff to track their use of the parking facility. Rather than paying upon each exit, cardholders are e-mailed monthly statements detailing their parking activity and the fees charged to their credit cards (which are automatically debited after each exit) or are e-mailed the remaining balance in the account (if the airport requires cardholders to maintain a deposit equivalent to one month of parking activity or other amount). Cardholders may park in any available space, but unlike some other value-added parking products, they are not guaranteed an empty space.

Because the corporate card can be shared among several patrons, they are often purchased by a company that then makes the cards available to all of its employees who are traveling on corporate business.

### Benefits

The reported benefits include

- Improved customer service because of simpler billing practices and improved reporting offered to participating customers.
- Enhanced service to a market segment composed primarily of frequent parkers and others traveling on business purposes. These customers need to track their business expenses, and either they or their employers are generally willing to pay a small monthly fee for the convenience of receiving monthly billing statements.

- Increased or maintained market share. Cardholders or employees provided corporate cards are unlikely to use competing off-airport parking products. For this reason, some parking operators (primarily private operators) offer customers volume-based discounts.
- Reduced cashier requirements and thus operating costs.
- No data quantifying the additional revenues resulting from this program were available; however, airport operators consider it to be successful based on the number of repeat customers who pay standard rates and minimal ongoing O&M costs.
- Easily combined with other complementary products, including pay per use, unlimited use, and loyalty programs.

## Implementation Actions

Implementation actions include

1. Assess whether a market exists for this specific product by conducting focus groups or surveys with potential customers and local businesses.
2. Select access technology that is compatible with the airport's existing or planned parking revenue control system. Generally, cards that can be waved in front of a reader upon entering and exiting the reserved zone, such as proximity cards or AVI tags, are generally used at airports. A credit card in/out technology could also be used.
3. Adapt, obtain, or develop software that tracks customer parking activity, automatically prepares monthly statements, and monitors the remaining balance in each account, if necessary.
4. Market and promote the new product using the airport website and flyers distributed to exiting customers, particularly those exiting garage or daily parking facilities.

## Key Considerations

Those identified by airport operators include

1. Separate entry and exit lanes are desirable so that cardholders can avoid exit delays. The presence of these dedicated lanes also helps make other customers aware of the availability of these cards.
2. The cost of access cards varies from \$50 to \$200 at various airports.

## Implementation Costs

The primary costs are (1) any required modifications to the parking access control system to allow it to accommodate access cards, and (2) the marketing program. One airport operator reported that advertisements placed as part of the



marketing program cost \$85,000. These costs exclude staff time or focus groups.

### Ongoing O&M Costs

O&M costs, which are primarily associated with reviewing the monthly billings, are reported to be minimal. Ongoing marketing was generally limited to the airport's website and word of mouth.

### Implementation Schedule

Implementation (including actions required to obtain management approval, marketing, planning, and start up) may require 3 to 6 months.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Guaranteed Space—Unlimited Use (B.8) and
- Automatic Vehicle Identification/Radio-Frequency Identification (E.3).

### Examples of Application

Airports where corporate cards or monthly billings are used include San Francisco, CA (ParkFast) and Seattle-Tacoma, WA (Premier Corporate Parking) international airports.

## B.7 Reserved Parking Zone—Pay Per Use

### Purpose

Enhance customer service, particularly for business travelers. Increase parking revenues with relatively little investment.

### Use by Customers

Customers who purchase an access card are guaranteed a parking space in a conveniently located area or zone reserved for cardholders. Customers pay a flat annual fee (to cover administrative costs) plus the standard duration-based parking fee for each use of the airport parking facility. Parking fees are billed against the customer's credit card, which is on file with the parking operator. Customers receive a monthly summary of the amounts billed to their accounts for the use of airport parking facilities. Because the access card can be shared among several users, the cards may be purchased by a company, which then makes the card available to all of its employees.



Source: Massachusetts Port Authority.

**Figure B.7.** Parking access card.

At airports where this product is offered, it is referred to as a “Gold Card,” “Passport,” or “Sure Park.” (See Figure B.7.)

### Benefits

Improved service for participating customers and increased parking revenues are the noted benefits. Specific benefits identified by airport parking operators include

- Enhanced service to customers consisting primarily of frequent parkers traveling on business purposes. These customers are (a) typically “just-in-time” travelers who value time savings (compared to cost savings), and (b) willing to pay higher fees for a product that guarantees easy access to empty spaces and avoids the time spent searching for empty spaces.
- Parking operators reported that access cardholders previously “hated” using airport parking facilities, particularly during busy periods when spaces were hard to find, but now over 95% of cardholders renew.
- Helped increase or maintain market share. Employees provided access cards are unlikely to use competing off-airport parking products. For this reason, some off-airport parking operators (primarily private operators) offer customers volume-based discounts.
- Increased parking revenue. Data quantifying the additional revenues resulting from this program were not available; however, airport operators considered this product to be successful based on the number of repeat customers (including new customers) and the minimal ongoing O&M costs.
- May be implemented to offer customers a range of complementary products, including monthly billing, pay per use, unlimited use, and valet services.

## Implementation Actions

Implementation actions identified by airport operators include

1. Assess whether a market exists for this product by conducting focus groups with potential customers, and determining if conveniently located spaces are available during peak times.
2. Identify potential locations for a reserved parking zone. The number of spaces should be flexible to respond to market changes. To establish the number of spaces to be reserved, it was assumed at certain airports that about 25% of cardholders would park at any one time.
3. Select access technology that is compatible with the parking revenue control system. Some airports use proximity cards or AVI cards that can be waved in front of a reader upon entering and exiting the reserved zone.
4. Market the program. Contact potential customers. Airport operators have used e-mails to American Express and Diners Club members, airline frequent flyers, advertisements in newspapers, and coupons provided to exiting customers. The best sources of potential customers are cardholders of a monthly billing program, if such a program exists.

## Key Considerations

Key considerations identified by airport operators include the following:

1. The selected zone should provide customers with a benefit not available in adjacent or nearby locations. This product has been unsuccessful when parking is readily available in adjacent locations or parking structure levels. In other words, this product works best when there is a regular shortage of available parking spaces.
2. A separate entry is required and a dedicated exit lane should be provided so cardholders can avoid exit delays.
3. The cost of access cards varies from \$50 to \$200 at various airports.
4. Sufficient conveniently located parking spaces must be available to provide guaranteed spaces.
5. First consider monthly billing programs that do not provide a guaranteed space (B.6), and then initiate a guaranteed space program to this customer base.

## Implementation Costs

The primary costs are (1) any required modifications to the parking access control system to allow it to accommodate the access cards, and (2) the marketing program. One airport operator reported that the advertisements placed as part of the marketing program cost \$85,000. Another airport reported

that the total implementation costs were \$65,000. These costs exclude staff time, focus groups, and acquisition of new access control equipment, if required.

## Ongoing O&M Costs

O&M costs were reported to be minimal. Ongoing marketing was generally limited to the airport's website and word of mouth.

## Implementation Schedule

Implementation (including the actions required to obtain management approval, marketing, planning, and start-up) may require 6 months or more.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Valet Parking (B.1 and B.4),
- Monthly Billing—Pay per Use (B.6),
- Guaranteed Space—Unlimited Use (B.8), and
- Automatic Vehicle Identification/Radio-Frequency Identification (E.3).

## Examples of Application

Airports where reserved parking zones with pay per use have been implemented include those serving Atlanta, Boston, Houston, Sacramento, and San Francisco, as well as many privately operated off-airport parking facilities.

## B.8 Guaranteed Space—Unlimited Use

### Purpose

Improve customer level of service, particularly for frequent travelers and those traveling for business purposes. Increase parking revenues while requiring relatively little capital investment by offering a higher priced product and by maintaining market share.

### Use by Customers

Customers who purchase access cards (sometimes called *Gold Cards*) are guaranteed to find an empty parking space in a designated portion or zone of a parking facility (typically a garage). Access is card-activated via a proximity card, magnetic-stripe card, or AVI transponder. Thus, only cardholders can access this designated zone. Cardholders are charged a flat monthly fee rather than a fee based on actual use of the park-



ing facility. The fee is electronically billed to the cardholder's credit card and the cardholder is e-mailed a receipt.

Potential cardholders are typically (1) "just-in-time" travelers who value time savings more than cost savings and (2) willing to pay higher fees for a product that guarantees easy access to empty spaces and minimizes time spent searching for an empty space.

## Benefits

Reported benefits include

- Enhanced service to a market composed primarily of frequent parkers traveling on business purposes. Customers prefer the easy billing/payment available with this product. Customer preference for this product is evidenced by reports that cardholders previously "hated" using airport parking facilities, particularly during busy periods when spaces were hard to find, but over 95% of cardholders renew.
- Improved gross and net parking revenues. At one airport, this product generates greater revenue per space than another product because the price of this product is equivalent to 15 to 20 days of general parking, but most customers parked for fewer than 15 days each month. Ongoing O&M costs were reported to be minimal.
- Improved customer perception of airport parking products by marketing availability of a range of products, and the branding of this product.
- Increased or maintained market share. Customers who purchase Gold Cards are unlikely to use competing off-airport parking products. This allows the airport to target major employers.
- Could be packaged with other services, including monthly billing, pay per use, unlimited use, and valet services.

## Implementation Actions

Implementation actions identified by airport operators include

1. Assess whether a significant market for this product exists by conducting focus groups with potential customers, and determine if adequate numbers of conveniently located spaces are available during busy periods. Determine which product(s) customers would use if the guaranteed spaces were not available.
2. Identify potential locations for a reserved parking zone. The number of spaces should be flexible to respond to market changes. To establish the number of spaces to be reserved, some airport operators have assumed that on an average day, about 25% of cardholders would park at the airport.
3. Select access technology that is compatible with the parking revenue control system. At most airports, cards that

can be waved (or tapped) in front of a reader upon entering and exiting the reserved zone, such as proximity cards or AVI cards, are used.

4. Market the program. Contact potential customers. The best source of potential customers is current cardholders of other value-added programs, if these programs already exist at the airport. Some airport operators have used e-mails to American Express and Diners Club members, airline frequent flyers, advertisements in newspapers, and coupons to exiting customers. The operator of one airport is attempting to develop a link between the hubbing airlines' reservation pages and this parking product.

## Key Considerations

Those identified by airport operators include

1. The selected zone should provide customers with a benefit not available in adjacent or nearby locations. For example, this product has been unsuccessful when parking is readily available in adjacent locations or levels.
2. Focus groups should be used to determine features customers are seeking and cost points (i.e., the additional amount customers are willing to pay for improved service and a guaranteed space).
3. Separate entry and exit lanes should be provided so that cardholders can avoid entry and exit delays. The presence of dedicated lanes helps with marketing this product.
4. Periodically survey existing customers to determine which products they formerly used and the products they would use if guaranteed spaces were not available to support analyses of resulting net revenues.
5. Periodically require that participating companies/cardholders verify that all of their cards are still in the possession of their employees. Some airport operators were concerned that former employees of participating companies might continue to gain access to the reserved area.

## Implementation Costs

Implementation costs were reported to be minimal. The primary costs were for marketing and promotion and monitoring and billing cardholders.

## Ongoing O&M Costs

There are no ongoing O&M costs, other than maintaining the billing program and software.

## Implementation Schedule

Implementation (including the actions required to obtain management approval, vendor selection, marketing, planning,

construction and startup) was reported to require about 6 months, including 2 months for internal meetings.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Reserved Parking Zone—Pay per Use (B.7),
- Loyalty Programs (C.5), and
- Branding (F.7).

## Examples of Application

Airports providing guaranteed spaces with unlimited use include those serving Boston (Logan International Airport) and Paris (Charles de Gaulle).

## B.9 Validated Parking—Retail

### Purpose

Encourage customer patronage of airport concessions and terminal area tenants.

### Use by Customers

Customers shopping in terminal stores and restaurants are offered coupons or cards providing discounted or free parking in airport-operated public parking facilities.

### Benefits

The reported benefits include

- Improved wayfinding to concessionaires located in pre-security areas that attract customers who are not airline passengers.
- Improved opportunities for some tenants to compete with off-airport locations offering free parking, such as restaurants or hotels/motels having convention space or meeting rooms.
- Improved retail sales, if combined with an airportwide offering, such as head-of-the-line privileges at security screening or access to an airport-operated club room.

### Implementation Actions

Implementation actions include

1. Issue concessionaires and tenants ticket validation equipment and establish strict controls for the use of this equipment.

2. Install exit ticket readers that can recognize and accept validated tickets.
3. Track validated tickets to determine the number and value of the tickets each concessionaire validates.
4. Establish procedures limiting the number of tickets concessionaires are allowed to validate each month or charge for a validated ticket, tickets exceeding a certain monetary value, or tickets in excess of the allowed number.

## Key Considerations

Key considerations include

1. Ticket validation procedures should be established and compliance with these procedures assured. If not properly managed, validated tickets can provide an opportunity to circumvent a parking system and can lead to a loss of parking revenues.
2. Ongoing monitoring of concessionaire use of ticket validation equipment will help assure compliance with assigned procedures and avoid improper validations.

## Implementation Costs

Primary costs are for the acquisition and deployment of parking access and revenue control equipment that allows ticket validation and accepts validated tickets.

## Ongoing O&M Costs

There are no ongoing O&M costs, other than for maintenance of the ticket validators used by concessionaires.

## Implementation Schedule

The schedule for new parking revenue control equipment acquisition and deployment governs the overall schedule.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Onsite Sale of Food, Beverages, and Other Products (C.3) and
- Loyalty Programs (C.5).

## Examples of Application

Since September 2001, few U.S. airports seek to attract non-airline passengers to in-terminal concessions. However, many non-airport locations, including parking facilities serving central business districts and retail centers, offer

reduced-rate parking if tickets are validated by participating merchants.

InterParking, the parking operator at Brussels Airport, offers “P-Card Shopping,” which can be used for the payment of parking at the airport and retail establishments throughout Belgium, and also for discounts or parking rebates at participating merchants. Payments are automatically deducted from the cardholder’s credit card, and can be tracked using a website maintained by InterParking ([www.pcard.be](http://www.pcard.be)).

One private operator (Park’n’Fly) offers customers discounts on the purchase of a 1-year security pass membership in *Clear*, a program allowing airline passengers who pay a fee to bypass queues.

## B.10 Validated Parking—Park-Sleep-Fly

### Purpose

Improve customer service, enhance revenues (both for the airport and the onsite hotel operator), and attract guests who would have otherwise used park-sleep-fly programs offered by hotels located off airport property.

### Use by Customers

Guests staying at least one night at an on-airport hotel are offered free or reduced-rate parking for multiple days. This offer is in addition to the validated parking typically offered guests for each night they stay at the hotel. Typically, hotel staff at the front desk or a concierge will validate a guest’s parking ticket.

### Benefits

Reported benefits include

- Improved customer service, particularly for those locally originating airline passengers with morning flights (or international flights, for which passengers must check in 2 hours before their departure time) and who have to drive long distances to the airport. These customers benefit by being able to arrive during the evening before their flights and park their cars for the duration of their trips for free or at a reduced rate. Typically, this product is attractive to non-business passengers (or passenger groups) residing an hour or more away from the airport.
- Increased on-airport hotel patronage because the program enhances the hotel’s ability to compete with hotels located off airport property.

- Enhanced airport revenues, because on-airport hotel operators typically pay concession fees (or management fees) to the airport operator; increased patronage.
- Increased revenue to the hotel operator, which can engage in yield management by filling rooms, which might have otherwise remained empty, with reduced-rate guests.

### Implementation Actions

Implementation actions identified by airport operators include

1. Negotiate and enter into a business arrangement with the on-airport hotel operator governing the park-sleep-fly program, including the validation program and parking fees.
2. Provide the hotel staff ticket validation equipment and strict controls for the use of this equipment. Alternatively, use prepaid exit cards (i.e., magnetic-stripe cards).
3. Install exit ticket readers that can recognize and accept validated tickets or cards.
4. If prepaid cards are to be used, prepare the card design and art work and arrange for their fabrication.
5. Track validated tickets or cards to determine the number and value of the validated tickets.
6. Work with local tour operators and promoters to provide travel packages that include the park-sleep-fly program.

### Key Considerations

Key considerations include the business arrangements with the hotel operator for tracking the use of the discount card and promotional activities.

### Implementation Costs

The primary costs are for marketing prior to implementation of the program and ongoing promotions and advertisements. Prepaid access cards cost about \$0.90 each to fabricate.

### Ongoing O&M Costs

The only significant ongoing O&M costs are for marketing and promotion.

### Implementation Schedule

Implementation of the park-sleep-fly program at Dallas/Fort Worth (DFW) was reported to take about 3 months, including design and fabrication of the prepaid cards.

## Supporting and Complementary Strategies and Technologies in This Guidebook

None were identified.

### Examples of Application

Airports with park-sleep-fly programs include those serving DFW, Orlando, and Toronto. DFW offers a park-sleep-fly discount program that enables participating hotel guests to park on the airport for up to 7 days at a discounted rate. Hotel guests purchase a prepaid card, provided to the hotel by the airport operator, and use the card upon exiting the airport parking facility. The airport, which sold over 1,500 park-sleep-fly packages in one recent year, receives \$10 per day from the hotel operator for each customer using the prepaid park-sleep-fly card.

## B.11 XXL (Extra Large) Parking

### Purpose

Enhance customer service by offering, for an additional fee, larger parking spaces that reduce the chance of a customer's vehicle being scratched or damaged by other vehicles or customers. These larger spaces can also be designated for use by customers with large vehicles, over-height vehicles, or vehicles pulling trailers.

### Use by Customers

After entering a parking facility, customers go into a separate nested area containing longer and wider spaces. Customers seeking to enter this gate-controlled area must insert their tickets into readers located at the entry and exit points. Ideally, this premium parking product is near the terminal building in a location that minimizes unprotected walking distances and level changes.

For example, at the P-20 Garage at Munich Airport, the general parking area is configured using spaces arranged at right angles to the parking aisle (i.e., 90° spaces) but the XXL zone is configured using spaces arranged at 70° angles to the aisle (i.e., 70° spaces). This layout results in wider spaces (about 10-ft wide versus the standard 8.5-ft width) and slightly longer spaces (about 19.5 to 20 ft long versus the standard 18-ft length). At Munich, where the primary market for this product appears to be customers with luxury vehicles, the cost of parking in the XXL zone is 50% higher than in the adjacent general parking area.

At Frankfurt Airport, the XXL zone is marketed for customers with large vehicles, over-height vehicles, and vehicles pulling trailers. Parking these types of vehicles is feasible because of the configuration of the parking structure and circulation ramps.

### Benefits

Apparent benefits include

- Improved service for customers willing to pay higher rates to minimize damage to their vehicles.
- Increased revenue even though the zone may contain fewer spaces because of the use of angled versus 90° spaces.
- Increased parking options for customers.

### Implementation Actions

Implementation actions include

1. Determine if sufficient customer demand for this product exists through the use of focus groups and/or observations of the number of luxury vehicles parked in airport facilities.
2. Select a conveniently located zone that can be reconfigured to yield wider spaces.
3. Install card-activated gate arms at the entry and exit of this zone. Alternatively, this zone could be activated using a reserved parking *Gold Card* or similar access card.
4. Market and promote the service. At Munich Airport, the product is advertised as being “extra large and extra close.”

### Key Considerations

Key considerations include

1. The zone should be easily accessible to both motorists and pedestrians.
2. The parking access system should allow for nested parking products and rates. That is, the access and egress controls to the XXL zone should be configured to charge higher fees for the use of these spaces.

### Implementation Costs

The primary costs are for (1) any required modifications to the pavement marking/stripping, (2) any changes or modifications to the parking access control system, and (3) marketing and promotion.

### Ongoing O&M Costs

There are no ongoing O&M costs other than the additional costs for maintaining additional revenue-control equipment.





Source: Jacobs Consultancy.

**Figure B.11. Munich Airport.**

## Implementation Schedule

The schedule is dependent upon the time required for new pavement marking and modifications to the revenue control system. The actions required to obtain management approval and construction are estimated to require 2 to 4 months, assuming major upgrades to the parking access system are not required.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Reserved Parking Zone—Pay per Use (B.7),
- Guaranteed Space—Unlimited Use (B.8), and
- Loyalty Programs (C.5).

## Examples of Application

Airports with XXL parking zones include those serving Munich and Frankfurt. See Figure B.11.

## B.12 Parking for Ladies and Families

### Purpose

Improve comfort and safety for female customers using airport parking facilities, particularly those using a parking structure. Improve customer perception of the airport.

## Use by Customers

This product consists of conveniently located parking spaces that are reserved for use by women. German law requires the allocation of parking spaces for women in public parking facilities at no additional cost. Similar spaces are provided in other parking facilities in Europe. In Miami, parking facilities are provided for parents traveling with young children. At European airports, ladies' spaces are nested areas within a larger facility that may be more brightly lit, located near the terminal building, have gate controlled access, or be monitored by video cameras. At Miami International Airport, spaces for families traveling with small children are conveniently located with signs indicating that they are reserved for authorized users, much like spaces reserved for disabled motorists.

## Benefits

Potential benefits may include

- Improved customer service, particularly for customers having negative perceptions of the safety and security of large parking structures.
- Enhanced customer perception of the airport and its parking system.
- Increased parking options for customers.

## Implementation Actions

Implementation actions include

1. Determine the market for this product and determine if a suitable parking area of adequate size is available and can be reserved for women or families traveling with small children.
2. Determine how to enforce and control the use of these reserved spaces.
3. Provide increased illumination in the designated parking areas and pedestrian corridors. Consider painting ceilings white to reflect illumination.

## Key Considerations

Those identified by airport operators include

1. Choosing the type of access controls. At Munich Airport and other public locations in Germany, signs are provided at designated spaces indicating that the spaces are reserved for women. It is not known how these signed restrictions are enforced.

At Frankfurt Airport, access to ladies' parking is controlled by gate access and monitored by video cameras



and microphones located near the entrance. To gain access, potential customers must push a button, which alerts a customer service agent, who uses the video system or speaks with the customer before raising the gate arm.

2. Implementation of enforcement measures that assure restricted access to the facility and improve both the perceived and actual safety in the facility.
3. The availability of such spaces needs to be promoted and marketed.
4. Customers may be willing to pay a small premium parking rate for this product; however, a potential negative impact is the perceived need to pay for safety, which would imply that existing facilities are unsafe.
5. Federal, state, or local laws may prohibit discrimination on the basis of gender.

### Implementation Costs

The primary costs are those associated with new signs and access controls.

### Ongoing O&M Costs

The most significant O&M costs are those associated with increased security measures and utilities for the ladies' parking area.

### Implementation Schedule

It is expected that the actions required to obtain management approval for ladies' parking may require substantial time as no known examples of this product exist in North America. Construction and installation schedules are expected to require less than 3 months.

### Supporting and Complementary Strategies and Technologies in This Guidebook

None were identified.

### Examples of Application

Airports with ladies' parking include those serving Munich and Frankfurt. This product is widely available in public and privately operated parking facilities in Germany. See Figure B.12a.

Miami-Dade County offers a special parking permit for parents or legal guardians traveling with a stroller that can be used until a child is 3 years old. Miami International Airport



Source: Jacobs Consultancy.

**Figure B.12a. Frankfurt Airport.**



Source: Jacobs Consultancy.

**Figure B.12b. Miami International Airport.**

has reserved spaces for this use conveniently located near the terminal. See Figure B.12b.

### **B.13 Secure Parking and Secure Parking with Valet Service**

#### **Purpose**

Enhance customer service by offering customers a product that, for an additional fee, provides an additional level of security for their vehicles and vehicle contents.

#### **Use by Customers**

Customers seeking a high level of security for their vehicles and their contents may park in an area surrounded by floor-to-ceiling fencing, monitored by guards around the clock, and where access by pedestrians and other vehicles is prohibited or limited to those passing through rolling gates that are normally closed.

Customers stop their vehicles at an office or in a lobby adjacent to the entry to the secure parking area, complete the necessary paperwork at a counter, and then either park their vehicles or leave them with a valet attendant. Upon returning to the garage, customers enter the lobby, pay at the counter for their stay, and then either retrieve their vehicles or wait for vehicle delivery by an attendant. At some airports, the lobby where customers pay for their parking is located away from the garage along a primary pedestrian path and a valet attendant retrieves the customer's vehicle.

Secure parking may be nested within general parking areas or accessed via separate entries and exits. This product is available at many large European airports and is often operated by a separate concessionaire. At these locations, secure parking costs 67% to 100% more than the adjacent general parking areas.

#### **Benefits**

The reported benefits include the following:

- Provides improved customer service, particularly for those customers with luxury vehicles or those who wish to leave valuables in their cars while parked.
- Provides additional options for customers.
- Provides additional revenue opportunities depending on the terms of the concession agreement. European airport staff reported high demand for this product both by customers seeking extra security and by celebrities.

#### **Implementation Actions**

Implementation actions identified by airport operators include

1. Identify a portion of the parking facility, particularly a parking structure that can be reserved and allocated for this use.
2. Advertise and award a concession for operation of this product. Either the airport operator or the concessionaire could be responsible for the installation of fencing and gate controls.

#### **Key Considerations**

Key considerations include

1. The extent of demand for this product must be determined.
2. The provision of secure parking may suggest to some that there are concerns with the level of safety and security offered in general parking areas.
3. The ability to provide a secure nested area that precludes pedestrian circulation needs to be investigated.

#### **Implementation Costs**

The primary costs are associated with the construction of the lobby and fencing, and the award of a concession to operate the secure parking area.

#### **Ongoing O&M Costs**

There are no ongoing O&M costs.

#### **Implementation Schedule**

Unknown, but estimated to require 4 to 6 months, including the actions required to obtain management approval.

#### **Supporting and Complementary Strategies and Technologies in This Guidebook**

- Valet Parking—Non-Curbside Drop-Off/Pickup (B.3),
- Reserved Parking Zone—Pay per Use (B.7),
- Guaranteed Space—Unlimited Use (B.8), and
- Vehicle Washing and Servicing (C.1).

#### **Examples of Application**

Airports with secure parking include those serving Brussels, Frankfurt, Munich, and Paris. See Figures B.13a and B.13b.



Source: Jacobs Consultancy.

**Figure B.13a. Munich Airport.**



Source: Jacobs Consultancy.

**Figure B.13b. Brussels International Airport.**

## CATEGORY C :

# Complementary Customer Services

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## CATEGORY C

# Complementary Customer Services

### C.1 Vehicle Washing and Servicing

#### Purpose

Improve customer service by allowing customers to have their vehicles serviced while they are parked. Enhance revenues by attracting potential customers from off-airport facilities and charging fees for additional services.

#### Use by Customers

After entering a parking facility, customers either leave their vehicles with a valet attendant or park them in designated spaces that are often located near the parking office. The customers authorize the desired vehicle services and indicate the date of their scheduled return. Services offered typically include washing, waxing, and detailing; fueling; routine servicing (e.g., oil change); dent removal; and tire rotation or replacement.

Typically, these services are performed by a nearby car wash, service station, or dealership operating under contract to the parking operator. At some airports, however, vehicles are washed by airport parking staff. At some parking facilities, vehicle servicing is performed by one or more automobile dealers offering factory-trained mechanics. At these locations, specific parking spaces are designated for each dealer or make of automobile (i.e., spaces for BMW, Mercedes, etc.).

#### Benefits

Potential benefits include

- Improved customer service, particularly for business travelers, high-income travelers, or others willing to pay higher fees for the convenience of having their vehicles serviced while they are away on travel.
- Increased revenues resulting from increased market share and the fees earned from the service station/car wash. The

revenues from this service at Denver International Airport represent less than 0.4% of total parking revenues.

- Improved perception of airport amenities.

#### Implementation Actions

Implementation actions include

1. Enter into a business arrangement with a local car wash, service station, or automobile dealership setting forth the range of services to be offered, schedule of rates for standard servicing tasks, and liability insurance.
2. Determine responsibilities for moving, securing, and storing customer vehicles.
3. Include service in advertising and promotional material. For example, one airport operator distributed an advertisement describing this service offering to gold- and platinum-level frequent fliers of the hubbing airline. This resulted in many new customers, 60% of whom had previously parked off airport.

#### Key Considerations

Key considerations include

1. Determining if sufficient customer demand for these services justifies the initial startup costs, training, and promotional costs. Demand may be high in locations where vehicles are soiled by rain and snow. The proportion of valet customers using car washing/servicing varies from about 2% at Denver International Airport (the airport operator has worked informally with a service station located on airport property for more than 10 years) to about 30% at Minneapolis-St. Paul International Airport (where vehicles are washed by airport staff).
2. Selecting a reliable and trustworthy service station/car wash. Customers expect the airport operator to be responsible for overseeing the work performed and if the work is not satisfactory, customers will complain about the airport, not the service station.



## Implementation Costs

Other than marketing/promotion and legal arrangements to allow transferring custody of customer vehicles to other parties, the initial start-up costs are minimal.

Although most airport operators have customers' cars washed and serviced offsite, it is possible to wash a car within an existing parking structure using small mobile car washing equipment, particularly those that use little water.

## Ongoing O&M Costs

Ongoing O&M costs are reported to be minimal.

## Implementation Schedule

Implementation, once a satisfactory service station/car wash is selected, can occur within 2 months, depending on the time required to obtain management and legal approval.

## Supporting and Complementary Strategies and Technologies in This Guidebook

Vehicle washing and servicing can be offered as an additional service at an existing parking facility. Complementary strategies and technologies include

- Valet Parking (B.1, B.2, and B.3),
- Secure Parking and Secure Parking with Valet Service (B.13),
- Loyalty Programs (C.5),
- Baggage Check-In (C.7), and
- Web-Based Reservations (F.3).

## Examples of Application

Airports with parking products that include vehicle washing and servicing are those serving Denver and Minneapolis-St. Paul, as well as many private parking operators.

## C.2 Concierge Services

### Purpose

Improve customer service by providing a broader range of complementary services. Increase airport revenues.

### Use by Customers

After entering a parking facility, using a concierge service or service from another staff member located in the parking office or other nearby location, customers can arrange to (1) pick up

or drop off their laundry or dry cleaning, (2) purchase groceries or other retail products to be placed in the customers' vehicles upon their return, (3) rent CDs/DVDs for the duration of their trip, and/or (4) have other similar services performed.

Typically, these services are performed by laundry/dry cleaning establishments or other concessionaires operating under contract to the parking operator. At some parking facilities, the parking operator operates a CD/DVD rental library for customer use. The retail products may represent products sold by the airport's in-terminal retail concessionaires, which can be selected from a catalog.

## Benefits

Potential benefits include

- Improved customer service and satisfaction, particularly for business travelers, high-income travelers, or others willing to pay higher fees for the convenience of having services performed while they are traveling.
- Potential revenues resulting from increased market share and the fees earned for the concierge services, and potentially from the in-terminal concessionaires. The extent of the potential revenue is unknown as the airport parking facilities offering concierge services are privately operated and no data were available on the revenues resulting from these operations.
- Improved perception of airport amenities and products.

## Implementation Actions

Implementation actions include

1. Enter into a business arrangement with laundry/dry cleaning or other businesses.
2. Arrange logistics for the placement of orders, pickup and delivery of laundry or retail products, and for securing these items until the customer returns.
3. Hire and train parking staff to serve as concierges.
4. Market and promote the service.

## Key Considerations

Key considerations include

1. Determining if sufficient customer demand for these services justifies the initial start-up, training, and promotional costs.

It is not known whether concierge services generate positive revenues or operate as a loss-leader to support marketing/brand recognition because all identified examples of concierge services were offered at parking facilities operated by private entities that did not share revenue or profit/loss data.

2. Selecting reliable and trustworthy service providers, and provisions for the pick up, delivery, and storage of customer orders.
3. Recognizing that customers will expect the airport operator to be responsible for the services performed (i.e., dry cleaning ready and garments cleaned satisfactorily) and will complain about the airport if the service is not delivered as expected.
4. Avoiding distribution of candy or maps to exiting customers. One parking operator reported that such “gifts” were unsuccessful because customers did not trust the candy, and local residents, who account for the majority of parking customers, do not need maps.

### Implementation Costs

The implementation costs are minimal.

### Ongoing O&M Costs

Ongoing O&M costs are reported to be minimal.

### Implementation Schedule

Once a satisfactory service provider is selected, implementation can occur within less than 2 months depending on the time required for management and legal approval.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Valet Parking (B.1, B.2, and B.3),
- Secure Parking and Secure Parking with Valet Service (B.13),
- Loyalty Programs (C.5),
- Baggage Check-In (C.7), and
- Web-Based Reservations (F.3).

### Examples of Application

As part of the Gateway valet parking program at Vancouver International Airport, concierge services are offered, including dry cleaning, ordering flowers, and other services. Private parking operators, including Red Rocket in Santa Clara (serving Mineta San Jose International Airport), offer similar services.

## C.3 Onsite Sale of Food, Beverages, and Other Products

### Purpose

Improve customer service by providing a broader range of complementary services. Increase airport revenues.

### Use by Customers

After entering a parking facility, customers can purchase food, snacks, and beverages from vending machines, a coffee cart, or a small retail establishment. In addition to food or beverages, other products may be sold (e.g., traveler-oriented products, such as those sold in hotel lobbies or at airport newsstands).

### Benefits

Potential benefits include

- Improved customer service and satisfaction, particularly for business travelers.
- Potential revenues from the sale of goods and services.
- Improved perception of airport amenities and products.

### Implementation Actions

Implementation actions include

1. Determine the mix of food and products desired by parking patrons, an optimal location (i.e., along a major pedestrian path) where these items can be offered, the likely volume of business, and the size of the establishment this volume warrants.
2. Prepare concession terms, prepare and disseminate an invitation for bids, advertise, and award a concession contract for the service(s).
3. Help concessionaire(s) market and promote the service(s).

### Key Considerations

Key considerations include

1. Determining if sufficient customer demand exists for these services. (See reference to former kiosk at Seattle-Tacoma International Airport under Examples of Application.) Vending machines appear to be popular because of their relatively low investment and ongoing O&M costs. Revenues from vending machines or food kiosks located in parking facilities are typically included in reported airportwide food/product sales and not reported separately. Thus, revenue data from sales in parking facilities were not available.
2. Selecting suitable site(s). The site must be visible, but should not interfere with pedestrian traffic and flow. At some airports, pedestrian traffic is dispersed along multiple paths, reducing the business opportunities at any one location.
3. Recognizing that parking facilities with “captive markets,” such as those where large groups of passengers must wait for shuttle buses or arriving airline passengers, are ideal locations for these services. (See reference to consolidated rental car centers under Examples of Application.)

4. Considering that, depending on their location(s) and configuration(s), permanent or fixed retail establishments will need to comply with local health, building, and fire codes. Compliance may trigger the installation of fire sprinklers, plumbing, or other equipment—not otherwise required—which will increase the construction cost of the parking facility. (See reference to former kiosk at Seattle-Tacoma International Airport under Examples of Application.)

### Implementation Costs

The primary costs are those associated with preparing and awarding a concession contract. These costs are minimal.

### Ongoing O&M Costs

Ongoing O&M costs, other than those related to the oversight of contractors, are reported to be minimal.

### Implementation Schedule

Implementation, once the satisfactory service site(s) and concessionaire(s) are selected, can occur within 4 months depending on the time required to determine a site location and achieve approval of the concession contract.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Economy/Long-Duration Parking (A.3) and
- Cell Phone Lots (A.6).

### Examples of Application

Other than vending machines (see Figure C.3), no examples of U.S. airports offering onsite retail sales were identified. In the late 1990s, a coffee kiosk was located in the main parking structure at Seattle-Tacoma International Airport near a busy sky bridge, but this kiosk has since been eliminated. It was reported that the kiosk did not comply with health department and local building codes, and did not generate significant revenue for the concessionaire or the airport.

Food/beverage and retail shops, as well as coffee carts, are located in the lobbies of several consolidated rental car facilities, including those located at the airports serving Dallas/Fort Worth, Phoenix, and San Francisco. These concessions, unlike those in public parking facilities, have “captive” markets consisting of rental car customers (and their traveling companions) waiting to pick up a rental car. The ground floors of many non-airport parking structures contain stores, shops, or restaurants, especially those located in urban areas. Typically, these retail facilities do not rely entirely upon parking facilities to generate a customer base.



Source: Jacobs Consultancy.

**Figure C.3.** *Miami International Airport.*

## C.4 Pre-Ordered In-Flight Meals to Go

### Purpose

Improve customer service by allowing customers to pre-order and pick up ready-to-eat meals when they park. Enhance revenue by providing an additional source of revenue.

### Use by Customers

Before arriving at a parking facility, customers use the Internet or telephone to select and order a freshly prepared meal from a menu of available choices. Customers can pick up their orders at the parking office or other location, after they have parked their vehicles but before they board the shuttle bus. The meals can be carried through security (as they contain no liquids or gels) and onto the aircraft. The meals can be heated just before they are to be picked up by a customer or, alternatively, they can be heated during the customers' journey using a chemical heat pack, which may be included with the meal.

An outside contractor is used to prepare the meals and deliver them to the parking facility.

### Benefits

Reported benefits include

- Improved customer service and satisfaction, particularly for business travelers or others who place a high value on time, prefer not to shop for meals in the airport terminal, or prefer the higher quality meals available through this service.
- Creation of brand loyalty because the service is attractive to repeat customers.

- Improved revenues as a result of the additional product sold, and potentially improved market share over competitors that do not provide pre-ordered meals.

## Implementation Actions

Implementation actions include

1. Conduct market research to determine the size of the potential customer market, preferred meal choices, and willingness to purchase meals at a parking facility.
2. Interview and select food contractor who will prepare and deliver meals. Agree upon menu choices, prices, required lead time for orders, and business terms.
3. Develop food storage area in parking offices or area of high pedestrian activity in a parking structure or lot.
4. Provide method for customers to order and pre-pay for meals via the Internet or telephone. Assure that information is reliably and accurately shared with food contractor and parking staff.

## Key Considerations

Those identified by airport operators include

1. Extent of the customer market for this product, which appears best suited for airports with large volumes of long-haul flights (e.g., 2 hours or more) and a high proportion or large volume of business travelers.
2. Concentrated circulation paths within a parking facility that allow a single meal pick-up point to serve all customers, as opposed to dispersed paths.
3. Availability of freshly prepared meals (as opposed to pre-packaged meals) from a nearby, reliable provider.
4. Current Transportation Security Administration (TSA) baggage and passenger screening regulations.
5. Terms of airport business arrangements with in-terminal food and beverage concessionaires. In some locations, this product may be viewed as competing with these concessionaires, who may have an exclusive contract.

## Implementation Costs

The primary costs are associated with developing a website or telephone system to allow customers to order meals, the cost of a refrigerated food storage area, and the staff time needed to distribute the meals and oversee/market the program and food vendor.

## Ongoing O&M Costs

Key ongoing costs include those for the staff handing out meals and overseeing the program and food vendor. Costs would also be incurred for updating the menu (unless the menu is hosted on the food contractor's website).

## Implementation Schedule

The schedule is unknown, but is expected to require 6 months or more, including actions required to obtain management approval, arranging a contract with a food vendor, and modifying a website to display the menu or provide a link to the vendor's website.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Valet Parking (B.1, B.2, and B.3),
- Secure Parking and Secure Parking with Valet Service (B.13),
- Loyalty Programs (C.5),
- Baggage Check-In (C.7), and
- Web-Based Reservations (F.3).

## Examples of Application

Pre-ordered in-flight meals were available at a parking structure operated by off-airport operator "Wally Park," serving Los Angeles International Airport. This service has been discontinued because of competition from the food and beverage concessions located after security checkpoints inside the terminal. The improved quality, availability, and lower costs of food for sale near the aircraft gates reduced the attractiveness of the pre-ordered meals, which had been provided by SkyMeals of Long Beach, CA.

## C.5 Loyalty Programs (Frequent Parker Programs)

### Purpose

Improve parking revenues by maintaining or increasing market share versus off-airport competitors. Improve service by determining the preferences of the most frequent parking customers.

### Use by Customers

Customers who participate in a frequent parker program offered by the airport or parking operator receive points that, depending on the specific program, can be applied toward available gifts, reduced cost or free parking, or airline miles. Customers register for the program using the Internet or mail-back forms.

### Benefits

Potential benefits of loyalty programs include

- Encourages repeat customers and thereby improves or maintains market share by providing benefits to repeat customers.



- Provides data to mine for future parking initiatives and customer contact information (i.e., e-mail addresses or other contact information), which can be used for customer satisfaction surveys and tests of new products or services.

### Implementation Actions

1. Determine number and frequency of returning parking customers (could be attained from license plate inventory).
2. Conduct customer outreach focus groups to determine level of interest and what rewards (e.g., gifts, discounted or free parking, or airline miles) would interest customers.

### Key Considerations

Those identified by airport operators include

1. Acquisition of software to establish and operate the program.
2. Ongoing costs to operate the program and purchase gifts or miles for customers.
3. Use of airline miles may be popular at an airport where one airline has a large market share.

For example, at Wilkes-Barre/Scranton International Airport, to be eligible for frequent parker program participation, customers must fly 50,000 miles or more per year with one of the airlines serving the airport and park in designated spaces in the parking structure.

### Implementation Costs

Specific costs were not reported. The key costs are those for developing the website or telephone system and the initial marketing program.

### Ongoing O&M Costs

Key ongoing O&M costs include

1. Staff costs for maintaining the website and software that tracks individual customer accounts, and interacting with customers.
2. Marketing and promoting the program.
3. Costs of rewards, including allowing free parking or purchasing the gifts or airline miles.

### Implementation Schedule

The schedule is unknown, but is expected to require 6 months or more, including the actions required to obtain management approval, acquiring the necessary software, implementing the website, and marketing and promotional activities.



Source: Cincinnati/Northern Kentucky International Airport.

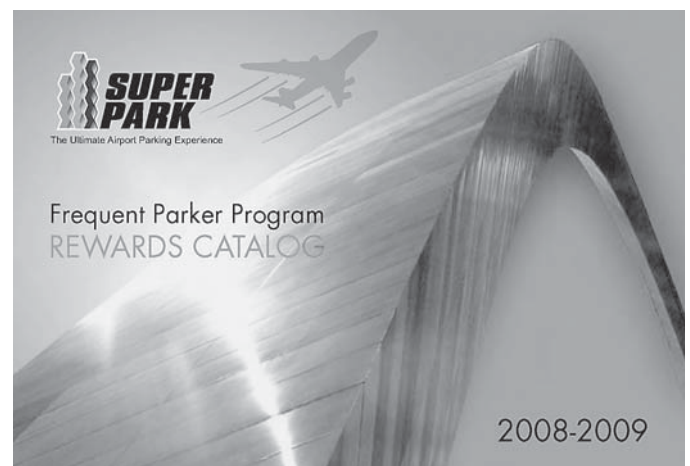
**Figure C.5a.** Frequent parker rewards program at Cincinnati/Northern Kentucky International Airport.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Monthly Billing—Pay per Use (B.6),
- Reserved Parking Zone—Pay per Use (B.7),
- Guaranteed Space—Unlimited Use (B.8), and
- Web-Based Reservations (F.3).

### Examples of Application

Airports with loyalty programs include those serving St. Louis (e.g., Super Park operated by Central Parking Systems) and Cincinnati/Northern Kentucky (e.g., CVG Parking Advantage), as well as most private off-airport parking operators (including those that operate on- and off-airport parking facilities). See Figures C.5a and C.5b.



Source: St. Louis International Airport.

**Figure C.5b.** Frequent parker rewards catalog for St. Louis International Airport.



As noted earlier, Wilkes-Barre/Scranton International Airport has a frequent parker program, which is available only to members of elite airline mileage programs. A customer who has earned 50,000 or more miles per year and participates in a major airline frequent flyer program is eligible to obtain a permit that grants access to convenient terminal garage parking. The cost of parking in the dedicated area is the same as the cost to park in adjacent facilities.

## C.6 Passenger Check-In Kiosks

### Purpose

Improve customer service by permitting customers to check in for their flights and receive boarding passes in a parking facility, including those located away from the terminal area (e.g., economy lots requiring the use of shuttle buses).

### Use by Customers

While walking to the terminal or before boarding a shuttle vehicle that transports customers to the terminal, the customer uses a credit card or airline confirmation number to obtain a boarding pass from an electronic self-service ticketing kiosk or a common-use ticketing kiosk. The customer may then proceed directly to security upon arrival at the terminal building.

In addition to printing a boarding pass (and sometimes baggage tags), customers can change flights or seat assignments, print receipts, and perform other functions typically offered by self-service ticketing kiosks serving one airline or multiple airlines.

### Benefits

Potential benefits include

- Enhanced customer service, particularly for passengers traveling only with carry-on baggage, because this option allows them to bypass the ticket counter.
- Improved market share from offering customers a service not generally available at privately operated parking lots.

### Implementation Actions

Implementation actions include

1. Confirm that a market for this service exists.
2. Confirm the availability of suitable technology (i.e., common-use ticketing kiosks).
3. Select suitable location(s) to install the kiosks and provide the necessary communications and power systems.
4. Coordinate with the airlines that have the largest market share to determine their willingness to participate and

support system implementation and maintenance, if the airport does not have a common-use system.

## Key Considerations

Those identified by airport operators include

1. Whether a common-use ticketing system is in use at the airport. Parking is unlikely to be the driver for implementing such a system, but rather an additional user if the system exists.
2. Extent of demand for this product. An increasing proportion of airline passengers arrive at the airport with preprinted boarding passes obtained using the Internet or other source (e.g., check-in kiosks available in hotel lobbies). Thus, demand for this strategy may be declining.
3. Willingness of the larger airlines to participate in this program, including installation of kiosks and consideration of the ongoing maintenance costs. This is less of a consideration at airports with common-use ticketing equipment.
4. Implementation costs, including costs of kiosks and supporting networks, particularly at airports where multiple kiosks are required. Airports with concentrated pedestrian paths, dominant hubbing airline(s), or common-use equipment would require less equipment.
5. Maintenance costs, including provisions for repairing equipment failures or service outages, and customer service implications caused by unreliable equipment.
6. Existence of a parking facility that provides a suitable location(s) to install equipment. The location should be weather protected and heated; secure, well lit, and under surveillance (similar to an ATM machine) to avoid vandalism; and provide access to a secure communication network suitable for use by the airlines. The parking facility also should offer concentrated passenger flows, so that only a few kiosks are required.
7. Foreknowledge that this strategy is not suitable in a surface parking lot because passenger flows are not sufficiently concentrated.

## Implementation Costs

Each common-use self-ticketing kiosk costs approximately \$10,000 to \$15,000 to install, depending on the equipment and location.

## Ongoing O&M Costs

The costs of ongoing operation (maintaining ticket stock), maintenance, and surveillance of the kiosks are the responsibility of the airport operator.



**Figure C.6.** Common-use self-ticketing kiosk.

### Implementation Schedule

About 2 to 4 months are required to approve, design, and install a kiosk, depending on the availability of supporting cable and power.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Baggage Check-In (C.7).

### Examples of Application

Airports with passenger check-in kiosks (see Figure C.6) at a remote parking facility (or other off-airport location) include those serving Las Vegas, Minneapolis-St. Paul, San Francisco, and Vancouver.

## C.7 Baggage Check-In

### Purpose

Improve customer service and enhance market share by permitting customers to leave their checked bags and receive boarding passes in a parking structure or facility located away from the terminal area (e.g., economy lots requiring the use of shuttle buses), thereby avoiding having to carry bags on a shuttle vehicle.

### Use by Customers

When entering the parking facilities or before boarding a shuttle bus, customers leave their checked bags with an attendant and pay a small fee for the bag service (e.g., \$3 per

checked bag plus airline bag check fee) and boarding pass. Baggage is stored securely by the baggage agent (typically a third-party baggage handler or concessionaire), who transports the bags to the appropriate airline where they are processed and screened with other checked baggage.

### Benefits

Potential benefits include

- Enhanced customer service for passengers who are checking baggage, because they can bypass the ticket counter.
- Improved market share by offering customer service not generally available at privately operated parking lots.

### Implementation Actions

1. Determine if an adequate market exists for this service, and if the airport operator is willing to subsidize the operation, if necessary.
2. Determine which airlines are willing to participate and ascertain their market shares.
3. Select a third-party baggage handling company that will be responsible for coordination with the airlines and TSA.
4. Construct the baggage counter and baggage storage area.
5. Market, advertise, and promote the service.

### Key Considerations

Those identified by airport operators include

1. Determination of whether sufficient business exists to support this service. The primary market consists of domestic, non-business passengers with several pieces of checked baggage who typically check in 1 to 2 hours in advance of their flight departures, are traveling on participating airlines, and are willing to pay baggage handling fees in addition to the airline bag check fees. Not all airlines participate in these services, and the service is not available to passengers on international flights.

At some airports, the primary market consists of passengers who are non-resident, non-business customers traveling to/from destination resorts (e.g., casinos) or cruise ships.

2. At several locations, the airport operator has chosen to subsidize the cost of this service because the fees (e.g., \$3/bag) charged by the third-party baggage handling company are insufficient to cover the costs, particularly during initial years of the service.
3. Airports where this service has been implemented (e.g., San Francisco International Airport) report that, after the airlines initiated bag check fees, demand for this service declined or remained steady (despite increasing passenger traffic).

4. Availability of an appropriate location for baggage check-in within the parking facility. The site should provide for a staffed baggage check-in counter (which requires electrical power and—ideally—is climate controlled) and should have adjacent, secure, weather-protected, baggage storage immediately adjacent to the vehicle to be used to transport the baggage securely to the terminal. Passenger flows within the parking facility should be concentrated so that a single counter/area can serve all customers.

## Implementation Costs

The major implementation costs include those for

1. Staff time to analyze the size of the market and select a baggage handling company, which may involve issuance of a Request for Proposal (RFP).
2. Construction of the baggage counter and storage area. Secure modular containers could be used for storage.
3. Electrical power, telephone/communication, and data lines.

## Ongoing O&M Costs

Ongoing airport operator O&M costs are minimal.

## Implementation Schedule

The implementation schedule varies based on the time required to negotiate with the third-party baggage handling company and the airlines. Total implementation time may vary from a minimum of 3 months (assuming a sole source award to a baggage handling company) to 12 months (assuming a competitive proposal process) depending on the time required for contract negotiation, approvals, and initial start up.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Passenger Check-In Kiosks (C.6).

## Examples of Application

As of 2009, third-party concessionaires offering this service include BAGS, Inc. and Bags-to-Go. San Francisco International Airport offers baggage check-in at a remote parking facility (see Figure C.7). Similar services are operated in remote locations, but not parking facilities, near the airports serving Las Vegas and Vancouver.

Remote baggage check-in was available for passengers using remote express bus services to Los Angeles International Airport (LAX) from September 2006 to March 2008. This service was discontinued because of low demand. Less than 2% of the bus passengers used the service at one



Source: Jacobs Consultancy.

**Figure C.7. Baggage check at long-term parking facility, San Francisco International Airport.**

location, and less than 1% of passengers used it at two other locations.

These three remote locations being used for baggage check-in were located between 10 and 20 miles from LAX. Baggage check was available for \$5 for up to two checked bags on most domestic airlines, except Southwest Airlines and US Airways. The cutoff time for baggage check was 3 hours prior to flight time. The estimated annual operating costs for limited hours of operation at the three locations, plus personnel to accept the bags at the airport's international terminal where they were processed, was approximately \$250,000. The majority of the costs were subsidized by the airport operator. The remote baggage check did not generate new express bus passengers.

## C.8 Pet Kennels

### Purpose

Improve customer service by offering customers the ability to board a pet while they travel. Increase revenue from fees earned for the provision of an additional product.

### Use by Customers

Customers bring their pets to the airport, board them in a licensed kennel, and park at the kennel. When the parking facility is co-located with a kennel, it is sometimes referred to as a “park-and-bark.”

At these airport pet kennels, similar to other boarding kennels, customers can arrange to have their pets bathed, groomed, or attended to medically by a veterinarian for an additional fee.

When customers return to the airport, they can pick up their vehicles and pets at the same location.

## Benefits

Reported benefits include

- Increased customer service for parking patrons and airport employees, who can also use the service.
- Additional airport revenues derived from the kennel, which is typically operated as a concession. At Minneapolis-St. Paul International Airport, the concessionaire pays 8% of its gross revenues plus building and ground rentals. Some airports receive over \$100,000 annually in concession fees paid by kennel operators.
- Increased revenues generated through attracting additional customers to the parking facility.

## Implementation Actions

Implementation actions were reported to include

1. Select site with a 1-acre minimum to allow for parking, the kennel, and runs/exercise areas. The site should provide “easy on/easy off” access.
2. Decide whether to use an existing building or a new building.
3. Prepare and issue requests for information followed by requests for bids or RFPs. The RFP should be carefully structured to attract businesses experienced in operating facilities that provide for boarding pets, animal day care, and training. The RFP should require that
  - a. Customers are allowed to drop off or pick up their pets during the same hours that airline passengers, unlike traditional kennel customers, arrive at, and depart from, the airport. Provision should be made for customers who may experience flight delays and be unable to pick up their pets at the originally scheduled times.
  - b. The kennel be staffed by qualified individuals with access to a veterinarian or a paraveterinary technician.
  - c. Kennel operators be limited to organizations qualified to operate a kennel, including those that operate kennels nationwide, as well as local not-for-profit animal protection services.
  - d. “Exotic” pets as well as dogs and cats can be boarded.
  - e. Upscale services that provide for training and grooming are considered.
  - f. A discount rate is provided for people who work at the airport.
4. Select and award contract. Alternatively, enter into a sole-source business agreement with a not-for-profit organization (e.g., the ASPCA).

## Key Considerations

Those identified by airport parking providers include

1. Availability of a suitable site for the kennel. To enhance customer level of service, the kennel should be located close to the major airport entry road, easy for customers to find, and close to parking.
2. Business terms with the existing parking operator. Most concession contracts with parking operators and some management agreements grant the concessionaire or management company the exclusive right to operate public parking facilities located on the airport.
3. Business terms with the kennel operator. Some airports charge only land rent, while others charge building and land rent plus a percentage of gross revenues derived from the kennel and the parking operations. These terms vary depending on whether the airport operator or the concessionaire is responsible for constructing the site improvements, including construction of the kennel.
4. Number of parking spaces to be provided at the kennel. The kennel at Minneapolis-St. Paul International Airport provides about 100 public spaces.

## Implementation Costs

Implementation costs, other than site preparation and staff costs for preparing and awarding the contract, are minimal.

## Ongoing O&M Costs

Ongoing costs, other than for oversight of the concessionaire, are minimal. The concessionaire is responsible for a marketing program, public relations, and advertising.

## Implementation Schedule

Obtaining approval from management, issuing the RFP/bid documents, and project start-up can require 6 to 12 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Vehicle Washing and Servicing (C.1),
- Onsite Sale of Food, Beverages, and Other Products (C.3), and
- Passenger Check-In Kiosks (C.6).

## Examples of Application

Airports with parking products that include pet kennels include those serving Jacksonville and Minneapolis-St. Paul (see Figure C.8). Privately operated kennels marketing to airline passengers include those located in Atlanta, Charlotte, Houston





Source: Metropolitan Airports Commission.

**Figure C.8. Pet boarding at Minneapolis-St. Paul International Airport.**

(Hobby and Bush Intercontinental), New Orleans, Orlando, and Philadelphia, operated by “Pet Paradise” and other companies.

## C.9 Shaded Spaces

### Purpose

Improve comfort and convenience for customers who would otherwise have to park in uncovered areas. Potentially increase revenues if higher fees are charged for covered spaces within a parking lot.

### Use by Customers

Customers parking in shaded spaces in surface lots or on the rooftop of parking structures have the comfort of their vehicles being protected from snow, rain, hail, and bright sun when lightweight covers, often made of fabric, plastic, or metal sheets, are used to shade all or a portion of each space. In the southwestern United States and other regions, these covers are referred to as *shade ramadas*. In many parking lots, particularly privately operated parking facilities, customers parking in shaded spaces are charged an extra fee or a higher fee.

### Benefits

Potential benefits may include

- Improved customer service and convenience, particularly in communities that frequently experience inclement or very hot weather.

- Improved service for customers parking in surface lots.
- Increased choice of parking options and customer services.

### Implementation Actions

Implementation actions include

1. Estimate cost per space of constructing a shade structure complying with local building codes.
2. Determine if higher fees are to be charged for the shaded spaces, and how the customer base will react to the addition of a new product/service. The estimated net new revenues should allow recovery of amortized construction costs.
3. Determine which spaces are to be covered and, if they are to be nested within a larger lot, how access/egress will be controlled.

### Key Considerations

Those identified by airport operators include

1. Structural systems that support shade canopies or covers must comply with local building codes. In areas subject to strong winds or snow loads, the cost per square foot of these structures can be almost as much as the cost of a parking structure.
2. Because of the cost of construction, shade canopies may be desirable in climates where sun is a problem, but not in locations that experience heavy snow and ice loads.
3. Determine if the potential higher fees (and incremental revenues) from shaded spaces will be sufficient to recover the costs of the canopies. One airport operator (at Dallas/Fort Worth) reported a 3- to 4-year return-on-investment from adding shade canopies, while other (smaller) operators reported subsidizing the cost of shade canopies.
4. Ideally, the shade should cover most of the vehicle and provide protection from wind-driven rain. Such shade cover allows customers to more comfortably load/unload baggage from their vehicles during rain storms.

### Implementation Costs

The primary costs are for the shade structure, as presented in Appendix A.

### Ongoing O&M Costs

The primary O&M costs are associated with structural maintenance, which is dependent on the material used (e.g., fabric, metal, plastic) and local conditions (i.e., deterioration caused by sun).

### Implementation Schedule

It is estimated that the total time to implement, including obtaining approval from management may be 4 to 9 months,



including 1 to 3 months for design and 2 to 4 months for construction.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Economy/Long-Duration Parking (A.3),
- Business Parking (B.5),
- Secure Parking and Secure Parking with Valet Service (B.13), and
- Shaded Spaces with Solar Panels (C.10).

## Examples of Application

Airports with shaded rooftop parking include those serving Albuquerque, Las Vegas, Little Rock, Phoenix, and Salt Lake City. Shaded spaces in surface lots can be found at the airports serving Abilene, Dallas/Fort Worth, and numerous privately operated lots.

### C.10 Shaded Spaces with Solar Panels

#### Purpose

Improve comfort and convenience for customers who would otherwise have to park in uncovered areas. Increase parking revenues. Support airport and regional sustainability and environmental goals (i.e., reduce the environmental footprint). Reduce electrical power needs and airport operating costs.

#### Use by Customers

The vehicles of customers parking in surface lots or on the rooftops of parking structures are protected from snow, rain, hail, and bright sun by solar panels that shade all or a portion of each space.

#### Benefits

Potential benefits are reported to include

- Improved customer service and convenience, particularly for customers parking in surface parking lots and at airports that frequently experience hot, sunny days.
- Reduced environmental footprint resulting from reduced utility needs (i.e., compatibility with management's sustainability/green airport goals).
- Increased revenues if higher fees are charged for covered spaces in a parking facility, and reduced utility costs.

#### Implementation Actions

Implementation actions include

1. Determine if proposed lot (or rooftop) provides a suitable location for solar panels.

2. Estimate cost per space of constructing and installing solar panels and supporting infrastructure.
3. Determine opportunities for a public-private partnership involving local electric utility, state or federal agencies, and private developer responsible for installation and maintenance of solar panels.
4. Compare estimated costs and benefits of installing solar panels versus conventional shade structures.

## Key Considerations

Those identified by airport operators include

1. Availability of funding or grants from state or federal agencies, or public-private partnerships (e.g., the partnership of Pacific Gas and Electric Company and World Water & Solar Technologies Corp. at Fresno Yosemite International Airport). The availability of financial support appears to be a key determinant in the project's financial feasibility.
2. Evaluation of whether to install solar panels in a parking lot or at a free-standing site. Some airport operators determined that a free-standing solar farm was preferable to panels located above a surface parking lot because the:
  - a. Costs of the infrastructure (including solar tracking) required for a small solar panel installation were lower.
  - b. Structural grid used to support the panels was not consistent with that required for a parking lot.
  - c. Local electric utility or private developer was willing to participate in a small solar farm.

## Implementation Costs

The primary cost would be for installing the shade structure, as presented in Appendix A. State and/or federal financial grants may be available to assist with the costs of purchasing and installing solar panels.

## Ongoing O&M Costs

Ongoing O&M costs may be the responsibility of the participating private company.

## Implementation Schedule

It is estimated that the total time to implement, including the actions required to obtain management approval may be 12 months or more because of the extent of the coordination required among the utility, airport operator, state/federal agencies, and private developer.



Source: HOK, Inc.

**Figure C.10a.** *Solar panels shading parking at Vacaville, California, office campus.*

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Economy/Long-Duration Parking (A.3),
- Business Parking (B.5), and
- Secure Parking and Secure Parking with Valet Service (B.13).

### Examples of Application

Airports with solar panels include Fresno Yosemite, Charlotte Douglas, and Denver International airports, although, none of these airport operators chose to install the panels over a parking lot or structure. Non-airport locations with solar panels above surface parking lots include those in privately owned lots in California, such as Santa Rosa (Agilent Technologies) and Sunnyvale (Applied Materials), and Nevada's Springs Preserve Parking Lot in Las Vegas (see Figures C.10a and C.10b).



Source: Clark County Department of Public Works.

**Figure C.10b.** *Spring Preserve Parking Lot in Las Vegas, Nevada.*

## C.11 Electric Charging Stations

### Purpose

Improve comfort and convenience for customers using “plug-in” electrically powered vehicles. Support airport and regional sustainability and environmental goals (i.e., reduce the environmental footprint).

### Use by Customers

Customers with plug-in electric vehicles use charging stations while their vehicles are parked at the airport.

### Benefits

Potential benefits are reported to include

- Improved customer service and convenience for customers operating electric vehicles.
- Improved perception of airport sustainability and environmental friendliness.
- Increased revenues if fees are charged for the use of a charging station.

### Implementation Actions

Implementation actions include

1. Determine if sufficient electric vehicles operate at the airport to warrant installation of charging stations now or in the future.
2. Determine whether to purchase charging stations or allow a concessionaire to install and operate the stations.
3. Determine where to place the charging stations.
4. Determine what, if any, customer charges will be associated with the charging stations and if owners of the electrically powered vehicles will be required to have a permit to use the stations.

### Key Considerations

1. Extent of demand for charging stations.
2. Cost to customer for using the service. If customers are to be charged a fee, it may be appropriate for a concessionaire to provide and operate the charging stations.
3. If the stations are to be provided and operated by a concessionaire, decide whether to require installation of a common-use station or to allow installation of stations that can only be used by customers who are subscribers to a specific charging network.
4. Determine if customers are allowed to park for long durations at the available charging stations (i.e., limiting access to other customers, including those parked for short durations).

## Implementation Costs

The primary cost is that associated with the charging station. A variety of charging stations are now available—coin operated, solar-panel powered, and electrically powered. These designs and technologies are expected to change as plug-in electric vehicles become more popular. One currently available product (Smartlet) costs between \$1,000 to \$2,000 per charging station. Some stations are mounted on poles, such as light poles. Other charging stations in Davis (CA), were reported to cost between \$6,000 and \$7,000 to replace.

## Ongoing O&M Costs

Ongoing O&M costs are expected to be minimal and may be the responsibility of the concessionaire.

## Implementation Schedule

It is estimated that the total time to implement, including obtaining management approval may be 3 to 12 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Hourly/Short-Duration Parking (A.1).
- Valet Parking—Curbside Drop-Off/Pickup (B.1),
- Reserved Parking Zone—Pay per Use (B.7).
- Secure Parking and Secure Parking with Valet Service (B.13), and
- Shaded Spaces with Solar Panels (C.10).

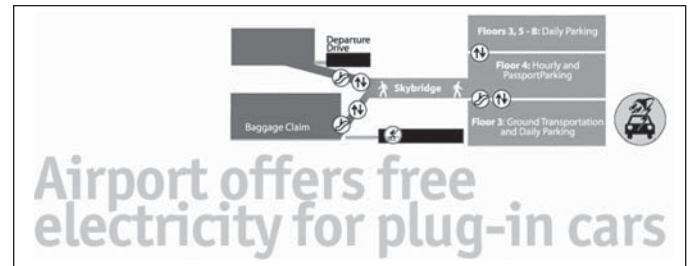
## Examples of Application

At Seattle-Tacoma International Airport, six spaces are offered for electric plug-ins. These spaces are available on a first-come, first-served basis. The electrical charging is offered free of charge. Los Angeles International Airport provided free charging stations for use by the General Motors EV-1, but these have been removed. Non-airport locations with electric charging stations accessible to the public include those in many public on-street locations in California (e.g., Arcata, Davis, San Francisco, and San Jose), Seattle (City Hall and library), and in the state of Washington. See Figures C.11a through C.11c.



Source: ABC News.

**Figure C.11a. Charging station.**



Source: Port of Seattle.

**Figure C.11b. Ad for free plug-in electric car charging.**



Source: Kimley Horn & Associates.

**Figure C.11c. Munich Airport.**

## CATEGORY D:

# Parking Space Availability and Guidance Systems

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# Parking Space Availability and Guidance Systems

## D.1 Space Availability via the Internet Prior to Arrival

### Purpose

Improve customer service by advising parking patrons of the number of spaces available prior to their departure from homes, offices, etc. Reduce vehicle miles traveled by customers who would, if uninformed, travel to facilities that are fully occupied.

### Use by Customers

As customers prepare to depart their homes, offices, etc., and travel to the airport, they check an Internet website that provides information on the specific numbers of available spaces or an indication of whether or not spaces are available.

### Benefits

Benefits reported by airport operators include

- Reduced chance of a poor customer experience because customers receive information that assists them in avoiding parking facilities that have few or no empty spaces.
- Reduced vehicle miles traveled by customers and reduced emissions since customers are less likely to have to circulate among parking facilities to locate available spaces.
- Additional data since the technologies used to collect space-availability information also generate detailed data on customer use of individual parking facilities, which can be used to analyze trends in space occupancy and to support planning and financial decisions.
- Provision of a means of communication with customers away from airport property, which offers opportunities for marketing/advertising.

### Implementation Actions

Systems providing space availability information for individual parking facilities are standard at airports, especially at those airports with multiple parking facilities. Space information is typically determined using differential counts derived from magnetic loop detectors embedded in the pavement at the entries and exits of each parking facility, but can also be gathered using other sensor technologies, providing space availability by level, sector, or space (see Sections D.4, D.5, and D.6).

Implementation actions for external displays of parking availability include

1. Identify information to display (e.g., real-time updates based on entry/exit counts versus manual updates based on parking operations staff observations). This action is easiest to implement during the design of parking facilities.
2. Determine whether or not the parking revenue control system requires any upgrades or modifications to be able to provide real-time information to an Internet server.
3. Design website(s) interface(s) to display information (i.e., colors, fonts, layout) and potential links to other relevant sites.
4. Identify entity to host website. Typically, the airport website hosts the page(s) associated with parking facility occupancy.

### Key Considerations

Those identified by airport operators include

1. Website must provide reliable and consistent access to customers with minimal down time. Data presented must be accurate.
2. Website must update at frequent intervals (e.g., 15 minutes) to provide near real-time information on space occupancy.



## Implementation Costs

For most installations, equipment that counts vehicles entering/exiting a facility is a standard component included in the design and construction cost of the parking facility. Additional costs may include those for designing and implementing any webpages that display occupancy information.

## Ongoing O&M Costs

O&M costs for equipment used to count vehicles entering and exiting parking facilities are typically bundled with O&M costs for the entire parking garage. O&M costs for maintaining the webpage(s) that display occupancy information are often bundled with general airport website management and hosting costs.

## Implementation Schedule

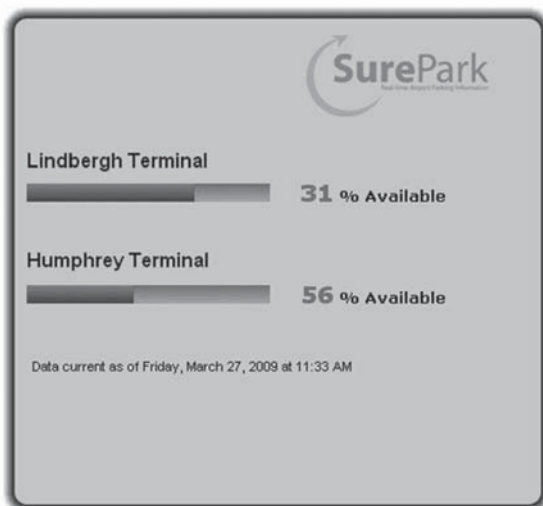
Depending on the facility occupancy module of the revenue control system, the information can be readily obtained and posted to the airport website.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D.

## Examples of Application

Occupancy of public parking facilities is monitored at most U.S. airports. This information is available via the Internet in real time (see Figure D.1) at the airports serving Minneapolis-



**Figure D.1.** Parking facility availability display from Minneapolis-St. Paul International Airport website.

St. Paul, Portland (OR), and Washington, DC (Reagan National and Dulles).

## D.2 Space Availability via Phone/Radio Prior to Arrival

### Purpose

Improve customer service by indicating to parking customers the number of available spaces in each airport parking facility prior to their arrival at the airport. Reduce vehicle miles traveled by customers who would, if uninformed, travel to facilities that are fully occupied.

### Use by Customers

As customers approach the airport, they can call a toll-free airport information number or tune their radios to a dedicated Highway Advisory Radio (HAR) station. The phone number or HAR recording can provide information on the specific numbers of available spaces or just an indication of whether or not spaces are available.

As a variation, one operator allows patrons to send a text message to a phone number. The content of the text message sent indicates when the patron would like to receive a text message indicating parking availability (i.e., patrons would send “10” if they wanted to receive the information in 10 minutes).

### Benefits

Benefits reported by airport operators include

- Improved customer experience because customers are provided information that will assist them in avoiding parking facilities having few or no empty spaces.
- Reduced vehicle miles traveled by customers and reduced vehicle emissions since customers are less likely to have to circulate among parking facilities to locate available spaces.
- Additional data since the technologies used to collect space-availability information also generate detailed data on customer use of individual parking facilities, which can be used to analyze trends in space occupancy and to support planning and financial decisions.
- Provision of a means of communication for arriving customers to receive real-time information about curbside congestion, which may encourage the use of parking or cell phone lots.

### Implementation Actions

Systems providing space availability information for individual parking facilities are standard at airports, especially at those airports with multiple parking facilities. Space information is

typically determined using differential counts derived from magnetic loop detectors embedded in the pavement at the entries and exits of each parking facility, but can also be gathered using other sensor technologies, providing space availability by level, sector, or space (see Sections D.4, D.5, and D.6).

Implementation actions for providing parking availability information via phone or radio include

1. Determine whether the parking revenue control system requires any upgrades or modifications to be able to provide real-time information.
2. Determine frequency of updates to the recorded information.
3. Determine procedures for manually or automatically updating the recorded information.
4. Obtain necessary telephone number, answering equipment, or HAR transmitter license.

### Key Considerations

Those identified by airport operators include

1. Recorded messages on telephone recordings and HAR station broadcasts must be reliably and consistently available to customers, with minimal down time. Data presented must be accurate.
2. Recorded messages must be updated regularly (e.g., several times a day, or as conditions change) to provide useful information regarding space availability.
3. Recorded messages must be clear and easily understandable. The use of messages prerecorded by professionals or airport public relations staff is recommended.

### Implementation Costs

For most installations, equipment that counts vehicles entering and exiting a facility is a standard component included in the design and construction cost of the parking facility. Additional costs would include those for equipment used to record and play the messages and, for HAR, installation of a transmitter.

### Ongoing O&M Costs

O&M costs for equipment used to count vehicles entering and exiting parking facilities are typically bundled with O&M costs for the entire parking garage. Additional costs include staff time to update the recorded message and, for HAR, costs to maintain and operate the transmitter.

### Implementation Schedule

It is likely that the implementation schedule will be dependent on the time required to arrange for a phone line and acquire a license for a HAR transmitter.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D.

### Examples of Application

Occupancy of public parking facilities is monitored at most U.S. airports. Many airports have implemented a telephone line and HAR station that provide real-time occupancy information.

## D.3 Space Availability by Facility

### Purpose

Improve customer service by advising parking customers of the number of spaces available in various parking facilities. Reduce vehicle miles traveled by customers who would, if uninformed, travel to facilities that are fully occupied.

### Use by Customers

As customers enter the airport or approach individual parking facilities, a display indicates whether parking spaces are available in particular parking facilities. These displays can provide specific numbers of available spaces or just indicate whether they are full or open.

### Benefits

Benefits reported by airport operators include

- Improved customer experience because customers are provided information that will assist them in avoiding parking facilities having few or no empty spaces.
- Reduced vehicle miles traveled by customers and related vehicle emissions since customers are less likely to have to circulate among parking facilities to locate available spaces.
- Additional data since the technologies used to collect space-availability information also generate detailed data on customer use of individual parking facilities, which can be used to analyze trends in space occupancy and to support planning and financial decisions.
- Provision of information that can be incorporated into an airportwide intelligent transportation system.

### Implementation Actions

Systems providing space availability information for individual parking facilities are standard at airports, especially at those airports with multiple parking facilities. Space information is typically determined using differential counts derived from magnetic loop detectors embedded in the pavement at the

entries and exits of each parking facility, but can also be gathered using other sensor technologies, providing space availability by level, sector, or space (see Sections D.4, D.5, and D.6).

Implementation actions for external displays of parking space availability include

1. Identify locations on entry roads where displays are to be installed, considering sight distances, nearby distractions, and time/distance available to customers to react to the message.
2. Identify preferred method for transmitting space availability information to displays (e.g., real-time updates based on entry/exit counts, manual updates based on parking operations staff observations). This action is easiest to implement during the design of parking facilities.
3. Determine information to be displayed on the sign(s). This information can range from “full/open” to actual space counts. Determine if, in addition to the name of each parking facility, information such as parking rates is to be displayed.
4. Select display technology, considering the advantages and disadvantages of each for the specific application proposed. An increasing number of airport operators are choosing to install light-emitting diode (LED) displays. The benefits of LED over other lighting methods include efficiency (more light per watt), gradual dimming as opposed to burnout, long useful life (i.e., 50,000 hours or more), and the ability to be frequently turned on and off without affecting useful life. The experience of local highway and public works departments with dynamic signage also can be helpful.

## Key Considerations

Those identified by airport operators include

1. Displays indicating parking availability should be located so as to allow patrons adequate time to choose between available parking options. Display locations should also account for other potential visual “clutter” that could make it difficult for patrons to locate and discern parking availability information.
2. Care should be taken when selecting displays to assure that they are clearly visible during both daytime (with and without bright sunlight) and nighttime.

## Implementation Costs

For most installations, equipment that counts vehicles entering and exiting a facility is a standard component and is included in the design and construction cost of the parking facility. Additional costs may include those for the external signs indicating parking availability at the airport’s various parking

facilities and the communication link and software controlling the signs. See Appendix A for examples of signage costs.

## Ongoing O&M Costs

O&M costs for equipment used to count vehicles entering and exiting parking facilities are typically bundled with O&M costs for the entire parking facility. O&M costs for external displays are typically limited to those for the electrical power used for variable message displays and the type of signs, as well as occasional light bulb replacement.

## Implementation Schedule

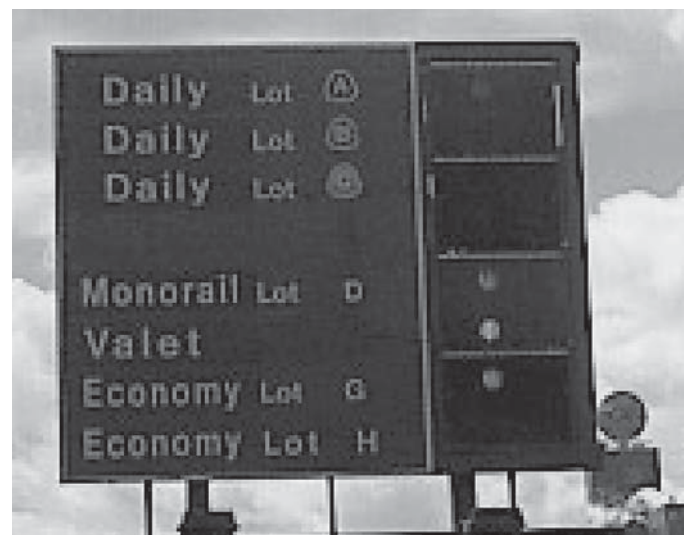
This strategy is typically implemented as part of garage construction. Thus, the schedule is driven by the planning, design, and construction of a garage as a whole. Typically, design and construction of new signs require 2 to 4 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D.

## Examples of Application

Occupancy of public parking facilities is monitored at most U.S. airports, and most have displays informing patrons of the parking facilities that have available spaces (see Figures D.3a through D.3c). Airports with displays on the major entry road



Source: Jacobs Consultancy.

**Figure D.3a.** Example of parking facility availability indicator.



Source: Jacobs Consultancy.

**Figure D.3b.** Garage availability at Minneapolis-St. Paul International Airport.



Source: Jacobs Consultancy.

**Figure D.3c.** Parking facility availability indicator at Baltimore/Washington International Thurgood Marshall Airport.

indicating parking availability by facility include those serving Baltimore, Boston, Denver, and Sacramento.

## D.4 Space Availability by Parking Level

### Purpose

Improve customer service by guiding parking patrons to the levels within a multilevel parking facility that have

available spaces, and reduce the amount of time required to find parking. Reduce vehicle emissions by reducing the amount of time required to find parking within a parking structure.

### Use by Customers

As customers enter a parking structure, a variable display indicates the number of spaces available on each level. At the entrance to each level, a variable display indicates the availability of spaces on that level. These displays can provide specific numbers of available spaces or just indicate whether spaces are available.

### Benefits

Benefits reported by airport operators include

- Improved customer level-of-service as a result of the reduced time required to locate an available parking space.
- Reduced vehicle miles traveled and reduced vehicle emissions created by customers looking for available parking spaces, as they are able to bypass full floors.
- Data generated on use of levels within parking facilities can be used to analyze trends in space occupancy and to support planning and financial decisions.

### Implementation Actions

Systems providing information on the availability of parking spaces on individual parking garage levels are common at airports. Information for these systems is typically gathered using induction loop detectors embedded in the pavement at each entry and exit point on a parking level. Typically, these systems are installed during parking garage construction. It is important to determine the preferred sensor technology so that it can be incorporated into the garage design prior to construction.

### Key Considerations

Those identified by airport operators, assuming that the displays are installed in an existing structure rather than as part of the original construction, include

1. The installation plan should minimize disruption to ongoing parking operations.
2. Care should be taken when selecting displays, especially those located near the entry to the structure or a level, to assure that they are clearly visible during a motorist's transition from daylight to the dimmer interior of the garage.



3. Displays should be placed so as to assure that they are clearly visible to entering motorists, but out of the way of pedestrian traffic.
4. Displays should be placed so as to assure that motorists see the information at low speeds (i.e., as they pass through the entry plaza) and prior to vertical circulation elements of the garage.
5. The placement of loop detectors requires care to assure that reinforcing steel of the garage structure does not interfere with loop detector operation and that the loop does not detect unintended vehicles (i.e., vehicles traveling in adjacent lanes).
6. Differential counting systems require manual adjustments, typically on a daily basis, to reconcile the counts to the overnight vehicle inventory.
7. Display technology should be selected considering the advantages and disadvantages of each for the specific applications proposed. An increasing number of airport operators is choosing to install LED displays. The benefits of LED over other lighting methods include efficiency (more light per watt), gradual dimming as opposed to burnout, long useful life (i.e., 50,000 hours or more), and the ability to be frequently turned on and off without affecting useful life. The experience of local highway and public works departments with dynamic signage can also be helpful.

## Implementation Costs

Costs vary depending on (1) whether the system is installed as part of construction of a new garage or installed in an existing garage and (2) the technology used. Installation of vehicle detectors and induction loops typically cost \$900 to \$1,100 per loop, but that cost does not include the costs to connect the loops to a central computer or the costs of the computer and the displays. Costs of these other elements are provided in Appendix A.

## Ongoing O&M Costs

O&M costs related to this strategy are typically bundled with O&M costs for the entire parking garage. Thus, incremental costs for the by-level counting system are unavailable.

## Implementation Schedule

When installed as part of new garage construction, the implementation schedule is driven by the overall planning, design, and construction for the new garage. When installed in an existing parking structure, the implementation schedule is driven by the number of levels and entry points, but can require less than 3 months.



Source: Jacobs Consultancy.

**Figure D.4a.** By-floor space availability indicators at Baltimore/Washington International Thurgood Marshall Airport.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D.

## Examples of Application

Most U.S. airports have by-level counting systems that inform customers of space availability (see Figures D.4a and D.4b).



Source: Jacobs Consultancy.

**Figure D.4b.** Parking availability signs at Brussels Airport.



## D.5 Space Availability by Aisle/Sector

### Purpose

Improve customer service by guiding parking patrons to areas within a parking facility with available parking spaces and reducing the amount of time required to find an available space. Reduce vehicle emissions by reducing the amount of time required to find a parking space.

### Use by Customers

As customers enter a garage, a variable display indicates the number of spaces available on each level. At the entrance to each level, a variable display indicates the availability of spaces in each direction. At the beginning or end of each aisle (or sector), a variable display indicates the availability of spaces in the aisle (or sector). For displays at the entrances to levels and individual aisles/sectors, the displays can provide specific numbers of available spaces or just a green or red signal indicating whether spaces are available.

If desired, additional sensors can be installed at the ends of aisles so that, as a vehicle enters an aisle, the available space tally is reduced in anticipation of the vehicle parking in one of the available spaces.

### Benefits

Benefits reported by airport operators include

- Improved customer level-of-service resulting from the reduced time required to locate an available parking space.
- Reduced vehicle miles traveled, and associated vehicle emissions created by patrons looking for available parking spaces, as they are able to bypass full aisles/sectors.
- Data generated on use of areas within parking facilities, which could be used to identify areas for specialized parking.
- Lower installation cost than by-space availability systems (see Section D.6).
- Ability to track parking occupancy in surface parking facilities and on parking garage roofs.

### Implementation Actions

1. Prepare cost-benefit analysis to determine justification of the investment in a by-sector guidance system.
2. Prepare functional plans and specifications identifying locations and characteristics of key components (i.e., detector technology, locations, and display signs inside and outside of facility).

3. Prepare designs and select vendor and contractor for installation.
4. Assure that detectors/indicators function properly and reliably, and are well maintained.

### Key Considerations

Those identified by airport operators include

1. Signage placement. Signs indicating available spaces in an aisle or sector are typically hung from the ceiling, which, depending on the garage structural system and dimensions, could result in motorists having difficulty locating and reading the signs.
2. Display technology should be selected considering the advantages and disadvantages of each for the specific application proposed. An increasing number of airport operators are choosing to install LED displays. The benefits of LED over other lighting methods include efficiency (more light per watt), gradual dimming as opposed to burnout, long useful life (i.e., 50,000 hours or more), and the ability to be turned on and off frequently without affecting useful life. The experience of local highway and public works departments with dynamic signage also can be helpful.
3. If installing the system in an existing parking facility, the installation plan should minimize disruption to ongoing parking operations.
4. Positions of the detector locations should be determined so as to minimize the number required. Minimizing the number of detectors not only reduces cost, it also reduces the number of opportunities for counting errors because each detector would have a limited probability of an inaccurate reading for each vehicle.
5. Differential counting systems require manual adjustments, typically on a daily basis, to reconcile the aisle/sector counts to the overnight vehicle count.
6. If employee parking is provided in the facility, the system will need to account for surges of traffic during shift changes. Also, employees may drive at higher speeds through the parking facility, which may affect the ability of the sensors to accurately count vehicles.
7. To date, the use of induction loop detectors linked to differential counters is the technology most commonly used to monitor the number of available spaces in an aisle/sector. One airport operator uses machine-vision rather than loop detectors for its by-sector space availability system. With this system, cameras located throughout the parking facility feed video images of the cars passing through their field of vision to software that analyzes these images and determines the number of occupied spaces.

## Implementation Costs

By-sector guidance system costs typically include the cost of detectors, small variable message displays for aisles and zones, larger displays for floors or for outside the parking structure, conduit for data transmission to the central computer processor, and computing equipment to process the input from the detectors and provide appropriate instructions for the guide signs.

Costs vary depending on (1) whether the system is installed as part of construction of a new garage or in an existing garage and (2) the technology used. One airport operator that installed a machine-vision system in an existing garage reported a cost per space of approximately \$400. See Appendix A for further information.

## Ongoing O&M Costs

O&M costs predominantly consist of costs to maintain the detection equipment and display signs. Additional information is provided in Appendix A.

## Implementation Schedule

Implementation (including actions required to obtain management approval, preparing design and specifications, and installation/testing) can require up to 4 years depending on the time required to obtain approval. An actual installation required approximately 6 months for 2,700 parking spaces.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D.

## Examples of Application

Airports with by-sector guidance include those serving Dallas/Fort Worth (Terminal D Garage), Houston (Bush Intercontinental, Garage A/B), Raleigh-Durham, and Seattle-Tacoma.

## D.6 Space Availability by Space

### Purpose

Improve customer service by guiding parking patrons to individual parking spaces and reducing the amount of time required to search for an available space. Reduce vehicle emissions by reducing the amount of time required to find an

empty space. Increase effective capacity of a parking facility by making it easier for customers to locate the last available spaces in busy facilities or in long aisles.

## Use by Customers

Customers entering a garage see a variable display indicating the number of spaces available on each level. At the entrance to each level, a variable display indicates the availability of spaces in each direction. At the end of each aisle, a variable display indicates the availability of spaces in that aisle. In addition, above each space, in a location visible from the end of the aisle, a ceiling-mounted empty/full indicator signals whether a space is occupied (typically red) or available (typically green—or blue for spaces required by the Americans with Disabilities Act). The displays at the entrances to levels and individual aisles can provide specific numbers of available spaces or just an empty or full signal indicating whether spaces are available. The information from the individual space detectors updates the space availability information displayed at the entry to the garage, levels, and aisles.

## Benefits

Benefits reported by airport operators include

- Very favorable customer reactions, as evidenced by (1) surveys that indicated a decrease in the perception of the time it takes to find an available parking space, and (2) customer responses during focus groups.
- Improved customer perception of the parking facility as an enjoyable parking option.
- Reduced customer time required to locate an available parking space.
- Reduced vehicle miles traveled, and associated vehicle emissions, by customers looking for available parking spaces.
- Increased allowable occupancies before a level is closed. Prior to installation of the system, a level would be declared “full” if occupancy exceeded 90%. With the space detectors, the level is declared “full” when occupancy approaches 100%.
- Lower construction costs to accommodate projected parking demand. In recognition of the difficulty customers have finding the last empty space in a large parking facility, parking structure designers typically include a 10% “circulation” allowance when sizing new facilities. If a facility will have a by-space guidance system, the designers can reduce the circulation allowance to 5% or less.
- Increased revenues resulting from the ability to achieve higher allowable occupancies, which can potentially provide financial justification for installation of an individual space guidance system. For example, with a 1,000-space

garage, a by-space guidance system can increase occupancy by 5% or more, effectively adding at least 50 spaces to the capacity of the garage. Constructing these same 50 spaces would, at \$20,000 per space, cost \$1 million. A by-space guidance system costing \$1,000 per space (for a total installation cost of \$1 million) could achieve the same capacity increase as construction and at the same cost, while providing the other benefits described in this section.

- Increased number of parking spaces per floor. With a by-space guidance system, a parking garage can have dead-end aisles, thereby reducing the need for continuous circulation capability.
- Detailed data on the use of areas and levels within parking facilities, which can be used to analyze trends in space occupancy and to support planning and financial decisions.

### Implementation Actions

1. Prepare analysis to support the investment in a by-space guidance system, considering improved customer service and improved space occupancy.
2. In cooperation with information technology (IT) and parking operations staff, prepare functional plans and specifications identifying requirements for compatibility with existing IT systems (such as the parking revenue control system), and locations and characteristics of key components (i.e., individual detectors/indicators, display signs inside and outside the facility, additional sensors).
3. Prepare designs and select contractor for installation.
4. Install detectors with minimal disruption to existing parking operations (i.e., close only a portion of an existing facility at one time during a retrofit).
5. Assure that detectors/indicators function properly and reliably, and are well maintained.

### Key Considerations

Those identified by airport operators include

1. If installing the system in an existing parking facility, develop an installation plan that minimizes disruption to ongoing parking operations.
2. Installing the system in an existing garage may initially be less effective than a new garage installation. Repeat garage patrons who have established their search and use patterns may continue to follow their patterns rather than follow the direction of the by-space guidance system.
3. Vendor involvement and support during the design process is critical.
4. Early on in the planning and design process, determine how to link the by-space guidance system with the parking revenue control system.

5. When configuring conduits and selecting equipment, consider the possibility of condensation and how moisture may accumulate.
6. When evaluating costs, consider the number of dynamic signs required, as these significantly increase the per-space costs.
7. Systems providing availability information by individual spaces are typically part of larger systems that provide space availability by individual parking facilities (see Section D.3), levels within a parking structure (see Section D.4), or aisles/sectors within a parking facility (see Section D.5).
8. By-space availability systems have predominantly been installed in parking garages so that the individual indicators/detectors required of the system can be mounted above each parking space and the full/empty signals above each space are visible from a distance.
9. To date, most by-space availability systems use ultrasonic detectors to determine if an individual space is occupied. Other possible technologies include infrared, inductive loops, and machine vision, but because of the costs and accuracy of these technologies, they are predominantly used to count moving vehicles or detect the presence of a vehicle stopped for a short period of time (such as at an entry or exit gate arm).

### Implementation Costs

By-space guidance system costs typically consist of costs for individual space monitors, small displays for aisles and zones, larger displays for levels or for the parking structure entrance, conduit for data transmission connecting the individual detectors, and computing equipment to process the input from the detectors and provide appropriate outputs to the guide signs.

Costs vary depending on whether the system is installed as part of the construction of a new garage or installed in an existing garage. One airport operator that installed the system in an existing garage reported a cost-per-space of approximately \$1,100. Of this cost, approximately \$700 was for the ceiling-mounted sensors and the remainder was predominantly for the dynamic displays. Another operator reported a per-space installation cost of approximately \$400.

### Ongoing O&M Costs

O&M costs are very low and predominantly consist of occasional bulb replacements and testing to confirm that sensors are operational. One airport operator reported an unanticipated increase in O&M costs because sensors that had been damaged by condensation needed to be replaced.

## Implementation Schedule

Implementation (including the actions required to obtain management approval, preparing design and specifications, and installation/testing) can require up to 4 years, depending on the time required to obtain approval. An actual installation required approximately 6 months for 2,700 parking spaces.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All value-added parking products in Category C and
- All other parking space availability and guidance systems in Category D.



Source: Jacobs Consultancy.

**Figure D.6a.** By-floor space counter linked to by-space detector system at Baltimore/Washington International Airport.



Source: Port of Portland.

**Figure D.6c.** Individual space indicator at Portland International Airport.



Source: Jacobs Consultancy.

**Figure D.6d.** Individual space indicators at Baltimore/Washington International Airport.



Source: Port of Portland.

**Figure D.6b.** Space availability displays at Portland International Airport.

## Examples of Application

Airports with by-space guidance include those serving Baltimore, Jacksonville, and Portland (OR), as well as many parking structures throughout Europe. See Figures D.6a through D.6d.

## D.7 Managed Fills

### Purpose

Improve customer service by assisting parking customers in finding available parking spaces within large surface parking lots and reducing patron waiting time for shuttle buses.



## Use by Customers

As customers enter the parking lot, parking operations staff or dynamic signs located at the entrance direct them to a defined area within the parking lot where spaces are available. Once parked, patrons board a shuttle bus, which is waiting at a stop within the defined area. The shuttle bus then travels directly to the terminal building (the shuttle may operate on demand or may operate on a schedule). When customers return from their trips, a shuttle bus picks them up at the terminal and proceeds to the parking lot. Within the lot, the shuttle bus may follow a predefined route (stopping only at stops requested by customers onboard) or may stop at each onboard patron's vehicle.

## Benefits

Benefits reported by airport operators include

- Improved customer service because customers are directed to available parking spaces.
- Reduced shuttle bus travel time from the lot to the terminal because the bus operates nonstop en route to the terminal (shuttle buses may still need to travel the complete route when transporting customers back to their vehicles).
- Improved parking staff image as a result of the potential for one-on-one contact between customers and parking operations staff, which reduces confusion about the service.
- Reduced vehicle miles traveled, and associated vehicle emissions from customers circulating through the parking lot looking for an available space.
- Increased occupancy levels in parking facilities because parking operations staff can completely fill a portion of the parking facility.

## Implementation Actions

1. Determine which facilities, if any, would realize customer service and operational benefits from a managed-fill operation.
2. Identify likely staffing and equipment needs to implement the service.
3. Analyze the potential benefits of the service and the capital and incremental operating costs that would be incurred.
4. Develop busing schedule and plan, and methods for communicating between bus drivers/dispatcher and attendants directing incoming motorists to the defined areas.

## Key Considerations

Those identified by airport operators include

1. Operating costs. Operating the shuttle buses and providing additional staff to direct patrons costs more than traditional self-park operations.

2. Development costs. Implementing the system in an existing lot may require relocation of shuttle bus stops and, if the shuttle bus route or equipment is modified, upgrade of the bus lane pavement.
3. During periods when the facility is very full, it may be difficult to identify an area within the parking facility that has a high concentration of available parking spaces.
4. It may be easier to introduce this service at airports where a parking management agreement is in place than at airports where the parking is self-operated or where parking concession agreements are in place. Parking management agreements typically allow the introduction of new products and services, and it is relatively easy for a parking management company to add staff to meet the needs of the service.

Airport operators that operate their own parking facilities may be reluctant to add staff to meet the needs of the service if it would be difficult to later reduce staff if the service is eliminated.

At airports where parking concession agreements are in place, the parking operator may be unwilling to implement the service without a reconsideration of the concession fee, since the parking operator would incur additional expense with no guarantee of additional revenue.

5. If variable message signs are used, the parking operator should be aware of the potential for low-visibility conditions, such as fog.

## Implementation Costs

Implementation costs will vary depending on the facility used for the service and the extent of improvements required to accommodate the service. One operator reported that it would cost approximately \$300,000 for pavement improvements to an 8,000-space surface lot to accommodate the service.

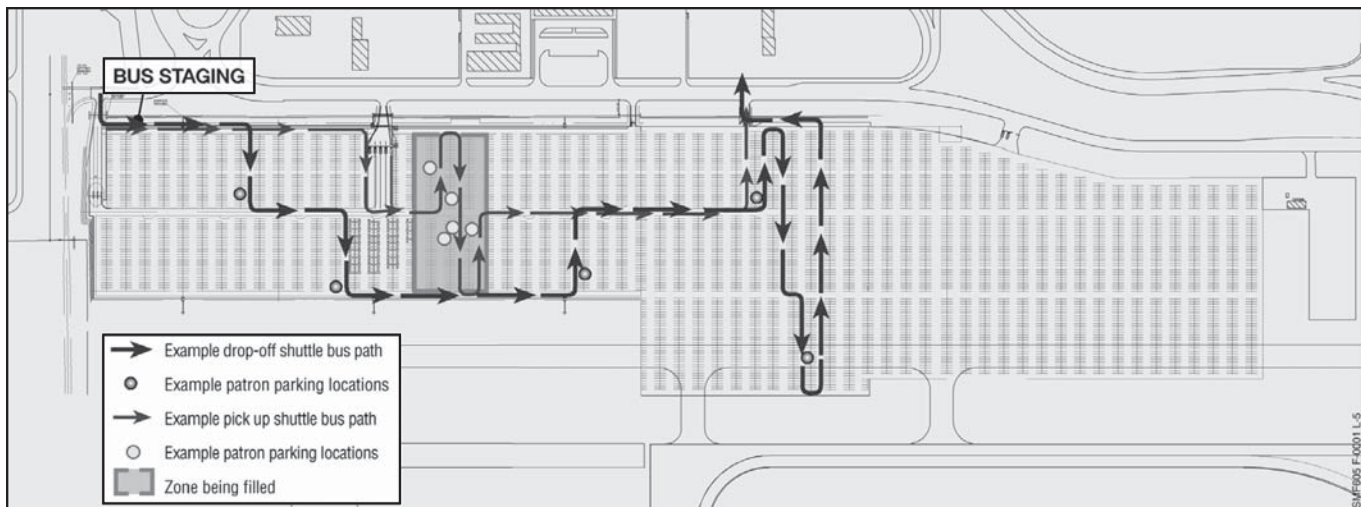
## Ongoing O&M Costs

Incremental O&M costs associated with the service primarily consist of additional shuttle bus operating costs and the costs of staff required to direct customers to available spaces. One operator estimated that the service would incur additional annual operating costs of approximately \$600,000 (\$350,000 for shuttle buses and \$250,000 for staff).

## Implementation Schedule

From the time the actions required to obtain management approval are initiated to opening day of the program, it can take approximately 1 year, but the schedule is highly variable depending on the time required to receive approval and the extent of parking lot improvements that may be required to accommodate the service.





Source: Sacramento International Airport.

**Figure D.7.** Paths of shuttle buses picking up and dropping off customers in a managed-fill operation.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D,
- Marketing (F.8), and
- Parking Facility Operation Options (H.1).

## Examples of Application

This strategy has been implemented at the airports serving Atlanta, Fort Myers, and Sacramento (see Figure D.7).

## D.8 Parking Compartments

### Purpose

Improve customer service by making it easier and quicker for customers to find empty parking spaces, thereby reducing vehicle emissions/vehicle miles traveled. Improve parking facility operations and occupancy by continuously monitoring space occupancies by sector.

### Use by Customers

Lights or signals located at the entry to each parking compartment enable customers to easily find empty spaces. With this strategy, a parking structure or lot is divided into a series of parking compartments, each containing about 75 to 100 spaces. Each compartment is surrounded by walls or barriers that prevent vehicles from moving between adjacent compartments. Each compartment has one gate-controlled entry and one gate-controlled exit, which allow the number of

occupied spaces in each compartment to be accurately monitored. Signals located at the entry indicate whether or not there are empty spaces in the compartment.

At Frankfurt Airport, motorists enter a parking facility and drive along a one-way road that passes the entrance to each compartment on a level, and exit onto another one-way road. Red/green traffic control signals, which are located on islands opposite the entry to each compartment, indicate if a compartment contains empty spaces.

Customers wishing to enter a compartment insert their tickets into a ticket reader located on the same island as the signals, opposite the entry gate. If there are empty spaces in the compartment, the ticket reader will raise the barrier gate and allow vehicles to enter. If the compartment is full, the ticket will not be accepted and access will be denied. The ticket reader stamps the compartment number and time on the accepted ticket. This information allows staff to help customers locate their vehicles. Upon exiting the parking compartment, the customer again inserts the ticket into a reader to activate the exit gate.

### Benefits

Benefits reported by airport operators include

- Reduced customer time required to locate an available parking space.
- Reduced vehicle miles traveled, and associated vehicle emissions, as a result of the reduced time spent and distance traveled by motorists searching for empty parking spaces.
- Reduced cost to install when compared to systems requiring installation of single-space detectors and many dynamic

signs—especially in parking facilities with many parking bays. The primary components—signal heads, ticket readers, gate arms, and loop detectors—are readily available and competitively priced.

- Unlike overhead-mounted individual space detectors, can be implemented in surface lots.
- Level of customer service and information is comparable to individual space detector systems.
- Increased revenues resulting from higher occupancies.
- Potential increase in the number of parking spaces per level. With parking compartments, a parking garage can have dead-end aisles as there is a reduced need for continuous circulation. Airport planners typically size parking facilities that don't include parking compartments to include a 10% allowance for circulation. If they assume a facility will have parking compartments, planners may reduce the circulation allowance to 5% or less.
- Ability to obtain real-time data on compartment-by-compartment use/occupancies.

### Implementation Actions

1. Implementation of parking compartments begins with facility planning and design. Although it is possible to retrofit a structure or lot to provide parking compartments, the decision is best made during initial planning and design to provide for the necessary one-way flows, island/signal locations, and numerous ticket readers/gate arms.
2. Other implementation actions are identical to those associated with the design, acquisition, and testing of standard ticket readers, gate arm mechanisms, loop detectors, signal heads, and supporting differential space counters. No specialized equipment or advanced technology is required.
3. Develop a marketing program advising customers of the purpose and use of the signals and parking compartments.
4. Assure that all components are functioning properly and are well maintained.

### Key Considerations

Those identified by airport operators include

1. Parking compartments are best suited for a parking facility with numerous parking bays. Frankfurt Airport has a long, narrow structure with the bays oriented along the narrow dimension, resulting in many parking bays on each level of the parking structure, each separated by walls. Parking compartments are not well suited for large structures with open floor plates and flexible circulation patterns.
2. Unlike a system using individual space detectors, the design of this system requires little vendor involvement. In fact, at Frankfurt Airport, the system uses gate arms and ticket reader equipment from multiple vendors or manufacturers.

### Implementation Costs

The costs of parking compartments include the control equipment—the ticket readers/gate arms and loop detectors at the entry and exits, the signal heads, and the walls or barriers. The costs of control equipment are presented in Appendix A. The costs of the walls or barriers depend on the type of structure and whether they were added to an existing structure or lot or were part of the original design.

### Ongoing O&M Costs

Overall reported O&M costs are low but compared to traditional parking facilities, many more ticket readers/gate arms are required in order to control each parking compartment. Thus, the equipment maintenance costs are higher than those for a traditional parking facility.

### Implementation Schedule

The implementation (including the actions required to obtain management approval, preparing design and specifications, and installation/testing) schedule is unknown. If an existing parking structure can be reconfigured, the time is expected to be much less than convincing management to configure a structure to allow for parking compartments.

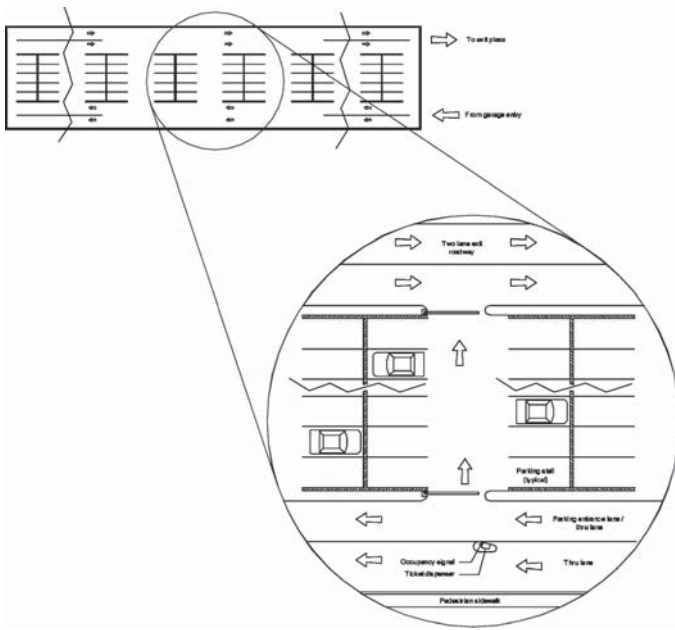
### Supporting and Complementary Strategies and Technologies in This Guidebook

- All Duration-Based Parking Products in Category A,
- Web-Based Reservations (F.3), and
- Yield Management (F.4).



Source: Jacobs Consultancy.

**Figure D.8a.** Entry to parking compartment at Frankfurt Airport.



Source: Jacobs Consultancy.

**Figure D.8b.** Typical parking compartment configuration at Frankfurt Airport.

Note that parking compartments are not compatible with the systems discussed in Section E.2, Credit Card In/Out.

## Examples of Application

Frankfurt Airport (see Figures D.8a and D.8b) was the only airport identified as having parking compartments.

## D.9 Space Locators

### Purpose

Improve customer service by helping customers remember where they parked their cars. To a lesser extent, reduce staff time and costs spent helping customers locate their vehicles.

### Use by Customers

Using one of several technologies, customers are provided with information to help them remember where they parked their vehicles. These technologies or methods are

- **Paper Space Locators.** Customers can take free space locators or reminders from dispensers located along major pathways. These space locators are ticket-sized paper slips showing the level/zone where the vehicle is parked and that contain advertising messages on the reverse side.

- **Modified Time/Date Stamps.** Customers can insert their tickets into machines that print their levels/zones on the tickets. These printers, which are modified time/date stamps (similar to time clocks), can be located near elevators or major pedestrian pathways.
- **Automated Space Locators.** Customers who have parked overnight can locate their vehicles by inserting their tickets into readers located near major pedestrian pathways. Vehicle locations are automatically determined by using vehicle license plate numbers (encoded into the ticket or provided by the customer) and the overnight license plate inventory.

## Benefits

Potential benefits are reported to include

- Helps remind customers where they parked their vehicles.
- Creates good will among customers through improved customer perception of the airport.
- Increases revenue if paper space reminders are the responsibility of a concessionaire.
- Reduces number of customers asking for staff assistance to locate their vehicles. However, no before-and-after data are available indicating the change in staff time and effort, if any.

## Implementation Actions

Implementation actions differ according to the technology.

**Paper Space Locators.** At some airports (e.g., San Francisco International), a concessionaire has agreed, at no charge to the airport operator, to print space locators and assure that an adequate supply of reminders is available. In return, the concessionaire retains all revenue derived from the sale of advertising printed on the reverse side of the space reminders. Accordingly, the implementation actions are

1. Issue a Request for Information to determine if a local advertising company or other businesses are interested in a potential space locator concession.
2. Issue bid invitations if there appears to be sufficient interest, or award a sole-source concession.
3. Award and monitor contract.

**Modified Time/Date Stamps.** If a suitable location is available for installation of the equipment (e.g., at or near the elevator cores), this equipment can be installed by airport staff or an outside vendor. These machines are standard time/date stamps modified to print the level number/zone indicator. Accordingly, implementation actions are

1. Determine if a suitable enclosure exists at or near the elevator cores or other locations that offer weather protection.

2. Order/purchase equipment from vendors. At Miami International Airport, the equipment used was modified Simplex 100 time/date stamps.
3. Determine who will maintain the time/date stamps (repair the machines, change ribbons, etc.). At Miami International, janitorial staff change the ribbons and Simplex repairs the equipment when needed.

**Automated Space Locators.** This system requires that (1) the customers have parked overnight and taken their tickets with them (or know their license plate numbers), (2) a license plate recognition system is used to encode license plate numbers on tickets, and (3) an overnight license plate inventory is conducted daily. The automated space locator uses the overnight license plate inventory file to find where the vehicle is parked.

This application is best suited for parking operations where customers are encouraged to take their tickets with them after they park (e.g., pay-on-foot revenue control systems). At Boston's Logan International Airport, an automated space locator was installed as part of a new pay-on-foot system.

This technology could be installed as an addition to an existing revenue control system. In this instance, the implementation actions are identical to those required to expand or add hardware or software components to an existing system—confirm that the new components are compatible with the existing system, and test the operation before going “live” to assure that there are no unexpected effects.

## Key Considerations

Those identified by airport operators include

1. Install space locators, regardless of the technology, in visible locations where customers, on their way to the terminal, will see them while waiting for an elevator or passing the entrance to a walkway, bridge, or tunnel.
2. Install space locators in climate-controlled locations. Time/date stamps and time clocks may prove unreliable if located in areas subjected to freezing temperatures or high humidity. Ticket readers also require enclosures that protect the components from the environment.

## Implementation Costs

The costs of implementing a paper space locator are borne by the concessionaire. The costs of purchasing and modifying a time/date stamp are about \$650 each. The cost of ticket readers is presented in Appendix A. Additional costs may be required to enable the ticket reader to communicate with the license plate inventory database, depending on the equipment manufacturer.

## Ongoing O&M Costs

At San Francisco International Airport, the concessionaire provides the space locators and dispensers. The airport parking management contractor is responsible for placing space locators in the correct dispensers and assuring that the dispensers are full. The ongoing costs for maintaining the time/date stamps at Miami International Airport were reported to be about \$100 per unit when repairs were required. It was noted that the vendor would not enter into a maintenance contract with the airport operator because the time/date stamps are exposed to inclement weather. The O&M costs for automated space locators are generally considered part of the total parking revenue control system O&M costs. A separate breakdown of the costs of this equipment was not available.

## Implementation Schedule

It is estimated that the total time to implement (including obtaining management approval) may be 6 months or less for the paper space locators and time/date stamps. The schedule for implementing an automated space locator is the same as that for the purchase of a pay-on-foot system. The schedule for a stand-alone installation would depend on the type and manufacturer of parking revenue control equipment already in place.

## Supporting and Complementary Strategies and Technologies in This Guidebook

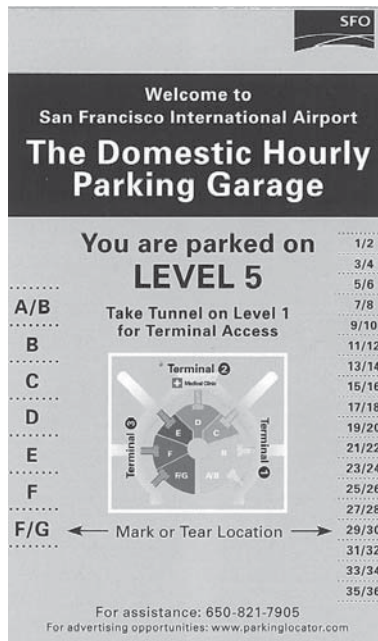
- Pay-on-Foot Systems (E.1),
- License Plate Recognition (E.6),



Source: Jacobs Consultancy.

**Figure D.9a.** Floor reminder dispenser at San Francisco International Airport.





Source: San Francisco International Airport.

**Figure D.9b.** Floor reminder card from San Francisco International Airport.

- Branding (F.7), and
- Automated Overnight License Plate Inventory (H.3).

## Examples of Application

Paper space locators are used at San Francisco International Airport, time clocks that stamp tickets are used at



Source: Jacobs Consultancy.

**Figure D.9c.** Floor reminder stamp from Miami International Airport.

Miami International Airport, and ticket readers linked to the license plate inventory are used at Boston's Logan International Airport. See Figures D.9a through D.9c.

## D.10 In-Vehicle Parking Technologies

### Purpose

Improve customer service through improved wayfinding by integrating emerging technologies with airport information systems.

### Use by Customers

The three emerging technologies most relevant to this strategy are (1) in-car global positioning system (GPS) installed by the manufacturer, (2) GPS installed by an after-market third party, and (3) GPS-enabled cell phones.

### Benefits

Benefits could potentially include

- Reduced chance of a poor customer experience because customers gain information that assists them in avoiding full parking facilities.
- Reduced vehicle miles traveled and associated tailpipe emissions because patrons are less likely to have to travel between parking facilities to locate available spaces.
- Increased collected data on use of individual parking facilities. This information could be used to determine parking rate decisions or establish specialized parking products.
- Improved communications with motorists on the airport roadway network, which could lead to marketing opportunities.

### Implementation Actions

In-vehicle parking technologies have not yet been implemented; however, actions would likely include

1. Determine what information to share through in-vehicle technologies.
2. Determine level of participation, if any, from communications companies.
3. Determine level of participation, if any, from parking revenue control vendor.
4. Contract with communications consultant to make necessary modifications to existing equipment/software and add new equipment/software as needed.



## Key Considerations

Those identified by airport operators include

1. The GPS navigation technology supporting this strategy is becoming more popular, for both manufacturer-installed systems and after-market systems.
2. Determine whether the parking revenue control system or other airport information system has the technical capabilities to communicate to outside data receivers.
3. Determine benefit-cost of improved customer service versus implementation and O&M costs.

## Implementation Costs

As a future technology, implementation costs are unknown at this time. Costs for equipment to collect the availability information would be similar to those for other parking space availability systems (see Section D.6).

## Ongoing O&M Costs

Since this strategy relies on a future technology, O&M costs are unknown at this time. Ongoing O&M costs for equip-

ment to collect the availability information would be similar to those for other parking space availability systems (see Section D.6).

## Implementation Schedule

Implementation time would vary depending on the readiness of the technology and the other considerations noted in this section.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All other parking space availability and guidance systems in Category D and
- IntelliDrive (E.4).

## Examples of Application

No airport has yet integrated information systems with in-vehicle parking technologies.

## CATEGORY E:

# Cashierless Transactions

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# Cashierless Transactions

## E.1 Pay-On-Foot Systems

### Purpose

Improve customer service by reducing exit plaza delays. Reduce operating costs by reducing the number of required exit lanes and reliance on exit cashiers. Increase revenue security by reducing the number of opportunities for employees to handle cash.

### Use by Customers

Customers pay their parking fees at unattended pay stations, and receive an exit pass, which they insert into a reader at the exit plaza. Pay-on-foot (POF) stations typically accept cash and credit cards (some may accept only credit cards) and issue customer receipts and, if cash is used, change. Customers must keep their parking tickets with them so that they are able to pay at the pay stations before returning to their vehicles. A key aspect of successful POF implementation is teaching customers to keep their tickets with them and to use the POF stations to avoid exit delays.

Some airport operators (as well as many urban parking garage operators) supplement the POF system with a single cashier located near the POF stations. These cashiers process transactions for customers unwilling or unable to use the POF stations.

### Benefits

Significant reductions in exit delays, number of required staffed exit lanes, and opportunity for theft or fraud resulting from less staff handling of cash. Specific benefits identified by parking operators include the following:

- Provides faster processing times at facility exits and eliminates exit delays and queues, thereby improving customer service. Processing of exiting vehicles is reduced from a range of 90 to 120 seconds per vehicle to 15 seconds per vehicle. One airport reports 7 seconds per vehicle.
- Reduces/eliminates the need for cashiers, thereby reducing operating costs. Initially, the benefits from reduced labor costs are offset by the additional staff needed to train/assist unfamiliar customers during initial months of operations and an increased number of maintenance technicians needed, in part, because of the more complex equipment dispersed throughout the airport terminal (versus concentrated at an exit plaza), and the need to assure system reliability.
- Reduces staff handling of cash, resulting in less opportunity for fraud or theft.
- At most European airports, all parking transactions are paid at POF stations. At U.S. airports with successful installations of POF stations (see Key Considerations), over 85% of all transactions are paid in this manner, while at less successful installations, fewer than 35% of all transactions are paid in this manner. The proportion of customers using POF stations is directly related to factors identified in Key Considerations, as well as the customer's familiarity with POF (e.g., in Europe, where POF parking has been used for many years, it is often viewed as the standard method to pay at all parking facilities).
- The required exit plaza size is reduced because fewer exit lanes are required as a result of the reduced transaction time required and readers require narrower islands than do cashier booths, resulting in smaller plaza widths.
- Emissions from vehicles at the exit plaza are reduced. One operator reported that, with 80% use of POF stations and the corresponding 49-second reduction in average vehicle processing time at the exit plaza, exiting vehicles generated approximately 2.26 tons carbon monoxide less than if POF was not available.

### Implementation Actions

1. Prepare plans and specifications, select vendor/contractor to install system. Select a user-friendly POF station design. Give particular attention to the face plate to assure that the required sequence of steps (i.e., insert ticket,

insert card or cash, receive exit pass and any change) are easily understood.

2. Consider the use of some credit-card-only stations versus stations that accept both cash and credit card, as the former are less expensive to purchase and maintain.
3. Train staff to assist customers during the transition period and to perform required system maintenance.
4. Prepare marketing and advertising program. Successful utilization follows a well-designed and extensive publicity campaign.
5. Assure that pay stations function properly and reliably and are well maintained.

## Key Considerations

Those identified by airport operators include

1. Assess if the airport configuration is suitable for POF stations. Ideally, there should be a limited number of pedestrian paths between the parking facility and the terminal, and prominent locations should be available for the required POF stations. All locations should have space for redundant POF stations.
2. Some airport operators temporarily maintained staffed counters in the parking facility for customers with exception tickets. Most airport operators either direct these customers to a parking office (often located near the exit plaza) or provide an audio communication between the POF station and remotely located supervisors (with supervisors also having access to video cameras).
3. Develop procedures for lost tickets (e.g., video recording of exiting vehicles, use of license plate readers, use of overnight license plate inventories, or other measures).
4. Implement pre-implementation marketing and advertising program to remind customers that they must keep their tickets with them, and can benefit from using the pay stations rather than waiting in exit queues. Less training is required at airports serving a customer base composed of frequent travelers (e.g., business travelers).
5. Avoid phased-in implementation. Highest customer use occurs when customers are required to use the POF system rather than allowed to have continued access to exit cashiers.
6. Assure participation by airport staff representing parking operations, audit/finance, IT, and engineering throughout the design and vendor selection process.
7. Avoid burdening a system with too many optional features that may complicate day-to-day parking operations. Review the airport's business practices and determine which features are essential, and which are optional.
8. Implement program for assuring system reliability. Customers may be discouraged from using POF stations if they do not function reliably or are out of service.

## Implementation Costs

POF cash and credit card stations cost about \$35,000 to \$50,000 each, while credit-card-only stations cost about \$9,000 to \$13,000 (see Appendix A). These costs exclude ticket dispensers, exit verifiers, and other supporting equipment. Additional cost items include staff training, a marketing program, signage, and potential exit plaza reconfiguration (e.g., removal of booths).

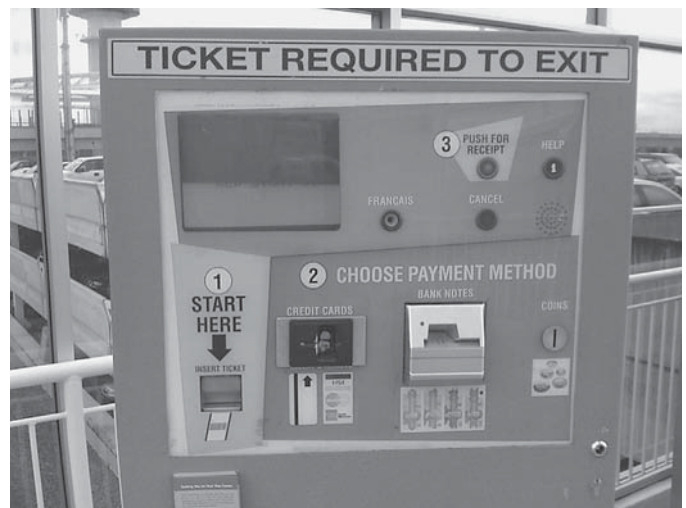
## Ongoing O&M Costs

O&M costs include those for equipment maintenance (whether performed by the vendor or airport staff) and



Source: Jacobs Consultancy.

**Figure E.1a.** Pay-on-foot station located inside passenger terminal at Manchester (U.K.) Airport.



Source: Jacobs Consultancy.

**Figure E.1b.** Pay-on-foot station located at entrance to parking garage at Vancouver International Airport.



Source: Skidata, Inc.

**Figure E.1c.** Cash and credit card (left) and credit card only (right) pay-on-foot systems.

supervisor time to respond to customer questions (see Appendix A).

### Implementation Schedule

Implementation (including obtaining approval from management, preparing design and specifications, and installation/testing) can require 2 to 3 years depending on the time required for management approval.

### Supporting and Complementary Strategies and Technologies in This Guidebook

POF systems are often implemented as part of a revenue control system upgrade or replacement. Complementary strategies and technologies include

- Space Locators (D.9),
- Credit Card In/Out (E.2), and
- License Plate Recognition (E.6).

### Examples of Application

Airports with POF systems include those serving Baltimore, Boston, Indianapolis, Portland, Raleigh-Durham, San Diego, San Francisco, Seattle-Tacoma, Toronto, Vancouver, Washington, DC (Dulles), other U.S. airports, and many airports throughout Europe. See Figures E.1a through E.1c.

## E.2 Credit Card In/Out

### Purpose

Improve customer service by reducing exit plaza delays. Reduce number of required exit lanes and reliance on exit

cashiers. Reduce opportunity for theft or fraud since there is less need for staff to handle cash.

### Use by Customers

Customers entering the parking facilities insert their credit cards into card readers, which read the credit card numbers and open the gates. To exit, customers drive to exit gates and insert the same credit cards into the readers. The revenue control system calculates the fee, charges the customer's credit card account, returns the card to the customer, issues a receipt, and opens the gate. A key aspect of a successful credit card in/out system is teaching customers to remember to use the same credit card to enter and exit the parking facility.

### Benefits

Significant reductions are realized in exit delays, required staffed exit lanes, and the opportunity for theft or fraud resulting from staff handling of cash and potential ticket swapping. Specific benefits identified by airport parking operators include

- Improved customer service as a result of the reduced exit delays and queues due to faster processing times. One airport parking operator reported that before credit card in/out was installed, typical customer wait times in the parking exit plaza queue were approximately 2.5 minutes. After installation of credit card in/out, typical customer wait times in the parking exit plaza were reduced to 30 seconds.
- At airports where credit card in/out was added to an existing pay-on-foot revenue control system, customers may experience a higher level of service because they can bypass payment kiosks and proceed directly to their vehicles. The exit processing time for credit card in/out transactions, although longer than the processing time for pay-on-foot stations, is still only 30 seconds or less.
- Increased parking revenue for operators that charge a higher daily parking rate for customers electing to use cash instead of the credit card in/out system (i.e., those who offer a "discounted" rate to customers who enter and exit using the preferred method of payment—credit cards).
- Rapid customer acceptance of the new technology. Airport operators have reported usage levels exceeding 75% within 2 years of implementation.
- Reduced staff handling of cash, resulting in less opportunity for fraud or theft.
- Reduced opportunity for fraud or theft involving ticket swaps.



- Can be implemented at smaller parking facilities that may not have the capacity to justify the expense of staffed cashiering.
- If desired by the operator, credit card in/out transactions can be implemented as a component of a pay-on-foot parking system or as an option in a cashiered system.
- At U.S. airports with successful installations of credit card in/out (see Key Considerations), over 70% of all transactions are paid in this manner, while at less successful installations, fewer than 50% of transactions are paid in this manner. The proportion of customers using credit card in/out is directly related to factors identified in Key Considerations, as well as the customer's familiarity with the technology (e.g., at one U.S. airport where credit card in/out has been offered for over 4 years, transactions paid in this manner exceed 80%).
- Reduction in exit plaza size because credit card readers require narrower islands than do cashier booths, resulting in narrower plazas.

## Implementation Actions

1. Explain benefits to airport management and/or key decision makers.
2. If credit card in/out can be incorporated within the existing revenue control system, work with system vendor to activate the capability. Acquisition of new entry and exit readers capable of reading credit cards may be necessary.

If implementation is part of a larger revenue control system upgrade, it is likely that the implementation process will be driven by the requirements of other components of the system.

3. Train staff in customer support and maintenance.
4. Prepare marketing and advertising programs. Successful utilization follows a well-designed and extensive publicity campaign.
5. Assure that exit and entry readers function properly and reliably, and are well maintained.

## Key Considerations

Those identified by airport operators include

1. Procedures for misplaced or mismatched credit cards (e.g., customers who lost their cards while traveling, or whose accounts have reached maximum balances). Typically, these procedures are similar to those for processing the tickets of exiting customers who have insufficient cash, or who do not have a valid credit card (i.e., those who are commonly referred to as "promise to pay" customers).
2. Proportion of frequent travelers using the system. At airport parking facilities where a high proportion of the patrons are business travelers, patron acceptance of credit

card in/out was rapid and a high proportion of customers used the system. One airport operator reported 70% use of credit card in/out at its close-in parking facility (the facility commonly used by business travelers) and 40% use of credit card in/out at its remote economy parking facility (the facility commonly used by leisure travelers).

3. Well-designed pre-implementation promotional, marketing, and advertising program to inform customers of the option so that they are aware of the benefits of using the technology and, when they enter the facility, they are ready to use a credit card rather than taking a ticket. Less training is required at airports serving a customer base consisting mostly of frequent travelers (e.g., business travelers).
4. Monetary incentives to encourage the use of credit card in/out. One airport operator charges a higher daily rate for customers paying with cash.
5. Participation by airport staff representing parking operations, audit/finance, IT, and engineering throughout the design and (if necessary) vendor selection process.
6. Program for assuring system reliability. Customers may be discouraged from using the system if the readers are frequently out of service.
7. Well-designed credit card readers at entry and exit lanes that clearly indicate which way customers should insert their cards.
8. Backup systems to allow customers to exit in case of power failure or disconnection with the credit card processing system.

## Implementation Costs

The cost of implementing a credit card in/out system varies depending on whether it is part of a large parking revenue control system upgrade or if it is a stand-alone project. Typical costs may include those for acquisition of new entry/exit readers and a software modification to the revenue control system to allow for the storage of credit card numbers. Typical costs for new ticket issuing or reader machines that accept credit cards and costs for upgrading ticket issuing or reader machines to accept credit cards are presented in Appendix A.

Additional cost items include staff training, a marketing program, signage, and potential exit plaza reconfiguration (e.g., removal of cashier booths that are no longer required). Although some airport operators leave the cashier booths in place, they may be confusing to patrons who see an "open" lane and expect a cashier to be present.

## Ongoing O&M Costs

O&M costs include those for equipment and software maintenance (whether performed by the vendor or airport staff) and supervisors to respond to customer questions. One

airport operator indicated that approximately \$200,000 per year was spent on ongoing marketing and promotion during the initial 3 years of its credit card in/out system.

### Implementation Schedule

To date, most credit card in/out installations at airports were either implemented as part of a larger parking revenue control system upgrade where other components of the system were the principal drivers of the schedule or inactivated components of an upgrade that were activated at a later date (and thus, required a minimal period of time to implement). When credit card in/out transactions became the main focus of one parking revenue control system upgrade, the entire process from concept initiation to opening day required less than a year.

At many airports, the cost of implementing a credit card in/out system was sufficiently low that the project did not require approval by the airport commission or board.

### Supporting and Complementary Strategies and Technologies in This Guidebook

Credit card in/out systems can be implemented as part of a revenue control system upgrade or replacement, or implementation of a pay-on-foot parking system. Complementary strategies and technologies include:

- All value-added parking products in Category B,
- Pay-on-Foot Systems (E.1),
- Proximity Cards (E.5), and
- License Plate Recognition (E.6).

### Examples of Application

Airports with credit card in/out systems include those serving Baltimore, Denver, Des Moines, Detroit, Indianapolis,

Minneapolis-St. Paul, Portland (OR), Salt Lake City, San Francisco, Seattle-Tacoma, Tampa, Toronto, Vancouver, and Washington, DC (Dulles). The airports serving Denver, Des Moines, Minneapolis-St. Paul, and Salt Lake City use only credit card in/out transactions at one or all facilities, while most of the other airports cited have pay-on-foot systems that allow patrons the option of using credit cards similar to a credit card in/out system. See Figure E.2.

## E.3 Automatic Vehicle Identification (AVI)/Radio-Frequency Identification (RFID)

### Purpose

Improve customer service by reducing exit plaza delays. Reduce operating costs by reducing the number of required exit lanes and reliance on exit cashiers. Reduce opportunity for theft or fraud as there is less need for staff to handle cash.

### Use by Customers

Customers receive AVI tags from the parking operator or use a regional toll tag (e.g., E-ZPass, SunPass, FasTrak) furnished by a regional toll road or bridge agency. These tags, which are normally permanently affixed to a vehicle (although some agencies allow tags to be transferred between vehicles), can be accurately read by AVI readers located 10 ft or more from vehicles passing through a “read zone” at high rates of speed (e.g., over 50 miles per hour). The AVI tag is associated with either a credit card account or a prepaid account. When a customer enters an entry lane to the parking facility, an AVI reader registers the tag, records the tag number and date/time, and signals the gate to open. To exit, the customer drives to an exit gate where an AVI reader registers the tag number and date/time, calculates the parking fee, charges the credit card (or deducts from a prepaid account), may issue a receipt, and opens the gate to permit the customer to exit.

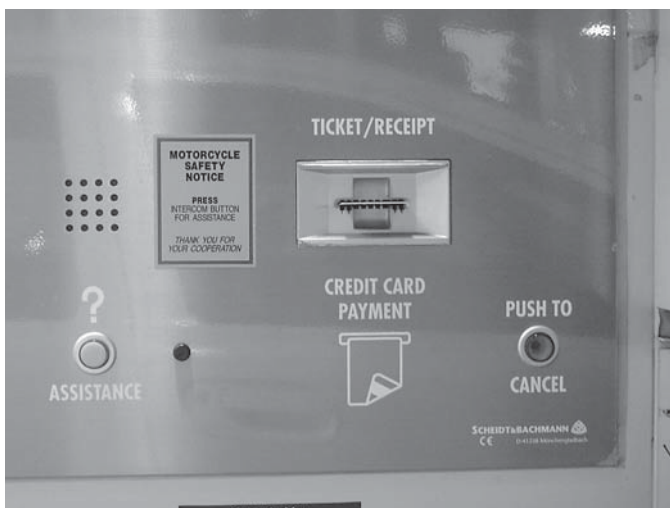
AVI tags are already in use at most airports for the management of commercial vehicles and airport-owned vehicles.

### Benefits

Potential reduction in exit delays, reduction or elimination of required staffed exit lanes, and reduced opportunity for theft or fraud resulting from staff handling of cash.

### Implementation Actions

To date, there have been a limited number of applications where an airport operator has installed equipment to accept



Source: Jacobs Consultancy.

**Figure E.2.** Credit card in/out exit.

public parking payment via AVI tags. Typically, the AVI reader equipment was installed as part of a larger revenue control system installation or upgrade, where other factors dictated the implementation steps and schedule. However, as part of the installation, an airport operator will need to take the following steps:

1. Confirm that an AVI reader (capable of reading regional tags or airport-issued tags) can be integrated with the existing or planned parking revenue control system.
2. Identify location and placement of equipment required to read the AVI tags.
3. For installations using toll tags distributed by another agency, establish agreement with the agency (or clearinghouse) responsible for distributing toll tags, including fees to be retained by the clearinghouse, how and when parking fees will be collected and transferred to the airport, and provision for commercial vehicles or other special card holders.

For airport operators issuing their own toll tags, establish program whereby the airport operator would issue toll tags to patrons who elect to join the program and provide appropriate financial details (e.g., name, vehicle information, and credit card information).

4. Identify locations for tag readers at entry and exit plazas so as to minimize the potential for reading tags in nearby entry or exit lanes.
5. Establish airport policies regarding single-vehicle or multiple-vehicle use of AVI/RFID tags.
6. Establish standard operating procedures regarding exception transactions while using AVI/RFID tags (e.g., unreadable tags, dropped tags) and anti-passback procedures (e.g., if a tag has been read at an entry lane, it cannot be re-used at an entry lane until it has been read at an exit lane.).

## Key Considerations

Those identified by airport operators include

1. In areas where toll tags are issued by a regional transportation agency, the airport operator should acquire readers for those tags rather than issuing its own tags.
2. For readable distance and read zones, care must be taken in the “tuning” and placement of AVI readers or antennae to assure that only tags in vehicles in a designated lane are read, and to avoid reading tags in vehicles in adjacent lanes, which would result in multiple reads.
3. Driver expectations when using toll tags should be recognized. One U.S. airport operator found that some customers expect that their regional toll tags would be used at the airport in the same manner as they are used on regional toll facilities—i.e., they expect to be able to drive through a toll lane without stopping, and may not expect to find

gate-controlled exit lanes. These customers are surprised to find a gate arm and to find that the gate arm does not open immediately as they approach it.

4. Payment collection process. Depending on the toll tag system, the agency issuing the toll tag may need to collect payment from the parking patron’s account and transfer it to the airport. Alternatively, the airport operator could require patrons with toll tags to register their tags with airport staff, who would then charge an associated credit card or send a periodic billing statement.

In the event that a toll agency collects payment and transfers it to the airport, the agency may require that the patron associate a credit card with the toll tag account. Many toll agencies operate on a prepaid system, wherein patrons deposit an amount to their toll accounts, which is debited every time the patron uses a tolled facility. When the account reaches a certain minimum threshold, the toll agency refills the balance by charging a credit card or bank account. As roadway tolls are typically \$5 or less, minimum prepaid balances may not be sufficient to cover potential fees for stays of multiple days in an airport parking facility.

5. One U.S. airport operator has determined that accepting regional toll tags for parking payment has resulted in only a minimal improvement in transaction time compared to standard self-service credit card payment. Since much of the transaction time includes calculating the fee and issuing the receipt, the time savings offered to customers using an AVI tag is limited to the time it takes the customers to insert and retrieve their credit cards (assuming that customers have their credit cards ready as they approach the exit gate).
6. Integration with other authorities. If the toll tag is issued by another authority (i.e., a local toll road agency), the airport operator may need to establish procedures for determining which agency collects the payment from the parking patron, how payment will eventually be made to the airport enterprise, and what fees the airport operator will have to pay other agencies to process the transactions.
7. Clearinghouse fees should be considered. Agencies responsible for administering the AVI/RFID system typically charge the airport enterprise (and other customers) administrative fees of between 3% and 6% of gross revenues for the tasks they perform. These tasks include collecting fees, paying credit card fees (often 2% to 3% of transaction revenue), providing locations or websites where customers can open accounts and receive tags, and maintaining customer accounts and account records.
8. If a system is configured to read AVI tags at a parking entry plaza, the revenue control system should not issue a parking ticket for that vehicle. One airport operator reported that if a ticket is issued to a patron using an AVI tag, the ticket may become lost because the patron is not required to use it to exit the parking facility (the

revenue control system uses the AVI tag to calculate the fee based on when the tag was read at the entry to the parking facility).

## Implementation Costs

The incremental cost of adding AVI readers to an existing revenue control system is provided in Appendix A. In determining this cost, it was assumed that incorporation of the AVI reader does not require significant upgrade or modification to the revenue control system, which would result in additional costs.

Typical costs incurred will also include those for software modification to the revenue control system to allow for the storage of the AVI/RFID tag numbers of those tags authorized to use the system.

## Ongoing O&M Costs

Specific O&M costs include those for maintenance of tag readers, administrative staffing costs, and (if necessary) staff time to coordinate with any regional collection agency.

## Implementation Schedule

AVI/RFID reader installations at airports have usually been implemented as part of a larger parking revenue control system upgrade where other components of the system were the principal drivers of the schedule. Revenue control systems can take approximately 18 to 36 months to install depending on contract processing and vendor availability.

## Supporting and Complementary Strategies and Technologies in This Guidebook

AVI/RFID readers can be implemented as part of a revenue control system upgrade or replacement. Complementary strategies and technologies include

- All value-added parking products in Category B,
- Credit Card In/Out (E.2),
- IntelliDrive (E.4), and
- License Plate Recognition (E.6).

## Examples of Application

AVI technology is used at numerous U.S. airports for the management and control of commercial ground transportation vehicles. Airports where regional toll tags are accepted for payment of public parking fees include those serving Albany, Dallas (Love Field), Dallas/Fort Worth, Houston (Bush Intercontinental and Hobby), Newark, New York (Kennedy and LaGuardia), Orlando, and San Francisco.

Airport-issued tags for parking access (as opposed to tags issued by a regional toll road or bridge agency) are used at Raleigh-Durham International Airport.

## E.4 IntelliDrive

### Purpose

IntelliDrive, formerly known as the Vehicle Infrastructure Integration (VII) Program, is a U.S.DOT-sponsored research program intended to develop technologies that improve the ability of drivers and vehicles to avoid, or reduce the impact of, collisions. The overall goal of the program is to reduce the traffic crash rate by 90% by 2030.

### Use by Customers

The focus of the research is to examine existing, emerging, and future technologies that allow vehicles to exchange information with other vehicles and roadway infrastructure and “take over” vehicle control so that vehicles avoid collisions.

In the near-term, research is expected to focus on applications that use dedicated short-range communication (DSRC) to transmit information among multiple vehicles and between a vehicle and roadway infrastructure. DSRC includes radio-frequency identification (RFID), a technology currently in use for vehicle toll collection.

Some European automobile manufacturers are already installing RFID tags during production and, as part of IntelliDrive, it is anticipated that, eventually, all manufacturers will install RFID tags on every new automobile as part of the assembly process.

It is expected that airport operators will be able to use IntelliDrive technology in a fashion similar to the way AVI tags or proximity cards (see Sections E.3 and E.5) are used.

### Benefits

In addition to the benefits afforded by AVI, IntelliDrive technologies may also provide

- The ability to collect fees for the use of airport roadways (including the curbsides).
- The ability to communicate space availability (by facility), parking rates, directional guidance, or other information directly to vehicles equipped with on-board GPS or equivalent systems.
- The ability to operate a ticketless parking system.
- Potentially improved vehicle tracking and locating within large parking facilities (or the enhanced ability to use nested parking areas).



- Improved tracking of airport-operated shuttle buses and other vehicles.
- Information regarding customer frequency, facility use, and other metrics.

### Key Considerations

As a future initiative, no specific considerations have been identified by airport operators. It is anticipated that considerations will be similar to those associated with the use of AVI or regional toll tags for parking fee payment (Section E.3), as well as overall considerations associated with the IntelliDrive effort, such as privacy.

Some experts expect that, within 10 years, a sufficient share of the vehicle fleet will have IntelliDrive technology installed to support the use of parking access and revenue control systems compatible with such technology.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- All value-added parking products in Category B,
- In-Vehicle Parking Technologies (D.10), and
- License Plate Recognition (E.6).

### Examples of Application

Components of the IntelliDrive research effort, such as RFID tags, are currently in use at numerous airports as part of automatic vehicle identification for commercial vehicles and at a limited number of airports where regional toll tags are accepted for parking payment. Some aspects of IntelliDrive, such as automated collision avoidance, are in the testing phase, while others, such as automated vehicle control on highways, are many years away from implementation. As an airport parking technology, it is believed that aspects of the IntelliDrive technology will become useful once a certain portion of the vehicle fleet is equipped with RFID tags.

## E.5 Proximity Cards

### Purpose

Control access to specific parking facilities or products. Increase revenue security by eliminating the opportunity for employees to handle cash.

### Use by Customers

Customers entering the parking facilities, instead of pulling tickets at the entry plaza, hold proximity cards, similar in size to a credit card, within two feet of a reader, which receives a

signal “broadcast” by the proximity card and opens the gate. To exit, parking patrons drive to an exit gate and perform the same operation. The same proximity card may also be used for pedestrian access, as patrons return to their parked vehicles. After reading the card, the revenue control system calculates the fee, charges the amount to an account associated with the card, and opens the exit gate.

### Benefits

Potential reduction in exit delays, reduction or elimination of required staffed exit lanes, and reduced opportunity for theft or fraud resulting from staff handling of cash. To date, proximity card applications for airport parking facilities have been primarily limited to employee parking and access to special public parking products.

### Implementation Actions

Implementation actions include

1. Determine if proximity cards are the best solution for access control for a particular application.
2. Determine if the existing revenue control system or access control computing system can incorporate proximity card readers; work with system vendor to activate the capability.
3. Assure that card readers function properly and reliably, and are well maintained.

### Key Considerations

Those identified by airport operators include

1. Develop procedures for managing control of the proximity cards to ensure that they are held only by those authorized to use them. For example, one U.S. airport operator expressed concern that airport tenants issuing proximity cards to employees for airport-operated parking lots could not ensure that the cards were returned when the employee no longer worked for the tenant.
2. Participation by airport staff representing parking operations, audit/finance, IT, and engineering throughout the design and (if necessary) vendor selection process.
3. Program for assuring system reliability. Customers may be discouraged from using the system if the readers are frequently out of service.
4. When issuing cards, establish time/date block controls limiting length of time cards are valid.

### Implementation Costs

The cost of implementing a proximity card system varies depending on whether it is part of a large parking revenue control system upgrade or if it is a stand-alone project. The



number of proximity cards to be issued is a key consideration since the costs of the readers at the entry and exit gates is relatively fixed (for a given peak period flow rate) while the number of cards to be issued can vary widely depending on the number of customers, the marketing program, and other factors. Other than employee parking facilities, most airport applications do not require large numbers of proximity cards; therefore, the per-card cost will be higher than for installations requiring thousands of cards.

Typical costs will also include those for the acquisition of proximity card readers, potential entry/exit plaza modifications, and software modifications to the revenue control system to allow for the storage of the identity numbers associated with each card authorized to use the system. Unit costs for proximity cards and the card readers are provided in Appendix A.

### Ongoing O&M Costs

O&M costs include those for equipment maintenance (whether performed by the vendor or airport staff) and staff responsible for managing the proximity card program.

An additional cost item includes staff time to manage and control the cards (i.e., frequently verifying that cards are held by authorized users).

### Implementation Schedule

Proximity card installations at airports have usually been implemented as part of a larger parking revenue control system upgrade where other components of the system were the principal drivers of the schedule.

### Supporting and Complementary Strategies and Technologies in This Guidebook

Proximity card systems can be implemented as part of a revenue control system upgrade or replacement. Complementary strategies and technologies include

- All value-added parking products in Category B,
- License Plate Recognition (E.6), and
- Advertising Sales—Interior, Exterior, Tickets, and Equipment (F.6).

### Examples of Application

Airports with proximity card systems include those serving Seattle-Tacoma and other U.S. airports, as well as many throughout Europe, including Dublin Airport (see Figure E.5).



Source: Jacobs Consultancy.

**Figure E.5.** Exit verifier with proximity card reader at Dublin Airport.

## E.6 License Plate Recognition

### Purpose

Improve revenue security by matching license plates to issued tickets (reducing or eliminating ticket swapping). When used as a substitute for a parking ticket, improve customer service by reducing exit plaza delays and reduce number of required exit lanes and reliance on exit cashiers.

### Use by Customers

License plate recognition (LPR), or automatic number plate recognition, is typically a complementary technology to other parking payment systems. At present it is rarely used as the primary method of identifying entering/exiting vehicles because of the current accuracy rates and other factors (e.g., the variety of license plates to be read), but is used to support other technologies.

As a customer enters a parking facility and stops to pull a ticket, the LPR system records a digital image of the customer's license plate. Optical character recognition (OCR) software "reads" the license plate number and codes the number into the ticket before the ticket is issued to the customer. As a customer exits the facility and stops at the exit gate, the LPR system records a second digital image of the license plate and the OCR software again "reads" the license plate number. If the

license plate number matches that coded into the parking ticket, the vehicle is allowed to exit upon payment of the parking fee. If the plate numbers do not match, typically the vehicle is not allowed to exit until a supervisor or other staff confirm that the plates were correctly read.

One airport operator uses LPR in conjunction with a parking reservations system. When customers make their parking reservations online, they enter their license plate numbers along with their payment information. When the vehicle enters the parking facility, the LPR system reads the license plate and opens the entry gate.

Another airport operator uses LPR to assist patrons in locating their vehicles upon returning from a trip. As part of the overnight inventory software, the parking space location is automatically linked to each vehicle's license plate number. When a customer pays their parking fees at a pay-on-foot station, the revenue control system reads the LPR-coded license plate on the ticket, looks up where the customer parked using the overnight inventory, and prints the vehicle location on the parking ticket. Alternatively, a customer can insert their ticket into a reader and determine their vehicle location (e.g., if a customer plans to pay at the exit).

## Benefits

- Significantly reduced ability of patrons to “swap tickets” or engage in other fraudulent activity to avoid paying parking charges. LPR systems can help the parking operator identify customers who may attempt to exit with a stolen or fraudulent ticket. This is accomplished by matching the exiting vehicle's license plate number (and, in certain instances, the entire vehicle image) with that of the entering vehicle as coded on the parking ticket recorded at the time of entry by the LPR system, and detaining suspicious vehicles until the mismatch can be resolved by a supervisor.
- Potentially increased customer service by helping customers locate their vehicles within a large parking facility.
- In Europe, some tax bureaus require that a parking ticket or receipt display the vehicle's license plate number to enable the cost of parking to be claimed as a business expense. LPR technology can automatically print a vehicle's license number on the ticket or receipt.

## Implementation Actions

Implementation actions include

1. Estimate parking revenue lost due to ticket swapping and other fraud preventable by LPR technology. Conduct a cost-benefit analysis to determine if LPR is financially justifiable. Some airport operators have found that the costs

of LPR (capital and O&M costs) are not justified if the airport has a well-run parking operation.

2. Identify system accuracy goals.
3. Determine requirements for integration with the existing or planned parking revenue control system.
4. Once a parking revenue control system has been selected, for each entry and exit lane identify the location of cameras and lighting fixtures.
5. Conduct in-field testing for final adjustments to the locations for cameras and lighting fixtures.

## Key Considerations

Those identified by airport operators include

1. Accuracy. An airport operator will need to determine the level of accuracy required of the LPR system to meet its needs. Currently, accuracy of LPR installations in the United States varies, and is often 90% or lower. Most operators use staff (on a full-time basis or those also assigned other duties) to monitor the LPR system and, as needed, enter license plate numbers if the LPR system cannot successfully read a plate number.

There is a trade-off between the ability to identify a unique vehicle and the ability to read a license plate. The probability that a unique vehicle is being identified increases geometrically with each additional digit captured, as it is unlikely that another vehicle will have the same combination of numbers and/or letters. However, the read time and effort also increases with each additional digit recognition required. Thus, some airport operators accept four or five digits as a match rather than requiring the entire plate to match.

The level of accuracy increases when the system is required to match additional digits (e.g., 3, 4, or 5 of the 6 digits on a license plate).

Some LPR system vendors are supplementing their technology with a system that captures images of a larger portion of each vehicle. These images are used, in combination with the identified license plate number, to increase the ability of the system to accurately match a vehicle to an individual parking ticket.

2. License plate variety. In Europe, vehicle license plates vary less than in the United States. Most European plates consist of black text on a solid background color, have consistent fonts and font sizes, and must be mounted on both the front and back of the vehicle. This consistency allows for very high accuracy of LPR systems.

In the United States, each state (as well as the District of Columbia) issues its own license plates and most states issue a large variety of license plates that may use different fonts and colors, incorporate non-alphanumeric symbols, have words (i.e., *Pearl Harbor Survivor*), or varying

background images. In addition, many airports attract patrons from nearby states. It is possible for two vehicles from adjacent states to have the same license plate number (particularly with vanity plates). This wide variety of potential license plate styles reduces an LPR system's ability to read accurately.

3. Lighting. The intensity and angle of light illuminating a license plate can affect LPR accuracy. One operator reported that during a 5-minute period each day when the sun is at a certain angle, glare makes it extremely difficult for the LPR cameras and OCR system to successfully read license plates.
4. Obscured plates. Mud, snow, salt, or dirt reduces the ability of an LPR system to accurately read license plates. License plates installed in nonstandard locations (e.g., on a tail gate of a truck) may be out of camera range. Trailer hitches and other objects may block the camera sight line. The use of infrared cameras is reported to improve accuracy when plates are obscured by dirt, mud, or reflections.

## Implementation Costs

Typically, LPR systems have been installed as part of a new revenue control system installation or an upgrade. Unit costs for key components are provided in Appendix A.

## Ongoing O&M Costs

Typically O&M costs are combined with other parking operations, management, and maintenance costs. Additional cost items may include staff time to monitor the LPR system and manually enter or accept a license plate number (if the system is unable to automatically read a plate).

## Implementation Schedule

Typically, LPR systems are installed as part of a larger revenue control system installation or upgrade. As such, it is likely that other elements of the system will dictate the implementation schedule.

## Supporting and Complementary Strategies and Technologies in This Guidebook

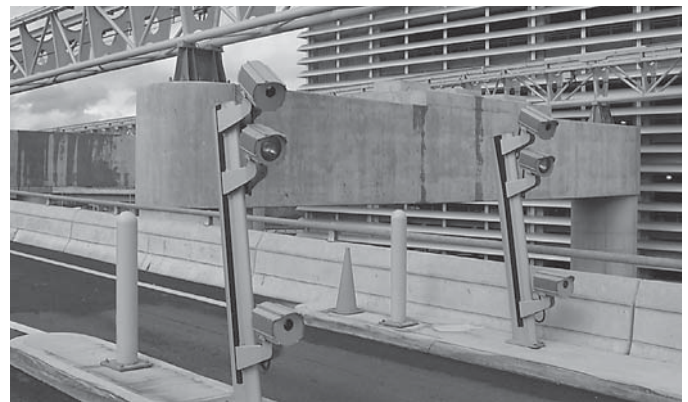
LPR technology can be implemented as part of a revenue control system upgrade or replacement. Complementary strategies and technologies include

- All value-added parking products in Category B and any product where customers must enter a special (or nested) access-controlled area,
- Space Locators (D.9), and



Source: Jacobs Consultancy.

**Figure E.6a.** Entry gate and license plate recognition camera at Dublin Airport.



Source: Jacobs Consultancy.

**Figure E.6b.** License plate recognition cameras at Toronto Pearson International Airport.

- All cashierless transactions in Category E or other payment systems where an operator may wish to have a vehicle license plate coded onto the ticket issued to the vehicle.

## Examples of Application

License plate recognition is used at the airports serving Atlanta, Birmingham, Boston, Phoenix, Raleigh-Durham, San Francisco, Washington, DC (Dulles), Toronto, London (Heathrow and Gatwick), Birmingham (U.K.), Manchester (U.K.), and Dublin (see Figures E.6a and E.6b).

## E.7 Cellular Telephone/Pay by Cell

### Purpose

Improve customer service by increasing payment options, reducing reliance on exit cashiers, and eliminating customer

need to carry coins (for parking facilities with parking meters). Increase revenue security by eliminating the opportunity for employees to handle cash.

## Use by Customers

Pay by cell is predominantly used by municipalities for on-street parking operations and parking facilities that are not gate controlled. One airport operator currently offers this payment option.

Currently, there is one predominant pay-by-cell method for paying parking fees. Customers approach parking meters or pay stations and dial a number displayed at the meter/station. Once connected and after setting up an account linked to a credit card, customers enter the space number and the amount of time they wish to purchase. Customers can dial the same number to either pay for additional time or, if they return to their vehicles without having parked for the full time they paid for, receive credit for unused time. Other possible pay-by-cell methods include

- Upon returning to a pay station, customers insert their tickets. When the fee is displayed, customers dial a number to indicate that payment should be charged to an account linked to a credit card.
- The cell phone can display a bar code that is read by an optical scanning device at the pay-station/meter.
- The cell phone can function as an RFID tag or proximity card that, when placed near a pay station or meter, is read and recorded. (See Section E.3 for further discussion of RFID payment systems, and Section E.5 for further discussion of proximity card payment systems.)

## Benefits

Airport operators and parking technology vendors believe that pay by cell is best used in situations where patrons pay for parking at parking meters or pay stations and are required to pre-pay for parking (such as at an on-street parking meter). This technology has limited stand-alone application in an airport environment where gated revenue-control is common. However, pay by cell could be added as a payment option for pay-on-foot systems (see Section E.1) and it would support the benefits typically realized through the use of pay-on-foot revenue control.

## Implementation Actions

Implementation actions could include

1. Enter into a business arrangement with a third party that will receive the pay-by-cell phone calls, charge patron

credit cards, transmit payments to the airport enterprise, and provide real-time information regarding the vehicles for which parking fees have been paid.

2. Market and promote the service.
3. Monitor usage during a trial period to determine the viability of the service. Prepare a cost-benefit analysis to determine whether to continue offering a pay-by-cell option.

## Key Considerations

Applicability to an airport's parking operation is a factor. Airport operators offering prepaid metered parking may find that pay by cell enhances customer level of service by offering increased payment options and the ability to pay for additional time without needing to return to the parking space to "feed the meter." Pay-by-cell systems may be less applicable at airports where in-lane payment technologies are used.

## Implementation Costs

To date, a pay-by-cell parking system has been implemented at only one airport. Municipalities that have installed such a system report that implementation costs approximately \$5,000 to make arrangements with the pay-by-cell company and post the appropriate notices on parking meters.

## Ongoing O&M Costs

Based on municipality experience with pay-by-cell systems, it is expected that O&M costs would be low and would be directly related to use of the system. Thus, O&M costs could be covered by a per-transaction fee (pay-by-cell systems serving municipal parking facilities often charge customers a transaction fee).

## Implementation Schedule

The schedule to implement pay by cell will depend on coordination with the third-party receiving the pay-by-cell calls and the time required to integrate the pay-by-cell system with the existing parking revenue control system.

## Supporting and Complementary Strategies and Technologies in This Guidebook

In an airport environment, it is expected that pay by cell could be implemented to support pay-on-foot systems (Section E.1).

## Examples of Application

Currently, customers using the South Terminal parking lot at Vancouver International Airport are allowed to pay by cell. Several municipalities use pay by cell as a payment method



for on-street parking. The vendor providing the pay-by-cell service at Vancouver International Airport is unaware of any other airports where a similar service is provided.

## E.8 In-Car Meters

### Purpose

Improve customer service by increasing payment options, requiring that customers pay only for the exact amount of time they parked, eliminating customer need to carry coins (for parking facilities with parking meters). Increase revenue security and reduce operating expenses compared to conventional parking meters and pay stations.

### Use by Customers

In-car meters are typically used for on-street parking and parking facilities that are not gate controlled. Customers obtain a small display device that can be hung in a visible location inside the car (such as the rear view mirror or attached to the inside of a window). Upon parking, the customer activates the display device by inserting a smart card that has a pre-loaded dollar amount. While the vehicle is parked, the display device deducts value from the smart card at the advertised cost per unit of time. When the customer returns to the vehicle, the smart card is removed from the display device. Customers are able to add value to the smart card as needed.

In-car meters are predominantly used by municipalities for on-street parking. As such, no airport operators have offered this payment option and there is limited information available regarding implementation, schedule, and cost considerations.

### Benefits

In-car meters appear to be best used in situations where patrons pay for parking at parking meters or pay stations and are required to prepay for their parking (such as at an on-street parking meter). Airports that implement this technology may realize lower O&M costs because in-car meters require no equipment, such as parking meters or pay stations. However, this technology has limited stand-alone application in an airport environment where gated revenue-control is common.

### Key Considerations

Key considerations include

1. Applicability to an airport's parking operation. Airport operators offering pre-paid metered parking may find that

in-car meters enhance customer level-of-service by offering increased payment options, and requiring that customers pay only for the exact amount of time they parked.

2. The size of the parking operation. In-car meters rely on enforcement to ensure that meters are properly displayed and that sufficient credit is available on the smart card. Airport operators with large parking facilities may find it expensive to monitor large numbers of in-car meters.
3. Limitations. Use may be limited to those communities or regions that have deployed this technology and where most motorists have in-car meters.

### Ongoing O&M Costs

Staff O&M costs are anticipated to be lower than for conventional metered parking operations because the entire system is located within a patron's vehicle and no on-street equipment is required.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Valet Parking (B.1, B.2, and B.3) and
- Advertising Sales—Interior, Exterior, Tickets, and Equipment (F.6).

### Examples of Application

Currently, in-car meters for the payment of parking fees have not been implemented at any airports. Several municipalities use in-car meters as a payment method for on-street parking.

## E.9 In-Lane Processing

### Purpose

Improve customer service by reducing processing time at the exit booth. Reduce number of required exit lanes.

### Use by Customers

In-lane processing is predominantly used by businesses, such as drive-through restaurants, to collect needed information from a customer (i.e., the customer's order) while the customer is queued to minimize processing time once the customer reaches the cashier. At airports, rental car companies frequently use this approach to process customers as they return their vehicles; in-lane processing allows customers to proceed directly from their vehicles to the terminal.

While customers are queued at an exit lane, a "roving cashier" with a mobile ticket reader and credit card processor



approaches drivers in their vehicles to read their parking tickets, calculate parking fees, collect payment, issue receipts, and recode the tickets. When customers reach the exit gate arm, they put their tickets into an exit verifier, which then opens the gate.

In-lane processing for parking is used at events (e.g., concerts and sporting events) having pronounced peak periods to reduce entry/exit delays and improve customer service, but parking at these events is typically prepaid, one set fee, and cash only.

## Benefits

Reduces the number of required exit lanes and reduces exit delays by allowing the simultaneous processing of multiple vehicles in the same exit lane.

It is likely that in-lane processing would not result in a significant reduction in average total transaction time for a customer because the transaction time in-lane would be similar to that at a typical cashiered exit booth and the time required to open the gate would not change significantly.

For airports with a limited number of exit lanes, constrained physical space to add more exit lanes, and standard cashier-based revenue controls, in-lane processing could be used during peak periods where exiting volumes exceed the capacity of the exit lanes, resulting in excessive vehicle queues. Under such conditions, in-lane processing increases the capacity of the exit lanes (in proportion to the number of roving cashiers) without increasing the number of exit lanes.

## Key Considerations

In-lane processing appears to have limited utility as an airport parking technology. The benefit of reduced exit lane requirements is similar to the benefit that can be realized by pay-on-foot systems, but without the additional potential benefit of reduced staffing requirements.

Few airport operators have adopted in-lane cashiering because of the advent of reliable pay-on-foot and credit card in/out technologies, and the need to acquire specialized equipment to facilitate in-lane cashiering.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Holiday/Overflow Parking (A.9) or other parking products that require customers to pay a fixed fee regardless of their parking duration.

## Examples of Application

No airport operators use in-lane processing of parking patrons on a regular basis. This strategy has been used at holiday/overflow lots when the airport operator established a flat fee for parking (i.e., rather than a duration-based fee) and could thus collect the fee from entering motorists. In-lane processing is used for parking at special events and in other industries, such as drive-through restaurants, airport rental car facilities, and airline baggage check counters.

## CATEGORY F:

# Revenue Enhancement Strategies

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## CATEGORY F

# Revenue Enhancement Strategies

### F.1 Parking Rate Adjustments

#### Purpose

Enhance parking revenues consistent with other goals of the airport operator. Balance demand among available parking facilities.

#### Use by Customers

Customers are presented a menu of airport parking products, available at a range of costs and level of convenience. Knowing the costs of each product, customers can select a preferred product.

#### Benefits

Potential benefits are reported to include

- Increased revenue resulting from modifications to existing parking rates. As a general guideline, the proportional increase in revenue is likely to approximate the proportional increase in rates (assuming an across-the-board increase), with adjustments for (a) customers who switch from one parking product to another higher or lower priced product, (b) new customers who would have otherwise used other airport access modes or privately operated off-airport parking facilities, or (c) customers who decide not to park because of the increased costs and choose to use other airport access modes or privately operated off-airport parking facilities.

The total parking demand at an airport is fairly inelastic (i.e., increases in cost of \$2 to \$3/day are unlikely to affect customer demand). In some locations, temporary, short-term reductions in demand (i.e., 3 to 6 months) have occurred as customers adjust to new prices, but after this period, demand typically rebounds to former levels.

- Improved availability of spaces in short-duration facilities (e.g., if the cost of parking in short-duration areas is

adjusted to discourage long-duration customers) leading to improved customer service and potential reductions in curbside traffic and emissions from circulating vehicles.

- Improved availability of spaces in long-duration facilities (e.g., if rates are adjusted to balance demand among available facilities), leading to improved customer service.
- Potentially improved market share or maintenance of existing market share.

#### Implementation Actions

Implementation actions appear to vary depending on the specific goals of airport management as several types of potential rate adjustments are available. Potential implementation actions and the corresponding goals include

1. Encourage customer use of a desired facility by modifying the differential costs for parking. For example, increasing the cost differential between short-duration and daily facilities will encourage customers to use the less expensive facility (typically, the daily parking facility). Similarly, decreasing the cost differential between these facilities will encourage customers to use the more expensive facility (typically, the short-duration parking facility). Reducing the cost of parking in a structure, for example, may attract customers who would have otherwise parked in less expensive surface facilities or in off-airport parking facilities, thereby increasing airport revenues.
2. Increase market share by maintaining or establishing competitive rates. For example, offering competitive rates and concurrently improving customer service may attract customers who would have otherwise selected privately operated, off-airport parking facilities. Such changes can lead to increased revenues depending on the expected change in market share.
3. Increase revenues by offering weekend or long-duration parking discounts. For example, some operators offer weekly rates or “free” parking for the 7th day to attract market share. Since a very small percentage of all cus-

tomers park for 6 days or more, such discounts may attract new customers and increase revenues.

4. Increase revenues by offering weekly flat rates. For example, offering flat-rate, discounted fees for the first week (or for 2 weeks) may attract long-duration, price-sensitive customers who would not have otherwise parked at the airport (e.g., those traveling on non-business purposes—see Section A.8, Vacation Parking). Since very few customers park for 6 days or more, such discounts may attract new customers and increase revenues.
5. Increase revenues by altering the cost of each hourly increment. For example, an airport operator can increase revenues by changing a rate from \$1.00 for 30 minutes to \$1.00 for 20 minutes or \$1.00 for 12 minutes. Adjusting the hourly rate increment to accelerate when customers reach the daily maximum rate may increase revenues by 3% to 10%. Changes to hourly rate increments may minimize the concerns of approval boards/commissions, which often primarily focus on the daily maximum rate.

### Key Considerations

Those identified by airport operators when modifying or adjusting parking rates include

1. Cost of public parking at peer airports.
2. Cost of parking in downtown areas.
3. Cost of the trip using other access modes, especially taxicabs, between the airport and downtown areas.
4. Length of time since last rate adjustment.
5. Likely length of time until next rate adjustment.
6. Process (if any) to obtain board, commission, or council approval in a public setting (at airports where such approvals are required, rate adjustments are requested less frequently than at airports where the airport director or equivalent has the authority to adjust rates).

### Implementation Costs

The key costs are for the required staff time and the costs of changing signs, websites, and other locations where parking rates are displayed. Modern parking revenue control systems can easily accommodate changes to rates or hourly time increments.

### Ongoing O&M Costs

No O&M costs are associated with maintaining existing parking rates or making rate adjustments.

### Implementation Schedule

It is estimated that the total time to implement, including the actions required to obtain management approval may be

from 1 to 12 months or more depending on the approval process and need for public meetings.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All duration-based parking products in Category A and
- Strategic Pricing (F.2).

### Examples of Application

Most airport operators adjust their parking rates at regular intervals to reflect the specific goals of airport management, inflationary trends, and customer demand.

## F.2 Strategic Pricing

### Purpose

Enhance parking revenues consistent with other goals of the airport operator. Maintain or increase market share.

### Use by Customers

Customers can make informed decisions (and be encouraged to use certain facilities) if they are aware of the cost and level of service or convenience of each available parking product.

### Benefits

Potential benefits are reported to include the ability to maintain or enhance market share and assure that customers are provided a choice of parking products even on the busiest days of the year. Airport management—particularly where there are no nearby privately operated parking facilities—may provide customers with a low-cost parking option to discourage or limit competition based solely on price.

Alternatively, an airport operator may choose not to serve a specific customer market if it expects that its operating costs will exceed the potential revenues (e.g., when shuttle bus operating costs exceed the potential parking revenue). This may occur when an off-airport parking operator is able to offer very low rates.

For example, in 2006, daily parking rates at the long-term parking facility at San Francisco International Airport were reduced from \$13 to \$12 in a market where off-airport parking operators were charging \$13 to \$15 a day. When airport rates were reduced, off-airport parking operators responded with coupons and discount programs, but airport management reported that on-airport parking use increased about 27% and revenues increased 15% to 20% due to increased market share.

## Implementation Actions

Implementation actions include establishing and adopting policies addressing parking operations and revenues.

## Key Considerations

1. The proportion of parking spaces operated by privately operated parking providers located near the airport and their rates (both published and discount rates).
2. The availability of property near the airport for parking development, both short duration and long duration.
3. Management's policy on the extent of cooperation versus competition with privately operated parking providers near the airport. (Some airport operators, particularly those with small sites or constrained terminal areas, consider privately operated parking providers to be "partners" with the airport.)

## Implementation Costs

The key costs are for required staff time to obtain management and board/commission approvals.

## Ongoing O&M Costs

No ongoing O&M costs are associated with strategic pricing initiatives.

## Implementation Schedule

It is estimated that the total time to implement, including the actions required to obtain management approval may be from 1 to 12 months or more, depending on the approval process and need for public meetings.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- All duration-based parking products in Category A and
- Parking Rate Adjustments (F.1).

## Examples of Application

Specific policies regarding strategic parking pricing to compete with privately operated parking providers near the airport have been established at the airports serving Albuquerque, Austin, Dallas/Fort Worth, Norfolk, Raleigh-Durham, Sacramento, San Francisco, and Tucson. The airports serving Brussels, Munich, and Paris offer weekly, biweekly, vacation parking, and other products to attract customers who might not otherwise have parked at the airport.

## F.3 Web-Based Reservations

### Purpose

Improve customer service by allowing customers to reserve spaces over the Internet. Increase revenues and provide for the prepayment of parking fees.

### Use by Customers

Using an airport operator's website (or a site hosted by a private company on behalf of the airport enterprise), customers choose from a menu of parking options, select, reserve, and pay for their desired product and any additional services in advance, just as they would reserve a rental car, hotel room, or airline seat. Typically, customers must reserve spaces 72 hours in advance of their arrival at the airport. Upon their return from their trip, customers can exit faster, as their fees were prepaid.

Most parking reservation systems require a customer to prepay using a credit card, which may be verified upon entry and exit. The reservation system in use at Manchester Airport (U.K.) requires customers to also enter their license plate numbers, which are read by a license plate recognition system (see Section E.6) upon entry and exit, and used to calculate parking fees.

At most airports, customers pay the standard duration-based parking fees. However, at some airports, customers who prepay receive a discounted fee that may be up to 50% less expensive than the standard rate.

### Benefits

Potential benefits are reported to include

- Increased revenues, because web-based reservation systems
  - Allow airport operators to intercept or attract customers who might otherwise use the Internet to reserve space at an off-airport parking facility.
 

It is reported that 80% of airport parking customers select their parking product prior to arriving at the airport.
  - Promote premium services, including car care services. Customers are likely to purchase a parking product based on value, even if the price is higher, if they are offered more services or more choices at the time they make their parking decision.
- Improved customer service and convenience, particularly at airports where parking facilities (or preferred parking facilities) are frequently full.
- Increased awareness, and thus use, of economy or reduced-rate surface lots.



- Increased revenues from customers who prepay for advanced reservations. In addition, some parking operators charge cancellation fees.
- Ability to develop a customer database, using reservation data, which can be used for marketing, customer feedback, and other purposes.

## Implementation Actions

Implementation actions include

1. Prepare a benefit-cost analysis comparing the estimated increase in parking revenues with the costs of establishing and maintaining the web-based reservation system. If using software provided by a private party, consider the costs of this service. Also consider customer service goals and objectives.
2. Determine the basic design and content of the website. It should clearly present a detailed explanation of the products and services offered, the standard rates, and available discounts (if any).
3. Acquire or develop the necessary software to manage the website. Several businesses manage airport parking reservation websites for a fee, which eliminates the need to develop an independent website.
4. Integrate the airport's parking access and revenue control system and audit records with the web-based reservation software.
5. Ideally, the website is partnered with complementary websites, such as those of the major airlines serving an airport or major travel websites (e.g., Orbitz, Expedia, etc.) so that, when prospective customers are looking for air travel or airport services, they will be exposed to the airport parking website.
6. Assure that adequate spaces are available for customers with reservations. At Manchester Airport (U.K.), about 10% of the total available public parking spaces are typically dedicated to prepaid web-based reservations.

## Key Considerations

Those identified by airport operators include

1. Decide whether or not to integrate valet parking services into the system.
2. Consider allowances for cancellations and any fees for cancelled reservations.
3. Identify appropriate number of spaces to be set aside for reservations.
4. Determine whether to charge customers who prebook a discounted fee. At Manchester Airport (U.K.), the discount may be up to 50% less than the standard rate, depending on the facility and the parking duration.

5. Determine process for identifying entering customers holding reservations.

With one method, customers enter and exit using the credit card used to reserve the space. When customers enter, the system recognizes the credit card and grants access to the customer. Upon exit, the system checks the reservation database to ensure that customers have not exceeded the duration of their reservation. If they have, the system then charges the credit card the appropriate additional fees.

6. Confirm the reliability and performance history of the software provider.

## Implementation Costs

Costs include those for staff time to design the web page and third-party costs incurred to develop the necessary software to manage the website. The costs of developing software in-house were reported by one operator to be "reasonable." The operator of Detroit Metropolitan Wayne County Airport, which has implemented a web-based reservations system for its guaranteed space program (Select Park), paid about \$418,000 for the necessary software upgrade to its existing parking revenue control system.

## Ongoing O&M Costs

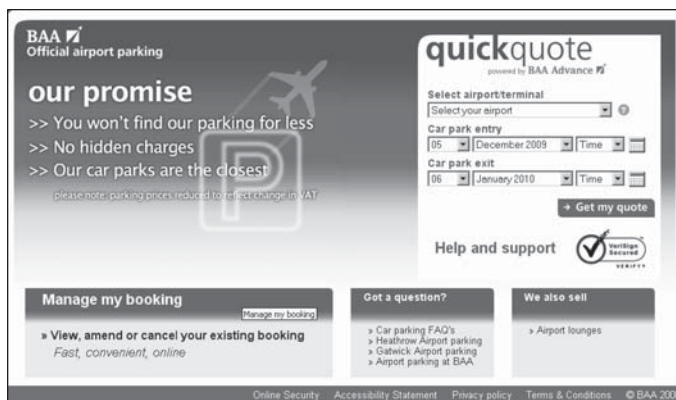
Ongoing O&M costs are negligible, if performed by airport staff (as opposed to by an outside contractor). One private company stated that its standard fees for providing the "engine" for the website, providing airport staff with management reports, and paying website commissions to publicize the service on the Internet consist of a service fee of \$5 per reservation (paid by the customer at the time the reservation is made) plus the parking revenues from the first day of parking. Customers using AirportParkingReservations.com are charged an \$8 service fee.

## Implementation Schedule

It was reported that up to 24 months were required to acquire and install the reservation system, including obtaining management approval.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Monthly Billing—Pay per Use (B.6),
- Reserved Parking Zone—Pay per Use (B.7),
- Guaranteed Space—Unlimited Use (B.8),
- Vehicle Washing and Servicing (C.1),
- Loyalty Programs (C.5),



Source: British Airports Authority.

**Figure F.3.** Home page of British Airports Authority's Web-based parking reservation system.

- Credit Card In/Out (E.2),
- License Plate Recognition (E.6),
- Parking Rate Adjustments (F.1), and
- Yield Management (F.4).

## Examples of Application

Customers can reserve parking spaces at the airport serving Detroit (scheduled for summer 2009) and at many European airports, including those serving Dublin, Frankfurt, London, Manchester, Munich, Paris, and other airports operated by BAA plc, and at many privately operated off-airport parking facilities throughout North America.

An example of a privately hosted site is AirportParkingReservations.com (which serves privately operated off-airport parking facilities) and its subsidiary ParkingUSA.com (which intends to serve airport-operated parking facilities). The management of ParkingUSA indicates that its services were briefly used on a test basis at Fort Lauderdale/Hollywood International Airport, and that negotiations with several airport operators were under way at the time this report was prepared.

Some websites (e.g., the sites maintained by Aeroports de Paris for Charles de Gaulle International and Orly airports) display not only parking rates and reservation information, but also travel times, walking distances, and the availability and frequency of bus or people-mover service for each parking product. See Figure F.3.

## F.4 Yield Management

### Purpose

Enhance revenues by varying the cost of parking to reflect actual or predicted space availability and customer demand.

### Use by Customers

Using an airport operator's website (or a site hosted by a private company on behalf of the airport operator), customers select, reserve, and pay in advance for the desired parking product and services (as they would with any web-based reservation system). Upon returning from their trip, customers can exit faster, because they have prepaid.

With yield management, the fee that a customer is quoted varies depending on when the reservation is made and the number of spaces available (or expected to be available)—unlike traditional fixed-fee parking products. Typically, the parking rate increases as the arrival date approaches and the predicted occupancy of the facility nears capacity.

### Benefits

Potential benefits are reported to include

- Increased revenues, similar to the improvements experienced by other travel-oriented businesses that have used yield management techniques (e.g., airlines, rental car companies, and hotel operators). Data on the extent of the revenue increases were not available from individual airport operators.
- Managed demand by adjusting daily rates to attract or discourage additional customers.
- Improved service (reduced costs) to those customers who reserve spaces in advance.
- Improved revenue because customers are more likely to request additional value-added services.

### Implementation Actions

Implementation actions are reported to include

1. Decide whether to acquire the necessary software or develop the software using in-house resources. Most airport operators use commercially available software, but Fraport AG, the operator of Frankfurt Airport, developed their software in-house.
2. Issue an RFP or request for bids to vendors qualified to furnish the software or to operate the yield management system on behalf of the airport.
3. Integrate the airport's parking access and revenue control system and audit records with the web-based reservation software.
4. Use historical parking activity data and airline passenger data to forecast parking demand, then compare the forecasts with actual demand on a real-time basis. Adjust rates as necessary to manage demand to maximize revenues or balance the use of available facilities.

5. Modify the (existing) web-based reservation system to accommodate yield management.

## Key Considerations

Those identified by airport operators include

1. System requirements. Requires a web-based reservation system. Web-based reservations are a natural introduction to this product.
2. Audit management. Auditors at one airport were concerned because, with variable pricing/yield management, the revenue associated with each ticket varies not only by parking duration and location, as with a static ticket, but also according to the date/time the ticket was issued. Vendors indicate that available software addresses this concern.
3. Customer confusion and potential dissatisfaction. Some operators were concerned that customers used to static prices may not understand why they are not quoted the same rate every time they use a parking facility. However, the airline, hotel, and rental car industries appear to have addressed this issue.
4. Prior approval of rate changes. At most publicly operated airports, changes in parking rates must first be approved by an airport board or commission—a process

that can require several months or more. With a yield management program, the airport parking operator must have the authority to vary the rates instantaneously (within a fixed range) without prior approval of the board or commission.

## Implementation Costs

Implementation costs are expected to be limited to the costs of implementing a web-based reservation system.

## Ongoing O&M Costs

Ongoing O&M costs are associated, initially, with one staff member being available to predict daily space occupancies and determine future rates, but this task can be increasingly automated. Alternatively, the services of a software vendor or third-party contractor can be used. The costs of these services were unavailable.

## Implementation Schedule

It is estimated that implementation, assuming that a reliable web-based reservation system is already in operation, may require 6 months or more depending on the time required to obtain management approval.

Source: Frankfurt Airport.

**Figure F.4.** Home page of Frankfurt Airport's parking reservation webpage, which varies (or manages) parking rates in response to anticipated customer demand.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Monthly Billing—Pay per Use (B.6),
- Reserved Parking Zone—Pay per Use (B.7),
- Guaranteed Space—Unlimited Use (B.8),
- Loyalty Programs (C.5),
- Credit Card In/Out (E.2),
- Web-Based Reservations (F.3).

## Examples of Application

Airports where yield management is implemented include Frankfurt Airport (software developed in-house), several airports in the United Kingdom (e.g., Glasgow-Prestwick, Leeds-Bradford), and the airport serving Copenhagen. The services of Chauntry, Ltd. are used at each of these airports, with the exception of Frankfurt Airport (see Figure F.4), to develop and host the website for the airport parking reservation system and to furnish the dynamic pricing software.

Examples of parking facilities using yield management can also be found in downtown locations or locations serving special events. Rates in facilities serving downtown areas or special events may be adjusted based on the operator's experience, and may not be linked to a web-based reservation system; therefore, they typically do not require the sophisticated yield management software that may be required of an airport application.

## F.5 Coupons

### Purpose

Enhance revenues by increasing market share. Improve customer service.

### Use by Customers

Customers may obtain airport parking coupons from an airport website (increasingly popular), direct mail (e.g., Valpak), travel agents, airport staff (as they enter or exit a parking facility), or other sources. Some parking operators accept coupons issued by competitors. When opening parking facilities at new locations, some operators (particularly private businesses) offer discounts to customers who present a receipt demonstrating that they previously used a competitive product.

### Benefits

Potential benefits as reported by airport operators include

- Improved market share and, therefore, revenues, particularly at airports where off-airport parking providers serve a large share of the total market.

- Increased revenues by encouraging customers to move “up market” by allowing them to try, and hopefully continue to use, a higher-priced product.

For example, to promote the use of a premium parking product, Dallas/Fort Worth (DFW) staff regularly issue discount coupons to customers exiting lower priced parking products. These coupons allow customers to park in a premium area at a cost that is only slightly greater than what they just paid for parking in an economy area. Follow-up interviews indicated that 10% to 30% of the customers, depending on which parking product they formerly used, reported that they were likely to use the premium product again.

- Increased awareness of airport parking products (e.g., when coupons are for a specific product).
- Encouraged use of “park and stay” versus “pick up/drop off” (patrons parking for less than 30 minutes) by distributing coupons to these customers.

At DFW, over 150,000 discount coupons were distributed to short-duration parkers with 3% returned (i.e., used by customers). Analysis of parking data indicated that this resulted in a reduction in drop off/pick up customers and about a 5% increase in parking revenues.

- Improved customer service by providing compensation to customers required to use less convenient parking when preferred parking areas are full.
- Improved customer database (when coupons are offered via the Internet), which can be used to market to targeted customers or assess customer opinions of existing or proposed parking products.

## Implementation Actions

Implementation actions were reported to include

1. Determine which parking product(s) to promote and develop, and issue coupons directed toward the intended customers (e.g., curbside users).
2. Determine amount of discount. Typically coupons offer a 10% discount, a seventh day free, or a discount of \$3 or less.
3. Offer coupons through the airport website. Coupons can be issued by sequential number, by e-mailing coupons to customers upon request, or by allowing customers to print their own coupons.
4. Assure that the parking revenue control system can accept coupons.
5. Develop a method for cashiers to validate coupons and assure that they cannot be reused improperly.
6. Determine the duration of the coupon program. Often coupons are used for a brief promotional period, although some parking facilities have permanent coupon programs.



## Key Considerations

Those identified by airport operators include

1. Compatibility with the revenue control system.
2. Days of the week when coupons are to be issued. Many airport operators issue tickets that are good for all dates. Others issue coupons good for specific dates to target specific markets (e.g., midweek business travelers).
3. Use of staff to issue discount coupons to existing customers rather than distributing coupons through the Internet or other means. DFW management believes that issuing discount coupons to existing customers allows coupons to be issued to “targeted” markets, and results in greater trust as customers tend to trust people handing out coupons who can answer questions and give them “peace of mind,” versus electronic distribution methods.
4. Some airport operators have experienced difficulty when the airport marketing department, rather than the parking department, was responsible for managing a parking coupon program, since marketing staff may not be sensitive to parking operations or customer needs.
5. Some airport operators have experienced difficulty when the parking management contractor or concessionaire, rather than airport staff, were responsible for overseeing a coupon program, since these companies may have different objectives than the airport operator.
6. There is a risk to revenues if coupons are not properly managed and secured.



Source: Dallas/Fort Worth International Airport.

**Figure F.5a. Parking coupon.**

## Implementation Costs

The costs of implementation are reported to be minimal. The primary costs are for printing, advertising, distributing the coupons, and—most importantly—the revenues “lost” because customers are able to park at reduced rates. Several airport operators believe that they were compensated for lost revenues by increased market shares or customers moving up-market.

## Ongoing O&M Costs

Ongoing O&M costs are reported to be minimal. Printing (e.g., if coupons are to be distributed through a service like Valpak), distributing, and managing the coupon system (including distributing coupons to existing customers) are typically the responsibility of current staff.

## Implementation Schedule

It is estimated that the total time to implement, including obtaining management approval is about 4 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Daily Parking (A.2),
- Economy/Long-Duration Parking (A.3),
- Business Parking (B.5),
- Reserved Parking Zone—Pay per Use (B.7), and
- Loyalty Programs (C.5).



Source: AMPCO.

**Figure F.5b. Parking discount coupon.**



## Examples of Application

Airports where coupons are issued include those serving Baltimore, Cincinnati, Dallas/Fort Worth, and Omaha. Customers purchasing a ticket through the airport website at Capital Region International Airport (Lansing, MI) receive a coupon for a 50% discount off their airport parking fees. Web-based coupons were issued at San Francisco and Oakland International Airports, but they were discontinued because of management changes. See Figures F.5a and F.5b.

## F.6 Advertising Sales—Interior, Exterior, Tickets, and Equipment

### Purpose

Increase revenues by increasing customer awareness of, and willingness to use, airport parking products.

### Use by Customers

Airport parking facilities are viewed by thousands of airline passengers and parking customers each day. The average income of airline passengers is greater than that of the general public and many passengers are decision makers for businesses, government agencies, and other institutions. Thus, these customers represent an attractive market for companies wishing to advertise their products and services, and willing to lease highly visible space on an airport to do so.

Advertisements can be placed within parking facilities on interior walls (e.g., in high-traffic areas, including walls and elevator doors); on exterior walls (e.g., parking wraps or three-dimensional objects); on the reverse side of parking tickets and receipts; on the reverse side of space reminder cards; on gate arms or other parking equipment; or on parking stripes, parking barriers, or other locations within a parking facility. Advertisements also can be placed within airport parking shuttle buses. In addition, an airport operator can sell the naming rights to a parking facility (e.g., Charlotte Douglas International Airport's T-Mobile Cell Phone Lot) or a single level.

### Benefits

Potential benefits are reported to include

- Increased revenue without the need to adjust parking rates. The Greater Toronto Airports Authority receives about CAN \$36,000 per year from advertisements placed on gate arms, column wraps, and pavement stripes.

- Increased airport revenues, while requiring little investment by the airport operator.
- Improved customer service, if wayfinding is improved by the use of facility names or visual clues provided by advertisement(s).

## Implementation Actions

Implementation actions are reported to include

1. Document the volume of customers using the parking facility on a daily or annual basis. Document the demographics (e.g., average household income, trip purpose, place of residence) of the typical customer who will be exposed to the advertisements.
2. Determine the type and extent of advertisements. Some airport operators prefer to limit advertisements because of concerns about aesthetics or visual distractions, while others seek to maximize revenue opportunities.
3. Determine if the existing advertising concessionaire (e.g., the company responsible for soliciting and placing advertisements inside the terminal) has rights to advertisements placed in or on parking facilities.
4. Develop an RFP or bid document describing proposed business terms/concession fees. Concession fees for in-terminal advertisements are typically 50% to 75% of gross revenues.
5. Establish an advertising policy if one does not already exist. It is important to establish a policy indicating those products, services, and messages that the airport operator will not allow to be advertised or displayed.
6. Solicit bids or proposals and award the concession contract.

## Key Considerations

Those identified by airport operators include

1. Amount of rent. The airport operator may wish to consider charging lower concession fees if it wishes to maintain design control, if the installation will require construction, or if the airport operator wishes to have ultimate ownership of the new fixture(s). Alternatively, lower rents can be charged during the initial months to allow the advertiser to recoup its investment.
2. Length of term. As with in-terminal and other concession contracts, the length of the term should be consistent with the amount of the investment required by the concessionaire.

The Greater Toronto Airports Authority receives 40% of the revenues derived from column wraps and pavement stripes, and 40%—increasing over the term of the agreement

to 50%—of the revenues derived from advertisements on gate arms.

### Implementation Costs

Implementation costs are minimal, since they typically are borne by the concessionaire.

### Ongoing O&M Costs

There are no ongoing O&M costs, as they are the responsibility of the concessionaire.

### Implementation Schedule

It is estimated that the total time to implement, including obtaining management approval would be less than 4 months depending on the time required to prepare, advertise, and award a concession contract.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- Space Locators (D.9) and
- Branding (F.7).

### Examples of Application

Many airports have advertisements or promotions for airport-owned concessions, airlines, or other services within parking facilities (see Figures F.6a and F.6b). Advertising displays in parking facilities are more common in Europe and



Source: Jacobs Consultancy.

**Figure F.6a.** Athens International Airport.



Source: Jacobs Consultancy.

**Figure F.6b.** Honolulu International Airport.

other overseas locations than they are at U.S. airports. Examples of North American airports with advertising concessions include

1. Interior walls and/or column wraps—Honolulu International Airport and Toronto's Pearson International Airport.
2. Exterior walls—New York's LaGuardia Airport (façade of Central Garage facing Grand Central Parkway) and San Francisco International Airport (exterior of an elevator/stair core). Non-airport garages also display advertisements on exterior walls (Figure F.6c).
3. Reverse side of parking tickets—Orlando International Airport and numerous non-airport locations.



Source: AP Photo/Mark Duncan.

**Figure F.6c.** Quicken Loans Arena in Cleveland.

4. Reverse side of space reminder cards—San Francisco International Airport.
5. Gate arms or other parking equipment—Toronto’s Pearson, Calgary, and Vancouver international airports.
6. Parking barriers and pavement markings—No airports where advertisements are placed on wheel stops or barriers or pavement markings were identified, but such advertisements are placed in parking lots serving grocery stores, drugstore chains, entertainment venues, big-box electronic stores, and home and hardware stores.
7. Naming rights—Several airport operators have sold naming rights for an entire parking facility (e.g., the T-Mobile Cell Phone Lot at Charlotte Douglas International Airport) or for portions of a parking facility (e.g., previously, each level of a parking structure at McCarran International Airport).

## F.7 Branding

### Purpose

Improve revenues by using name brand(s) to help customers select from available parking products located on and off the airport. Improve wayfinding by helping customers recall where they parked their vehicles.

### Use by Customers

There are two distinct types of branding. The first is the use of a name that clearly conveys the product being offered. The second is the use of a name that will help customers remember where they parked.

1. Product offering. Branding should convey the perceived value or benefit of a product. The brand name should help customers understand how a product differs from other available products.

For example, names such as *Red Lot*, *Lot D*, *East Lot*, or *Satellite Parking* do not indicate how a parking facility differs from other options. Names such as *Remote Parking* or *Shuttle Parking* may be accurate, but may not convey a positive message, while a *Park ’n Ride Lot* can easily be confused with a commuter parking lot. Generally, *Economy Parking* or *Discount Parking* is preferred. Using the airport’s call sign in the brand can also be useful (e.g., *ParkSFO*, *DIAPark*). It should be noted that these specific examples are privately operated lots.

2. Wayfinding. Use of a naming convention helps customers remember where they parked within a large facility. Combinations of colors, symbols (e.g., flowers or animals), and numbers are often used to support wayfinding.

Names of animals (*Coyote Lot*, *Dolphin Garage*), local features (*Mt. Elbert*, *Blue Deck*), or street names (*Terminal Road Garage*) help customers remember where they parked, but do not indicate the value of a product or distinguish it from other parking options. Similarly, names such as *Fast Class* or *Peanut Lot* do not clearly indicate the product offered.

### Benefits

Potential benefits are reported to include

- Distinguished parking products (both on and off airport).
- Conveyed level of service and convenience offered, if named properly.
- Improved wayfinding by helping customers recall where they parked.

### Implementation Actions

Implementation actions include

1. Determine what customers want (e.g., type of product) and select potential product name(s) that respond to customer preferences (e.g., cost, convenience, covered spaces) and wayfinding needs.
2. Consider whether to brand a single product or the entire menu of available parking products.
3. Determine the product’s distinguishing features and select a large number of potential names.
4. Test these names with persons who are not familiar with the parking facilities (e.g., use a focus group) and select the preferred name.

Often the services of an advertising or marketing firm are used to supplement those of airport staff.

### Key Considerations

It is reported that considerations when branding a product include

1. Make it easy to remember and recognize the product.
2. Attract attention.
3. Suggest product benefits or suggest use.
4. Distinguish the product from the competition.

For example, private operators have selected brand names such as *Park’nFly*, *Easy Park*, *FastPark*, *Parking Spot*, or *Express Park*. The airport parking facility brand names most commonly used are *Hourly*, *Daily*, and *Economy Parking*.

### Implementation Costs

The primary costs are reported to be for the time of staff or marketing consultants who select the name(s) and the costs



of signs, advertisements, or websites used to promote the names. Wayfinding names are generally selected during the design of a new or modified parking facility, with the costs of installation included in the construction costs.

### Ongoing O&M Costs

Ongoing O&M costs are minimal.

### Implementation Schedule

The implementation schedule can vary from 1 month to 6 months or more, depending on the number of people who must approve the names.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- All duration-based parking products in Category A,
- All value-added parking products in Category B,
- Vehicle Washing and Servicing (C.1),



Figure F.7a. Charles de Gaulle International Airport.



Source: Jacobs Consultancy.

Figure F.7b. Chicago O'Hare International Airport.



Source: Jacobs Consultancy.

Figure F.7c. Chicago O'Hare International Airport.

- Concierge Services (C.2),
- Onsite Sale of Food, Beverages, and Other Products (C.3),
- Pre-Ordered In-Flight Meals to Go (C.4),
- Loyalty Programs (Frequent Parker Programs) (C.5),
- Pet Kennels (C.8),
- Shaded Spaces (C.9), and
- Electric Charging Stations (C.11).

## Examples of Application

All airport parking products have brands and names (see Figures F.7a through F.7c). Many have distinctive names for the value-added or complementary products they offer. Airports with distinctive names for duration-based parking products include

- George Bush Intercontinental Airport's *Parking Cents* in Houston;
- Chicago O'Hare International Airport, where each level of the central parking garage is named after a local professional sports team;
- Lambert St. Louis International Airport's *SurePark*;
- Minneapolis-St. Paul International Airport's *MSP Value Parking* at the Humphrey Terminal; and
- Toronto's Pearson International Airport *Discount Parking*.

## F.8 Marketing

### Purpose

Increase revenues by creating high-value, but appropriately priced parking products, and by communicating the availability of these products to prospective customers.

### Use by Customers

Unlike many other strategies described in this report, customers do not “use” marketing, but marketing improves customer awareness of the available products and allows customers to benefit (i.e., make informed choices) by using the information provided.

### Benefits

Potential benefits include improved revenues, market share, and customer service.

### Implementation Actions

This brief summary is not intended to present a comprehensive description of a marketing program, or the steps required

to prepare a marketing plan. Numerous widely available books, articles, and other publications address these topics.

A marketing strategy provides a comprehensive plan that, when implemented, allows an airport operator to make the choices that will achieve its overall objectives (e.g., balance between improved customer service and improved net revenues). Since a single airport parking product cannot meet the price and service preferences of all customers, the marketing strategy determines which customers the airport operator wishes to target with each product, the value it will deliver from these customers, and the tactical marketing mix.

The tactical marketing mix—“the four Ps” of marketing—are product, pricing, placement, and promotion. As applied to airport public parking operations, a marketing plan provides a comprehensive strategic plan addressing the following:

1. **Product**—An airport parking product consists of a blend of duration-based parking products (i.e., the strategies included in Category A) plus value-added products (Category B) and complementary customer services (Category C). Parking products are designed based on an airport operator's analysis of its customers' needs and preferences, demographics, responses to changes in cost and convenience, and historical daily and seasonal variations in demand.
2. **Pricing**—As applied to airport parking, pricing is the parking rate(s) (or adjustments to existing rates). These rates can be established tactically or strategically (see Sections F.1 and F.2).
3. **Placement**—Placement refers to how the product is delivered to the customer and the environment in which the product is sold. Airport operators have long recognized the importance of (a) locating public parking within a short walk of the terminal (or providing courtesy shuttle service), (b) assuring that customers encounter minimal or no delays upon entering and exiting the parking facilities, (c) locating parking at sites that are readily accessible and visible from the airport entry road, and (d) assuring the safety of customers and their vehicles.
4. **Promotion**—As applied to parking, *promotion* refers to various methods of promoting the product, including a combination of advertising (Section F.6) and branding (Section F.7), potentially supported by web-based reservations (Section F.3) and coupons (Section F.5).

A standard marketing plan addresses

- **Objective**—The relative goals and objectives of the airport operator (e.g., improve customer service, enhance revenues, reduce operating costs).



- **Issues and Analysis**—An assessment of the current situation (strengths, weaknesses, opportunities, and threats), including historical and forecast revenues, transactions, space occupancies, market shares, and potential factors that may alter historical trends.
- **Strategy**—The marketing and financial objectives that, if achieved, will comply with the goals of the airport operator.
- **Implementation**—The specific actions to be performed to achieve the airport operator's objectives, and the schedule for implementing these actions, including changing the existing product mix (if appropriate).

Potential methods to promote products include

1. Sponsorship of public radio programs and advertising during popular sporting events.
2. E-mails to frequent flyers (particularly at airports with a dominant hubbing airline).
3. Airport websites.
4. Billboards located along airport access roadways and within parking facilities.
5. Display of messages on the exterior of airport parking shuttle buses.
6. Discount coupons (see Section F.5).

## Key Considerations

Those identified by airport operators include

1. Establish and document management goals and objectives, and a marketing budget.
2. Determine if the airport operator's advertising and/or marketing consultant has had prior experience with parking facilities.
3. Determine customer perceptions of existing products, parking needs and desires, and evaluation of potential products.

4. Determine the perception of customers using competing products.
5. Design and implement the marketing plan.
6. Test the results of the marketing plan and modify or terminate as appropriate.

## Implementation Costs

The costs of developing and implementing a marketing plan are highly variable, depending on the size of the airport, the local market, and the selected marketing plan. Preparing a marketing plan may cost from \$25,000 to over \$100,000, excluding advertising costs.

## Ongoing O&M Costs

Ongoing O&M costs may include costs for regular customer surveys and periodic updating of written/broadcast messages.

## Implementation Schedule

It is estimated that the total time to conduct and implement a marketing plan, including obtaining management approval of the results, may be 3 to 6 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

Nearly every strategy described in this report could be included in a marketing plan.

## Examples of Application

Airports where marketing plans have been implemented include those serving Atlanta, Houston, San Francisco, and many others.

## CATEGORY G:

# Safety and Security Strategies

- G.1 Visual Surveillance—Camera, 117
- G.2 Emergency Audio Communications, 118

# Safety and Security Strategies

## G.1 Visual Surveillance—Camera

### Purpose

Improve customer service by providing a deterrent to crimes against persons and property. Detect incidents in progress. Increase the likelihood that a perpetrator can be identified, arrested, and convicted.

### Use by Customers

Video surveillance through a closed-circuit television (CCTV) system can be effective for monitoring activity in a large area from a single point. No action by the customer is required to signal the CCTV system. When a suspicious person or incident is detected, or a door alarm is received, the person monitoring the CCTV system identifies the location and directs a responding security officer to the scene. A corresponding intercom system can be used to ward off the offender and inform the victim that assistance is forthcoming. Behavior-recognition technology can be integrated with CCTV systems to detect and alert security staff to suspicious behavior, such as a person lurking or fallen, or to other situations, such as two people about to converge. Such a system can monitor an entire network of CCTV cameras, filtering out the mundane and reducing the tedium of manually monitoring the system.

### Benefits

Benefits of a CCTV system may include

- Deterrence of crime, as the potential perpetrator may sense an increased possibility of being observed and apprehended.
- A greater sense of safety among parking patrons.
- Enhanced ability to apprehend and prosecute the perpetrators of crimes against persons or property, since the system can record an accurate depiction of the suspect and vehicle involved.

### Implementation Actions

1. Conduct a security audit to analyze the risk of different incident types and classify the parking facility as to its risk level.
2. Assure that all passive security features are incorporated into the facility to the maximum extent possible. Passive security measures are a physical part of the facility and enhance visibility—the ability to see and to be seen.
3. Determine which active security measures are necessary. Active security measures are those that invoke a human response and include security patrols, emergency audio communications, and CCTV.
4. If the need for CCTV is determined, procure the system with the assistance of appropriate security consultants/designers and system vendors.

### Key Considerations

1. Cameras must be positioned to effectively cover all areas of interest. The mounting locations must be carefully selected. Lighting variations, external light sources, vehicles, ramps, and structural features can all restrict the ability to effectively monitor the areas of interest.
2. The central CCTV monitoring station, including the operator monitoring the system, should be visible to parking patrons, if possible.
3. Several strategically located, high-capability cameras with pan/tilt/zoom capabilities will enhance the efficiency of the system.
4. The traditional rectangular housing protects only the camera and lens, but a domed circular housing covers and protects the entire assembly.

### Implementation Costs

Implementation costs include those for the CCTV system, the central monitoring station, and the personnel required to monitor the system and respond to incidents.

## Ongoing O&M Costs

CCTV systems require maintenance and upkeep to maintain picture quality and reliability. Associated personnel costs are also ongoing.

## Implementation Schedule

The schedule for planning, design, procurement, and installation of a CCTV system is typically 6 to 12 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Emergency Audio Communications (G.2).

## Examples of Application

Many airport parking facilities in the United States, as well as in other countries, have CCTV surveillance systems (see Figure G.1).



Source: Jacobs Consultancy.

**Figure G.1.** CCTV surveillance.

## G.2 Emergency Audio Communications

### Purpose

Improve customer safety and security by serving as a deterrent to crimes against persons and property, and hasten the response of security personnel to an incident.

### Use by Customers

Emergency audio communications can be provided by panic buttons, emergency telephones, or two-way intercoms. A call box with a panic button and a two-way intercom is the most common communication system for security purposes in parking facilities. The push-button calls an attendant and a two-way conversation can ensue. The attendant can mobilize an emergency responder. Panic buttons and intercoms are often mounted on freestanding pedestals, and blue lights with strobe effects have become common to make them easy to locate and to attract attention in case of an emergency. Use of a panic button or emergency intercom is dependent on the ability of a victim of an attack to reach the device and sound the alarm.

Intercoms are often used in conjunction with panic buttons, motion or sound surveillance, or CCTV to enhance the effectiveness of the overall system. If integrated with a CCTV system, a camera is automatically trained on the area when the call box is activated.

### Benefits

Benefits of an emergency audio communications system may include

- Deterrence of crime, as potential perpetrators may sense a decreased probability of success.
- A greater sense of safety among parking patrons.
- Enhanced ability for emergency responders to detect and respond to an emergency in the parking facility in a timely manner.

### Implementation Actions

1. Conduct a security audit to analyze the risk of different incident types and classify the parking facility as to its risk level.
2. Assure that all passive security features are incorporated into the facility to the maximum extent possible. Passive security measures are a physical part of the facility and enhance visibility—the ability to see and to be seen.
3. Determine which active security measures are necessary. Active security measures are those that invoke a human

response and include security patrols, emergency audio communications, and CCTV.

4. If the need for emergency audio communications is determined, procure the system with the assistance of appropriate security consultants/designers and system vendors.

## Key Considerations

1. Call boxes or voice-activated intercoms with panic buttons are often located in elevators, elevator lobbies, and stairwells, and sometimes in parking areas. Two-way intercoms also are generally installed in all cashier booths and at all unstaffed entry and exit lanes.
2. Standard voice-activated systems are generally not practical in parking areas because of background noise.
3. Two-way intercoms make it possible to zero in on an incident and communicate to the victim that help is on the way, possibly deterring the perpetrator.
4. Panic buttons can be subject to abuse by vandals, leading to a “cry wolf” syndrome among those monitoring the system. CCTV coverage in the area surrounding a panic button discourages false alarms.

## Implementation Costs

Implementation costs include those for the audio communications system, the central monitoring station, and the personnel required to monitor the system and respond to incidents.

## Ongoing O&M Costs

Audio communications systems require maintenance and upkeep to maintain functionality and reliability. Associated personnel costs are also ongoing.

## Implementation Schedule

The schedule for planning, design, procurement, and installation of an audio communications system is typically 6 to 12 months.

## Supporting and Complementary Strategies and Technologies in This Guidebook

- Visual Surveillance—Camera (G.1).

## Examples of Application

Many airport parking facilities in the United States, as well as in other countries, have emergency audio communications systems (see Figures G.2a and G.2b).



Source: Walker Parking Consultants.

**Figure G.2a.** Emergency callbox at Ronald Reagan Washington National Airport.



Source: Jacobs Consultancy.

**Figure G.2b.** Minneapolis-St. Paul International Airport emergency communications system.



## CATEGORY H:

# Operational Enhancements

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# Operational Enhancements

## H.1 Parking Facility Operation Options

### Purpose

Improve or maintain customer service and net revenues by selecting a parking operations method that reflects the airport operator's tolerance of financial risk and available staff expertise.

### Use by Customers

Customers do not “use” the parking facility operation options, but the level of service they are provided can be affected by the operations method used.

### Overview of Options

Public parking facilities at airports are generally operated using one of three methods: (1) self-operation, (2) management agreement, or (3) concession contract. Airport parking operational elements include fiscal oversight/accounting, and audit; parking lot operations/customer service; revenue control systems operation and maintenance; shuttle bus/transportation operations; and employee parking. At some airports, these elements are operated using a single method (e.g., parking management agreement), while at other airports, multiple methods are used (e.g., shuttle buses are operated using a management agreement, while parking lots are operated using a concession contract, and the revenue control equipment is maintained by airport staff).

### Overview of Methods of Operation

An overview of the three most commonly used operating methods and a comparison of their advantages and disadvantages is provided in this section. Although there are many hybrids and variations of these methods, for simplicity purposes, only the three most commonly used or basic methods are described here.

**Self Operation.** All staff responsible for the day-to-day operation of the airport parking facilities are employees of the airport operator, including cashiers, shift supervisors, audit and office staff, and the parking manager(s). On a day-to-day basis, airport staff define and directly manage customer service standards, monthly and annual budgets, revenue control procedures, and all other aspects of the parking operation. Airport operator policies and procedures, as well as local ordinances, are used to govern daily operations.

The airport enterprise retains all revenues, but pays all capital and operating costs. Since all parking staff are employees of the airport operator, their salaries and benefits, and work rules (e.g., grounds for dismissal) are the same as those of other airport employees.

**Parking Management Agreement.** All staff responsible for the day-to-day operations of the airport parking facilities are employees of a professional parking management company. The management company's responsibilities are defined by a management agreement with the airport. Airport policies and local ordinances are augmented by the agreement, which may include standard operating procedures governing daily parking operations.

The management company may provide every element of parking management—including shuttle bus operations—or just one element. Companies are generally competitively selected based on their qualifications and designated parking manager and key staff.

The airport enterprise retains all revenues less the approved direct costs of the management company and the agreed-upon management fee. Direct costs include staff salaries and benefits, approved overhead, and the costs of uniforms, office furniture and supplies, and required vehicles. Management agreements may include incentives and penalty clauses to encourage the desired levels of customer service, safety, and revenue control.

The appropriate airport staff review and approve the management company's annual budget, staff assignments, and labor schedule and establish standards for operation and revenue collection procedures. Agreements also define an airport operator's right to regularly audit revenues and revenue collection procedures.

A management agreement requires that the airport operator oversee the contractor's compliance with the established standards and procedures, instruct the contractor to modify staff schedules or hours (e.g., in response to anticipated changes in customer activity), and assure that the contractor is operating efficiently. As such, airport operators using management agreements typically employ one or more full-time staff with experience in parking operations to oversee the management contractor.

**Parking Concession Contract.** All staff responsible for the day-to-day operation of the airport parking facilities are employees of a qualified parking company (or concessionaire). The concessionaire's responsibilities are defined by a contract with the airport operator. Airport policies and local ordinances are augmented by the contract, which typically defines the minimum customer service standards and other aspects of parking operations.

The concessionaire may provide just one element of the parking operation, but frequently provides every element. Companies are generally competitively selected using a bid process based on a minimum annual guarantee (MAG) amount bid, with the percentage to be retained by the airport enterprise stated in the bid documents.

The concessionaire retains a percentage of total gross revenues (e.g., 5% to 15%) and agrees to pay the airport operator a MAG. The concession contracts include the airport operator's right to audit the concession revenues and revenue collection procedures.

A concession contract requires that the airport operator audit the reported revenues and enforce compliance with the customer service standards and other contract provisions. As such, airport operators using concessions contracts require fewer staff resources and less experienced staff than a self operation or a management agreement because the concessionaire frequently is responsible for every element of the parking operation.

### *Overview of Operational Elements*

Some airport operators manage all elements of a parking operation under a single contract to achieve economies of scale, while others prefer using multiple contracts to allow for specialization and to provide a system of cross checks and bal-

ances. Each element may present an opportunity to involve small or disadvantaged business enterprises (S/DBEs).

The five operational elements are described as follows:

1. **Fiscal Oversight, Accounting, and Audit** may range from daily oversight of cash handling/credit card processing to annual audits. Oversight may be retained by airport staff or contracted to an independent third-party firm.
2. **Parking Lot Operations/Customer Service** represents the largest portion of daily operations. Tasks include fee collection, traffic direction, customer service and assistance, signage, safety and security, and facility cleaning and maintenance.
3. **Revenue Control Systems Operation and Maintenance** components include daily system hardware and software repair, programming, and maintenance of ticket-issuing machines, ticket readers, gate arms, and other equipment; ticket control and stocking; and license plate inventory. Some of these components may be retained in-house or provided by revenue control system manufacturers and installers. Separation of the maintenance, repair, and programming of the revenue control systems from the daily operations adds a desirable revenue control check and balance.
4. **Shuttle Bus/Transportation Operations** include transportation of customers to and from public parking lots, employee parking lots, and special event or holiday lots. Transportation operations may be subdivided into separate elements of bus driving operations and bus maintenance and repair operations. Key decisions include assignment of the responsibilities for bus maintenance, bus acquisition, and fuel purchase. Some airport operators that have qualified bus mechanics prefer to perform maintenance in-house, while others prefer to use outside resources. Often cost savings can be realized by the airport operator purchasing shuttle buses and fuel directly rather than requiring a contractor do so, but these cost savings may be offset by the lead time an airport operator requires to purchase a bus.
5. **Employee Parking** facilities are for a different customer base than public parking lots. They are operated differently to meet the needs of these customers (e.g., employees use permits or access cards, not cash or credit cards). This different style of parking operation may present an opportunity to use a separate operational contract for this service.

### *Advantages and Disadvantages of Alternative Operational Methods*

**Self Operation.** Although this operational method clearly provides the airport operator with the highest level of control,

revenue retention, and oversight of daily operations, it also results in the highest costs and risk exposure. The majority of daily parking operation costs are related to staffing. Employee recruitment, training, retention, and benefits costs are generally higher for municipalities or public agencies than for professional management companies. With self operation of the parking facilities, all costs are borne directly by the airport operator instead of being “fronted” by a management company or concessionaire and then partially or wholly reimbursed by the airport enterprise. Self operation also presents the airport operator with the highest level of risk exposure from unsatisfactory or improper revenue collection and controls, customer service levels, or facility operations and maintenance. Self operation requires the highest number of airport staff positions.

**Parking Management Agreement.** These agreements allow an airport operator to take advantage of the professional services of a specialized company and reduce the number of airport staff dedicated to parking. These companies frequently have experience gained through operating airport facilities nationwide as well as operating other publicly and privately owned parking facilities. This experience, combined with the “private employer” status (i.e., lower salary/benefit costs than parking staff employed by an airport or other public agency) often translates to lower costs and thus higher net revenues (compared to the other two operational methods, depending on the salary cost differentials). With this management method, a high degree of risk is contractually shifted away from the airport enterprise to the management company. While reducing costs and shifting risk, this method also lowers the airport operator’s level of direct control over daily operations. The airport enterprise retains all revenues less expenses, but receives no income guarantee from the management company.

As noted, experienced airport staff are required to oversee the parking management company.

**Parking Concession Contract.** This management method allows an airport operator to maximize the experience and financial strength of a professional parking concessionaire. While providing all of the benefits of a professional parking management company described previously, a concession contract provides a MAG, minimizes the airport operator’s risk exposure, and requires the lowest number of airport staff positions and level of parking expertise. Concession contracts may minimize the airport operator’s level of direct control of daily operations, but they maximize the entrepreneurial expertise of the private concession contractor.

## Implementation Costs

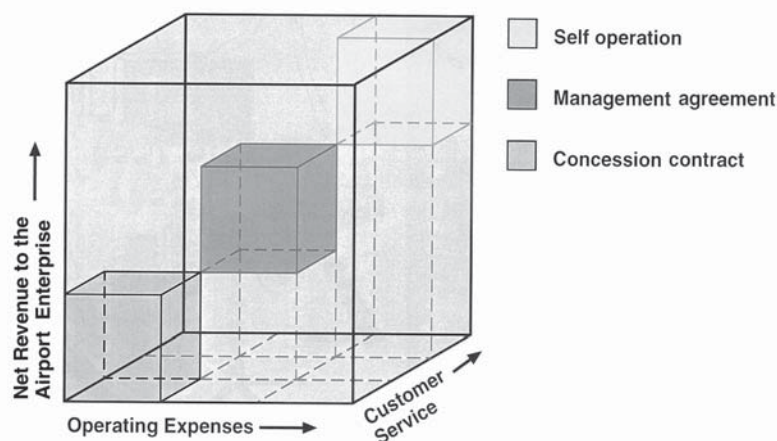
The costs of implementation are limited to preparation of the bid/RFP document and review of bids/proposals.

## Ongoing O&M Costs

Ongoing O&M costs are the responsibility of the private concessionaire, except with self operation.

## Implementation Schedule

It is estimated that the total time required to implement and award a contract, including obtaining management approval, can range from 6 to 18 months or more depending on the time required for management approval of key decisions, the extent of the changes to be made to an existing contract or the time required to develop a new contract, and the level of “political” interest in the contract award. Converting an airport parking



Source: Jacobs Consultancy.

**Figure H.1.** How parking operations affect risk/net revenues, operating costs, and customer service.

facility from a management agreement or concessions contract to self operation is estimated to require the same length of time—if not longer—to allow for the recruitment and hiring of the necessary management staff.

## Examples of Application

Airports where all or portions of the parking facilities are managed under self operation include those serving Dallas/Fort Worth (DFW), Grand Rapids, Norfolk, and Seattle-Tacoma. Airports where management agreements are used include those serving Denver, Los Angeles, Salt Lake City, and San Francisco. Airports where concession contracts are used include those serving Baltimore, Honolulu, and San Jose. Many airport operators use multiple operational methods. For example, at DFW, a variety of methods are used—self operation for all public parking facilities, except a lot offering trunk-to-trunk service (which is operated using a management agreement), a concession contract for valet parking, and a management agreement for employee parking. See Figure H.1.

## H.2 Privatized Facility Development

### Purpose

Improve net revenues and preserve airport capital by developing new parking facilities without using airport funds. Receive large upfront payment. Reduce airport staff time required to oversee or manage the parking operation. Reduce risks associated with funding new parking facilities using airport-supported bonds.

### Use by Customers

Most often, airport parking facilities are financed using airport funds or general airport revenue bonds. Alternatively, some airport operators “privatize” their public parking facilities (i.e., award a long-term contract to a private entity for the development and operation of airport parking facilities). Under the terms of these contracts, the private entity may be responsible for designing, building, operating, and maintaining the public parking facilities, or some combination of these tasks.

Although the specific contract terms differ among the airports where parking facilities have been privatized, the private entity is generally responsible for all aspects of the parking operation and related business decisions. The private entity can—without obtaining the approval of the airport operator—modify parking rates, introduce new services and products, and establish operating standards. Thus, compared to a con-

cession contract, the private entity has greater latitude in making decisions affecting revenues and customer service.

## Benefits

Potential benefits reported by private developers and the airport operators that have retained them are as follows:

- Allows the construction of the parking structure(s) without obligating airport revenues or requiring airline (majority in interest) approvals. Allows airport funds to be used to support other capital investments and operating needs. Preserves future debt capacity of the airport operator.
- Private companies can be more creative and act more quickly when responding to customer needs. They do not need to obtain prior approval from multiple layers of airport management, or from an airport board or commission.
- Private companies can typically design and build a new structure or purchase and install new parking revenue control equipment faster than an airport operator can because of procurement regulations and bidding procedures most airport operators must follow.
- It is easier for private companies than airport staff to offer discounts to volume customers and sell the parking products to travel agents and corporate travel planners.
- Guarantees that the airport operator will receive a specified annual fee (a MAG) or lease payment plus a percentage of gross revenues.
- Minimizes or eliminates the risk to airport operators resulting from a decrease in parking customers, airline traffic, or other causes. For example, after the terrorist attacks in 2001, the consortium operating the parking facility at one airport was obligated to continue to pay the MAG despite a drastic decrease in airline traffic.

## Implementation Actions

Implementation actions were reported to include

1. Evaluate whether to privatize a new (or existing) parking facility. Among the key concerns or disadvantages of privatization are that the airport operator would
  - Forego future revenue, as the private entity would retain a larger share of the revenue than would a concessionaire or parking management contractor, and may benefit more from unanticipated increases in airline traffic or parking demand than would the airport operator.
  - Be unable to approve or disapprove changes to rates, customer services, or the introduction of new technologies or services, as these decisions become the responsibility of the developer/operator under privatization.



- Need to enter into a business agreement with a much longer term than a concession contract or management agreement.
2. Prepare requests for bids (or proposals)—key aspects include the following:
    - Length of term (see Key Considerations),
    - Fees to be paid to the airport enterprise (see Key Considerations),
    - Developer obligations (see Key Considerations),
    - Limitations on the use of the property,
    - Ownership of the structure upon expiration of the lease (typically ownership reverts to the airport operator), and
    - Careful preparation of the bid or RFP documents because comparison of the resulting bids or proposals is more complex than those for parking concessions or management agreements.
  3. Evaluate and award bids.

### Key Considerations

Those identified by airport operators include

1. Term of lease—A key determinant of the lease term is the amount of investment required by the private entity. At Bradley International Airport, a private consortium was awarded a 25-year lease with two 5-year extensions. At Gulfport-Biloxi International Airport, a 32-year lease was awarded. At Oakland International Airport, a 50- to 99-year lease was considered and at Luis Munoz Marin International Airport in San Juan, a 50- to 75-year lease was considered.
2. Fees paid to the airport enterprise—Typically, these fees include a minimum annual guaranteed lease payment, a percent of annual gross revenues (e.g., 6%), and ground rent, and may also include a one-time up-front payment.
3. Developer obligations—The obligations of the private entity should be clearly defined to assure that the parking facilities are operated and maintained in accordance with the performance or functional specifications established by the airport operator. At some airports, contractors are obligated to build an initial parking structure plus construct a second structure or extension when certain demand triggers occur. In these situations, the airport operator must also clearly define the development standards for new construction.

One airport operator noted that increased specificity of developer obligations would likely lead to lower bid amounts.

4. The potential effects that the decisions of the private company may have on areas of the airport not under the company's responsibility. For example, if the private company

decides that higher hourly parking rates will optimize its revenue, some patrons may choose to use the airport curbsides instead.

5. Responsibilities of the airport operator for areas inside and outside of the lease line (e.g., utilities, roadway maintenance, security).
6. Limitations on the airport operator, including building competing facilities, parking for employees, and other topics.
7. Ability of the private company to enter into agreements with third parties (such as rental car concessionaires) that may have existing agreements with the airport operator or that may compete with entities that have existing agreements with the airport operator.
8. Extent of controls retained by the airport operator.
9. Extent of risk assumed by the private entity/investor.
10. Amount of off-airport competition and current market shares of the competition.

### Implementation Costs

The costs of implementation are limited to those for assessment of the benefits and costs of privatization, preparation of the bid/RFP document, and review of bids/proposals.

### Ongoing O&M Costs

Ongoing O&M costs are the responsibility of the private concessionaire.

### Implementation Schedule

It is estimated that the total time required to implement and privatize a parking facility (i.e., award a contract to a private entity), including the time required to obtain management approval can be 12 to 18 months or more depending on the time required for management approval.

### Examples of Application

Airports with privatized public parking operations include those serving Gulfport-Biloxi, Hartford, New Orleans, Providence, and Brussels (Belgium).

## H.3 Automated Overnight License Plate Inventory

### Purpose

Improve accuracy of overnight license plate inventory (LPI) count. Reduce staff time and costs to perform overnight inventory count.

## Use by Customers

License plate inventory is a key component of an overall parking revenue control system. LPI data are used to confirm the parking duration of exiting vehicles when, for example, the customers have lost their parking tickets. Vehicle parking duration is determined by inventorying/recording the license plate number of each vehicle on a daily basis (usually at midnight or early morning hours when there is little activity). Additionally, LPI data provide useful information for customer service (e.g., finding lost vehicles), law enforcement, and operations.

Traditionally, LPI is conducted by airport or parking operator staff walking or driving through a lot along a fixed route and manually recording the license plate numbers of parked vehicles. A significant number of staff hours is required to conduct this inventory. Manually recording or entering the plate numbers provides opportunities for error.

LPI can be conducted using vehicle-mounted or mobile license plate recognition (LPR) readers. These systems use optical character recognition (OCR) software, which takes a digital image of a license plate, then “reads” the license plate number and automatically adds it to the inventory. A mobile LPR reader enables LPIs to be conducted more quickly and accurately while reducing the required staff hours.

## Benefits

Benefits include

- LPI systems support more efficient operations and reduce the opportunity for fraud or theft.
- LPI data include the exact location of each parked vehicle, which can be used to help customers, who know their license plate numbers, find lost vehicles.
- The LPI can be cross-referenced against lists for wanted/stolen vehicles, vehicles that are associated with unpaid parking fines, and vehicles in the process of being repossessed.
- Inventory data can be used to identify rental cars and abandoned vehicles left by customers in the paid parking lot.
- Automated LPI systems can potentially increase the accuracy of LPI records by eliminating human error, if LPR read rates are sufficiently high.
- Automated LPI systems reduce required staff time.

## Implementation Actions

Implementation actions include

1. Identify potential deficiencies with the current LPI system and collection method(s).

2. Determine requirements for integration of mobile LPR devices with existing or planned parking revenue control system.
3. Prepare a benefit-cost analysis for purchasing mobile LPR devices.
4. Purchase mobile LPR devices and integrate with existing LPI/revenue control system.
5. Conduct in-field testing to determine optimal locations for cameras and lighting fixtures.

## Key Considerations

Those identified by airport operators include

1. Accuracy goals. An airport operator will need to determine the level of accuracy required of the LPR devices to meet its needs. Currently, accuracy of entry/exit plaza LPR installations in the United States varies and is often 90% or lower. Some airport operators have elected to use staff to monitor the LPR system and, as needed, enter license plate numbers if the LPR device cannot successfully read a license plate.
2. License plate variety. In Europe, there is less variety among vehicle license plates than in the United States. Most European plates consist of black text on a solid background color and have similar fonts and font sizes. This consistency allows for very high accuracy by LPR systems. In the United States, many states issue several varieties of license plates that may use different fonts and colors, incorporate non-alpha-numeric symbols, have words (e.g., *Pearl Harbor Survivor*), or have varying background images. In addition, many airports accommodate patrons from nearby states. This wide variety of potential license plate styles reduces an LPR system’s ability to read accurately.
3. Lighting. The intensity and angle of light illuminating a license plate can affect LPR accuracy. Since LPI is most often taken at night, devices should be tested under low-light conditions.
4. Obscured plates. Often, license plates may be obscured by trailer hitches, mud, snow, salt, or other road grime, all of which reduce the ability of an LPR system to successfully read license plates.

## Implementation Costs

The primary implementation cost would be for the purchase of mobile LPR devices. Appendix A provides the estimated costs of these devices.

### Ongoing O&M Costs

The primary O&M costs are for maintenance of the mobile LPR devices. Net operating costs may be reduced if staff time required to conduct the nightly LPI is sufficiently decreased. No data are available.

### Implementation Schedule

Depending on the time required for airport management approval and device ordering and delivery, implementation could take less than 2 months.

### Supporting and Complementary Strategies and Technologies in This Guidebook

- License Plate Recognition (E.6).

### Examples of Application

No airport applications of these systems were identified, but they are used in other industries. See Figure H.3.



Source: [www.parktrack.com](http://www.parktrack.com).

**Figure H.3.** *Handheld license plate reader for conducting license plate inventories.*



## CHAPTER 5

# Selecting Potential Strategies and Supporting Technologies

This chapter describes the factors to be considered by airport operators when they select a potential parking strategy and supporting technology. Tables 5.1 through 5.3 are intended to help identify those strategies that respond to the specific objectives of airport management. These tables, which list the identified strategies in this guidebook, indicate which strategies would best improve customer service (Table 5.1), enhance revenues (Table 5.2), or result in more efficient operations (Table 5.3) and provide a qualitative evaluation of each strategy's ability to achieve the stated objectives.

In these tables, the strategies are ranked according to whether the effects they provide are very positive, somewhat positive, neutral, somewhat negative, or very negative. However, two strategies receiving the same ranking or score may not have the same effect on customer service, revenues, or operations. For example, two strategies, Parking Rate Adjustments (F.1) and Validated Parking—Park-Sleep-Fly (B.10), can have very positive effects on enhancing revenues, but the amounts of new revenues may not be the same.

The following sections list the key considerations used to develop these rankings and to define *provide a high level of customer service*, *enhance parking revenues*, and *improve operational efficiency*. These three definitions are provided because airport operators may define these terms differently or place different emphasis on the individual components of the rankings.

### Provide a High Level of Customer Service

The level of customer service provided by an airport parking product or service is typically defined by one or more of the following factors:

- **Unassisted walking distance**—The distance customers walk between their parking spaces and their destinations within the terminal building or shuttle bus stop. Shorter walking distances equate to a higher level of customer service.
- **Weather protection for the vehicle and customer**—The extent to which parked vehicles are covered or enclosed; the extent to which customers are protected from the elements while either waiting for a shuttle bus or walking to and from their parking spaces. Products or services in which vehicles are covered or enclosed and customers are protected from the weather equate to a higher level of customer service.
- **Reliable availability of a parking space**—The level of comfort customers have that they will be able to locate a parking space in the facility of their choice. This factor increases in importance if the customers believe they may be late for their scheduled departure or were delayed en route to the airport. Services that provide reliable availability or guaranteed spaces equate to a higher level of customer service.

- **Ease of circulation**—Clear wayfinding and ease of circulation, both for drivers and pedestrians, including the efficiency of the garage ramping system. Express ramp systems are usually more efficient in delivering cars to and from available parking spaces.
- **Time required to locate an available parking space**—The in-vehicle travel time between when customers enter a parking facility and when they park. Shorter travel times equate to a higher level of customer service.
- **Time spent at the entry or exit of a parking facility**—The amount of time customers wait in a vehicle queue at either the entry or exit plaza. Parking services or technologies that reduce this time equate to a higher level of customer service.
- **Number of level changes**—The number of times customers must change levels while walking between their parking spaces and their destinations. Fewer level changes equate to a higher level of customer service.
- **Perception of security for vehicle and customer**—Customers' perceived level of security and safety for their parked vehicles and for themselves as they travel between their parking spaces and the terminal building. A perception of safety and security equates to a higher level of customer service. This perception may be enhanced by bright lighting, glass-enclosed stairways or elevators, and unobstructed view lines (e.g., those that are not limited by interior ramps, shear walls, closely spaced columns, or other objects).
- **Perception of cleanliness**—The cleanliness and maintenance of a facility may affect customer perception of a facility and the level of service it offers. A clean, well maintained facility is more appealing than a facility that contains dirt and trash strewn about, oil drippings, and odors and that is dimly lit.
- **Availability of advance information**—The timely availability of accurate information regarding key factors that may influence customer decisions on which parking facility or product they will choose. These factors could include parking fees, space availability, roadway congestion, and services provided by a parking product. Some of this information (e.g., parking rates and services, roadway congestion) may need to be available for customers as they depart for the airport while other information may be more important once customers are closer to the airport (e.g., parking space availability for a specific facility or product). Services that provide the proper information at the proper time in a customer's journey to the airport equate to a higher level of customer service.
- **Availability of additional services**—The number and range of available useful products or services from which customers may choose. A large menu of services equates to a higher level of customer service, as long as the product offerings are not confusing to customers.
- **Baggage assistance**—The availability of services that reduce the distance customers must carry their baggage as they travel between their parking spaces and their destinations within the terminal building. Services that reduce this distance equate to a higher level of customer service.
- **Customer independence**—The extent to which customers do not have to rely on other services (i.e., a shuttle bus) during their parking experience. Parking products or services that allow customers to walk between their parking spaces and the terminal building equate to a higher level of customer service.
- **Customer satisfaction measures**—Feedback from customers and independent assessments (such as mystery parkers) regarding parking products and services. High scores or few complaints from independent assessments equate to a higher level of customer service.

## Enhance Parking Revenues

For public parking at airports, the effect of a parking product or service on parking revenues is typically based on the following factors:

- **Gross revenues**—The amount of total revenues generated by a parking product, service, or facility.



- **Market share**—The share of airline passenger parking transactions, revenues, or occupied spaces that is accommodated in airport-owned parking facilities versus privately operated off-airport facilities. A strategy or technology that increases the airport's market share provides an opportunity for additional parking revenues.

## Improve Operational Efficiency

For public parking at airports, the effect of a parking product or service on operating efficiency is typically based on the factors listed below. More efficient operations enable an airport enterprise to retain more of the revenue collected in parking fees (i.e., net revenue).

- **Cost of staff**—The number of staff hours (whether airport or contract employees) and cost per staff hour (including salary and benefits) related to operation of a parking facility, product, or service. Fewer staff hours or lower costs per hour indicate more efficient operations.
- **Other operating expenses**—The non-staff costs of operating a parking facility, product, or service. These costs may include utilities, maintenance materials, credit card fees, shuttle bus operations (vehicle leasing or depreciation, fueling, maintenance), uniforms, and management or concession fees. Lower costs for these items indicate more efficient operations.
- **Square footage per parking space**—The number of vehicles that can be stored within a given area. Some parking strategies, such as valet parking, allow vehicles to be stored more compactly than do others, such as a self-parking operation. A lower number of square feet per parking space indicates more efficient operations.
- **Revenue security**—Mitigation of the risk of losing revenue to customer or employee theft or fraud. Strategies or technologies that reduce a customer's or employee's ability or opportunity to handle cash, obtain lower-value parking tickets, exit a facility without paying, or wrongly claim damage to a vehicle indicate more efficient operations.

As noted, Tables 5.1 through 5.3 summarize the qualitative assessment of how each parking strategy or technology influences the three overall goals described above. The extent to which each strategy or technology is expected to positively or negatively influence an airport operator's ability to meet each overall goal was assessed using one of the following five ratings:

- **Very positive**—The strategy or technology positively and significantly influences many of the relevant factors that contribute to meeting a goal.
- **Somewhat positive**—The strategy or technology positively influences some of the relevant factors that contribute to meeting a goal, and perhaps influences a few factors significantly.
- **Neutral**—A strategy that equally provides positive and negative influences on factors that contribute to meeting a goal, or a strategy that has no effect on meeting a particular goal.
- **Somewhat negative**—The strategy or technology negatively influences some of the relevant factors that contribute to meeting a goal, and perhaps influences a few factors significantly.
- **Very negative**—The strategy or technology negatively and significantly influences many factors that contribute to meeting a goal.

In addition to identifying those strategies that best respond to management's objectives, it is helpful to identify complementary strategies and consider including them in the list of candidate strategies to be evaluated. Please see the descriptions of the strategies in Chapter 4 for lists of supporting and complementary strategies and technologies.

Table 5.1. Ability of strategy to improve customer service.

| Categories/Strategies              |                                                                   | Improves customer service |                   |         |                   |               | Notes                                                                                                                                   |
|------------------------------------|-------------------------------------------------------------------|---------------------------|-------------------|---------|-------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|                                    |                                                                   | Very positive             | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                                                         |
| A. Parking Products—Duration Based |                                                                   |                           |                   |         |                   |               |                                                                                                                                         |
| A.1                                | Hourly/Short-Duration Parking                                     | *                         |                   |         |                   |               | Also reduces curbside congestion.                                                                                                       |
| A.2                                | Daily Parking                                                     |                           | *                 |         |                   |               |                                                                                                                                         |
| A.3                                | Economy/Long-Duration Parking                                     |                           | *                 |         |                   |               |                                                                                                                                         |
| A.4                                | Very-Short-Duration Parking/Curbside Areas                        |                           |                   |         | *                 |               | Eliminates free curbside option.                                                                                                        |
| A.5                                | Free 30-Minute Parking                                            | *                         |                   |         |                   |               | Also reduces curbside congestion.                                                                                                       |
| A.6                                | Cell Phone Lots                                                   | *                         |                   |         |                   |               | Also reduces curbside congestion and recirculating traffic.                                                                             |
| A.7                                | No Overnight Parking Zones                                        |                           | *                 |         |                   |               | Increases assurance that short-duration spaces are available, but prohibits long-duration parkers from using convenient parking spaces. |
| A.8                                | Vacation Parking                                                  |                           | *                 |         |                   |               |                                                                                                                                         |
| A.9                                | Holiday/Overflow Parking                                          |                           |                   | *       |                   |               | Assures available spaces during busy periods, but spaces may be inconvenient.                                                           |
| A.10                               | Parking Condominiums                                              | *                         |                   |         |                   |               |                                                                                                                                         |
| B. Value-Added Parking Products    |                                                                   |                           |                   |         |                   |               |                                                                                                                                         |
| B.1                                | Valet Parking—Curbside Drop-Off/Pickup                            | *                         |                   |         |                   |               |                                                                                                                                         |
| B.2                                | Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In      | *                         |                   |         |                   |               |                                                                                                                                         |
| B.3                                | Valet Parking—Non-Curbside Drop-Off/Pickup                        |                           | *                 |         |                   |               |                                                                                                                                         |
| B.4                                | Valet Parking—Customer Transported to/from Airport in Shuttle Van |                           | *                 |         |                   |               |                                                                                                                                         |
| B.5                                | Business Parking                                                  |                           | *                 |         |                   |               |                                                                                                                                         |
| B.6                                | Monthly Billing—Pay per Use                                       |                           | *                 |         |                   |               |                                                                                                                                         |
| B.7                                | Reserved Parking Zone—Pay per Use                                 | *                         |                   |         |                   |               |                                                                                                                                         |
| B.8                                | Guaranteed Space—Unlimited Use                                    | *                         |                   |         |                   |               |                                                                                                                                         |
| B.9                                | Validated Parking—Retail                                          |                           | *                 |         |                   |               |                                                                                                                                         |
| B.10                               | Validated Parking—Park-Sleep-Fly                                  |                           | *                 |         |                   |               |                                                                                                                                         |
| B.11                               | XXL (Extra Large) Parking                                         |                           | *                 |         |                   |               |                                                                                                                                         |
| B.12                               | Parking for Ladies and Families                                   | *                         |                   |         |                   |               |                                                                                                                                         |
| B.13                               | Secure Parking and Secure Parking with Valet Service              |                           | *                 |         |                   |               |                                                                                                                                         |

(continued on next page)

**Table 5.1. (Continued).**

| Categories/Strategies                              |                                                                 | Improves customer service |                   |         |                   |               | Notes                                                                                            |
|----------------------------------------------------|-----------------------------------------------------------------|---------------------------|-------------------|---------|-------------------|---------------|--------------------------------------------------------------------------------------------------|
|                                                    |                                                                 | Very positive             | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                  |
| C. Complementary Customer Services                 |                                                                 |                           |                   |         |                   |               |                                                                                                  |
| C.1                                                | Vehicle Washing and Servicing                                   | *                         |                   |         |                   |               |                                                                                                  |
| C.2                                                | Concierge Services                                              | *                         |                   |         |                   |               |                                                                                                  |
| C.3                                                | Onsite Sale of Food, Beverages, and Other Products              |                           | *                 |         |                   |               |                                                                                                  |
| C.4                                                | Pre-Ordered In-Flight Meals to Go                               |                           | *                 |         |                   |               |                                                                                                  |
| C.5                                                | Loyalty Programs (Frequent Parker Programs)                     | *                         |                   |         |                   |               |                                                                                                  |
| C.6                                                | Passenger Check-In Kiosks                                       |                           | *                 |         |                   |               | Market for this service is declining, as more patrons check-in prior to leaving for the airport. |
| C.7                                                | Baggage Check-In                                                | *                         |                   |         |                   |               |                                                                                                  |
| C.8                                                | Pet Kennels                                                     | *                         |                   |         |                   |               |                                                                                                  |
| C.9                                                | Shaded Spaces                                                   |                           | *                 |         |                   |               | Benefits vary depending on local weather conditions.                                             |
| C.10                                               | Shaded Spaces with Solar Panels                                 |                           | *                 |         |                   |               |                                                                                                  |
| C-11                                               | Electric Charging Stations                                      |                           | *                 |         |                   |               | Limited customer base at present.                                                                |
| D. Parking Space Availability and Guidance Systems |                                                                 |                           |                   |         |                   |               |                                                                                                  |
| D.1                                                | Space Availability via the Internet Prior to Arrival            |                           | *                 |         |                   |               | Depends upon when information is received.                                                       |
| D.2                                                | Space Availability via Phone/Radio Prior to Arrival             |                           | *                 |         |                   |               |                                                                                                  |
| D.3                                                | Space Availability by Facility                                  |                           | *                 |         |                   |               |                                                                                                  |
| D.4                                                | Space Availability by Parking Level                             |                           | *                 |         |                   |               |                                                                                                  |
| D.5                                                | Space Availability by Aisle/Sector                              | *                         |                   |         |                   |               | Provides environmental benefits as well.                                                         |
| D.6                                                | Space Availability by Space                                     | *                         |                   |         |                   |               | Provides environmental benefits as well.                                                         |
| D.7                                                | Managed Fills                                                   |                           | *                 |         |                   |               |                                                                                                  |
| D.8                                                | Parking Compartments                                            | *                         |                   |         |                   |               | Provides environmental benefits as well.                                                         |
| D.9                                                | Space Locators                                                  |                           | *                 |         |                   |               |                                                                                                  |
| D.10                                               | In-Vehicle Parking Technologies                                 |                           |                   | *       |                   |               | Future technology, uncertain impacts.                                                            |
| E. Cashierless Transactions                        |                                                                 |                           |                   |         |                   |               |                                                                                                  |
| E.1                                                | Pay-on-Foot Systems                                             |                           | *                 |         |                   |               |                                                                                                  |
| E.2                                                | Credit Card In/Out                                              | *                         |                   |         |                   |               |                                                                                                  |
| E.3                                                | Automatic Vehicle Identification/Radio-Frequency Identification |                           | *                 |         |                   |               | Most beneficial if tag is issued by regional toll authority.                                     |
| E.4                                                | IntelliDrive                                                    |                           |                   | *       |                   |               | Future technology, uncertain impacts.                                                            |
| E.5                                                | Proximity Cards                                                 |                           | *                 |         |                   |               |                                                                                                  |
| E.6                                                | License Plate Recognition                                       |                           |                   | *       |                   |               | Limited applicability in North America.                                                          |
| E.7                                                | Cellular Telephone/Pay by Cell                                  |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                          |
| E.8                                                | In-Car Meters                                                   |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                          |
| E.9                                                | In-Lane Processing                                              |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                          |

(continued)

Table 5.1. (Continued).

| Categories/Strategies             |                                                              | Improves customer service |                   |         |                   |               | Notes                                                                                                                                                  |
|-----------------------------------|--------------------------------------------------------------|---------------------------|-------------------|---------|-------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |                                                              | Very positive             | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                                                                        |
| F. Revenue Enhancement Strategies |                                                              |                           |                   |         |                   |               |                                                                                                                                                        |
| F.1                               | Parking Rate Adjustments                                     |                           | *                 |         |                   |               | Depends on purpose of rate adjustments. Rate adjustments intended to increase space availability in a particular product may improve customer service. |
| F.2                               | Strategic Pricing                                            |                           |                   | *       |                   |               |                                                                                                                                                        |
| F.3                               | Web-Based Reservations                                       |                           | *                 |         |                   |               |                                                                                                                                                        |
| F.4                               | Yield Management                                             |                           |                   | *       |                   |               |                                                                                                                                                        |
| F.5                               | Coupons                                                      |                           | *                 |         |                   |               |                                                                                                                                                        |
| F.6                               | Advertising Sales—Interior, Exterior, Tickets, and Equipment |                           |                   | *       |                   |               |                                                                                                                                                        |
| F.7                               | Branding                                                     |                           | *                 |         |                   |               |                                                                                                                                                        |
| F.8                               | Marketing                                                    |                           |                   | *       |                   |               |                                                                                                                                                        |
| G. Safety and Security Strategies |                                                              |                           |                   |         |                   |               |                                                                                                                                                        |
| G.1                               | Visual Surveillance—Camera                                   | *                         |                   |         |                   |               |                                                                                                                                                        |
| G.2                               | Emergency Audio Communications                               | *                         |                   |         |                   |               |                                                                                                                                                        |
| H. Operational Enhancements       |                                                              |                           |                   |         |                   |               |                                                                                                                                                        |
| H.1                               | Parking Facility Operation Options                           |                           |                   | *       |                   |               |                                                                                                                                                        |
| H.2                               | Privatized Facility Development                              |                           |                   | *       |                   |               |                                                                                                                                                        |
| H.3                               | Automated Overnight License Plate Inventory                  |                           |                   | *       |                   |               |                                                                                                                                                        |

Source: Jacobs Consultancy, April 2009.

**Table 5.2. Ability of strategy to enhance parking revenues.**

| Categories/Strategies              |                                                                   | Enhances parking revenues |                   |         |                   |               | Notes                                                                                                                                                        |
|------------------------------------|-------------------------------------------------------------------|---------------------------|-------------------|---------|-------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                    |                                                                   | Very positive             | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                                                                              |
| A. Parking Products—Duration Based |                                                                   |                           |                   |         |                   |               |                                                                                                                                                              |
| A.1                                | Hourly/Short-Duration Parking                                     |                           | *                 |         |                   |               | Depends on prices for other parking products and goals of airport management (i.e., lower hourly/short-duration parking rates decrease curbside congestion). |
| A.2                                | Daily Parking                                                     |                           | *                 |         |                   |               | Depends on prices for other parking products.                                                                                                                |
| A.3                                | Economy/Long-Duration Parking                                     |                           | *                 |         |                   |               | Depends on prices for other parking products.                                                                                                                |
| A.4                                | Very-Short-Duration Parking/Curbside Areas                        |                           | *                 |         |                   |               |                                                                                                                                                              |
| A.5                                | Free 30-Minute Parking                                            |                           |                   |         |                   | *             |                                                                                                                                                              |
| A.6                                | Cell Phone Lots                                                   |                           |                   |         |                   | *             |                                                                                                                                                              |
| A.7                                | No Overnight Parking Zones                                        |                           |                   | *       |                   |               |                                                                                                                                                              |
| A.8                                | Vacation Parking                                                  |                           | *                 |         |                   |               |                                                                                                                                                              |
| A.9                                | Holiday/Overflow Parking                                          |                           | *                 |         |                   |               |                                                                                                                                                              |
| A.10                               | Parking Condominiums                                              | *                         |                   |         |                   |               |                                                                                                                                                              |
| B. Value-Added Parking Products    |                                                                   |                           |                   |         |                   |               |                                                                                                                                                              |
| B.1                                | Valet Parking—Curbside Drop-Off/Pickup                            | *                         |                   |         |                   |               |                                                                                                                                                              |
| B.2                                | Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In      | *                         |                   |         |                   |               |                                                                                                                                                              |
| B.3                                | Valet Parking—Non-Curbside Drop-Off/Pickup                        |                           | *                 |         |                   |               |                                                                                                                                                              |
| B.4                                | Valet Parking—Customer Transported to/from Airport in Shuttle Van |                           | *                 |         |                   |               |                                                                                                                                                              |
| B.5                                | Business Parking                                                  |                           | *                 |         |                   |               |                                                                                                                                                              |
| B.6                                | Monthly Billing—Pay per Use                                       |                           |                   | *       |                   |               |                                                                                                                                                              |
| B.7                                | Reserved Parking Zone—Pay per Use                                 |                           | *                 |         |                   |               |                                                                                                                                                              |
| B.8                                | Guaranteed Space—Unlimited Use                                    | *                         |                   |         |                   |               |                                                                                                                                                              |
| B.9                                | Validated Parking—Retail                                          |                           |                   |         | *                 |               |                                                                                                                                                              |
| B.10                               | Validated Parking—Park-Sleep-Fly                                  |                           | *                 |         |                   |               | Depends on how revenue is allocated to parking operation versus hotel operation.                                                                             |
| B.11                               | XXL (Extra Large) Parking                                         |                           | *                 |         |                   |               |                                                                                                                                                              |
| B.12                               | Parking for Ladies and Families                                   |                           |                   | *       |                   |               |                                                                                                                                                              |
| B.13                               | Secure Parking and Secure Parking with Valet Service              |                           | *                 |         |                   |               |                                                                                                                                                              |
| C. Complementary Customer Services |                                                                   |                           |                   |         |                   |               |                                                                                                                                                              |
| C.1                                | Vehicle Washing and Servicing                                     |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.2                                | Concierge Services                                                |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.3                                | Onsite Sale of Food, Beverages, and Other Products                |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.4                                | Pre-Ordered In-Flight Meals to Go                                 |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.5                                | Loyalty Programs (Frequent Parker Programs)                       | *                         |                   |         |                   |               |                                                                                                                                                              |
| C.6                                | Passenger Check-In Kiosks                                         |                           |                   | *       |                   |               |                                                                                                                                                              |
| C.7                                | Baggage Check-In                                                  |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.8                                | Pet Kennels                                                       | *                         |                   |         |                   |               |                                                                                                                                                              |
| C.9                                | Shaded Spaces                                                     |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.10                               | Shaded Spaces with Solar Panels                                   |                           | *                 |         |                   |               |                                                                                                                                                              |
| C.11                               | Electric Charging Stations                                        |                           | *                 |         |                   |               |                                                                                                                                                              |

(continued)



Table 5.2. (Continued).

| Categories/Strategies                                     |                                                                 | Enhances parking revenues |                   |         |                   |               | Notes                                                                                                 |
|-----------------------------------------------------------|-----------------------------------------------------------------|---------------------------|-------------------|---------|-------------------|---------------|-------------------------------------------------------------------------------------------------------|
|                                                           |                                                                 | Very positive             | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                       |
| <b>D. Parking Space Availability and Guidance Systems</b> |                                                                 |                           |                   |         |                   |               |                                                                                                       |
| D.1                                                       | Space Availability via the Internet Prior to Arrival            |                           |                   | *       |                   |               |                                                                                                       |
| D.2                                                       | Space Availability via Phone/Radio Prior to Arrival             |                           |                   | *       |                   |               |                                                                                                       |
| D.3                                                       | Space Availability by Facility                                  |                           |                   | *       |                   |               |                                                                                                       |
| D.4                                                       | Space Availability by Parking Level                             |                           |                   | *       |                   |               |                                                                                                       |
| D.5                                                       | Space Availability by Aisle/Sector                              |                           | *                 |         |                   |               |                                                                                                       |
| D.6                                                       | Space Availability by Space                                     |                           | *                 |         |                   |               |                                                                                                       |
| D.7                                                       | Managed Fills                                                   |                           | *                 |         |                   |               |                                                                                                       |
| D.8                                                       | Parking Compartments                                            |                           | *                 |         |                   |               |                                                                                                       |
| D.9                                                       | Space Locators                                                  |                           |                   | *       |                   |               |                                                                                                       |
| D.10                                                      | In-Vehicle Parking Technologies                                 |                           |                   | *       |                   |               | Future technology, uncertain impacts.                                                                 |
| <b>E. Cashierless Transactions</b>                        |                                                                 |                           |                   |         |                   |               |                                                                                                       |
| E.1                                                       | Pay-on-Foot Systems                                             |                           |                   | *       |                   |               | Assuming that payment method does not affect parking rate.                                            |
| E.2                                                       | Credit Card In/Out                                              |                           |                   | *       |                   |               |                                                                                                       |
| E.3                                                       | Automatic Vehicle Identification/Radio-Frequency Identification |                           |                   | *       |                   |               |                                                                                                       |
| E.4                                                       | IntelliDrive                                                    |                           |                   | *       |                   |               | Future technology, uncertain impacts.                                                                 |
| E.5                                                       | Proximity Cards                                                 |                           |                   | *       |                   |               | Cards may be associated with a specialized product, which may enhance parking revenues.               |
| E.6                                                       | License Plate Recognition                                       |                           |                   | *       |                   |               |                                                                                                       |
| E.7                                                       | Cellular Telephone/Pay by Cell                                  |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                               |
| E.8                                                       | In-Car Meters                                                   |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                               |
| E.9                                                       | In-Lane Processing                                              |                           |                   | *       |                   |               | Generally not appropriate for airports.                                                               |
| <b>F. Revenue Enhancement Strategies</b>                  |                                                                 |                           |                   |         |                   |               |                                                                                                       |
| F.1                                                       | Parking Rate Adjustments                                        | *                         |                   |         |                   |               |                                                                                                       |
| F.2                                                       | Strategic Pricing                                               |                           | *                 |         |                   |               | May reduce near-term revenues, but increase market share, which can result in higher future revenues. |
| F.3                                                       | Web-Based Reservations                                          |                           | *                 |         |                   |               |                                                                                                       |
| F.4                                                       | Yield Management                                                | *                         |                   |         |                   |               |                                                                                                       |
| F.5                                                       | Coupons                                                         |                           | *                 |         |                   |               | Depends on whether discount is offset by increased transactions.                                      |
| F.6                                                       | Advertising Sales—Interior, Exterior, Tickets, and Equipment    | *                         |                   |         |                   |               |                                                                                                       |
| F.7                                                       | Branding                                                        |                           | *                 |         |                   |               |                                                                                                       |
| F.8                                                       | Marketing                                                       |                           | *                 |         |                   |               |                                                                                                       |
| <b>G. Safety and Security Strategies</b>                  |                                                                 |                           |                   |         |                   |               |                                                                                                       |
| G.1                                                       | Visual Surveillance—Camera                                      |                           |                   | *       |                   |               |                                                                                                       |
| G.2                                                       | Emergency Audio Communications                                  |                           |                   | *       |                   |               |                                                                                                       |
| <b>H. Operational Enhancements</b>                        |                                                                 |                           |                   |         |                   |               |                                                                                                       |
| H.1                                                       | Parking Facility Operation Options                              |                           | *                 |         |                   |               | Depends on selected option.                                                                           |
| H.2                                                       | Privatized Facility Development                                 |                           |                   | *       |                   |               | May generate large lump sum payment or reduce capital development costs.                              |
| H.3                                                       | Automated Overnight License Plate Inventory                     |                           |                   | *       |                   |               |                                                                                                       |

Note: Operational expenses were not considered; see Table 5.3.

Source: Jacobs Consultancy, April 2009.

**Table 5.3. Ability of strategy to improve operational efficiency.**

| Categories/Strategies              |                                                                   | Improves operational efficiency |                   |         |                   |               | Notes                                                                                           |
|------------------------------------|-------------------------------------------------------------------|---------------------------------|-------------------|---------|-------------------|---------------|-------------------------------------------------------------------------------------------------|
|                                    |                                                                   | Very positive                   | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                 |
| A. Parking Products—Duration Based |                                                                   |                                 |                   |         |                   |               |                                                                                                 |
| A.1                                | Hourly/Short-Duration Parking                                     |                                 |                   | *       |                   |               | May require separate entry lanes.                                                               |
| A.2                                | Daily Parking                                                     |                                 |                   | *       |                   |               | May require separate entry lanes.                                                               |
| A.3                                | Economy/Long-Duration Parking                                     |                                 |                   |         | *                 |               | Shuttle bus operations are costly.                                                              |
| A.4                                | Very-Short-Duration Parking/Curbside Areas                        |                                 |                   | *       |                   |               |                                                                                                 |
| A.5                                | Free 30-Minute Parking                                            |                                 |                   | *       |                   |               |                                                                                                 |
| A.6                                | Cell Phone Lots                                                   |                                 | *                 |         |                   |               | Assumes a reduced need for curbside enforcement.                                                |
| A.7                                | No-Overnight-Parking Zones                                        |                                 |                   |         | *                 |               | Requires additional enforcement.                                                                |
| A.8                                | Vacation Parking                                                  |                                 |                   |         | *                 |               | Depends on need for shuttle bus.                                                                |
| A.9                                | Holiday/Overflow Parking                                          |                                 |                   |         | *                 |               | Increased efficiency if product can be combined with another product (such as economy parking). |
| A.10                               | Parking Condominiums                                              |                                 |                   | *       |                   |               | Service provided by third party.                                                                |
| B. Value-Added Parking Products    |                                                                   |                                 |                   |         |                   |               |                                                                                                 |
| B.1                                | Valet Parking—Curbside Drop-Off/Pickup                            |                                 |                   |         |                   | *             |                                                                                                 |
| B.2                                | Valet Parking—Curbside Drop-Off/Pickup with Airline Check-In      |                                 |                   |         |                   | *             |                                                                                                 |
| B.3                                | Valet Parking—Non-Curbside Drop-Off/Pickup                        |                                 |                   |         |                   | *             |                                                                                                 |
| B.4                                | Valet Parking—Customer Transported to/from Airport in Shuttle Van |                                 |                   |         |                   | *             |                                                                                                 |
| B.5                                | Business Parking                                                  |                                 |                   | *       |                   |               |                                                                                                 |
| B.6                                | Monthly Billing—Pay per Use                                       |                                 |                   |         | *                 |               |                                                                                                 |
| B.7                                | Reserved Parking Zone—Pay per Use                                 |                                 |                   |         | *                 |               | Lower space utilization.                                                                        |
| B.8                                | Guaranteed Space—Unlimited Use                                    |                                 |                   |         | *                 |               | Lower space utilization.                                                                        |
| B.9                                | Validated Parking—Retail                                          |                                 |                   |         | *                 |               |                                                                                                 |
| B.10                               | Validated Parking—Park-Sleep-Fly                                  |                                 |                   | *       |                   |               |                                                                                                 |
| B.11                               | XXL (Extra Large) Parking                                         |                                 |                   |         | *                 |               | Less efficient use of available area.                                                           |
| B.12                               | Parking for Ladies and Families                                   |                                 |                   |         | *                 |               |                                                                                                 |
| B.13                               | Secure Parking and Secure Parking with Valet Service              |                                 |                   | *       |                   |               | Service provided by third party.                                                                |

(continued)

Table 5.3. (Continued).

| Categories/Strategies                              |                                                                 | Improves operational efficiency |                   |         |                   |               | Notes                                                                                                     |
|----------------------------------------------------|-----------------------------------------------------------------|---------------------------------|-------------------|---------|-------------------|---------------|-----------------------------------------------------------------------------------------------------------|
|                                                    |                                                                 | Very positive                   | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                                                                           |
| C. Complementary Customer Services                 |                                                                 |                                 |                   |         |                   |               |                                                                                                           |
| C.1                                                | Vehicle Washing and Servicing                                   |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.2                                                | Concierge Services                                              |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.3                                                | Onsite Sale of Food, Beverages, and Other Products              |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.4                                                | Pre-Ordered In-Flight Meals to Go                               |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.5                                                | Loyalty Programs (Frequent Parker Programs)                     |                                 |                   |         | *                 |               |                                                                                                           |
| C.6                                                | Passenger Check-In Kiosks                                       |                                 |                   | *       |                   |               |                                                                                                           |
| C.7                                                | Baggage Check-In                                                |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.8                                                | Pet Kennels                                                     |                                 |                   | *       |                   |               | Service typically provided by third party.                                                                |
| C.9                                                | Shaded Spaces                                                   |                                 |                   | *       |                   |               |                                                                                                           |
| C.10                                               | Shaded Spaces with Solar Panels                                 |                                 | *                 |         |                   |               | Reduces utility expenses.                                                                                 |
| C.11                                               | Electric Charging Stations                                      |                                 |                   | *       |                   |               |                                                                                                           |
| D. Parking Space Availability and Guidance Systems |                                                                 |                                 |                   |         |                   |               |                                                                                                           |
| D.1                                                | Space Availability via the Internet Prior to Arrival            |                                 |                   | *       |                   |               |                                                                                                           |
| D.2                                                | Space Availability via Phone/Radio Prior to Arrival             |                                 |                   | *       |                   |               |                                                                                                           |
| D.3                                                | Space Availability by Facility                                  |                                 |                   | *       |                   |               |                                                                                                           |
| D.4                                                | Space Availability by Parking Level                             |                                 |                   | *       |                   |               |                                                                                                           |
| D.5                                                | Space Availability by Aisle/Sector                              |                                 | *                 |         |                   |               |                                                                                                           |
| D.6                                                | Space Availability by Space                                     | *                               |                   |         |                   |               |                                                                                                           |
| D.7                                                | Managed Fills                                                   |                                 | *                 |         |                   |               |                                                                                                           |
| D.8                                                | Parking Compartments                                            |                                 |                   |         | *                 |               |                                                                                                           |
| D.9                                                | Space Locators                                                  |                                 |                   | *       |                   |               |                                                                                                           |
| D.10                                               | In-Vehicle Parking Technologies                                 |                                 |                   | *       |                   |               | Future technology, uncertain impacts.                                                                     |
| E. Cashierless Transactions                        |                                                                 |                                 |                   |         |                   |               |                                                                                                           |
| E.1                                                | Pay-on-Foot Systems                                             |                                 | *                 |         |                   |               | Cashier cost savings may be partially offset by increased maintenance expenses.                           |
| E.2                                                | Credit Card In/Out                                              |                                 | *                 |         |                   |               | Revenue security may be partially offset by increased processing fees.                                    |
| E.3                                                | Automatic Vehicle Identification/Radio-Frequency Identification |                                 | *                 |         |                   |               | Revenue security may be partially offset by increased processing fees.                                    |
| E.4                                                | IntelliDrive                                                    |                                 |                   | *       |                   |               | Future technology, uncertain impacts.                                                                     |
| E.5                                                | Proximity Cards                                                 |                                 | *                 |         |                   |               | Revenue security may be partially offset by increased expenses to operate program and billing mechanisms. |
| E.6                                                | License Plate Recognition                                       |                                 |                   |         |                   | *             | Often requires additional staff.                                                                          |
| E.7                                                | Cellular Telephone/Pay by Cell                                  |                                 | *                 |         |                   |               | Generally not appropriate for airports.                                                                   |
| E.8                                                | In-Car Meters                                                   | *                               |                   |         |                   |               | Eliminates need for parking revenue equipment. Generally not appropriate for airports.                    |
| E.9                                                | In-Lane Processing                                              |                                 |                   | *       |                   |               | Generally not appropriate for airports.                                                                   |

(continued on next page)

**Table 5.3. (Continued).**

| Categories/Strategies                    |                                                              | Improves operational efficiency |                   |         |                   |               | Notes                                                      |
|------------------------------------------|--------------------------------------------------------------|---------------------------------|-------------------|---------|-------------------|---------------|------------------------------------------------------------|
|                                          |                                                              | Very positive                   | Somewhat positive | Neutral | Somewhat negative | Very negative |                                                            |
| <b>F. Revenue Enhancement Strategies</b> |                                                              |                                 |                   |         |                   |               |                                                            |
| F.1                                      | Parking Rate Adjustments                                     |                                 | *                 |         |                   |               | Can improve balance of parking space use among facilities. |
| F.2                                      | Strategic Pricing                                            |                                 |                   | *       |                   |               |                                                            |
| F.3                                      | Web-Based Reservations                                       |                                 |                   |         | *                 |               | Depends on who operates the system.                        |
| F.4                                      | Yield Management                                             |                                 |                   |         | *                 |               |                                                            |
| F.5                                      | Coupons                                                      |                                 |                   |         | *                 |               |                                                            |
| F.6                                      | Advertising Sales—Interior, Exterior, Tickets, and Equipment |                                 |                   | *       |                   |               |                                                            |
| F.7                                      | Branding                                                     |                                 |                   | *       |                   |               |                                                            |
| F.8                                      | Marketing                                                    |                                 |                   |         | *                 |               |                                                            |
| <b>G. Safety and Security Strategies</b> |                                                              |                                 |                   |         |                   |               |                                                            |
| G.1                                      | Visual Surveillance—Camera                                   |                                 |                   |         | *                 |               |                                                            |
| G.2                                      | Emergency Audio Communications                               |                                 |                   | *       |                   |               |                                                            |
| <b>H. Operational Enhancements</b>       |                                                              |                                 |                   |         |                   |               |                                                            |
| H.1                                      | Parking Facility Operation Options                           |                                 | *                 |         |                   |               |                                                            |
| H.2                                      | Privatized Facility Development                              | *                               |                   |         |                   |               |                                                            |
| H.3                                      | Automated Overnight License Plate Inventory                  |                                 | *                 |         |                   |               |                                                            |

Source: Jacobs Consultancy, April 2009.

# Evaluating Potential Strategies and Supporting Technologies

This chapter describes the factors frequently considered by airport operators when evaluating a potential parking strategy. The evaluation process leading to recommendation of a preferred strategy, or strategies, typically includes some or all of the following steps:

- Considering the specific characteristics of the airport and its customers;
- Evaluating the implications for affected organizations and stakeholders, as appropriate;
- Determining the required implementation actions; and
- Estimating the costs and benefits of implementation.

These steps are described in the following sections.

## Consider the Specific Characteristics of the Airport and Its Customers

After a list of potential strategies for implementation is developed, the next logical step is to consider which strategies best respond to the unique characteristics of the airport and its customers, recognizing that some strategies will be better suited to a particular airport than others. These unique characteristics relate to airport customers, the airport operator, and the physical airport facilities, as described in this section.

### Airport Customers

Passenger demographics and travel behavior, which have been addressed, in part, in previous chapters, that affect the evaluation of a parking strategy include:

- **Proportion of O&D airline passengers**—These passengers are an airport's parking customer base. O&D airline passengers start and end their trips at the airport as opposed to connecting passengers, who start and end their trips at other airports and thus are not potential parking customers. At some large-hub airports, over 40% of all airline passengers are connecting between flights, while at most medium- and small-hub airports, fewer than 10% of all passengers are connecting with other flights.
- **Proportion of local resident passengers**—At most airports, the majority of O&D airline passengers are local residents who park at the airport. Non-resident O&D passengers are more likely to use rental cars or other airport access modes and are unlikely to park at the airport other than when being picked up or dropped off. Examples of airports with a large number of non-resident airline passengers include those serving destination resorts (e.g., the airports serving Honolulu and neighboring island airports in Hawaii, as well as Las Vegas and Orlando) and airports serving large volumes of non-resident airline passengers on a seasonal basis (e.g., airports located near ski resorts in the winter or those serving national parks in the summer).



The need to base analyses of parking requirements and revenues on O&D passengers may appear obvious, but occasionally parking analyses are incorrectly prepared comparing trends in revenues per total passengers rather than per local resident O&D passengers. At airports with many connecting passengers or non-resident passengers, this error can result in misleading conclusions.

- **Proportion of business versus non-business passengers**—Trip purpose is an indication of the customer’s sensitivity to savings in travel time and/or travel cost. Business travelers are less sensitive to the cost of parking compared to non-business travelers because their travel expenses are likely to be paid by a third party. Non-business travelers (e.g., those traveling on vacation or family business) are more sensitive to parking costs because these costs may represent a significant percentage of the traveler’s total out-of-pocket travel costs, particularly for those customers parking for a week or more and using a heavily discounted airline ticket.

Business travelers are typically “just-in-time” travelers who value potential time savings and reliable or predictable travel times. They are more often willing to pay premium rates for parking products or services that minimize time spent searching for an open parking space and walking long distances, provide guaranteed space availability, or avoid unanticipated delays.

Business travelers typically depart early in the week and return late in the week. Thus, the peak demand for parking facilities serving business travelers occurs on Tuesdays through Thursdays. Non-business travelers are likely to depart on a Saturday and return on a Sunday. Thus, the peak demand for parking facilities serving non-business travelers occurs on weekends. The presence of a low-cost carrier at the airport tends to increase the proportion of non-business travelers.

- **Proportion of customers using alternative access modes**—It is helpful to consider the alternative access modes available to customers when considering potential parking rates, products, and services. The availability of attractive alternatives to private vehicles will affect customer responses to changes in airport parking costs, services, and products. For example, at some airports, the high cost of parking (including economy parking) has made chauffeured limousines an attractive alternative both in terms of cost and convenience. At other airports, the availability of high-quality and reasonably priced rail transit, express bus service, and shared-ride vans has reduced the demand for long-duration parking, particularly by passengers traveling for non-business purposes.
- **Proportion of customers using alternative parking options**—The availability of attractive and reasonably priced, privately operated off-airport parking facilities will affect an airport operator’s share of the total public parking market in the region. At some airports, more than 50% of the long-duration parking spaces are provided in privately operated lots. Often private parking operators (including those operating on airports, such as the privately operated Canadian airports) introduce new technologies and services before such technologies and services are adopted at publicly operated airports. Because the lots are privately owned, the parking operators can introduce new services, modify parking rates, offer volume discounts, and make other changes much faster than an airport operator, or an airport operator may be unable to make such changes. Thus, when considering new products, services, or rates, it is helpful to anticipate the way competing private parking operators may respond. It is also helpful to consider whether off-airport operators are considered “partners” or “competitors.”
- **Seasonal and weekly variations**—Many airports experience extreme peaks in public parking demand during the Thanksgiving weekend, Christmas holidays, spring break, or local events such as major sporting events. These unusual peak demands may result in the need to operate, on a temporary basis, holiday/overflow lots that—because of their interim nature—offer lower levels of customer service and the use of less expensive parking revenue control equipment and procedures.
- **Volume of international travelers**—The parking characteristics and durations of passengers on overseas flights differ from those on domestic and transborder flights. Typically, international passengers are accompanied to/from the airport by more family members or friends than are

domestic passengers. These passengers park for short durations rather than for the duration of their trip. Understanding the ratio of passengers to meeters/greeters or well-wishers can be helpful at international gateway airports or those that have a separate international terminal.

- **Infrequent travelers**—Most airline passengers travel infrequently. Thus, it is helpful for airport operators to understand the size of the customer market they are attempting to attract when evaluating the potential use of discount coupons, loyalty programs, or other programs that rely upon a customer base composed of frequent travelers.
- **Culture and social behavior**—The culture of the local market may influence parking demand and customer response to potential parking products and services—particularly short-duration parking. For example, when passengers from some cultures or countries arrive at, or depart from, the airport—whether they are flying on domestic or international flights—it is likely that they will be greeted at, or accompanied to, the airport by a large group of family members or friends and, perhaps, treated to a meal or beverage rather than just being dropped off at the curbside. When the local community includes a large volume of such passengers (e.g., southern Florida), these travel patterns may generate demand for more short-duration parking than might otherwise be expected.
- **Customer vehicles**—The type of vehicles used by an airport's customers may influence the customers' interest in certain parking products. For example, secure parking, valet parking, and vehicle washing and servicing may be attractive options in a market where many customers drive luxury vehicles. Electric charging stations require a market consisting of a significant number of all-electric vehicles or plug-in vehicles. The need for over-height or XXL parking is likely to be greater in markets where there is a high proportion of large sport utility vehicles and pickup trucks (e.g., the Midwest, Southwest, and mountain states).
- **Response to past changes in rates, services, or products**—Customer response to past changes in parking rates, or the introduction of new services or products, is an indicator of their likely future response. For example, it may be helpful to determine the proportion of customers who diverted to less-expensive parking products or alternative access modes in response to past rate increases.

## The Airport Operator

In selecting and evaluating potential parking strategies, it is helpful to review how the airport is financed; the current use of net parking revenues; how the airport and its parking facilities are operated, including staff resources and capabilities; and the preferences of airport management (e.g., the relative importance assigned to specific objectives). These and other characteristics relevant to airport operators are described in this section.

- **Emphasis on customer service**—Although all airport operators seek to provide a high level of customer service, some place a higher priority on this goal than others. Such airport operators allocate greater budget amounts and more staff resources to programs targeted at providing high levels of customer service. They may retain J. D. Power and Associates or similar organizations to evaluate how individual components of the airport, including parking, are ranked by customers of their airport and peer airports. These airport operators are often willing to forego potential net revenues to provide new or improved customer service features.
- **Emphasis on operating efficiencies**—All airport operators attempt to operate efficiently, but some make reducing or containing operating costs a higher priority than others. For example, in an effort to control costs, some airport operators may reduce shuttle bus frequencies, cashier hours, security patrols, or scheduled (or regular) facility maintenance, recognizing that such actions may inconvenience customers. These airport operators typically have limited operating budgets and higher priorities for the use of available funds.
- **Emphasis on parking revenues**—Net public parking revenues provide essential cash flow to support uneconomic airport functions (e.g., general aviation, public areas of terminals, roadways, and curbsides) and also represent the single largest source of equity funding of airport

capital improvements to reduce an airport's reliance on debt. Reductions in net parking revenues can jeopardize existing or planned capital improvements if these revenues are expected or required to fund capital improvements or pay debt service on revenue bonds. Thus, airport operators may be reluctant to consider new parking strategies that could reduce or endanger these revenues.

The nature of the airline-airport use and lease agreements (if any) may be an additional consideration when evaluating potential parking strategies. For example, airport enterprises that operate under residual cost or hybrid airline rate-making structures may be required to share all or a significant portion of their increased parking revenues with the airlines. Conversely, airport enterprises that operate under a compensatory rate-making structure can retain the surplus parking revenues and use them for any lawful aviation purpose. In addition, airport operators using residual and hybrid rate-making structures often must solicit airline majority-in-interest approval before investing in new parking systems or facilities and are required to justify the expense to the airlines through financial analyses or pro formas. Sometimes, parking improvements can result in a short-term reduction in surplus revenues even though long-term financial gains and significant customer service enhancements are expected. Given that the airlines frequently consider shorter time horizons than airport operators and their financial condition, these discussions can often become challenging and difficult for airport operators.

- **Ability to support additional capital and operating costs**—Parking strategies should be assessed in terms of both capital investments and ongoing maintenance costs. The ability to support additional capital and operating costs is a particular consideration for strategies that may be expensive to implement (e.g., revenue control systems) or that have significant ongoing costs (e.g., Internet-based reservation systems hosted by a private company). Conversely, although pay-on-foot systems or credit card in/out systems can increase costs in the near term (because of the cost of new revenue control equipment), future ongoing labor savings can be quite significant.
- **Tolerance of risk**—Compared to private companies, public agencies, including airport enterprises, are typically averse to risk—the risk of losing or foregoing revenues, the adverse publicity associated with a capital expenditure that ultimately proves to be unsuccessful, or an unfavorable “political” response to potential changes in rates or services. Airport operators may be more sensitive to the liability associated with injuries, accidents, negligence, or criminal activities occurring in parking facilities or elsewhere on the airport. Similarly, as public agencies, airport enterprises must strictly comply with applicable laws and regulations, including those related to work rules, protecting the environment, and accommodating disabled customers.

Many strategies alter the revenue control procedures and reduce the opportunities for fraud or theft. Some may inadvertently increase the exposure of the airport enterprise to theft by eliminating the linkage between a parking ticket and the entering vehicle to which it was issued.

- **Staff strengths and weaknesses**—To implement a new strategy and oversee its ongoing operation, it is helpful for the airport operator to honestly appraise the ability of airport staff (or the current contractor) in terms of competing work assignments and their relevant skills and experience. Relevant skills may include parking operations, marketing and sales, accounting/audit, or familiarity with proposed equipment or software. A key component of successful implementation is the continuous involvement of knowledgeable staff (see Chapter 7).

## Physical Airport Facilities

The physical arrangement of an airport and its parking facilities will influence the evaluation of potential parking strategies, as will proposed development and improvement projects. Factors relevant to the evaluation of parking strategies and technologies in terms of the physical airport facilities are listed in this section.

- **Adequate area**—Inherent in some strategies is the necessity for physical changes to the airport parking facilities or the entry/exit roadways, including creating new space or modifying exist-

ing space to accommodate the strategy. For example, some strategies require (1) providing space to store customers' vehicles (e.g., valet parking), (2) developing an appropriate area to house new computer equipment, (3) dividing an existing parking facility into nested areas or zones with gate-controlled access points, or (4) developing new parking facilities. Other strategies may require new or modified entry and exit routes for vehicles and pedestrians. It is important to confirm that an adequately sized site or location is available for these strategies.

- **Number and location of parking facilities**—Some airports have dispersed parking lots or garages, or facilities with multiple pedestrian or vehicular entry/exit points. If each parking lot or garage requires a separate entry and exit plaza, the implementation and operating costs of several strategies will increase because of the additional control equipment required. If the parking facilities have many pedestrian pathways between the terminal and parking facility, it will be more expensive to implement strategies that customers must use when they walk back to their parked cars (e.g., pay-on-foot systems) because of the increased equipment costs. Thus, these strategies have proven most successful at airports with concentrated pedestrian flows that minimize the number of locations where equipment or services must be provided.
- **Consistency with development plans**—It is important that any physical changes, construction of new facilities, or major modifications to existing facilities are consistent with the airport master plan or long-range land use plan. Typically, interim or temporary construction is not desirable unless there is a favorable expected return on investment (i.e., additional revenues will allow the capital investment to be recovered) or the proposed capital expenditures are required to support other projects as well.

## Evaluate the Implications on Affected Organizations and Stakeholders, as Appropriate

As stated previously, parking is integral to an airport's customer service and financing, and is one of the few services that passengers encounter that is controlled entirely by airport management. Since implementation of a new parking strategy may affect several airport departments or divisions, as well as other stakeholders, it is helpful to determine which entities will be affected and how they may be affected by the new strategy. Some of the factors to be considered include the following:

- **Parking staff**—Some strategies may result in a reduction in the current number of parking staff, a reassignment of staff to other (lesser paid) duties, or otherwise affect their salaries and benefits. Other strategies require increased oversight of bus drivers, valet attendants, or other employees serving parking customers (e.g., remote baggage-check facilities).
- **Parking management**—It should be confirmed that a strategy expected to generate new revenues or attract new customers will do so and not divert existing customers to lower-priced products. The likely operational effects of the new strategy should be reviewed, along with changes in policies or procedures, and it should be determined which changes must be approved by management or the airport board.
- **Maintenance, IT, and engineering staff**—Many of the strategies increase the responsibilities of airport facility maintenance staff (or the contractor responsible for facility maintenance), airport IT staff, or engineering staff. Strategies requiring construction, acquisition of new equipment, or modifications to power or an IT network may require the involvement of engineering and IT staff.
- **Audit, finance, and properties staff**—Some strategies result in changes to the reports available to audit staff, the way revenues are received or reported (e.g., those that result in increased use of credit cards), or require new business agreements with new concessionaires or modifications to agreements with existing concessionaires or parking management companies. A contract or procurement process may require the approval of the airport's risk management staff, procurement staff, or legal counsel.

- **Public relations or marketing staff**—Many of the identified strategies—particularly those that represent the introduction of a new service—will require a marketing or advertising program to alert potential customers. Often this requires the participation and support of the airport’s public relations or marketing staff.
- **Operators of off-airport parking facilities**—These off-airport operators will be affected by any strategy that reduces their business volume, revenues, or ability to conduct business. It is likely that they will object to changes affecting their profits by complaining directly to members of the airport’s governing board, commission, or city council.
- **Airport boards and commissions**—Many strategies, particularly those affecting parking rates or involving a major capital expenditure, require the approval of an airport board or commission. These boards are often interested in how a strategy will affect airline passengers and the airport’s finances in terms of changes in costs and services. It may be helpful to cite the experience of other airport operators—especially the operators of identified peer airports—who have implemented the same or similar strategies.
- **Other approving agencies**—Depending on the type of strategy, it may be necessary to obtain the approval of other agencies, including those responsible for building inspections/code compliance, and local environmental permitting agencies.

## Determine the Required Implementation Actions

Chapter 7 provides an overview of implementation actions. For purposes of evaluating a potential strategy, the key considerations are to determine the level of effort, responsible parties, and lead time required to implement a strategy. Among the key considerations are the following:

- **Required approval process**—It is necessary to determine the procedures required to gain approval for and implement a strategy. For example, which agencies must approve the strategy? Are a competitive proposal process and preparation of designs or specifications required? Will operating procedures change? Can airport staff simply issue an acquisition order for the equipment? Are environmental or building permits required? Are there any building or fire code compliance issues?
- **Level of effort required**—Determine if the implementation tasks can be conducted using just airport staff or if outside support or expertise is required.
- **Lead time required**—Estimate the total time required for obtaining management approval, design (if required), acquisition, implementation, and testing (if required). Determine if the strategy requires new business agreements, changes to existing business agreements (e.g., valet parking), or approval to revise policies (e.g., coupons) or operating procedures (e.g., reserved parking). The total time will also be dependent upon whether the supporting infrastructure is in place or must first be designed and built.
- **Availability of responsible persons**—Establish which entity and staff will serve as the lead and agree to oversee implementation of the strategy. Confirm that they have adequate expertise and adequate time to devote to implementation of the strategy and assess other competing priorities and whether or not the other priorities are likely to interfere with the success of this project.
- **Airport management approval**—Determine the steps typically required to obtain the approval of airport management or the airport board. Establish what information or analyses they typically expect.
- **Airline approval**—Capital expenditures exceeding certain amounts may require approval from the airlines.

## Estimate the Costs and Benefits of Implementation

A key step in the evaluation of a strategy is estimating its costs and benefits. The costs may include the initial costs of construction, acquisition, and installation, as well as the expected



ongoing costs of operations and maintenance (O&M). An initial estimate of construction costs and O&M costs can be prepared using the information contained in Appendix A. Changes in the estimated O&M costs for existing or new facilities may vary depending on many factors. These include the prevailing wage rates, the age of existing facilities, and the quality of the maintenance program.

The expected benefits may include the following:

- Increases in gross or net parking revenues;
- Improvements to operational efficiencies or reductions in O&M or labor costs;
- Improvements to customer service, perhaps quantified by the value of the time saved by customers while searching for empty spaces or from other savings;
- Environmental benefits that may include reduced emissions resulting from reduced vehicle idling while in queues at entry/exit plazas, from reductions in vehicle miles traveled while recirculating on the airport or within a lot or garage to locate an empty space, or from reduced vehicle miles traveled by parking shuttle buses; and
- Reduced opportunities for fraud or theft.



## CHAPTER 7

# Key Implementation Steps

This chapter presents the steps required to implement the selected strategies and suggested follow-on actions. It is assumed at this point that a preferred strategy, supporting technology, and—potentially—a complementary strategy have already been selected using the process described in Chapter 6.

Implementation of a parking strategy generally includes the following steps:

- Obtain management approval to proceed,
- Develop an implementation plan,
- Implement the strategy, and
- Conduct follow-on review and evaluation.

These steps are described in the following sections.

### Obtain Management Approval to Proceed

The first step is to obtain approval from airport management and/or the airport commission or board, if required. Typically, low-cost/low-risk strategies may be approved by airport staff, while higher cost/higher risk strategies require the approval of senior management or the airport board. These approvals may be preceded by a series of actions to obtain the prior approval of management or to “pre-sell” the concept to management and to identify anticipated questions or concerns. It is also helpful to assure that other airport departments or divisions that may be affected by implementation of the strategy (either during implementation or ongoing operations) support implementation of the strategy.

The information needed to provide a compelling argument for implementation of a strategy will vary depending on the selected strategy, management’s familiarity with the strategy, and the level of information available. The required information typically includes some of the following:

- **Use by customers and/or the airport parking operator**—The description should explain to decision makers how the strategy will be used by customers and/or the airport parking operator.
- **Purpose of the strategy**—A description of how implementation will help improve customer service, enhance net parking revenues, improve operational efficiency, reduce operating costs, or achieve other objectives.
- **Estimated benefits and costs**—A key consideration is the estimated costs of implementation, including the capital costs and ongoing operating and maintenance costs. Often the capital and O&M costs are easier to estimate than the value of the resulting benefits (other than changes in gross revenues). For example, it is more difficult to estimate the value of cus-

tomers time savings, improved customer service, vehicle emission reductions, or certain operating costs.

- **Estimated implementation schedule**—It is helpful for management to understand the length of time required to implement the strategy (including obtaining senior management approval) and when the expected benefits may begin to accrue.
- **Potential risks**—Some of the strategies carry greater risk than others in terms of customer acceptance, revenue loss, or disruption to passenger service or airport operations. It is important for management to be aware of these risks.
- **Supporting information**—Other information may be useful to management, including the airport or non-airport locations where the strategy has been used.

The strategy descriptions provided in Chapter 4 include much of the above information and can be used as a starting point for these presentations to management. Estimates of costs can be developed using the material included in Appendix A, with adjustments made to reflect the local region and airport configuration.

## Develop an Implementation Plan

The actual implementation plan will vary significantly depending on the type of the strategy selected. Implementation may include (1) construction or procurement of equipment, including hardware and software (e.g., revenue control or space guidance systems), (2) award of new business agreements (e.g., contracts with parking operators, Internet-based reservations, vehicle washing and servicing), or (3) establishment of new airport policies or programs (e.g., coupons, branding, or reserved parking). Each of these strategies may require different implementation actions.

- **Construction or procurement of equipment**—Construction of new facilities and procurement of equipment can be accomplished using a competitive selection process (e.g., bids or proposals), sole-source award (e.g., purchasing equipment from an approved vendor), design/build, or other processes. Competitive selections typically involve preparing (1) preliminary plans, (2) detailed plans, (3) detailed design specifications and cost estimates, (4) requests for bids or proposals, plus issuance, (5) contract award, (6) testing, inspection, and acceptance, (7) staff training, and (8) public relations and marketing.
- **Award of new business agreements**—Award of new business agreements requires preparing and issuing requests for bids or proposals, and then subsequent award of contract and monitoring for contract compliance.
- **Establishment of new airport policies or programs**—The procedures for implementing new policies vary among airports and may vary further based on the seniority of the individuals responsible for recommending implementation of the strategy. At a minimum, it is useful to have a formal or informal understanding of the actions required to implement the strategy, the person(s) responsible for each of these actions or tasks, the expected duration of these tasks, and an approved budget for implementation.

During the interviews with airport operators conducted as part of this research, the need for internal coordination was repeatedly identified as a key aspect of the successful implementation of a parking strategy. Airport staff discussed the need to form an implementation team that included representatives from each of the affected entities (e.g., parking operations, IT, audit/accounting, public relations/marketing, and engineering/facilities maintenance) and that met on a regular basis throughout the planning and implementation of the strategy. These meetings were conducted to assure that all parties understood how the strategy would affect their organization, to identify and resolve potential concerns, and to resolve unanticipated problems that always occur during implementation of a new program or technology. Airport

staff identified a lack of prior coordination as one of the primary causes for unsatisfactory or delayed implementation of a strategy.

The interviews also identified the importance of having parking operations staff (or a similar group) function as the “owner” or “customer” for the strategy. As the owner, these staff accept responsibility for arbitrating conflicting recommendations, avoiding scope and budget “creep” and maintaining the original schedule and focus. Airport staff described instances of strategies having been implemented unsatisfactorily or having the final product not meet expectations because the parking staff did not “own” implementation of the strategy. Examples included (1) expansion of the complexity and cost of a proposed revenue control system beyond the original purpose and need because of the desire of an IT department to add unneeded “bells and whistles,” and (2) an audit department belatedly requiring that the system produce seldom-used reports that were not included in the original plans or specifications and that were never used. Airport staff described the need to work cooperatively with other departments as no single group has all of the skills and experience needed to implement a strategy successfully.

## **Implement the Strategy**

Implementation typically implies award of a contract, installation of new equipment, or adoption of a policy. It is suggested that, when feasible, consideration be given to phased roll-out (or soft opening) of a new system or use of a pilot program. For example, it is suggested that a new parking technology first be installed and tested at a low-volume parking facility before it is implemented at the largest, most heavily used facilities. Similarly, it is suggested that new programs be initiated during off-peak periods rather than during the busiest months of the year.

Use of such soft openings or pilot programs allows the parking staff to determine that all aspects of a technology or systems are operating as planned, that customers understand how to use a new program, and/or that a contractor has adequate time to mobilize and transition into a new role. Airport operators cautioned about difficulties resulting from opening a new facility or service before it was ready and lingering effects of the resulting negative publicity or poor first impression.

Staff training is an important part of the implementation of new technologies, equipment, or procedures. Training should be provided for the staff who will be using the equipment on a day-to-day basis (e.g., cashiers), as well as the supervisory and maintenance staff.

Prior to “opening day,” it is recommended that airport operators make customers aware of the new procedures or services by conducting a public relations or outreach program/marketing effort/educational campaign. It is helpful to alert customers to the new procedures (e.g., enter or exit via new paths, use new equipment, or pay in a different manner) before they arrive at the airport.

## **Conduct Follow-On Review and Evaluation**

It is recommended that airport staff gather data before and after implementing a new parking strategy, and continue to monitor the data described in Chapter 3. Analyzing the trends in these data can enable the airport operator to determine if the new strategy is achieving the expected benefits, and if its costs are in line with those projected.

Conducting before-and-after analyses also can be very useful. One of the challenges encountered during the conduct of this research was the lack of such data, and thus the inability of

airport staff to quantify the benefits resulting from implementation of a new strategy. For example, airport staff can readily compare year-to-year monthly revenues, but it is difficult to determine what proportion of any change is the result of a new strategy. Similarly, changes in customer service or operating expenses may not be documented, or not documented well enough to allow others to determine what proportion of any resulting benefits are the result of a new strategy.

In summary, these steps can facilitate the implementation of the strategies presented in previous chapters, and then evaluated with a preferred strategy selected considering the suggested metric presented in this guidebook.





## APPENDIX A

# Cost Estimates

**Table A-1. Capital costs.**

| <b>Parking Access and Revenue Control System (PARCS) Components</b> | <b>Approximate Cost Range per Unit</b> |             |
|---------------------------------------------------------------------|----------------------------------------|-------------|
| Ticket-only entrance                                                | \$16,000                               | to \$20,000 |
| Entrance controller (ticket, CC, gate, etc.)                        | 18,000                                 | to 22,000   |
| Exit controller (ticket, CC, gate, etc.)                            | 21,600                                 | to 26,400   |
| Exit controller (ticket, gate, etc.)                                | 18,000                                 | to 22,000   |
| Automated Pay Station (cash, CC, note dispenser)                    | 35,000                                 | to 50,000   |
| Automated Pay Station (CC only)                                     | 12,000                                 | to 18,000   |
| Central cashier station                                             | 11,700                                 | to 14,300   |
| Validator-only exit                                                 | 14,400                                 | to 17,600   |
| Credit card entry or exit lane                                      | 1,500                                  | to 2,000    |
| Payment-in-lane (cash, CC, note dispenser)                          | 31,500                                 | to 38,500   |
| AVI entry (E-ZPass compatible)                                      | 27,000                                 | to 33,000   |
| AVI reader                                                          | 3,000                                  | to 7,000    |
| AVI credential                                                      | 10                                     | to 40       |
| Proximity card                                                      | 3                                      | to 5        |
| ACS-only entry or exit (proximity or magnetic stripe)               | 6,000                                  | to 7,500    |
| Cashier at exit (cash, CC, card)                                    | 25,000                                 | to 30,000   |
| Automatic gate                                                      | 4,500                                  | to 5,500    |
| License plate recognition (LPR) lane                                | 8,000                                  | to 12,000   |
| Mobile LPR device                                                   | 7,000                                  | to 9,000    |
| Vehicle detector and loops installed                                | 900                                    | to 1,100    |
| Valet ticket dispenser                                              | 10,800                                 | to 13,200   |
| Valet fee computer                                                  | 15,750                                 | to 19,250   |
| Booths/shelters                                                     | 12,000                                 | to 16,000   |
| Additional count points                                             | 2,250                                  | to 2,750    |
| Fee computer                                                        | 18,000                                 | to 22,000   |
| Customer fee display                                                | 1,080                                  | to 1,320    |
| Intercom master station                                             | 13,500                                 | to 16,500   |
| Intercom remote station                                             | 450                                    | to 550      |
| CCTV installation (pan/tilt/zoom)                                   | 1,000                                  | to 7,000    |
| Variable message sign—single line                                   | 4,700                                  | to 5,700    |
| Changeable message sign—2 lines                                     | 3,200                                  | to 3,900    |
| Changeable message sign—3 lines                                     | 5,000                                  | to 6,000    |
| Multi-floor parking availability display                            | 5,400                                  | to 6,600    |
| Exit lane dynamic sign (full matrix color)                          | 9,000                                  | to 11,000   |
| Lane status sign (red X/green arrow)                                | 500                                    | to 750      |
| By-space parking guidance system                                    | 350                                    | to 500      |
| <b>Parking Office Equipment</b>                                     |                                        |             |
| System server                                                       | \$10,000                               | to \$15,000 |
| System software                                                     | 25,000                                 | to 30,000   |
| Facility controller                                                 | 13,500                                 | to 16,500   |
| Off-line machine read validator                                     | 900                                    | to 1,100    |
| Credit card server and software                                     | 10,000                                 | to 15,000   |
| ACS card software                                                   | 8,000                                  | to 10,000   |
| Valet package                                                       | 18,000                                 | to 22,000   |
| Additional workstations (including software)                        | 5,000                                  | to 10,000   |
| <b>Add to total equipment cost</b>                                  |                                        |             |
| Spare parts and stock                                               | 4%                                     | to 6%       |
| Installation and electrical                                         | 20%                                    | to 25%      |
| Documentation, training and warranty                                | 10%                                    | to 15%      |
| <b>Other Capital Costs</b>                                          |                                        |             |
| Structured parking space (above grade, open air)                    | \$13,000                               | to \$24,000 |
| Surface parking space                                               | 3,000                                  | to 5,000    |
| Shade structure                                                     | 1,800                                  | to 5,000    |
| Electric charging station                                           | 1,000                                  | to 7,000    |

**ABBREVIATIONS**

|                                        |                                  |
|----------------------------------------|----------------------------------|
| CC = Credit card                       | LPR = License plate recognition  |
| AVI = Automatic vehicle identification | CCTV = Closed circuit television |
| ACS = Access control system            |                                  |

Note: Actual cost will vary depending on the location of the project, the quantity being built or purchased, and other project-specific conditions. Approximate cost ranges are current as of Spring 2009.

Source: Walker Parking Consultants, April 2009.

**Table A-2. Operations and maintenance costs.**

| <b>Component</b>               | <b>Approximate Annual<br/>Operating Expense</b> |
|--------------------------------|-------------------------------------------------|
| Structured parking (per space) | \$300 to \$1,100                                |
| Surface parking (per space)    | 200 to 700                                      |
| Automated pay station          | 8% to 12%<br>of equipment cost                  |

Source: Walker Parking Consultants, April 2009.

# Glossary

**Automatic vehicle identification (AVI)**—An automatic vehicle identification (AVI) system is a long-range radio-frequency identification (RFID) or microwave identification system that automatically identifies vehicles with vehicle-mounted transponders (or tags) as they enter and pass through the range of the AVI system reader (the read zone) without any action by the driver.

**Compensatory agreement**—One of two basic airline-airport rate-making methodologies, whereby the airlines pay agreed charges and rates based on recovery of costs allocated to the facilities and services that they occupy or use. The airport entity assumes the risk of operating the airport so that it breaks even.

**Duration**—Duration refers to the length of time a vehicle is parked or remains within a parking facility as measured from when a driver receives a ticket (or inserts a credit card) until the time the driver exits.

**Flight information display (FID)**—Video monitors located in airport terminals and elsewhere that display the scheduled departure time and gate for every commercial aircraft.

**Focus group**—A focus group is a form of qualitative marketing research, where a group of 6 to 10 people are interviewed at the same time (as opposed to a one-on-one interview) about their attitudes toward a product, service, concept, advertisement, idea, or packaging. A focus group moderator asks the group questions in an interactive group setting that allows participants to talk with other group members. Frequently, focus groups are conducted in a setting that allows others to observe the participants as they respond to questions.

**Highway advisory radio (HAR)**—Licensed low-power AM radio stations established by individual airport operators to provide entering motorists with information about parking availability, traffic congestion, and other customer service notices.

**Instructions for bidder (IFB)**—Instructions for bidders describe the documents and information that prospective bidders must submit and which also contain useful supporting information (e.g., contract term and conditions and background information).

**License plate inventory (LPI)**—License plate inventories are regular (e.g., nightly) surveys that record the license plate number of every vehicle parked in a facility. Among other purposes, these inventories are used by cashiers to determine the parking duration (and thus fees due) of exiting customers who, for example, have lost their parking tickets.

**License plate recognition (LPR)**—License plate recognition systems are technologies that automatically recognize and record a vehicle's license plate number or combination of numbers and letters and, with some technologies, record an image of the entire rear view of a vehicle.

**Minimum annual guarantee (MAG)**—A minimum annual guarantee (MAG) amount is the minimum fee or amount that a business or concessionaire agrees to pay on an annual basis regardless of the revenues collected or business volume conducted.

**Nested**—As used in this guide, *nested* refers to a parking product that is located entirely within a second product. A parking customer first enters one parking facility, and then enters a second, more expensive *nested* product. To enter and exit the second product, a customer typically must pass through a second set of gate arms and/or ticket readers.

**O&D (origin and destination)**—Airline passengers who began (or will end) their trip at this airport as opposed to those passengers who are connecting from (or to) another flight.

**O&M**—Operations and maintenance.

**Optical character recognition (OCR)**—Optical character readers perform a form of license plate recognition.

**Pay-on-foot (POF)**—Pay-on-foot is a revenue control system that requires or encourages customers to pay their parking fees using cash or credit cards at an automated pay station or kiosk upon returning to the parking facility (or in the terminal building) rather than at an exit plaza. Upon paying their fees, customers are issued exit passes that are verified by exit readers (or verifiers) located in the exit lane.

**Proximity card**—Proximity cards (also known as “prox cards”) are credit-card-sized cards or tags containing integrated circuits used for access systems. When placed within 3 inches of a reader, integrated circuits inside the cards activate parking gates or other devices.

**Radio-frequency identification (RFID)**—See automatic vehicle identification.

**Request for proposal (RFP)**—Requests for proposals (or tenders) are invitations to submit competitive proposals. These documents describe the requested services or products to be furnished, the information to be contained in the proposal, the required format, due date, and other information that may be needed to prepare a proposal for consideration.

**Residual agreement**—One of two basic airline-airport rate-making methodologies, whereby the airlines pay the net costs of running the airport after taking account of commercial and other non-airline sources of revenue. The airlines (or signatory airlines) provide a guarantee that the level of charges and rents will be such that the airport entity can be operated in a break-even manner.

**Return on investment (ROI)**—The ratio of revenues (or benefits) resulting from an improvement and the cost of the improvement.

**Strategy**—As used in this guidebook, *strategy* refers to the entire spectrum of parking products, value-added services, rates and rate structures, safety and security features, and the techniques used to control parking revenue, promote operational efficiency, manage capacity, and balance facility use.

**Technologies**—As used in this guidebook, *technologies* refers to parking access and revenue control systems, ticket and ticketless payment systems, vehicle detection and guidance systems, parking reservation systems, and other parking-related hardware and software.

**Ticket dispensers**—Machines, located at entry lanes, that issue time-stamped tickets to entering customers when activated by a vehicle passing over a series of induction loops, a customer pushing a button, or other action.

**Transaction**—As used in this guide, a *transaction* is the act of issuing a parking ticket to a customer (or accepting a credit card at the facility entry). The number of transactions (or tickets issued) is equivalent to the number of customers using a facility. *Exception transactions* refer to



non-standard customer payments such as those from customers who have lost their tickets; have insufficient cash and “promise to pay”; who present invalid, mutilated, or unreadable tickets; or who otherwise can not be processed in a normal manner.

**Transponder**—As used in this guide *transponder* refers to a vehicle-mounted automatic vehicle identification (AVI) system tag or device that emits a signal detected by readers. (See automatic vehicle identification.)

**Turnover**—The number of times per day a parking space is used by a different vehicle. Parking spaces serving short-duration customers have higher turnover rates than those serving long-duration (e.g., daily or weekly) customers.



## APPENDIX C

# Suggested Sources for Further Information

The information presented in this guidebook is current as of April 2009. Given the rapidly evolving nature of parking strategies and technologies, it is inevitable that following completion of this guide there will be newly introduced strategies and technologies as well as changes in capital costs and O&M costs associated with the strategies and technologies that are documented in this guidebook. The following list summarizes potential sources of updated or additional information on strategies and technologies described in the guidebook or information specific to a particular application of a strategy or technology at an airport.

### Industry Publications

The literature review conducted as part of this research included numerous periodicals and other industry publications that frequently provide articles on airport parking issues. These publications, which are typically published monthly, include the following:

- *Parking* (published by the National Parking Association),
- *Parking Professional* (published by the International Parking Institute),
- *Parking Today*, and
- *Airport Retail News*.

Other publications may occasionally contain parking-related articles, but these four are exclusively dedicated to parking or to airport revenue issues.

### Airport Staff

Airport staff members were a vital resource during the research for this project. To supplement the information presented in this guidebook it is suggested that airport staff who may be evaluating potential parking strategies or technologies contact the staff of the airports that have already implemented these strategies or encountered similar challenges. In Chapter 4 of this guidebook, the description of each parking strategy or technology includes a list of airports that had implemented that strategy or technology at the time that this guidebook was written.

Some airports have one or more staff dedicated solely to managing the airport's parking operations (or overseeing a management company or concessionaire that is responsible for the day-to-day operations). At other airports, responsibility for the parking operation may be combined with other responsibilities, such as concessions, properties, or operations. Contact information for airport parking staff is often contained in directories published by one or more of the publications listed above or may be available through individual airport websites and switchboards.

## **Airport Websites**

Individual airport websites typically provide information on the locations and types of parking products offered, parking rates, accepted forms of payment, and other helpful information. Some airports also provide space availability information on their websites, as well as other information that may be useful for parking customers.

## **Equipment Vendors**

Parking equipment vendors and manufacturers, including those interviewed during this research effort, are able to provide current information about their products and their applications. Some vendors have recommended that, prior to issuing a request for bids or proposals, airports considering certain parking technologies issue a formal Request for Information (RFI), whereby the airport asks vendors to suggest potential solutions and describe how their product or mix of products may be able to address the airport's issues.

## **Industry Conferences and Tradeshows**

Parking industry groups, such as the International Parking Institute and the National Parking Association, sponsor annual conferences that typically have sessions related to airport parking. These conferences are also attended by vendors of products related to all aspects of a parking operation. Other conferences and tradeshows include those sponsored by international, regional, or local parking associations.

## **Other Parking Professionals**

In addition to airport staff, equipment vendors, and parking industry groups, there are parking management companies and consultants with extensive expertise in both airport and non-airport parking. These companies and consultants can be found in the directories and industry publications described here, as well as through Internet searches.



## APPENDIX D

# Bibliography

This bibliography presents the results of the literature search, with each reference presented in alphabetical order. Generally, the literature search was limited to articles published or presented since 2002, due to the rapid evolution of technologies and changes in parking strategies. The relevant literature is listed below.

- "A New Way to Pay for Parking." *Industry Insights Magazine*, Jan/Feb 2007. <http://www.carlwalker.com>.
- Abram, Frank. "Video Surveillance Technology Makes Parking Facilities More Secure." *Parking Today*, Jun 2003, 34.
- Affiliated Computer Services (ACS). "ACS and MasterCard Worldwide Introduce Contactless Payments to Parking Areas at Major U.S. Airports." Press release, Jun 12, 2007.
- "Airport Parking Options." *Airports*, Aug 8, 2006, 4.
- Akeroyd, Caroline. "CCTV Means Safer Parking and Higher Profits in the UK." *Parking Today*, Oct 2006, 23.
- Aldridge, K., Carreno, M., Ison, S. G., Rye, T., and Straker, I. "Car Parking Management at Airports: A Special Case?" Presented at 2006 Annual TRB Meeting, Washington, D.C., Jan 22–26, 2006. CD-ROM.
- Bassett, James. "Seven Steps to Better Hiring." *Parking Today*, Jan 2006, 24.
- Beebe, Richard. "Economic Consequences of Airport Parking Restrictions." *Parking Today*, Oct 2001, 4.
- Bernatovich, Bill. "Automated Access and Revenue Control with Integrated Systems." *Parking*, Nov 2006, 53–55.
- BIA. "Teamwork Parking Solution at Bradley International Airport in CT." *Parking Today*.
- "Boston Logan to Install Parking Availability Signs at Garages." *Airports*, Nov 7, 2006, 4.
- Burns, Dennis. "Best in Class: Parking Operations." *Parking Professional*, 2004, 12–14.
- Burns, Dennis. "Best in Class: Parking Operations." *Parking Professional*, 2005, 18, 26, 34, and 65.
- Burns, Dennis. "Parking as an Economic Development Tool." *Industry Insights*, Mar/Apr 2007.
- Butcher, Thomas. "The FAA 300-ft Rule: The Parking Industry Responds." *Parking Today*, Feb 2002, 34.
- Butcher, Thomas and Smith, Mary. "Market-Focused Parking Products at Airports." *Parking Today*, Apr 2003, 22–23.
- "BWI Launches Parking Promotion, New Parking Option." Press release, Mar 21, 2006.
- "BWI Welcomes Spring with Parking Promotion, Unveils New Credit Card Option." Press release, Mar 21, 2006, [http://www.bwiairport.com/press\\_releases/142](http://www.bwiairport.com/press_releases/142). Accessed June 21, 2006.
- Carleton, Jake. "Managing a Parking Facility Under Construction." *Parking*, 2004, 45.
- Christian, Francis. "The State of SmartCards." *Parking Professional*, 2003, 43.
- City of Chicago, Department of Aviation. "Remote Skycap Service to Open in O'Hare Parking Lot E." Press release, Oct 16, 2006.
- Civitelli, Michael. "Seattle-Tacoma International Airport—Airport Parking Marketing." Presented at TRB Annual Meeting, Washington, D.C., Jan 11–15, 2004.
- Cook, Barbara. "Parking's Possibilities." *Airport Magazine*, Dec/Jan 2007.
- "Crisis or Challenge?" *Industry Insights*, Mar/Apr 2007, 2.
- "Dallas/Fort Worth International Airport Parking Overview." Presented at 2005 American Association of Airport Executives (AAAE) Annual Meeting, Fort Lauderdale, FL, Nov 15, 2005.
- Decker, Rick. "Island Parking: Flexible, Responsive, Cost Effective." *Parking Professional*, 2003, 35.
- Dekozan, David. "Is it the Next Frontier for Parking?" *Parking Today*, Apr 2007, 26–27.
- Denda, Dale. "Security and the 300-ft Rule: The Parking Industry is Ground Zero." *Parking Today*, Feb 2002, 20.
- "Detroit Metro Airport Parking Will Soon be Easy as 1-2-3!" PRNewswire, April 27, 2007. As reported in the Airport Ground Transportation Association (AGTA) newsletter Sep 9–12, 2007.
- "DFW Unveils New Passenger Amenities." DFW press release, Nov 9, 2006.

- "DFW Uses Fabric for Covered Parking." *Parking Today*, Apr 2007, 14.
- DiVito, Tom. "Meter Security." *Parking Today*, Feb 2006, 14.
- Donoghue, Larry. "Airports Need Audits, Too . . ." *Parking Today*, Apr 2007, 30–31.
- "Douglas Parking Offers Option to Pay for Parking by Cell Phone." *Parking*, Oct 2006, 23.
- Duffy, Rick. "Case Study: Toronto Int'l Airport Installs POF Parking Revenue Control System." *Parking Today*.
- Duncan, Gavin, Villalobos, Dan, and Jones, Kim. "Parking Elasticity and Feasibility." Presented at Airport Parking Seminar, Parking Industry Exhibition, Chicago, Aug 2006.
- Ellis, Bill. "A Brief History of This New Technology (P&D)." *Parking Today*, 2003, 38.
- "ExpressLane Parking Program Description." <http://www.expresslaneparking.com/program.html>.
- Farooq, Sajid. "BART Unveils New Ticketless Travel Proposal." *San Francisco Examiner*.
- Finney, Martha and Dasch, Deborah. "The Ingredients of Forgettability." *The Parking Professional*, Jan 1992, 36–40.
- Fornal, Chris J., Rylander, Gary F., and Letourneau, Matthew J. "Milwaukee, WI, USA's Summerfest Advanced Parking Guidance System." *ITE Journal*, Jun 2006, 34–44.
- "Fort Wayne Makes Free Parking Shuttle Service Permanent." *Airport World*, Jun 5, 2007, 3–4.
- Franklin, Bill. "Drive-By Chalking in Calgary." *Parking Today*, 2006, 17.
- Geraghty, Bill. "How to Collect More of What You Are Owed." *Parking Today*, Feb 2006, 34.
- Gibbs, Evonn. "Plan-Ahead Parking Saves Time, and Generates Revenues at JIA and BWI." *Airport Revenue News*, Dec 2001, 46–48.
- Gibbs, Evonn. "With Bold Marketing: Airports Can Beat Parking Competitors at Their Own Game." *Airport Revenue News*, Apr 2004, 34–37.
- Haag, Gerhard and Byrnes, Larry. "Automated Parking: Two-Year Report Card." *Parking* 43, no. 8 (Sep 2004), 38–41.
- Hammer, Marit. "Lisbon Lions: Portugal Takes Parking Lessons from Norway: A TTI Exclusive." *Traffic Technology International*, Feb/Mar 2006, 83–84.
- Harkins, Robert. "Now, How to Get Prepared for the Worst!" *Parking Today*, Jan 2007, 30.
- Hibbs, George. "Airport Structures Require Creative Designs for Increasing Demand." *Parking Today*.
- Hoover, Rod. "Parking Revenue is Texas Size at DFW." *Parking Today*.
- "Horizon Air Offering Shuttle Passengers A Day of Free Parking." *Airports*, Sep 10, 2002, 21.
- "Indy Offers Web-Based Reserved Parking at Daily Rates." *Airports*, May 16, 2006, 2.
- Jacobs Consultancy. "Analysis of Future Parking Demands and Rates." Denver International Airport. May 21, 2007.
- Jacobs Consultancy. "Review of Innovative Airport Parking Products and Services." Dallas/Forth Worth International Airport Board. May 8, 2007.
- Jacobs Consultancy. "New Technologies to Control and Manage Airport Ground Transportation." San Francisco International Airport. Apr 5, 2006.
- Jensen, Jay. "Fabric Shade Systems for Airport Parking: 'Changing the Mind-Set of an Industry.'" *Parking Today*.
- Jewell, Mark. "Reserved Parking, via Phone." *San Francisco Examiner*.
- Jobin, Matt. "Airport Parking: Achieve Security with Creative Planning." *Parking*, 2004, 33.
- Johnson, James. "Parking Security at Airports." *Parking Today*, Oct 2001, 26.
- Kangas, Scott. "A Beginner's Guide to RFID." *Parking Professional*, 2006, 53.
- Kayler, Kimberly. "Building Technique Gains Momentum." *Parking Today*, Jun 2006, 24.
- Koerselman, Marius. "Cashless Society." *Traffic Technology International*, Feb/Mar 2006, 68–69.
- Larsen, Juliene. "AVI and No Visible Reader." *Parking Today*, May 2007, 28.
- Leigh Fisher Associates. "Landside Operations Workshop." San Francisco International Airport. Apr 10, 2002.
- Lombardi, Tom. "Airport Parking Marketing on the Internet: Past, Present, Future." *Parking* 43, no. 1 (Jan/Feb 2004), 29–33.
- Maimon, Steve. "Parking Structures—Going Green, the Beginning." *Parking Today*, Jun 2007, 18.
- Marta, Suzanne. "DFW Launches Parking Program." *Dallas Morning News*, October 17, 2002. As reported in the Airport Ground Transportation Association (AGTA) newsletter, Winter, 2003, 15.
- Martens, Jon. "Art of Maximizing Your Profits." *Parking Professional*, 2004.
- "Massport, SpotScout Use Web in Different Ways for Parking." *Airports*, May 15, 2007, 3.
- "Maximizing Parking Revenue, Minimizing Risks." *Airport Magazine* 13, no.1 (Jan/Feb 2001), 8–9.
- Mayer, Kevin. "Security and Safety: Architectural Mesh System Supplies Solution for Hospital Parking Garage Design." *Parking Today*, Apr 2007, 22.
- Monaghan, Don. "Guide to the Design and Operation of Automated Parking Facilities." Walker Parking Archives, 2004 presentation, Indianapolis, IN.
- Monaghan, Don. "Enhanced Security with Mechanical Access Parking Structures." Walker Parking Archives, 2002 presentation, Indianapolis, IN.
- Monahan, Donald. "Lower Your Lighting Costs—Save the Planet." *Parking Today*, Nov 2006, 20.
- Morkunas, Teri. "Customer Service: Where We Have Been, What We Have Done, and Where We Are Going." *Parking Professional*, 2004, 23.



- Mysz, Chris. "Have You Suspected Low Revenue Due to Inaccurate Vehicle Count?" *Parking Today*, Jan 2007, 25.
- Napolitano, Paul. "LAX and HNL Plunge into Valet Parking." *Parking*, Oct 2006, 36–39.
- Neumann, Richard. "Right on Queue." *Traffic Technology International*, Feb/Mar 2005, 24–26.
- "New 'Pay & Go' Parking System at Dulles." *Washington Post*. October 3, 2002. As reported in the Airport Ground Transportation Association (AGTA) newsletter. Winter, 2003, 5.
- "New Phone Parking Scheme Launched." *BBC News*, Feb 28, 2007. [http://news.bbc.co.uk/2/hi/uk\\_news/england/london/5397076.stm](http://news.bbc.co.uk/2/hi/uk_news/england/london/5397076.stm).
- Olley, Sue. "West Palm Beach Rings in New Year with 'Pay-by-Cell-Phone' Success." *Parking Today*, Feb 2007, 18.
- "Park at Love Field and Win." (Contest Guidelines) Nov 2006 through Apr 2007.
- Pascoli, William. "Steel Could Make Sense in Your Next Parking Garage." *Parking Today*, 2004, 38.
- Paternoster, Joanne. "The Importance of Customer Service in the Airport Environment." Presented at 2005 American Association of Airport Executives (AAAE) annual meeting, Fort Lauderdale, FL, Nov 15, 2005.
- Phillips, Tim and Beebe, Dick. "Airport Parking Revenue Control System Procurement." *Parking Today*, Oct 2002, 18–21.
- Pilling, Mark. "The Friendly Face of Parking." *Airport World* 8, no. 4 (Aug/Sep 2003), 41–42.
- Pilling, Mark. "Airports Seek Parking Revival." *Parking* 7, no. 5 (Oct/Nov 2002), 55–57.
- "Portland Drivers Have Access to Airport Parking Guidance System." Jul 17, 2007, 41–42.
- Postma, Mark. "Impact of September 11 on Airport Parking in the U.S." Feb 2002, 30.
- Pratt, Shaun. "'Smart Garage' Technology and Wayfinding System." *Parking Today*, Mar 2004, 40.
- Pratt, Shaun. "Spacious, Comfortable, Secure: DFW's 8,100-Space Parking Facility." *Parking* 43, no. 1 (Jan/Feb 2004), 43–46.
- Psaraki, V., Stathopoulos, A., and Abakoumkin, C. "Parking Capacity Requirements for Relocated Airports: The New Athens International Airport." *Transportation Research Record* 1788 (2002), 19–25.
- Ramos, Robin Tobin. "Water, Valets Perk Up Airport Park-and-Rides." *Atlanta Business Chronicle*. Jan 5, 2007.
- Ramroop, Tara. "FasTrak to be Accepted at Airport Lot." *The Examiner*.
- Rich, David. "Pushing Parking." *Airport Magazine* 16, no. 2 (Mar/Apr 2004), 48–52.
- Rich, David. "Parking Safety: Strategies to Improve Security in Your Parking Facility." *Parking Today*, 2003.
- Rich, Richard. "Wireless: The Next Frontier of Revenue Control." *Parking Today*, Mar 2007, 20.
- Rich, Richard and Kinnell, Richard. "Slipping into the Future: New Technologies and Trends in the Parking Industry." *Parking*, Mar 2006.
- Rowland, Joey D. "An Inconvenient Truth." *Industry Insights*, Jan/Feb 2007, 1.
- "Ryanair Offers Discount Parking and Lounge Access Online." *Aviation Daily*, Mar 27, 2006, 29.
- "SFO Landing Fee Cuts Help Lure Low-Cost, Intl. Air Service." *Aviation Daily*, May 16, 2007, 6.
- Shank, Jeff. "Tough Times at Airports Make Shuttles More Popular than Ever." *Parking Today*.
- Spasov, Vikenti, et al. "The Stacker Cranes—A Good Solution for Parking in Large Urban Areas." *Parking Today*, Mar 2004, 46.
- Stainforth, Roger. "Sign Up." *Traffic Technology International*, Feb/Mar 2005, 20–22.
- "Summer Time and the Living Is Easy at DFW International Airport." *PRNewswire*, May 24, 2007.
- Taylor, Mark. "How to Build Longevity and Security into Your Next Parking Structure—And Keep it That Way!" *Parking Today*, Jun 2003, 32.
- Teich, Rudor. "Lincoln Park: Upscale Parking Innovations." *Traffic Technology International*, Feb/Mar 2006, 79–80.
- "Terrorism and Parking?" *Parking Today*, Oct 2001, 30.
- "Training and Technology Back USA Parking's 'Best of the Best' Valet Service." *Parking* 44, no. 8 (Oct 2005), 85–87.
- Tsamboulas, D., and Nikoleris, A. "Passengers' Willingness to Pay for Airport Ground Access Time Savings." Presented at 2006 Annual TRB Meeting, Washington, D.C., Jan 22–26, 2006. CD-ROM.
- Unnikrishnan, Madhu. "Gerald Ford Airport Seeks Bid for \$120 Million Garage Project." *Airports* 25, no. 19 (May 15, 2007), 1–2.
- Van Horn, John. "Airport Ventures into New Lighting Technology." *Parking Today*.
- Van Horn, John. "Airports—Work With Off Airport Operators!!!" *Parking Today*.
- Van Horn, John. "City and Airport—One Operation Helps Another." *Parking Today*.
- Van Horn, John. "John Wayne Airport: Named for the 'Duke'—But Designed for Convenience." *Parking Today*.
- Van Horn, John. "Lexington Bluegrass Airport Parking Deck: You Can Use Prismatic Lighting for Appearance and Security." *Parking Today*.
- Van Horn, John. "LPI at Airport Parking, or the Lack of it." *Parking Today*.
- Van Horn, John. "Screenwalls Let Airport Parking Decks Take Flight." *Parking Today*.
- Van Horn, John. "Tampa: An Airport Designed to Succeed." *Parking Today*.
- Van Horn, John. "Smart Cards Are the Tool; But the Payment System Needs a Bit More." *Parking Today*, May 2007, 18.
- Van Horn, John. "Bellevue Hospital Turns 68 Spaces into 272, and in Only Five Months." *Parking Today*, Apr 2007, 38.

- Van Horn, John. "Cell Phones Replace Conventional Entry Tickets . . . and More." *Parking Today*, 2006, 16.
- Van Horn, John. "System Solves Valet Delivery Problems." *Parking Today*, Mar 2006, 14.
- Van Horn, John. "Mass General Extends Parking Security." *Parking Today*, Jun 2006, 22.
- Van Horn, John. "Two-Way Video Makes for a Friendlier POF System." *Parking Today*, Aug 2006, 22.
- Van Horn, John. "For Charlotte, P by S is 'Fashion Forward.'" *Parking Today*, Dec 2006, 18.
- Van Horn, John. "Power Costs Plummet in Florida Garages." *Parking Today*, Mar 2003, 15.
- Van Horn, John. "Teamwork Parking Solution at Bradley International Airport in CT." *Parking Today*, 2002.
- Van Horn, John. "Toronto Pearson Airport Getting \$889M Makeover; 12,600-Space Garage Underway." *Parking Today*, 2002.
- Van Horn, John. "Industry Members Meet with FAA on Security Reimbursement, 300-ft Rule." *Parking Today*, Feb 2002, 38.
- Van Horn, John. "What Do Israel, Lebanon, and Ireland Have to Say about Terrorism and Parking?" *Parking Today*, 2001, 30.
- Vernon, Matt. "Going Undercover . . . Covered Parking for Hospitals." *Parking Today*, Aug 2006, 18.
- Walker Parking Archives. "Car Sharing." Indianapolis, IN.
- Walker Parking Archives. "Four Lessons Learned from Airlines." Indianapolis, IN.
- Walker Parking Archives. "Parking Location Reminder." Indianapolis, IN.
- Walker Parking Archives. "University Garage Financing Strategy." Indianapolis, IN.
- Waller, Joe. "Landside Makeover: New Concepts for Enhancing Customer Service and Increasing Revenue." Landrum and Brown. [www.landrum-brown.com](http://www.landrum-brown.com) (accessed Jul 19, 2005).
- Ward, Carol. "Parking Amenities Spur Loyalty." *Airport Revenue News* 5, no. 61 (Oct 2006), 12–14.
- Ward, Carol. "Parking Strategies Technology and Amenities Drive Parking Satisfaction." *Airport Revenue News*, Oct 2006.
- Ward, Carol. "Parking Technologies Increase Efficiencies, Help Bottom Line." *Airport Revenue News*, Nov 2005.
- "Web Site Allows Passengers to Reserve Parking Off Airport." *Airports*, May 9, 2006, 2.
- Wenzl, Joseph F. "Reaching Nirvana: What Is and What May Be in Parking Revenue Control Technology." *Parking* 44, no. 3 (Apr 2005), 26–29.
- Wunk, Thomas. "Forthcoming PARCS Technologies." Presented at 2005 American Association of Airport Executives (AAAE) Annual Meeting, Fort Lauderdale, FL, Nov 15, 2005.
- Yedinak, Mark. "Selecting a Computerized Parking Control System." *Parking Professional*, 2005, 21.
- Zuckerman, Amy. "Space: The Final Frontier." *Traffic Technology International*, Feb/Mar 2005, 68–69.

*Abbreviations and acronyms used without definitions in TRB publications:*

|            |                                                                                                |
|------------|------------------------------------------------------------------------------------------------|
| AAAE       | American Association of Airport Executives                                                     |
| AASHO      | American Association of State Highway Officials                                                |
| AASHTO     | American Association of State Highway and Transportation Officials                             |
| ACI-NA     | Airports Council International-North America                                                   |
| ACRP       | Airport Cooperative Research Program                                                           |
| ADA        | Americans with Disabilities Act                                                                |
| APTA       | American Public Transportation Association                                                     |
| ASCE       | American Society of Civil Engineers                                                            |
| ASME       | American Society of Mechanical Engineers                                                       |
| ASTM       | American Society for Testing and Materials                                                     |
| ATA        | Air Transport Association                                                                      |
| ATA        | American Trucking Associations                                                                 |
| CTAA       | Community Transportation Association of America                                                |
| CTBSSP     | Commercial Truck and Bus Safety Synthesis Program                                              |
| DHS        | Department of Homeland Security                                                                |
| DOE        | Department of Energy                                                                           |
| EPA        | Environmental Protection Agency                                                                |
| FAA        | Federal Aviation Administration                                                                |
| FHWA       | Federal Highway Administration                                                                 |
| FMCSA      | Federal Motor Carrier Safety Administration                                                    |
| FRA        | Federal Railroad Administration                                                                |
| FTA        | Federal Transit Administration                                                                 |
| IEEE       | Institute of Electrical and Electronics Engineers                                              |
| ISTEA      | Intermodal Surface Transportation Efficiency Act of 1991                                       |
| ITE        | Institute of Transportation Engineers                                                          |
| NASA       | National Aeronautics and Space Administration                                                  |
| NASAO      | National Association of State Aviation Officials                                               |
| NCFRP      | National Cooperative Freight Research Program                                                  |
| NCHRP      | National Cooperative Highway Research Program                                                  |
| NHTSA      | National Highway Traffic Safety Administration                                                 |
| NTSB       | National Transportation Safety Board                                                           |
| SAE        | Society of Automotive Engineers                                                                |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act:<br>A Legacy for Users (2005) |
| TCRP       | Transit Cooperative Research Program                                                           |
| TEA-21     | Transportation Equity Act for the 21st Century (1998)                                          |
| TRB        | Transportation Research Board                                                                  |
| TSA        | Transportation Security Administration                                                         |
| U.S.DOT    | United States Department of Transportation                                                     |